

ARCHITECTURAL
RESEARCH
ADDRESSING

SOCIETAL CHALLENGES

Editors

Manuel Couceiro da Costa
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Architectural Research Addressing Societal Challenges

Editors

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VOLUME 1

Changing society
In transit – global migration
Renaturalization of the city

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Foreword

EAAE/ARCC International Conferences

The EAAE/ARCC International Conferences are held under the aegis of the EAAE (European Association for Architectural Education) and of the ARCC (Architectural Research Centers Consortium). The conferences are organized every other year, in collaboration with one of the member schools / universities of those associations, either in North America or in Europe.

The EAAE/ARCC Conferences began at the North Carolina State University College of Design, Raleigh / 1998 with a conference on Research in Design Education; followed by conferences in Paris / 2000, Montreal / 2002, Dublin / 2004, Philadelphia / 2006, Copenhagen / 2008, Washington / 2010, Milan / 2012, Honolulu / 2014 and Lisbon / 2016.

The conference discussions focus on research experiences in the field of architecture and architectural education, providing a critical forum for the dissemination and engagement of current ideas from around the world.

The issues are progressively refined and detailed, always open to general issues and the international dimension is expanding with a growing presence of researchers from other continents, what has been occurring since Copenhagen / 2008, with scholars and teachers from Australia, Africa or the Far East.

EAAE/ARCC International Conference – Lisbon 2016

Following an application process, the proposal of the FAUL (Faculty of Architecture of the University of Lisbon) for the hosting and organizing of the EAAE/ARCC International Conference 2016, in Lisbon, was accepted by the EAAE Council, during the Meeting in Prague (January 2014) and launched during the EAAE/ARCC International Conference – Honolulu 2014.

FAUL represents the newest link in an institutional chain, related to architectural teaching in Portugal, founded in the XVIth century with the "Paços da Ribeira Architecture Class". We regard 1881 as a critical year, when, through the creation of the "Civil Architecture Course of the Royal Academy of Fine Arts of Lisbon", the public teaching of architecture began, later followed by the establishment of the "Fine Arts High School of Lisbon".

In 1979, the Faculty of Architecture of the Technical University of Lisbon (FAUTL) was created, by the integration of the Department of Architecture of the Fine Arts High School of Lisbon, into the university. With the fusion of Technical University of Lisbon with the (classical) University of Lisbon, in 2012, renamed as FAUL, our faculty become an organic unit of the renewed University of Lisbon (∼45.000 students) – the aim is the construction of a powerful research university, engaged with education, innovation and technology transfer, focused on people, where the value of knowledge, merit and participation is raised and which is engaged with Portuguese society and the Lisbon region, but also with European dimension and open to the world.

According to the EAAE/ARCC International Conferences principles, the 10th edition/Lisbon 2016 whose theme was "Architectural Research Addressing Societal Challenges", was attended by architects, professors, researchers and students from all over the world. Overall there were about 280 participants and 182 accepted paper submissions, representing 107 universities, 33 countries and 5 continents, so enlarging the geographic reach and strengthening the potential of these conferences.

More than numbers, the scientific and social qualities of the event were also recognised, which was reflected in the many complimentary emails from the participants and now reinforced with the publication of the proceedings – we believe the quality of the conference is related to the evidence of a strong local identity together with broad global partnership.

By this we mean that representatives of EAAE, ARCC and FAUL, so from a large array of universities, were involved in every aspect of her conference including establishing the constitution of the conference committees (organizing and scientific committees), the boards of reviewers and moderators as well as participants.

Other partner organizations, related to the world of architecture, also contributed and were determining factors in that achievement, namely CIAUD (FAUL Architecture, Urbanism and Design Research Center), AEAULP (Academy of Architecture and Urbanism Schools of Portuguese Speaking Countries) and TRIENAL (Lisbon Architecture Triennial). As well as the organizations mentioned above, some individuals, the keynote speakers,

who came from different countries, China, USA, Belgium and Portugal, also presented high quality lectures related to the sub-themes of the conference.

Last but not least, we must acknowledge Lisbon, the city itself, including its people, history, culture, architectural patrimony, urban landscape, cuisine and climate, as a major contributor towards the success of the conference …

THEME

Since architectural research is at the core of EAAE/ARCC International Conferences, the scientific aspects to develop must be framed and specified.

Looking at the major issues of our era, we stressed (in 2014), the escalating interdependency of nations, that drives global geopolitics to shift ever more quickly and that societies seem unable to control any change that affects their cities, whether positive or negative. Challenges are global, but solutions need to be implemented locally. How can architectural research contribute to the future of our changing society? How has it contributed in the past? The chosen title "**Architectural Research Addressing Societal Challenges**", synthesizes all this, framing the call for papers. Papers were further divided into the following five sub-themes:

1. A changing society

Modernism and the quest for an industrialized welfare-society established a new standard of equality pursued by architects. Today, extreme wealth and urban poverty coexist, at times, within the same city. Worldwide, some nations are dealing with an ageing population, while others are concerned with overpopulation and birth control. Can architects find new standards for such extreme differences? How did the role of the architect evolve from the modernist period to today? We are looking for research that reflects the imprints of societal changes on architecture.

2. In transit – Global migration

A increasing number of people are on a global quest for work, knowledge, protection, adventure and a better life. The number of migrants worldwide reached 250 million in 2014. World Tourism is booming. How does this global mobility affect cities and cultures? How does the traveller from the past differ from the migrant today? We are looking for research on how architecture interacts with and deals with these questions. We are also looking for historical studies of situations that might mirror the present condition.

3. Renaturalization of the city

The urban areas are conceptualised in new ways. Urban and rural conditions overlap. Built areas merge with landscape and nature. How can research reconceptualize the urban condition? What will the city of the future look like? What was the presence of Nature in the urban fabric of the past? We are looking for research that focuses on this transformation process, past or present, and points to possible ideals for future urban development.

4. Emerging fields of architectural practice

The context within which architecture operates is drastically changing and new practices are emerging. The challenge of Climate Change sets a revised scientific and political agenda. Moreover, economic and socio-cultural changes challenge the role of both the architect and architectural practice. Furthermore, new conceptual methodologies, facilitated by emerging computer-aided technologies, expand the possibilities of the design and construction process. This leads us to question how the role of the architect will be affected by this changing context? What are the future possibilities suggested by new fields of development? What kind of new practices are emerging? There is a need for knowledge as to how architecture will answer, redefine or adapt.

5. Research on architectural education

Education in the discipline of Architecture has evolved, mirroring societal challenges and conditions. Architectural Education can also be considered as a multitude of traditions with different national flavours. New social challenges address architectural education. How can architectural education respond to the changing role of the architect? How should the ideal biotope for architectural education look like? How is it related to research or practice? Which didactics prepare students to take position and face future societal challenges? We are looking for contributions on the emerging field of research on Architectural Education.

Those were the questions.

In the next part of these proceedings we will present the papers, or in other words the answers, which were organized according to the sub-themes above. When we received the submissions, we found that it was possible to further sub-divide those sub-themes, which we did for a better understanding of the global approach towards Architectural Research Addressing Societal Challenges.

Hope to see you in the next EAAE/ARCC International Conference 2018, in the United States of America, in the city of Philadelphia.

Lisbon, 30 September 2016
Manuel Couceiro da Costa/Chairman
EAAE/ARCC International Conference – Lisbon 2016



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Keynote Speakers

Galen Cranz
University of Chicago, USA
Lecture: *Renaturalizing the City*

Pedro Gadanho
EDP – MAAT/Museum of Art, Architecture and Technology, Lisbon, Portugal
Lecture: *Emergent Practices in the Face of Social Change*

João Luís Carrilho da Graça
Faculty of Architecture, University of Lisbon, Portugal
Carrilho da Graça/arquitectos
Lecture: *Terra*

Jan Masschelein
University of Leuven, Belgium
Lecture: *Addressing societal challenges: reclaiming and designing (in) "school/university"*

Wang Shu / Lu Wenyu
Architectural School at China Academy of Art, Hangzhou, China
Amateur Architecture Studio
Lecture: *The possibility of co-existence of the urban and rural areas*



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Changing society

Urban transformation



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Change agents in urban transformation: The case of Helsinki

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ABSTRACT: We live in times of great change, and our cities are facing significant transformation. This paper is a study of change agency in an urban context. It explores different views of change agents, acting for formal and informal fields of the transformation of the urban environment. In the paper a fourfold classification model is created. It describes the field of change agency in urban transformation, in relation to the rate of centralization and scale. A case of Helsinki is studied through the fourfold classification model. Helsinki is currently facing major changes, both in the built environment and in the urban culture, as new self-initiated collective urban events are gaining popularity. Restaurant Day is one example of a local self-initiated event, which has grown rapidly and expanded in five years from Helsinki to 74 countries. New kind of activism is changing the scene and initiatives arising from the grass-roots levels are becoming recognized. This development offers new roles and emerging fields also for architects working in urban development. The aim of this paper is to explore how bottom-up and top-down dynamics of change can be reconciled and how the roles of the change agents are interconnected. Change agency is analyzed through themes of distributed leadership and co-creation.

1 INTRODUCTION

This paper aims to contribute to the discussion of societal challenges by examining change agency in the urban context. It explores the complex phenomena of the dynamic development process of a city through the viewpoints of change agents, both at formal and informal levels. Bottom-up and top-down dynamics are examined, to provide both traditional and alternative views on the process of the changing city. This study provides a framework for understanding the complex roles that contribute to constituting the urban environment. The aim is to clarify the understanding of the roles and dynamics of city development and offer a new point of view on the changing metropolis.

As power and leadership are increasingly distributed, there are more factors accounting for urban development. Cities have always naturally faced transformations, but nowadays possibilities for participation have increased, which has led to greater unpredictability. However, there is a growing need to increase the flexibility of the existing structures. Understanding the emergence of community-led and private initiatives in urban development is important for identifying potential ways of collaboration (van Meerkerk *et al* 2013, Zhang *et al* 2015). The processes of public engagement are generally gaining importance (Evans-Cowley & Hollander 2010, Monno & Khakee 2012). Informal urban development rising from ground up challenges mainstream planning theory (Porter *et al* 2011) and top-down perspectives are combined with bottom-up data to examine urban change (Lawless 2013).

1.1 *Change agency*

The development of cities is typically led by centrally managed city planning departments, which produce carefully studied general plans and detailed master plans. The city planners and the decision makers are the obvious actors of change in the development process. They are in the position to conduct externally driven episodic change. Karl E. Weick and Robert E. Quinn have researched change agency and the tempo of change. They see a distinction between episodic change and continuous change, based on the differences in the perspective of the observer. According to Weick and Quinn, the role of a change agent with macro perspective is "to be a prime mover who creates change. The perspective is distant and change linear, progressive and goal-seeking" (Weick & Quinn, 1999, p. 366). Interesting, authentic urban development often also arises from the grass-roots level. Contingency is typical of the processes of emergent and self-organizing change arising from the grass-roots level. "Change is constant, evolving, cumulative, a pattern of endless modifications. The role of a change agent is to be a sense maker, who redirects change in a process of recognizing and reframing current patterns, while showing how intentional change can be made at the margins. The perspective is local. The change is a redirection of what is already under way. It is cyclical, processional and without an end state." (Weick & Quinn, 1999, p. 366). Nowadays an expanding group of independent change agents operate in the field where the dynamics of top-down and bottom-up development meet. They function as mediators

and negotiators in the development process of a city, as well as culture-makers. Their work happens in cooperation and conversation, in creating a common understanding.

In his research Raymond Caldwell defines different discourses of change agency. Rational and dispersalist discourses seem to be relevant when considering change agency in today's cities: "Rational discourses identify intentional action and agency with rationality, expertise, autonomy and reflectivity" (Caldwell, 2006, p. 5). On the other hand, "Dispersalist discourses locate agency as a decentered or distributed team or group activity of self-organizing learning, operating outside conventional hierarchical structures or control systems" (Caldwell, 2006, p. 6). While the rational discourses offer a lens through which to observe the actions of well-structured expert organizations with power, the dispersalist discourses give space to the freely-formed organic development of change. Whereas rational discourses have traditionally prevailed, the significance of dispersialist discourses is currently clearly increasing. Spatial change agents are also described as "negotiators of existing conditions in order to partially reform them. Agents act with intent that is necessarily shaped and reshaped by the context within which the agent is working. An agent's action is guided by an initial transformative intent, but because of the dynamics of the structural context, that intent has to be responsive and flexible." (Awan *et al.* 2011, p. 32).

1.2 *Distributed leadership and co-creation*

According to Peter Gronn, the problem with the majority of leadership theory up until the 21st century has been the division into two parties: leaders and followers. He sees distributed leadership as an alternative for 'post heroic' leadership (Schedlitski & Edwards, 2014). The idea of distributed leadership suggests that "leadership is a widely dispersed activity throughout teams and organizations and that leadership capabilities and the development of these capabilities are needed at all levels within organizations." (Schedlitski & Edwards, 2014, p. 151). Distributed leadership represents a less formalized model of leadership where leadership responsibility is separated from the hierarchical models. Each individual can exert leadership and influence. According to Bennet *et al* (2003), the most remarkable attribute of distributed leadership is the division of leadership between various people. Three conclusions regarding distributed leadership can be made: (1) leadership is manifested in and arises from interaction, (2) the boundaries of leadership are open and various amounts of people and groups can participate in leadership, and (3) skills, abilities and expertise are widely dispersed (Buhanist 2008). Leadership may be considered as a regular, ordinary way in which to influence, in form of cooperation and coordination.

According to a study conducted by the London School of Economics, co-creation is a form of collaborative innovation, based on relationships. Emphasis is on the quality of the interactions. Co-creation is also a learning process. (LSE, 2009, p. 3). It has been acknowledged that co-creation can help to build value significantly. Cooperation can also prove to be a good source of results in urban development. The aim of co-creation is to strengthen knowledge processes by involving the user in the creation of meaning and future value. It transforms the consumer into an active partner and the users become change agents. The impact of co-creation can be seen in many levels: "1. Co-creation has a direct impact on traditional innovation practices and processes. 2. Co-creation can affect the quality and speed at which decisions are made in relation to the development and filtering of ideas. 3. Co-creation will enable creativity at individual and group level and potentially enable customer knowledge development and transfer across the organization. 4. Co-creation will increasingly be used as a way of creating strategy collaboratively" (LSE, 2009, p. 15).

2 MATERIALS AND METHODS

In this paper, the data collected for three cases of Helsinki is analyzed through themes of change agency, distributed leadership and co-creation. A mixed methods approach was adopted for this study. Data were collected through a combination of document analyses, observations and interviews. A fourfold classification model presenting different roles of urban development and the field in which the change agents of urban change act is introduced and tested by empirical analysis. Case studies were conducted in order to analyze change agency in urban development. The analysis is conducted to allow greater understanding of the complex field of urban change agency. Both centralized and decentralized viewpoints on the issue are examined, with an emphasis on how the different change agents understand transformation in a city and how their views are interrelated.

3 A FOURFOLD CLASSIFICATION MODEL

A fourfold classification model created in this study aims at describing change agency in urban development. It shows the fields in which the change agents operate. The classification model focuses on the individuals affecting the change in cities.

The official planning procedure with its stakeholders forms the background, in which these change actions operate. The background is the context of the operations. The political decision-making process as a standard procedure including its own roles and the official citizen participation included in the planning process are part of the context, and therefore they are not separately presented in the classification.

The fourfold classification model presented here describes the actions of change agents taking place in various phases in urban development. The model does not offer strict divisions, but shows the field

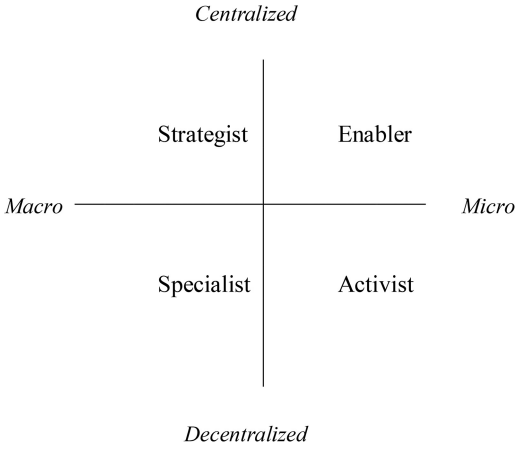


Figure 1. A fourfold classification model: change agency in urban development.

of operation. It is a flexible and adaptive system: individuals actively working on change in the urban environment can reciprocate in the field and take on different roles.

The change agents are categorized in relation to the rate of their centralization and in relation to their scale of activity. (Figure 1.) Each quarter describes the professional identities of a certain type of change agency. The level of centralization describes the location of a change agent in the networks in which they operate. Centralized actors typically belong to the public authorities, who use the legal power given to them based on their position. They conduct the change of cities and are typically explained by rational discourses. However, the significance of dispersialist discourses is increasing also in the public sector. The decentralized forces of change include private companies, including developers and architects, as well as organically organized teams, groups and individual actors operating in the urban environment with a goal of urban change. Explained by both rational and dispersal discourses, they are the agents arising from private initiatives.

The division between macro and micro scale of change agency describes the level they operate on. Whereas strategic planning deals with broad issues, it is characteristic to master planning to always have a close contact with the actual physical environment, with a certain site. Micro scale is characteristic of the urban events and temporary uses, typically arising from a potential of a place.

These dimensions clarify four roles of change agency in urban context. The roles that are defined are a strategist, an enabler, a specialist and an activist.

A strategist typically has a high position in the hierarchical centralized structure. They work at the strategic planning and master planning level of a city, covering complex issues with far-reaching impact. The view of development of a city is that of a macro perspective. An enabler also holds a position on the hierarchical power structure. They have the power to influence urban development on various scales from a single site to a district. They also have the position to affect the daily living environment in a rather short scope of time. The enabler has the resources and power to support or object to project-based development and therefore influence everyday circumstances. The processes of work of both the strategist and the enabler are based on rationality and systematicality.

A specialist is typically an expert working in a private company or on his own. They can contribute to urban change by offering alternative ideas, either under commission or voluntarily. A specialist can work e.g. as an architect, developer or researcher. They can have aspects of both rational and dispersal discourses.

An activist contributes to urban life by composing creative and innovative forms of using the urban environment. These can include events and temporary use. The processes of work are often self-initiated and cyclical and can be seen as a part of dispersal discourses. Both the specialist and activist use the media as a tool for influencing the course of urban development. They can be opinion leaders and media personalities and may have a remarkable impact on the course of urban development, as they possess the means to affect the values and attitudes of city dwellers.

The classification model helps to identify the different actors affecting urban change. It clarifies the roles while leaving room for adaptation and modification as the divisions are not strict separations. Individuals can move between the quarters, taking on different roles depending on the situation. Connecting to the other quarters is an important aspect of change agency. The classification model provides help and guidelines for commencing operations of co-creation. It defines some of the remarkably influential roles of the change agents, who could be involved in a co-creating process of urban development. As the model indicates how power is shared throughout the fields of various actors on different levels, it can be used as a framework when drafting an influential and innovative setup for collaboration and cooperation.

In the following sections the fourfold classification model is used in three cases in Helsinki: the different versions of strategic master plan, the Restaurant Day and the Helsinki Waterfront event concept.

4 CHANGE AGENTS IN URBAN DEVELOPMENT, CASE HELSINKI

4.1 *Strategic master plan case: strategists and activists operating separately*

In Helsinki a political committee and a city planning department operating under its supervision are responsible for city planning. The actual planning work is undertaken by professionals, mostly architects, planners and engineers. A participation procedure runs alongside the planning process, allowing city dwellers

to contribute their opinions and ideas. As former transportation and harbor areas are being transformed for new uses, seen from the macro level the city of Helsinki is facing a momentum of episodic change. In forthcoming decades, the city will have a major task of central importance for the urban structure as new areas are planned and built. Helsinki is expanding faster than ever before. The completion of the new cargo harbor in a new location has vacated the largest amount of space in a hundred years. This has provided the opportunity to develop the sites of the former port and railway yard areas for the construction of new housing and workplaces in the city. With the construction of new districts, the development projects will create approximately 100,000 residences and tens of thousands of jobs during the coming decades. A major land-owner in the former harbor areas, the city of Helsinki remains the most important actor of change in the new districts.

However, there is an even bigger change under way: the city of Helsinki is currently in the process of producing a new strategic city plan. The newly completed draft of the plan, designed by the strategic planning division of Helsinki City Planning Department, shows how the city can grow by 250,000 new residents by 2050. Directing the growth, the plan will have a major impact on how Helsinki will transform during the coming decades.

Besides the official strategic plan, alternative plans have been produced. Created by volunteering specialists and activists, the alternative strategic plans have gained wide media attention and triggered vivid discussion on the themes of future planning. The alternative city plans produced by voluntary groups of urban activists demonstrate one way in which contribution outside the official structure can have an impact on forming the future of the city by influencing public discussion. However, alternative plans do not always offer a realistic choice as they do not have to take into account all of the existing preconditions. More accessible methods of co-creation should be offered, to utilize the existing potential. Cooperation between the official and unofficial planning is currently on the level of discussion, but it is the wish of both parties that new ways of co-creation could be created.

4.2 *Restaurant Day case: activist driven*

Besides physical transformation, urban culture in Helsinki is currently turbulent – much has happened during the last years and it seems that the phenomenon has only started. The threshold for self-organized urban events used to be rather high, as the permission procedure was considered demanding and regulations were strict. The current upheaval is changing attitudes, as new self-initiated collective urban events are gaining enormous popularity. Restaurant Day is an example of a local self-initiated event, which has grown rapidly and expanded in five years from Helsinki to 74 countries. Restaurant Day is organized four times a year. During the event anyone can set up a restaurant for a day. It can take place anywhere: in private homes, on streets, in gardens and in parks. Collectivity is the key: anyone can participate and each organizer is responsible for their own contribution. The urban activists and founders of Restaurant Day have become the face of the currently escalating collective culture in Helsinki, arising from the grass-roots level. They see their role as being an advisor and mediator in linking people. Communality and having an impact on the society is a priority. Restaurant Day, with its open call for participation, is seen as a tool for democratization. According to the urban activists, the most significant change in the urban development of Helsinki is taking place in the values, thoughts and attitudes of the city dwellers. There is a clear change in the basic opinions and impressions of what can be done. When founding Restaurant Day, the activists simply announced that on a certain date anyone could establish a pop-up restaurant. The concept was clearly against various rules and regulations, but by the effective use of social media the organizers gained a following which could not be overlooked. Masses of city dwellers took the initiative to participate in the event and the phenomenon spread fast. The aim of the organizers is to change attitudes towards the use of the urban environment permanently, not just for a day.

In the case of the Restaurant Day change agency follows a model of a decentralized and distributed self-organizing group activity. The organizers of Restaurant Day operate outside traditional hierarchical structures. The network organization operates by horizontal coordination. The environments in which Restaurant Day operates are emergent and self-organizing. Change is a pattern of evolving adaptation. Change agents see the potentials of urban development and have the means to utilize them. The impact of their work shows the power of organic change, rising from the grass-roots level. Urban experiences arise from spatiality, but also from interaction. People, relationships between them, dynamics of urban life, incidents and encounters constitute the city. Communality and shared experiences affect the identity and image of a place and change the way in which the urban environment is seen and understood. The Restaurant Day event is a protest against existing circumstances and regulations, but it is a positive protest. Authentic change starts from within each city dweller. An influential way to change people is to offer an alternative: a positive vision including concrete actions. Considering the urban environment, the most effective change arises from the individuals, who constitute the city. Actions change along with values and attitudes. Participatory urban events can reveal new potentials of the daily living environment. As a result of the highly popular chain of collective events the city authorities up to the mayor have praised the phenomenon of the rise of a new culture of active participation and thinking in Helsinki. A major shift in attitudes and values took place as a marginal event arising from the grass-roots level, disregarding rules and regulations, became an accepted and encouraged part of the urban culture.

4.3 *Helsinki waterfront event concept case (enablers, specialists and activists in co-operation)*

In Helsinki, everyone lives within 10 kilometers from the shore. The downtown area is located on a peninsula and densely built, while the rest of the city is spread along shoreline. The city area also covers a vast sea area and over 300 islands. For a long time the inner city shores were mainly used as industrial areas and harbors, limiting the number of citizens living right by the shore. When the city's cargo and industrial harbors moved to a new location, vast areas were freed up for residential use. The construction of these new districts is set to continue until the 2030s, and the planning of further residential areas is already underway. The draft of Helsinki's new city plan proposes that the city structure be densified, which would free up space for further residential areas near the shores. The new districts under construction serve as testing grounds for new maritime housing solutions. (Helsinki City Planning Department). The seaside trail running along the city's shoreline is over 130 kilometers long and open to everyone. Opening the shoreline has long been one of the guiding principles of Helsinki's city planners, and in the future new maritime city districts will provide the city with more waterfront housing and leisure venues.

Helsinki's seaside trail offers magnificent and varied landscapes, and in the last few decades new maritime city districts have provided the city with even more open seaside trails. In order to enliven the waterfront during the summer and offer even more activities along the shoreline, the city of Helsinki developed an open shore event concept together with Yhteismaa for the summer 2015. The author of this paper was involved in the process. Yhteismaa – Finnish for Common Ground – is a non-profit organization, specialized in new participatory urban culture, co-creation, social movements and place making. In the concept, called Rantakesä in Finnish, fourteen places along the shoreline were offered for anyone to freely organize their own events. The different city departments agreed to give free access for non-commercial events on those pre-choosed locations. As a result the city dwellers willing to enliven their own hoods did not have to go through the usual path of applying for permissions. The requirement was that all the events had to be free of charge and open for everyone and there were certain restrictions considering the noise limits and night hours, but all in all the concept left it up to the citizens themselves to decide what kind of experiences the shoreline would offer. As a result a vast range of events took place along the waterline: for example yoga lessons, recycling workshops, music events, flea markets, an open dinner party, handicraft workshops, art projects, children's events and an open stage event for improvisation. Rantekesä will be organized again in the summer 2016.

In the Helsinki Waterfront event concept case the city authors had an enabling role in the process, which was based on cooperation and co-creation. The people of Yhteismaa had the roles of activists and specialists, bringing in their networks and expertise of urban culture. In the end it was the people on the city, who made the event happen and successful.

5 DISTRIBUTED LEADERSHIP AND CO-CREATION IN URBAN CONTEXT

In the big picture, major shifts of functions are taking place in cities. A view from closer in reveals constant modifications and adjustments at the level of daily lives in cities. Although these adjustments can be slight, it is even suggested, that "Small changes rather than comprehensive masterplans are more effective in steering urban development processes towards more desirable futures conditions" (Karvonen, 2014). There is significant change in the agency of urban culture. Continuous, adaptive change in cities can be seen in self-initiated projects and temporary uses of urban space. It may also rise from events, which can gain communal interest and importance and change the way in which people use their urban environment. Continuous change can rise from reactions to the possibilities and challenges of daily life. It might be inspired by a sudden window of opportunity or result from handling uncertainty. The perspective is local: continuous change often uses the momentum and the potential of the place. Nowadays, in Helsinki the many important actors in urban culture are private, independent groups and activists. The attitudes of the city administration are changing – and have to change. The course of development following the first Restaurant Day shows this: the city has seen the potential of the event and currently uses it in its official city marketing. Self-organized, loosely facilitated events have become powerful actors in urban change.

The phenomenon of distributed leadership is strongly evident in practice. Collaboration, co-creation and participation will continue to increase. Expertise will materialise through contribution and interaction. Today, leadership is examined through collaboration, interaction and multiple operators. The examination focuses on leadership in processes. It is important to be able to see the whole and its parts at the same time. Leadership develops through cooperation and discussion. An ability to see beyond what is familiar and adapt to change is key for success and even survival in a rapidly changing world. Various different forms of distributed leadership can be found in urban development processes. They can be seen in the operations of rapidly adaptive urban activism, arising from the grass-roots level, but they are also increasingly embedded in more formal urban development. The interesting future research topics include clarifying the understanding of the roles and dynamics of city development.

A variety of different views are needed for a changing metropolis. As the people make the city, co-creation is already embedded in the definition of a city. The question is how to bring together different actors and create forums for interaction. There is a need to

develop co-creation processes further. Tools for communication and conversation are developed both by the authorities and the urban activists. Cooperation is the key, not confrontation. The solution lies partly in the usage of new technologies, which become a valuable device for participation and co-creation. Identifying the different roles of change agency is essential for collaboration.

Many European cities aim at developing open processes of collaboration and participation, where bottom-up and top-down forces operate together. In Amsterdam 'Breeding Grounds', informal working places of cultural and manufacturing producers, provide spaces where independent organizations can collaborate, leading to the development of new initiatives. Berlin is known for spontaneous and unplanned use of open spaces and the redevelopment of the former Tempelhof airport is regarded as an opportunity to transform the area into a model location for participative urban development. The importance of informal tools has increased and as they contribute to spatial plans, the informal tools are nowadays accepted as an essential part of the planning process. "The tools available to the planning system are statutory plans and programmes and the legally permitted means of safeguarding and implementing them at all levels. In addition to statutory planning tools, supplementary, informal planning is possible" (Pahl-Weber & Henckel 2008, p. 43). Informal tools bring flexibility and can focus on certain aspects without the requirements linked to statutory plans.

In Berlin, agencies specializing in in-between use consultancy operate in the field where the dynamics of top-down and bottom-up development meet. The agencies work with a co-operative approach and bring together different actors involved in the city development process. These independent change agents function as mediators and negotiators in the development process of a city. Many of the individual, privately run projects of Tempelhofer Freiheit operate as networking channels. The Berlin Senate Department for Urban Development and the Environment still plays a guiding and coordinating role in the redevelopment of Tempelhof. (Berlin Tempelhof Project 2015).

Change in cities can hardly be managed only throughout as a rational and planned process. As a vast range of different factors affect the development of cities, both at the micro and macro levels, there are always unexpected twists and turns. However, a clear vision for the urban future is needed to guide development and lead transformation. For a comprehensive view of urban development, there must be room for both rational and dispersal discourses. As the different disciplines overlap, there is a need for new collaborative approaches to urban development.

6 CONCLUSIONS

This paper explores possibilities of combining collective urban development rising from grass-roots level with centralized city planning. Bottom-up and top-down dynamics do not have to be contradictory, and one way to enhance urban development could lie in finding possibilities to combine them. Postmodern societies are characterised by ambiguity, a low level of hierarchy, extensive participation, distributed leadership and uncertainty. The use of power is increasingly significant: more effective ways to exert influence are needed to get a message across in an environment of distributed leadership among a multitude of voices.

Co-creation is a form of collaborative innovation, based on relationships. It has been acknowledged that co-creation can help to build value significantly. Cooperation can also prove to be a great source of results in urban development. The aim of co-creation is to strengthen knowledge processes by involving the user in the creation of meaning and future value. It transforms the users into active partners as they become change agents. As seen from the examples of self-initiated collective urban events, individuals can take the initiative and have great influence on society. Phenomena may arise swiftly and people can cluster quickly. The actors of unofficial, organic urban culture can use significant power. Self-organizing and opinion sharing is easy and effective for the alternative forces of change. However, the urban activists often also believe that the main source of power is still found in politics, as the decision-making process remains political.

Identifying the different roles of change agency is essential for collaboration. A fourfold classification model created in this study defines and clarifies the roles. It shows the fields in which the change agents operate. The model does not offer strict divisions, rather it is a flexible and adaptive system: individuals actively working on change in the urban environment can reciprocate in the field and take on different roles. In the classification model change agency is categorized in relation to the rate of centralization and scale. Each quarter of the model describes the professional identity of certain type of change agency: a strategist, an enabler, a specialist and an activist. The classification model can offer help in organizing co-creation. As the model indicates how power is shared throughout the field of various actors on different levels, it can be used as a framework for collaboration and cooperation. The classification model also shows how leadership is distributed. Power can be based on authority, but collectivity can also be a significant source of power. Each view is important for formulating and constituting a comprehensive view of a changing metropolis. The dispersal discourses of urban change agency and the operation of the decentralized change agents offer an interesting topic for future research. Communality and sense making in urban development, as well as complex systems of self-organization are among the other rising themes in urban transformation.

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Urban regeneration of former industrial cities. A cure or a curse? The case of Ancoats conservation area in Manchester, England

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ABSTRACT: The anxiety to reverse the economic and socio-spatial degradation of deindustrialisation in Europe gave rise to a multitude of urban regeneration schemes. Urban regeneration practice has been at the centre of academic and political debate, characterised either as redemption or a chimera for the future of European cities. This paper revisits the topic, aiming to give an objective image of the nature of urban regeneration in the current socio-political system. Focusing on Ancoats in Manchester, we will explore the socio-spatial merits and pitfalls of urban regeneration schemes in the last three decades. We will argue that urban regeneration can have distinct implications on the social and spatial urban fabric, depending on the power balance of the stakeholders involved. The results of the research enrich the scientific discourse on the topic whilst offering lessons for future cases aiming at preserving a social, cultural and spatial balance.

1 INTRODUCTION

Since the 1980s European former industrial cities have been subjected to large scale transformations known as 'urban regeneration' practices. Intended to reverse physical, social and economic decline, urban regeneration has dominated academic and political discourse in recent decades.

On the one hand, politicians, property developers and some academics advocate urban regeneration projects, presenting them as the only opportunity to solve chronic urban problems (Florida, 2002). Conversely, opposition voices condemn them as vehicles of immaterial neoliberalism and gentrification (Hatherley, 2010). A limited number of researchers have tried to examine the topic objectively, acknowledging both the advantages and the disadvantages of urban regeneration (Porter & Shaw, 2010).

This research aims to complement the latter approach, challenging established assumptions that polarise the positive and negative implications of urban regeneration.

In this paper we will try to explore the social and physical impact of urban regeneration, using the example of Ancoats in Manchester, a city which has been described as *"the capital of regeneration"* (Hatherley. 2010: p. 119) Our particular focus is how urban regeneration impacts the tangible and intangible dimensions of industrial heritage, a key characteristic of the area under investigation.

The first part of this paper considers the urban and social development of Manchester and Ancoats in the eras of industrialisation and deindustrialisation. The second part focuses on the analysis of Ancoats' conservation area regeneration schemes. The paper will conclude by identifying the positive and negative implications of historic industrial areas' regeneration schemes.

Our research, positioned at the crossroads of urban regeneration and heritage preservation discourses, aspires to contribute to the current broad debate for a future social-inclusive, sustainable development of our historic cities.

1.1 *Methodology*

A multimethod research approach has been adopted to achieve the research aims outlined above. First, a literature review on the issue of urban regeneration was conducted resulting in the problem definition.

Second, the existing research base on Manchester's development was reviewed focusing on Ancoats; this involved an analysis of primary and secondary sources on the city's regeneration policy, followed by an analysis of selected literature focused on its industrial heritage. Further research covered relevant articles from local and national newspapers, as well as an on-line review of the main stakeholders' websites and publications.

Third, qualitative research was conducted, consisting of eleven face to face interviews with a wide range of stakeholders involved with the regeneration of Ancoats district. These included representatives from: the Homes & Communities Agency (HCA), the Ancoats Buildings Preservation Trust (ABPT) and

Historic England; four professionals who work in the converted industrial mills and five residents of the redeveloped Ice Plant and Royal Mills complex.

Finally, we undertook a field trip in June 2015, enabling us to experience the location first hand and establish a 'sense of place'. This research also provided us with photographic material and updated evidence for the creation of the map (Fig. 1) presented on this paper.

2 FROM INDUSTRIALISATION TO DEINDUSTRIALISATION

2.1 *Manchester's development*

In the late 20th century Manchester acquired the epithets, Madchester and briefly Gunchester, both of which were at least partly connected to the deindustrialisation that began during the post war years. Manchester's original nickname 'Cottonopolis' acknowledged its role as the globe's preeminent producer of cotton during the industrial revolution.

Established in the late 15th century, Manchester became the world's first industrial city growing at an incredible rate throughout the 18th and 19th centuries. The impetus for this unprecedented growth was the development of a number of technological processes, most importantly the evolution of steam power applications in industry. Simultaneously Britain's position as head of a global empire enabled it to source raw materials from around the world. The resultant economic, technological and trade boom had a profound impact on Manchester's urban tissue. Large textile mills and warehouses were erected to enable production on an 'industrial scale' whilst the city's growing population, attracted by increased employment opportunities, needed homes.

With industrial levels of production came industrial levels of grime and dirt and the city's influx of new workers experienced slum conditions in the hastily constructed residential dwellings. Ancoats, a district north of the city centre, epitomised this phenomenon and was one of the areas visited by Engels during his research for The Conditions of the Working Class in England in 1844. There he witnessed *"the defiance of cleanliness, ventilation and health"* which mill hands were subjected to both at work and home. Briefly, Ancoats was the heart of the *"world's most futuristic city"*, its *"repetition, inhuman scale and industrial materials of its mills*" offering a *"prophecy of the architecture of the future"* (Hatherley, 2010: p. 115). Manchester gave birth to the industrial age and soon cities across the globe were replicating its growth in productivity, population and poverty.

Ancoats' ensuing decline, discussed in more detail below, was replicated throughout Britain as manufacturing shifted across the globe in search of cheaper labour. As early as 1901, Reynolds Weekly Newspaper was predicting "*the first year of the new century will prove to have been the last year of good trade and we must look forward to a period of lean years and to decline in trade with our two great rivals, America and Germany"* (cited in Joyce, 2007: p. 9). That the *"lean years"* would last so long and that Manchester and other cities like it would be so slow to respond was perhaps harder to predict.

In the latter half of the 20th century Britain was economically stagnant, caught in the structural breakdown of industrialism but yet to be subjected to the violent jolt of Thatcherism and the deregulating forces of neoliberalism. Manchester ushered in the industrial and Capitalist age but was to become one of the most notable victims of the cyclical processes of Capitalism. Manchester's mills and warehouses represented outmoded structures that emerging technologies and cheaper labour in developing countries quickly replaced. As a result, Cottonopolis became a hollowed out city. By the 1970s the city centre was home to fewer than 400 residents (Hatherley, 2010: p. 116) yet its industrial origins cast a long shadow over its contemporary deindustrialised simulacra: *"The final disfigured, sighing remnants of the mighty industrial past had yet to be completely demolished, the statuesque warehouses and factories that had survived yet to be postmodernised as part of a glossy revitalisation of Manchester's historical enterprise."* (Morley, 2009: p. 9).

2.2 *Ancoats' rise and fall*

As the world's first industrial suburb, Ancoats is a district of huge historic significance (Hartwell et al. 2005: p. 106). Ancoats evolved as a result of increased housing demand from the area's growing population and the need to construct new modern textile mills. (Ancoats Buildings Preservation Trust. 2004) From its inception it was a mixed use district, with worker's housing extending on its north-west side and industrial sites covering its south side. Although the area's roots can be traced to the latter decades of the 18th century, its development gained real momentum in the 19th century. Ancoats proximity to the Rochdale Canal (Fig. 1, No: 01), completed in 1804, combined with the development of land for the construction of new mills saw Ancoats cement its positon at the heart of the industrial revolution. In the first three decades of the 19th century its population tripled, reaching more than 56.000 by 1861. (Rose et al. 2011: p. 33).

This 'golden era' of Ancoats is defined by two contrasting physiognomies. The first revolves around the district's industrial wonders. Ancoats was the site of the urban factory system's inception (Hartwell et al. 2005) From 1797 until the mid-19th century revolutionary steam powered cotton mills were erected in the area including Murrays Mills (Fig. 1, No: 02), et al. In contrast, Ancoats' alternative physiognomy was defined by poverty, overcrowding and slum-living (Nevell, 2014).

In the second part of the 19th century, Ancoats was subjected to a prolonged process of housing renewal. The local authority, in response to the notorious social

profile of the district, established a set of new by-laws to address the problem. As described by Nevell (2014) a series of 'unhealthy' housing rehabilitation and demolitions took place, intended to improve the sanitation level of the district. In 1897 slum demolition enabled the construction of Manchester's first model tenement block in Victoria Square (Fig. 1, No: 08), as well as the adjacent worker's cottages (Fig. 1, No: 09). The new accommodation, was of much higher quality but came with a significantly higher rental value, making it inaccessible to the district's poorest residents. This first wave of demolition and renewal by Manchester City Council (MCC) set a precedent that was to be repeated in cities all over Britain.

Towards the end of the 19th century Ancoats' industries began a slow process of degeneration as a result of increasing competition from cheaper international manufacturers, which simultaneously caused a reduction in population. With the exception of the interwar period, the 20th century saw Ancoats fall in to terminal decline. During the 1930s the district was subjected to expansive demolition schemes; communities were broken and removed; factories razed to the ground, schools and churches closed and the mills – formerly symbols of prosperity – were left abandoned. By the early 1960s Ancoats ceased to be a residential area while the cotton spinning era came also to an end.

3 REBIRTH

The *coup de grâce* for Ancoats occurred in 1987. The closure of the Daily Express site (Fig. 1, No: 10) exacerbated the sense of abandonment in a city that was experiencing increased levels of crime and gang related violence, resulting in its Gunchester moniker. However, it simultaneously provided a wakeup call. The regeneration of Ancoats, which is still occurring today, has its roots in this moment. In what follows we examine this process, breaking it down to four periods which differ from one another in terms of regeneration vision, stakeholders' action and power and development pace and quality.

3.1 *Sowing the seed of rebirth (1989–1999)*

The turning point for Ancoats came in 1989, when MCC designated it a Conservation Area, recognising for the first time its historic significance (Manchester City Council, 2016). In the following years the work of the MCC in collaboration with English Heritage (now Historic England) along with the action of the Ancoats Buildings Preservation Trust (ABPT) laid the groundwork for the district's rebirth.

The listing of historic buildings and the small scale interventions on the scarred urban environment, made possible by the Conservation Area Partnership Grant (CAP) from English Heritage put an end to the district's decline. Arguably the greatest impact on Ancoats' fortune resulted from the work of the ABPT, established in 1995. The Trust in its early days helped MCC to acquire the CAP grant, raised public awareness of Ancoats and argued for a proactive approach to the preservation and restoration of historic buildings (Ancoats Buildings Preservation Trust, 2004a).

A year later the Ancoats Urban Village Company was created by MCC, named after its first vision for the revival of the district. The Urban Village concept was based on the idea of a mixed use area with a strong sense of community. The establishment of the company, that aimed to attract commercial development to Ancoats was a facet of MCC's readiness to support the private sector (Blakeley & Brendan, 2013).

A contrasting process that occurred alongside the increased acknowledgement of Ancoats' history was the struggle of MCC to redefine Manchester's global profile. As a result, MCC led the city's bids for the 1996 and 2000 Olympics, hoping the interest and finance generated by a global event would redress the image of Manchester as a grim post-industrial city. These aspirations took a toll on Ancoats, caused by speculative buying of property which was left abandoned after the announcement of the bids' failure.

3.2 *Development fever (2000–2007)*

The first period established the foundation as well as the limitations of Ancoats' regeneration. At the dawn of the century, new players such as the North-West Regional Development Agency (NRDA) appeared, as a result of State policies (Blakeley & Brendan, 2013: p. 24).

The decisive move of the NRDA to acquire large parts of Ancoats with Compulsory Purchase Orders paved the way for a frenetic period of redevelopment. As shown in Figure 1, between 2000 and 2007 a plethora of historic buildings' conversions and new-built projects was realised. Perhaps the most important and ambitious project that set the tone for the conversion of the historic mills of the area was the restoration of Grade 2* listed Murray's Mills, undertaken from 2003 to 2006 by the ABPT. *"Everybody who wanted to develop at Ancoats wanted to know what is happening to Murrays Mills. [. . .] It was critical to get the complex repaired because people did not want to try to develop a new flat that looks out over a derelict site while there was vandalism happening … It was the catalyst that made everything else happen"*, states Kate Dickson (2015), former Director of ABPT.

In addition to the conversion of historic buildings, new developments started appearing in Ancoats, beginning with the erection of the residential complex MMII in 2003. (Fig. 1, No: 04). Darren Ratcliffe (2015), Historic Places adviser for Historic England, describes the MMII development: *"Facing on to the main road and being the closest to the centre the developer felt able to deal with that and sell it without being affected by what was behind, because it was very difficult to develop something in a rundown area. [. . .] And also with it being new built, the developers were able to set a value to the land and the units which could then*

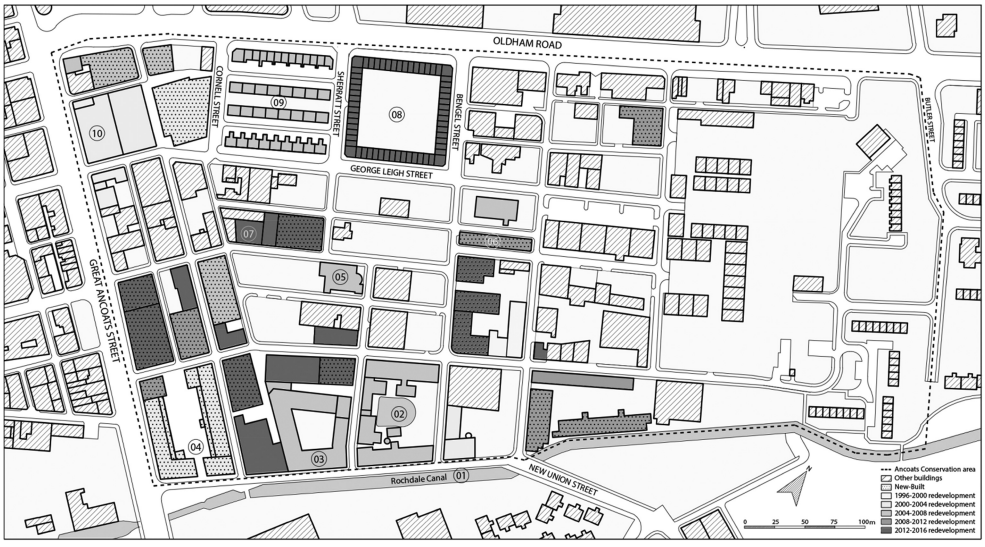


Figure 1. Ancoats' regeneration process, categorised into four distinctive periods which differ from one another in terms of regeneration vision, stakeholders' action and power and development pace and quality.

transfer into the mills. So they were setting a market rate with the new development."

After almost a century of decline, Ancoats appeared to be on the rise again. Once this process began however, the romanticism of the previous decade started to fade. MCC's desire to see the district's improvement resulted in too much trust being placed with developers. Ratcliffe (2015) recognises this tendency saying: "*The Council was prepared to accept an outline application on MMII with no design!"*

The concept of the Urban Village gradually gave way to a new idea, 'the Heart of Ancoats'. Even though the new concept was organised around a new public amenity – a square in front of the newly restored Saint Peter's Church – (Fig. 1, No: 05) it lacked the social qualitative characteristics of the previous scheme. In the years that followed, other less sympathetic schemes such as 41 Bengal Street (Fig. 1, No: 06) were built in Ancoats. An important characteristic of the development of the area at the time, common for both conversions and new-built projects, was the dominance of the residential function.

3.3 *Recession stagnation (2008–2012)*

The financial crisis that hit Britain in 2008 put a temporary halt to the rapid regeneration of the district. New development ceased; ongoing schemes were paused; conversions abandoned. With property developers withdrawing, folding or turning their attention to other parts of the UK, the willingness to favour a largely uncontrolled property development-led regeneration started to backfire.

Two cases highlight the essence of the period's stagnation and the impact of property development-led regeneration on the historic fabric. First, Murray's Mills; after a successful three-year restoration by ABPT and £10 million investment from the Heritage Lottery Fund and the NRDA (Ancoats Buildings Preservation Trust, 2004b), the complex was about to be sold to a developer, selected via competition. The Trust decided not to engage in the reuse of the Mills due to their limited financial means and the massive scale of the complex. Kate Dickson (2015) describing the events that followed the developer's selection, explains: *"The developer (once selected) wanted things changed and it was already too late to have that conversation . . . So it became a very acrimonious and difficult relationship. Finally, when the project came to an end the developer changed his mind and decided not to take it on. . ."*

The project remains uncompleted to this day.

Second, the Royal Mills complex scheme (Fig. 2, No: 03, 2), was left unfinished. ING development which realised the first stage of the scheme in 2006, withdrew from the UK during the crisis. Residents and professionals working in the Royal Mills complex interviewed for this research, commented on the developer's indifference. *"ING did not care. After 8 years there are still empty units on the ground floor"* (Royal Mills professional, 2015a). Another respondent adds: *"The atrium is lovely but it only works as a hallway. It is never used. They should have thought it through . . ."* (Royal Mills professional, 2015b). Such claims are bolstered by Phil Collings (2015), Senior Area Manager Greater Manchester HCA: *"ING transformed the building to put in office space, but they were not interested in fitting it out. They left the ground floor just a shell and it remained an unused space."*

3.4 *Towards a glossy Ancoats (2012–today)*

By 2012, Britain still reeling from the financial crisis began a slow process of recovery. The crash



Figure 2. The atrium of the Royal Mills' complex eight years after its conversion remains an attractive yet empty space.

caused major upheavals in Ancoats stakeholders' pool, redefining its former major players' roles. While the ABPT saw its influence wane and the NWCA was closed down by the Coalition Government (Blakeley & Brendan, 2013: p. 24) new actors such as the Homes and Communities Agency (HCA) entered the scene.

As highlighted in Figure 1, a new wave of development began. HCA, which acquired the assets of the NWCA, once again encouraged commercial investment in Ancoats. Important historic buildings such as the Ice Plant (Fig. 1, No: 07), were converted, while schemes halted by the crisis, like the Royal Mill complex, were completed.

A shared characteristic of this phase with the period prior to the crisis is the dominance of the residential function in the developments. Collings (2015) explains the reason for this mono-functional tendency and clarifies MCC' s position, *"In the Manchester market the residential uses are more valuable than the office uses. The local authority insisted in having a mixed use scheme."* Discussing the Royal Mills conversion, the same respondent also highlights another parameter of the residential development: *"The housing offered is not affordable. The average price is £200.000. The project is socially exclusive."* Collings' claim is confirmed by our comparative data analysis presented in Figure 3. The average rental price in Ancoats is considerably more expensive in relation to

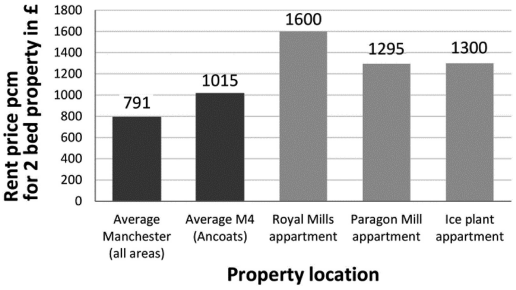


Figure 3. The comparison of the rent price in Ancoats and Manchester reflects the district's gentrification tendency.

Manchester's average. Of equal interest is the comparison of the converted historic complexes' rental value with Manchester's average figures. The results of this comparison clearly demonstrate the gentrification tendency of the current regeneration schemes. (home.co.uk. 2016, zoopla. 2016).

The analysis of the interviews conducted during this research provides an insight into the current state of Ancoats. It is notable that respondents recognised features of the regeneration involving Ancoats' intrinsic characteristics. The aesthetics and spatial qualities of the Victorian industrial complexes, boosted by their rehabilitation, were singled out as the most successful feature of the respective schemes. Most of the positive comments, also acknowledged the historic structures and their safeguarding (heritage preservation, reuse of historic buildings, successful blend of old & new, revival of a run-down area) whilst the majority of respondents referred to the advantageous location of the district in relation to Manchester's city centre, as one of its core qualities.

In contrast with the high evaluation of the regenerations' aesthetic result on a building level, many respondents appeared dissatisfied with the district's lack of amenities and its current social state. The scarcity of supplementary commercial and recreational amenities and the absence of green spaces were highlighted as shortcomings of the regeneration. Additionally, the lack of community spirit was a common criticism.

Closing the analysis of Ancoats regeneration, we need to refer to recent developments and future plans. The most important development predicted to have a decisive impact on the socio-spatial fabric of Ancoats, is the formation of Manchester Life Development Company (MLDC) in 2014. MLDC is a residential development joint venture company between MCC and Abu Dhabi United Group (Manchester Life, 2015).

The residential redevelopment of Ancoats and the neighbouring New Islington is the focus of the MLDC's agenda which has promised the development of more than 6.000 new homes by 2024. With the first phase of 'Manchester Life' underway, involving the process of planning applications for the reuse of three sites in Ancoats, including Murray's Mills, concerns have been expressed by the local community. The residents remain sceptical about the program of new

projects while highlighting a need for more amenities, claiming: "*The area is increasingly appealing to both young couples with children as well as older 'empty nesters'– it is no longer just about young professionals. Therefore, it is important to provide safe play spaces, recreational spaces and green spaces for the needs of a more diverse community."* (Tomlinson, 2015).

Reviewing current press coverage of Ancoats reveals there are plans for some modest development of small-scale supplementary uses around the Cutting Square and across Great Ancoats Street. The degraded state of the north-eastern part of the conservation area receives less attention.

4 CONCLUSIONS

In this paper we attempted to identify the impact of the regeneration practice on former industrial cities, examining the case of Ancoats. We discussed Ancoats' role and drew parallels with Manchester's development, demonstrating its spatial and social values and the problems it was facing. A detailed analysis of the full course of the district's regeneration and the stakeholders' action since the late 1980's as well as a division in periods with distinctive characteristics was sought, expanding the existing knowledge base. Finally, using data from our qualitative, desktop and field research we were able to evaluate the impact of the regeneration and highlight its merits and pitfalls.

The evaluation of our case can be summarised in three main conclusions.

First, throughout Ancoats' regeneration process considerably more focus was placed on the resolution of spatial rather than social problems. It was evident that, apart from the early vision of the Urban Village, all other concepts – driven mainly by partnerships with commercial developers – prioritised a development vision that sought to enhance only the built environment. It is worth highlighting that this spatial enhancement was indeed achieved, in a style sympathetic to the historic industrial structures that once defined Ancoats' character. However, it was achieved by using more piecemeal gestures rather than a comprehensive plan. Consequently, after almost two decades, there is still a lack of amenities and evident spatial discontinuities.

Second, Ancoats as a typical product of developer-led regeneration schemes, is gradually becoming a gentrified and socially exclusive area. The converted mills are sold or rented at extravagant values, limiting the potential residential clientele. The sleek new developments in conjunction with the lack of any type of interpretation of the history of the district place Ancoats in danger of becoming a sterilised English suburb with a few romantic Victorian features.

Third, the stakeholders' action has had an enormous impact, steering the direction of the regeneration. We suggest that even in a neo-liberal system, not everything is, nor should be, predetermined and left merely to market forces. The Ancoats example proves how actors from the voluntary sector such as the ABPT can exercise influence and achieve results for securing the district's historical and cultural sustainability. The case also demonstrates the considerable power of the local authority and illustrates the impact of its fluctuating priorities. As shown, the commercial developers' growing power is undeniable yet can be fortified or controlled depending on the political will of the local and national authority and the community engagement.

The growing power transfer from the public sector to commercial developers in the established neoliberal system, is expected to favour the described negative implications of urban regeneration more and more in the years to come. Thus, further studies need to be carried out to explore the potential and limitations of alternative development approaches.

Even though every case is *sui generis*, there is common ground in the regeneration of European former industrial cities, resulting from the influence of the established socio-political system they share. Therefore, the investigation of the regeneration history of Ancoats, a representative example that epitomises the problems of post-industrial cities, can inform future practice on similar cases, making this research highly relevant.

We suggest that the binary nature of debates on the positive or negative nature of regeneration practices of former European industrial cities is erroneous. Drawing from the Ancoats case, we recognise that urban regeneration in a neoliberal system can have both positive and negative implications for our historic cities. The positive ones concern mainly the physical enhancement and the preservation of tangible inherited assets whereas the negative revolve around the issue of social gentrification and the loss of intangible values of heritage. According to our research, the decisive factor that can influence the balance between the two is the stance of the actors, such as the local authority and the local community, involved in each project.

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Transporting transformations: A case study of built environment changed by transportation in rural China

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ABSTRACT: The vast areas of the countryside in China undergo a series of radical changes, both socially and spatially. Changing transportation is one of the affecting factors. In this paper, an in-depth observation on a specific built environment in rural context, the Xiaqiao village, is conducted to illustrate how the changing system of transport triggers a chain reaction in architectural transformation. The methodology of settlement morphology is implemented in the research by examining the transformation process of a built environment from different spatial levels in order to study how the socio-spatial structure transforms and develops.

1 INTRODUCTION

Rural China has been experiencing a series of dramatic transformations spatially, physically, and socially. It is often regarded as an aftermath caused by urbanization that obtains less attention in the academic field. Thus, this paper conducts an in-depth case study of the Xiaqiao village to research the transformation of the socio-spatial structure.

A wide range of affecting factors relate to the radical changes that happen, including economics, geography, population size, technological innovations, social concerns, and so forth (Headicar et al., 2009, Mandal, 1979). For the Xiaqiao village, the changing transportation system imposes significant influence on the development of rural built environments. The means of transportation is an important indicator to measure economic development. It decides the accessibility of goods and resources and the size of a local's communication circle. The technological breakthroughs of transportation weaken the influence that distance imposes on goods trading, knowledge and technology exchange, and the accessibility for the mobility of people (Gugler, 1978).

Xiaqiao locates within the mountainous region of the southern part of the Zhejiang province. Seven field surveys have been conducted since 2013. They provided me sufficient first hand data to explore the transformation of the village through the past 300 years, including geographical mapping, architectural drawing, and interviews with locals. The morphology methodology is used to examine the development process in different spatial layers from the settlement pattern (Habraken, 1998), building fabric, inner space, structure, and infill, to further discover the socio-spatial structure in the village.

2 THE VILLAGE IN GEOGRAPHICAL AND HISTORICAL CONTEXTS

2.1 *The Xiaqiao village and its geographical environment*

The terrain of the mountainous region where the Xiaqiao village locates is so complex. It is full of steep hills, deep valleys, rivers and basins. It is descripted by locals accurately as "nine tenths of the land are mountains, half of one tenth are rivers, and the other half are farmlands." (Fig. 1) Geographical constraints by mountains operate on the availability of transportation for people and goods. Mountainous part cut off the world inside from the outside world to some extent. Compared to the crisscrossing circulation network by roads and water in plains, the complex terrain largely increases the cost of time and money, decreases the efficiency in transporting goods, shuttles people and circulates information. The difficulties of transportation obstruct regional development and make it to be the poorest region in the province for a long period (Wu and Liu, 2009).

The separation of geography makes this mountainous region a comparatively independent area socially, economically and culturally in the province. Also, the numerous mountains and valleys also restrict efficient communication inside. Thus, it forms several inter-independent sub-regions. The Xiaqiao village is the center of the southeast region serving as a regional traffic hub. It locates in a small basin that connects five adjacent townships and hundreds of villages within, taking up an area of one third of the whole county. The exploitation, formation, and continuous development of the community all benefited from the advantages of its location for centuries. However, conversely,



Figure 1. Historical Map of the Region (Lin and Lin, 1975).

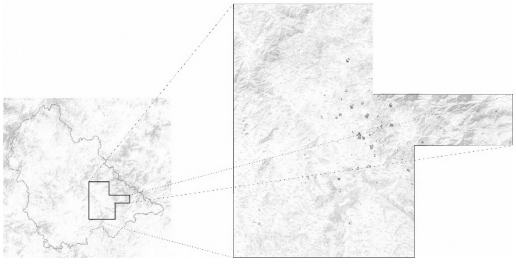


Figure 2. Geographical Distribution of Marriage Relations (Drawing by the Author Based on Google Maps, 2016).

the potential for the village's development is also restricted by the insular geographical environment and the undeveloped transportation system.

2.2 *The changing transportation system in the village*

Before the modern roads were well built, the traditional roads in the region were made of stone and mud allowing only a one meter width for horse rides and walking. It took a adult male half a day to arrive at Luoyang, the central town of the county, or Pingyang, the neighbour county, and three days to reach out at Wenzhou, the city to which the village belongs. The daily life and communication of the residents here are usually constrained inside a small geographical circle with a distance of half a day's walk. From the statistics of marriage and land reclamation counted from the family archives in the Qing dynasty, most of them are conducted inside the southeast part centered by the basin where the village locates (Fig. 2).

The first modern road going through the village was built from 1966 to 1971. Afterwards, more roads were planned, built and updated inside and around the village, and are still processing today (Fig. 3). The means of modern transportation changed the way people and goods travel. The time spent to move to other places has been drastically shortened. Nowadays, a resident only needs one and a half hours by car to reach the central Luoyang town or the neighboring Cangnan town, where a high speed railway station has been open for two years. It makes possible to transport villagers to places far away, such as Shenzhen or Shanghai, the two economic centers in China. To arrive at Wenzhou city, one only needs three hours via bus.

The improved transportation system is connecting the village with the whole world. Due to the advantage of the increased accessibility of transport, tourism has been developed tremendously, which changes the economic sector and lifestyle of the village. It is known that the village has received around 450,000 tourists in 2014, among which 60% are from Wenzhou and 40% percent from other places, including foreigners. It takes about 4.5 billion yuan in income from tourism and other relative industries. The gradually developed transportation system has been remodeling the rural landscape dramatically.

3 TRANSFORMATION OF SETTLEMENT PATTERNS

3.1 *Disappeared boundary*

The modern transport network dismantles the spatial separation between settlements. Traditional settlements are enclosed by geographical settings, such as mountain ridges, rivers, and farmlands as a result of adaptability to natural environments in the settling process, which always creates clear boundaries and can be defined clearly. The built area of Xiaqiao and that of its neighbor settlement Baifenqiang stood apart by the Dongxi River, farmlands and highlands between them. However, since modern construction, the Xinyang Road and the Sishui Road in the 1980s, both villages have grown along the line of traffic to maximize the usage of the roadside and finally merge together on space around the Dongxi river. Thus, the spatial boundary has disappeared through the connection of the roads (Fig. 4).

3.2 *Agglomerating settlements*

During the agrarian era, due to the limitation of capacity that a per area farmland can support, local peasants had to migrate to remote places to discover unexploited lands when the population increases continuously. Instead of concentrating, it is a process of settlement dispersing. However, the modern transportation system leads to a new round of population concentration. It reversed the movement of settlers existing in this

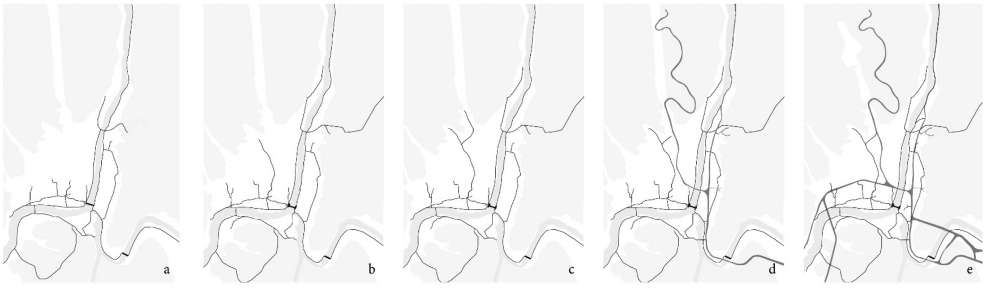


Figure 3. Construction of Roads along Temporal Sequence (a: The Early Stage of the Qing Dynasty; b: The Later Stage of the Qing Dynasty; c: The Republican Era; d: The Planned Economic Era; e: The Market Economic Era), (Drawing by the Author, 2016).

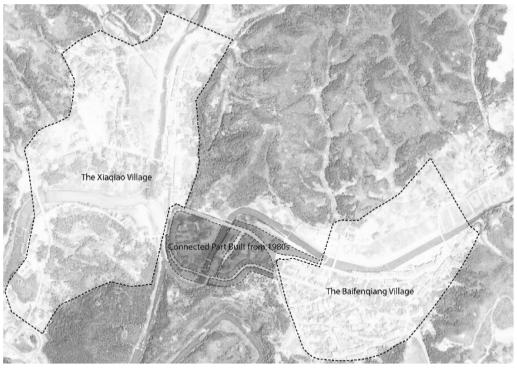


Figure 4. Connection of the Adjacent Two Villages (Drawing by the Author based on Google Maps, 2016).

mountain for centuries. Today, residents live in peripheral settlements moving toward a central one near the main road to increase the accessibility to reach more resources and opportunities for better life, education, and work. The advantages and economic interests can be seen on the roads via trade, and tourism stimulated the spatial agglomeration of settlements (Fig. 5). The new means of transport enable the mobility of people and their households sufficiently. Many families in Xiaqiao migrated from neighboring villages deep inside mountains in recent decades, and some of them are even from other cities and currently work here.

3.3 *Shifting value of land*

Houchi has been the best residential area with the highest built-up density, the longest history and the best Fengshui (Chinese Geomancy), which attracted the most influential families to compete for the right to live here until the 1970s. (Fig. 6) The area next to the Beijian bridge has been the primary trading field with several stores selling goods for passengers for a long time. The newly constructed road network reverses the spatial structure of the village. The original peripheral building groups around Nanshan Hill that are settled by the Chen family became more prosperous in the community because of its convenient location next to the new transport entrance from the province-leveled road into the village. New restaurants and hostels opened by renovating old dwellings. The first and also the busiest restaurants in Xiaqiao all belong to this area. In 2014, the first boutique hotel that can be booked via the internet in the small village operated by a couple living in Luoyang opened here as well. In contrast with the flourishing area of Nanshan, the west bank of Houchi contains two large traditional courtyard dwellings built by the elite from the wealthy Tang in Qing dynasty, but they have been desolated since the 1990s due to its location being away from the newly constructed roads.

The shift of land value also leads to the transfer of social structure. The previously powerless Chen family gained more power in the Xiaqiao village to compete with Tang and Lin. The convenient means of transportation brings in great income for the locals by tourists all around the world. Stimulated by the booming tourism, all space values are transferring. The wooden pavilion bridges and traditional dwellings lost their original function of traffic or accommodation and are now viewing spots for visitors. The area next to the Beijian bridge changed into a park where new construction is not allowed to protect the architectural remains and to attract tourists. Besides, a carpark, a spatial novelty that has never been seen in the village before, was built to fit the requirements of parking raised by new means of transportation.

4 TRANSFORMATION OF BUILDING FABRIC: NATURAL ENVIRONMENT ORIENTATION TO TRANSPORTATION ORIENTATION

The building fabric in Xiaqiao shows a clear shift from a natural environment orientation to a transport orientation (Fig. 7). During the pre-modern era, a close fit has been exhibited between an agrarian way of life and a domestic space. Conditions of a natural environment are always considered first for site selection. Thus, dwellings are built at the foot, or on the slow slope of a mountain, as a comprehensive measure for balancing the losses of farmlands by house occupation and Fengshui, the traditional evaluation system

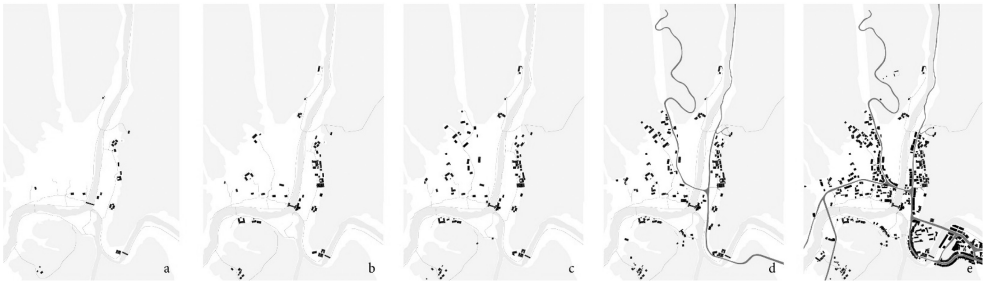


Figure 5. Growth of the Xiaqiao Village (a: The Early Stage of the Qing Dynasty; b: The Later Stage of the Qing Dynasty; c: The Republican Era; d: The Planned Economic Era; e: The Market Economic Era), (Drawing by the Author, 2016).



Figure 6. Function of Buildings in the Village (Drawing by the Author, 2016).



Figure 7. Co-existing Building Fabrics Built in Different Eras (Drawing by the Author, 2016).

of geographical environments in China. It is indeed a metaphor of environmental determinism (Fig. 8).

In addition, the direct relationship between the house and the traditional road has never been a necessary prerequisite in the site selection of new houses during the agrarian era. Essentially, house construction is often ahead of path construction. It is common that after the building was built, a pavement will be created spontaneously towards the new house. Besides, traditional houses always avoid facing main roads directly in pre-modern times both physically and mentally. They often are located on the secondary path deriving from the main road, with an enclosed courtyard wall or a receded space ahead as a transition so as to separate from the public.

However, the situation changes in the construction of modern road networks that a transportation-oriented approach to organize spaces is developed. Houses are emancipated from the restriction of farmland preservation and are lined up in a row trimly along the road. Houses are relocated next to new lines of transport, which substitutes the original group-shaped building fabric (Fig. 8). The line-rowed pattern fits the requirements of increasing mobility of rural populations as well as their accessibility for more resources. Meanwhile, transitional space has disappeared as well. The doors of new houses directly face the road and facilitate daily access. It fosters the spatial transformation from living spaces to small groceries next to the road where goods are sold to passengers and drivers.



Figure 8. Traditional Houses Built Next to Mountains (A, B, C); New Houses Built Along the Road (D, E, F), (Drawing and Photo by the Author, 2016).

5 TRANSFORMATION OF INNER SPACE AND ITS FUNCTION

Rural settlements only need to satisfy the requirements for a basic living during pre-modern times, like accommodation for shelter, cultivation for livelihood, and popular beliefs for spiritualism, with periodic fairs for exchange and other necessaries. With the all-directional transportation system spreading out, spaces with new functions are imported into houses. The tourists being transported through roads stimulates the renovation of common dwelling spaces into visitation spots, museums, stores, hotels, and restaurants entirely, or partially, by functional displacement of several selected rooms.

The new functions brought about cause a series of chain reactions in spaces. For example, the front space of the first floor in houses are always changed into small stores to sell snacks and groceries. It takes up the original space as the living room. Corresponding to the new situation, living rooms have to move backward and merge with the dining room and kitchen in the rear. In other cases, the front living room can be used as a temporary reception when the houses are partially changed into a hostel.



Figure 9. Envelops of New Houses (Photo by the Author, 2015).

6 TRANSITIONAL CONSTRUCTION SYSTEMS: MATERIALS, STRUCTURES, INFILL, AND FURNISHINGS

Rapid means of modern transportation improves the availability of transportation for goods and people. In this respect, new building materials and techniques are more accessible for local villagers, which in turn changes the form of vernacular dwellings immensely.

During the Qing dynasty, traditional dwellings were built by local builders and with local materials. Most of them used local wood while some poorer builders used mud-bricks. In the later Republic period, due to the rapidly expanding trade routes, newly imported material such as the steel used to construct window bars was being transported directly to the village. Right up until the 1970s houses were still being built by Xiagiao's villagers themselves, who used locally manufactured mud-bricks and quarried stone in response to the decreasing availability of wood. Both the architectural forms and construction methods are vernacular as a self-sufficient system with little reliance on the outside market.

The first batch of houses displaying modern architectural forms were built in the 1980s along the newly constructed East Sishui Road (Fig. 9). Since then,



Figure 10. Similar Organization of Inner Spaces in Traditional Houses (From Left to Right, A: The Central Hall of the Second Floor; B: The Central Hall of the First Floor; C: Kitchen in the Back; D: Private Domestic Space), (Photo by the Author, 2015).



Figure 11. Modern Furnishing in New Houses (Top: Kitchen; Bottom: Living Room), (Photo by the Author, 2015).

especially in the last two decades, the village has experienced unprecedented architectural transformation and modernisation. The transportation of new materials has been largely simplified by the use of trucks. Meanwhile, the outside world is more accessible to all villagers thanks to public buses and private cars and motorbikes. While still young nearly all residents leave the village for a larger city in search of a job or education. When they return home, they bring with them a modern domestic lifestyle along with new building techniques and novel architectural forms. The knowledge of modern architecture are then introduced to this remote village.

Instead of keeping to the traditional forms, the new houses are built totally in modern styles; with brick walls, larger windows, higher ceilings and bigger rooms. Fired bricks and steel reinforced concrete are the major materials used for the load bearing structures. Ornate tiles, colourful paint, clean glass, and aluminium alloy frames are used to clad the houses and decorate their facades. (Fig. 9)

Besides the decoration on the outside walls, inside the furnishing are different as well. The rooms in the traditional dwellings are sparsely decorated. Moreover, the type of furniture used and their arrangement in all traditional dwellings are so similar that there is hardly any variation. Chairs, tables, beds and cabinets are made of wood or bamboo and are allocated to rooms in keeping with conventional customs (Fig. 10). These days, however, a wide variety of appliances and furniture can easily be transported to every home which leads to a diversity of interiors. Instead of the completely self-operated construction method of vernacular dwellings, house construction takes full advantage of the newly found access to the wider world; as a part of the national market system or possibly even on the global level (Fig. 11).

7 CONCLUSION

Generally, under the influence of modern transportation that fastens and eases the circulation of goods and people whereby its all-directional roads' tentacles, spatial structures of rural landscapes are remodeled dramatically to fit the new needs created by increasing communication with the outside world. The Xiaqiao village transformed from a scattered pattern into a more compacted pattern. The whole system of construction transformed from traditional to modern including building form, techniques, and materials. All these changes are accelerated by economical interest and cultural globailiztion transported by new means of transportation. To respond to the new challenges raised

by the modern society, the village has to transform itself into the contexts of globalization gradually.

All the transformations happening in Xiaqiao is a small part of what is happening in rural China entirely. This analysis provided demonstrated the drastic changes that are now happening in every corner of rural China. It heralds a strengthening of ties between small villages and the whole world by this new means of connection.

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Emerging patterns of change for tomorrow's cities

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ABSTRACT: Today, climate and demographic changes are becoming the greatest challenges for cities and their multicultural populations. On the other hand, there is a growing societal acceptance of information and communication technologies around the globe. And this connectivity is influencing both design thinking and research methods, while generating large quantities and a wide variety of data. In this paper, emerging patterns of change for future cities are surveyed, and international networks for urban research are highlighted. As such, criteria to analyze and compare trends, shifts and hypes in urban studies and planning are searched. Moreover, interactions between open data and green infrastructures are foreseen, in order to promote public development for future cities. Finally, a need for common mind sets and methods is claimed, namely between computing and social sciences, to engage local communities and public organizations.

1 INTRODUCTION

According to Mortensen (2015) *change*, in its most general conception, can be seen as 'difference or non-identity in the features of things,' whilst another usage may be temporal change, exemplified by 'change in the properties of a body over time.' In his perspective, the change of temperature in distinct components of a body could be measured, the change in atmospheric pressure at different places might be recorded by isobars, and/or the change of parameters of a surface/body would be represented by numerical descriptions, contour lines or distinct colors. Nevertheless, '[c]hange is so pervasive in our lives that it almost defeats description and analysis' (Mortensen 2015).

At a recent TED Talk in Vancouver BC, Al Gore (2016) recalled our attention to a series of extreme weather events increasing around the world in recent years, which show dramatic *climate change* effects on cities, regions, countries and their multicultural populations, in past and present times, and for the future: Typhoon Haiyan in Philippines and Pacific Ocean, Storm Sandy in the west coast of the United States of America, particularly in New York City, and historic floods in Chile, Brazil, Serbia, Czech Republic, Mozambique, India, China, and Australia.

Since the turn of the 21st century, and for the first time in human history, the majority of the world's population is already living in metropolises, cities, towns, and other urban settlements. While the world's population by 2015 was estimated to be around 7.3 billion, of whom 60% are living in Asia, it is projected to reach 8.5 billion by 2030, and up to 9.7 billion people by the year 2050, of whom 66% will be living in cities. And this *demographic change* is not predicted to occur evenly in the entire globe, but also in extremes: whilst half of the global population growth between now and the year 2050 is anticipated to occur in Africa, a considerable decline is expected over the same period of time for the population in Europe (UN 2015).

This global and pervasive change in densification of urban populations, in developing and developed regions of the world, will certainly increase strains on the built environment, public spaces, buildings, infrastructures, transportation, energy, water, waste and other urban systems, and probably on the natural systems of the planet Earth as well.

On the other hand, there is a global acceptance of information and communication technologies (ICT) at all levels in societies, such as internet, static and mobile computing devices and wireless networks, clouds, GPS satellites, and so forth. As such, this *connectivity* between people, things, natural and built systems, is influencing design thinking and methods, while generating previously unforeseen quantities and variety of data.

What will cities look like in the future? How are networks of researchers generating and sharing data and knowledge on urban systems, in order to address these climate and societal challenges? In this paper, emerging patterns of change for tomorrow's cities are surveyed, while pointing out international *networks for urban research* that are tackling those challenges both in the lab, in the office, classroom, and at the auditorium, on headquarters and also on campus, in the field and increasingly online.

2 MODELS, FORESIGHT AND CHANGE

Whilst urbanization is already facing these complex and unprecedented challenges, such as climate and demographic changes, it is also influencing theorists, academics, researchers and planning practitioners to

understand cities as *complex systems* (Batty 2013, Jacobs 2001), through an interdisciplinary approach not only for real time sensing, visualizing, modeling, and managing processes for today's cities, but also for medium and long term strategic thinking and planning for the cities of tomorrow (Moir et al. 2014, Tewdwr-Jones & Goddard 2014, Ward 2004, Echenique & Saint 2001). Although several issues about knowledge transferability can be raised (e.g. a city is neither a tree nor a war), this understanding of complexity and uncertainty can have a considerable impact in urban studies and planning, since it has proven results in other fields during the 20th century, such as warfare and business operations, as it will be summarized in the following paragraphs.

2.1 *From warfare to business operations*

Mostly during second world war, researchers were mobilized into military operations and governments, to develop new fields, such as atomic and nuclear energy, radar, and computers: the results have been applied and known worldwide. In the 1950s and 1960s, many of these researchers were employed by private corporations and/or public institutes, to adopt the mathematical models and analysis to business operations, namely through foresight, trend reports, *scenarios* and other innovative processes that could alter past mental conceptions and enable unthinkable futures. Thus, corporate planning in such companies like General Electric (GE) and Royal Dutch/Shell Group (Shell) developed new standards for medium and long term strategic thinking and planning, which allowed these corporations to act quickly in crisis situations (e.g. Yom Kippur War in the Middle East and the following oil embargo), and to move into leading positions in the global markets, until today. Moreover, *systems thinking* was being developed by researchers, and applied to model interconnections and explore limits between key variables, such as population, natural resources, pollution, food and industrial production (Benn et al. 2014, Kosow & Gaßner 2008, Ringland & Young 2006, Wilson 1992).

2.2 *Complexity, computers and data*

Particularly since the 1970s, the initial acceptance of computers also started to change urban studies and planning, but they were available only to a limited number of theorists, researchers and practitioners. For example, Tobler (1970) and Batty (1976) developed models to analyze, visualize and understand urban complexity, through computing methods and collaborations with researchers from other fields, to enable innovative advances in urban research.

However, in the last decade static and mobile computing devices and wireless networks have been embedded in all aspects of our daily life, and societies in almost every location of the globe seem to accept this connectivity. These (new) digital possibilities are influencing both design thinking and research methods, and opening paths for novel sub-disciplines, for instance digital fabrication, generative and algorithmic design (Hanna 2013, Oxman & Oxman 2013, see also Hauschild & Karzel 2011).

At the moment, the possibilities of data to inform, model, manage and foresee complex urban systems and planning processes might be highly promising (if not overwhelming): more than 90% of all the data in the world has been generated since 2011, and this seems to be increasing non-linearly with more data being generated and released by people and/or things, groups and periods of time, which can be combined into larger groups and/or longer periods of time, shaping up what is presently named big data, and widening the range of advantages for research (Dragland 2013).

As such, between the utopian and dystopian urban visions imagined over the past centuries, and the best practice examples of urban planning around the world, there is the momentum to share *urban data* among public sector organizations, universities, transnational ICT corporations and local community groups involved and interested in urban research through international networks.

3 URBAN PATTERNS OF CHANGE

3.1 *Green, smart, refugee and collective*

In the past, several urban visions were proposed by historians, academic and practicing planners, novel writers and film directors, geographers, environmentalists and preservationists, local and neighborhood communities, public policy makers, and/or other stakeholders interested in urban processes, and some of these visions were planned, built and can be experienced today as best practice examples of resilient urbanism. In this section, emergent patterns of change in urban studies and planning will be surveyed: (a) the garden cities movement and its legacy for a green future; (b) the global smart cities trend, where governments and ICT corporations join forces; (c) the sudden increase of refugee camps, tent cities and shanty towns due to extreme weather events and man-made disasters; (d) the engagement policies and actions involving local communities; and (e) the open data initiatives.

3.2 *Garden, eco and green cities*

Initially proposed in *To-morrow: A Peaceful Path to Real Reform*, Howard's (1898) garden cities vision, i.e. a network of urban settlements combining city and country characteristics in order to manage social and economic change, has been claimed to be one of the most enduring and transferable of those visions, influencing urban planning in Europe and also worldwide, for more than one century (Ward 2016, Dunn et al. 2014, Hall & Ward 1998).

While addressing solutions to housing shortage and pollution issues in growing mega cities, such as London in the end of the 19th century (and in

many other locations still today), Howard developed an urban vision that combined both natural and built environment. Furthermore, the garden cities vision promotes a sense of community and considers limits of growth (e.g. the green belt strategy), while structuring a hierarchy of planning principles that allowed it to be reconfigurable and adapted in very different geographical, economic, cultural and even social contexts, and has ultimately also generated data and knowledge from scholars from distinct disciplines (Stern et al. 2013, Ward 1992, Hall 1988). And, to implement his urban vision, Howard also started the organization now known as the Town and Country Planning Association (TCPA), which laid ground for other similar groups in different countries, and for an international network that organized visits to the best practice case examples (e.g. Letchworth, Welwyn garden cities), meetings and conferences, even in some conturbated periods of world wars. Moreover, the garden cities movement (and the TCPA) helped to build the conceptual and methodological structure of a national planning policy in the United Kingdom, more concerned with environmental issues, and global policies for green cities which are still valid today, thus engaging through top-down and bottom up approaches, and promoting social and environmental values (Parsons & Schuyler 2002, Fishman 1977, see also Hein 2014, Jacobs 1961).

Considering the wide geographical application, the considerable timescale, the success of both top-down and bottom-up engagement, the promotion and adoption of social and environmental values, and how it laid ground for data and knowledge access through international networks and scholarly work, the garden cities movement can be considered the most meaningful (modern and) contemporary trend in urban studies and planning.

In fact, garden, eco and green labeled cities are spreading worldwide, though sometimes is not clear what ties together all these cities. Nevertheless, strong research in urban studies and planning with environmental motivations is still needed (Beatley 2012, Cohen 2011), to address these issues not only in higher education, but at all levels of society, for future generations and maybe even for the survival of humankind.

3.3 *Smart cities and ICT corporations*

ICT and Internet of Things (IoT) are currently being applied in experimental pilot initiatives across the globe to envision, monitor, and also manage urban systems (e.g. water, food, energy, green, waste, transport and communication), in order to generate and promote economic prosperity, social well-being, efficiency and sustainability.

On the one hand, recent examples from *tabula rasula* experiments with embedded ICT integrated in the earlier stages of the urban planning process (e.g. Songdo in South Korea, Masdar in the United Arab Emirates), developed by transnational corporations,

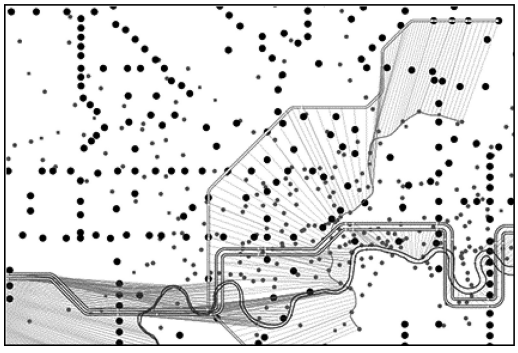


Figure 1. London's metrography, data visualization/ mapping processes, 2012. Authors: Benedikt Groß & Bertrand Clerc. (Courtesy of the authors). Available at: <http://benedikt-gross.de/log/2012/02/metrography-london-tube-map-to-large-scale-collective-mental-map/> [accessed 2016-2-21].

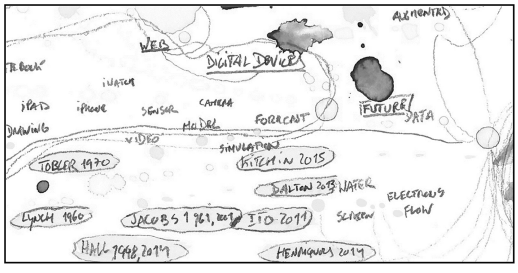


Figure 2. Timeline sketch, mapping technological processes and key researchers in urban studies and planning.

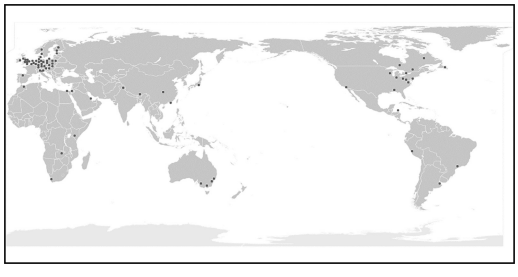


Figure 3. World map of garden cities.

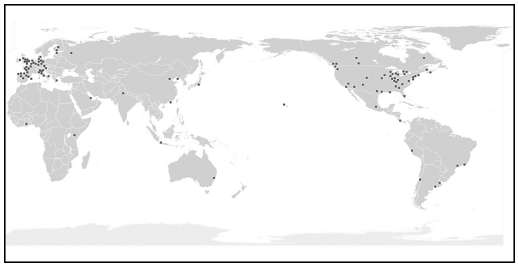


Figure 4. World map of open data initiatives, mostly distributed in Western Europe and North America regions.

seem to show evidence that successful cities thrive through a complex interaction of urban systems, whatever their classification relates to garden, eco, green, smart, or (gentrified) historic, with their local and neighborhood communities

On the other hand, and particularly through public developments in Europe, some degree of success is shown in overlapping new systems of ICT and IoT, which are adjusted to existing cities, alongside green infrastructure, tangible and intangible heritage, and so forth (Manville et al. 2014). And this seems to confirm that an interdisciplinary approach to cities is needed. While it could be argued that the association of both trends, i.e. urbanization and digitization, has indeed the potential to inform urban studies and planning, modeling, foresight, and also management processes in cities, there is still the need of evidence for civic and other cultural utilizations (Batty 2016, Kitchin 2016, 2015, Henriques 2014).

Particularly in smart cities, these transnational ICT corporations have been showing a deep interest in the generation of urban visions that seem to promote major changes in most urban lives, following such visionaries like Jane Jacobs or Le Corbusier (Greenfield 2016). This recent global smart trend (or is it only a hype?), promoted by corporations such as IBM, Cisco and Google, might raise ethical issues and other implications for the future of humanistic cities, since it implies opportunistic sensing and monitoring of its citizens through algorithms, sensors, cameras, crowdsourcing and other information extraction networks essentially from a top-down perspective. Nevertheless, more can be made through partnerships between some of these corporations, universities, local institutions and communities, to enable informal data collection and mapping efforts of bottom-up approaches, in order to augment our understanding of cities as complex systems.

3.4 *Refugee camps, tent cities and shanty towns*

Probably in every period of history, urbanization and temporary settlements such as refugee camps, tent cities, shanty towns and slums, have been associated (see also Lefebvre 2003). For example, between the 19th and the 20th century, slums were common in London (Yelling 2007), and Howard's invention of the garden cities vision was a response to those challenges. Nonetheless, refugee camps, tent cities and shanty towns continue to spread nowadays (Davis 2006, Neuwirth 2005), in particular caused by extreme weather events and other natural disasters, and also man-made disasters, for instance war, famine, social and economic inequality and/or pollution.

Although emergent research is being conducted in these areas (WHO 2016, Iosifova 2015, and also in forthcoming exhibitions at the Architecture Biennale in Venice and in the MoMA in New York), still much has to be done: their geographical location, timescale, the urgent necessity of both top-down and bottom-up engagement, and also the major social and environmental issues that these temporary cities are raising, make these temporary settlements one of the most underestimated trends in urban studies and planning for international networks. Available data and knowledge access could be a positive solution to promote research engagement, and perhaps even a meaningful shift for all humankind.

3.5 *Community engagement and open data cities*

Jacobs defended that '[n]o other expertise can substitute for locality knowledge in planning', thus arguing that '[t]he invention required is not a device for coordination at the generalized top, but rather an invention to make coordination possible where the need is most acute - in specific and unique localities' (1961), while laying the bases of a strong bottom-up reaction in the 1960s and following decades against the top-down approaches in urban studies.

Open data has been seen as a bottom-up approach to involve communities in the digitization of 'smart' urban systems and utilization of data sets, previously only available to researchers and institutions, in closed silos. Furthermore, the usability of transferable lessons between the smart and garden urban visions could allow a shift, in order to support new bottom-up perspectives on civic and social international networks to address climate and demographic change (Henriques 2016). This could promote community engagement in future cities, through interactions between environmental open data and green infrastructures, integrated in resilient urban systems to face extreme weather events. At the present stage, most of open data initiatives (either promoted by local institutions or by governments at a national level) are located in Europe and North America.

Moreover, hackathons and other collective events have been particularly successful in the last years, and these could be considered either a hype or a shift, within community engagement. These events can test, develop and show new methods and methodologies to conduct interdisciplinary research strategies and to involve public organizations, universities, corporations, and local communities.

While it seems that digital structures also follow geographical laws (Hecht & Moxley 2009), urban research concerning human factors (Walf et al. 2015, Henriques 2013, Zimring & Dalton) is needed. Perhaps, common(s) language(s) such as maths, sounds, images, visual and textual programming might represent possible links within international and multicultural networks.

4 CONCLUSION

In this paper, initial criteria to analyze and compare trends, shifts and hypes in urban research were searched: (a) geographical location; (b) timescale; (c) top-down and bottom-up engagement; (d) social



Figure 5. Excerpt of 'Dark clouds of factory smoke obscure Clark Av.', 1973. Author: F.J. Aleksandrowicz (Public domain).



Figure 6. Outskirts of Tacloban on Leyte island in Philippines, after Typhoon Haiyan, on November 8, 2013. Author: Trócaire/Caritas (Wikimedia Commons via Flickr CC-BY-2.0).



Figure 7. Za'atri camp in Jordan for Syrian refugees, on July 18, 2013. Author: U.S. Department of State (Public domain).



Figure 8. Attendees at the Spring 2013 hackNY Hackathon. Author: M. Czarnecka (Flickr CC-BY-SA-2.0).

and/or environmental values; and most importantly (e) data and knowledge access.

As stated in the EAAE/ARCC 2016 call, '[a]lthough challenges are global, solutions need to be implemented locally.' And international networks for urban research, including universities, can thus contribute to imagine, discuss, develop and promote alternative futures for a changing society. For example, the principles that supported the global garden cities movement can lay ground for open data initiatives: data is the new soil. Thus, possible interactions between environmental open data and green infrastructures are foreseen, for public development in tomorrow's cities. Nonetheless, future research is still needed, in experimental urban data visualization alongside user experience studies, within urban planning processes.

Although interdisciplinary research strategies are essential between corporations, universities and local businesses to address these urban challenges, such as climate and demographic changes, it was claimed a need for common mind sets and methods, particularly connecting both computing and social sciences, to engage with local and neighborhood communities, and public organizations.

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Transformation of Chinese traditional mountain village in contemporary era: The study case of Tangdu Village in Guizhou Province

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ABSTRACT: This paper, from the aspect of architectural conservation and renovation, discusses the transformation of a Chinese traditional mountain village facing the modernization. Through the comparison between the traditional architectures and modern architectures, this paper tries to find the continuity and deformation of the local traditional architectural culture. Rather than criticizing the villager's spontaneous constructions, it is better to consider their demand of development and give appropriate suggestion.

1 INTRODUCTION

Protecting the traditional Chinese village culture and its vernacular architecture is a topic of general interest and concern in recent years. Modernization, urbanization, and accelerated economic activity are capable of affecting developmental shifts in the most remote areas in China. The accelerated and unpredictable course of such transition is always of great concern in developing countries – lest something of significant cultural value be permanently lost in transition.

Whereas the forces that drive this form of widespread change are unavoidable – infrastructure and industry grow in complexity – the effects are not always easily understood as intrinsically good or bad. In order to promote policies which safeguard the valuable qualities of traditional Chinese village culture, it must be discerned how progression serves to efface rustic or regional heritage. Understanding the nature of this phenomenon will provide a course of appropriate action.

The Chinese Academy of Cultural Heritage (CACH) initiated a case study of a traditional village in 2014[1]. By tracking data pertaining to the structures in the village, CACH has documented both traditional and modern structures. The information gleaned from the study provides many facets for detailed analysis.

2 BRIEF PRESENTATION OF THE STUDY CASE: TANGDU VILLAGE

The object of this case study is Tangdu Village, located in the Huangping County of Guizhou Province. (latitude N 26°50′01.5″, longitude E 107°59′21.6″). By elevation Tangdu is considered a mountain village situated at an altitude varying between 750–950 meters above sea level. It is of moderate size compared to surrounding villages, comprising 3.2 square kilometers of administrative area and 371 households (Fig. 1). The aborigine, Ethnic Ge, a minority without official recognition, practices the native crafts, such as silver jewelry making, batik, and embroidery.

The local economic paradigm is expressed as a predictable agrarian self-sufficiency, though encroaching modernization has changed the landscape of the village in recent years. This can be seen in the advent of modern concrete, brick, and multi-story buildings that have been gradually replaced existing structures.

Heretofore there has been little consideration of intrinsic value regarding the disappearance of traditional wooden structures in the village. On the other hand, the shift in building material preference is not motivated by any logical external force such as a desire to cultivate tourism or the intervention of outside interest in commercial exploitation.

The noticeable change in construction activity is entirely motivated by local internal interests. These circumstances make Tangdu village an ideal subject of inquiry. This case study clearly demonstrates an underlying evolutionary template at work on a societal level. Tangdu Village rests on the cusp of an imperceptible pivot of which pre-industrial standards of living give way to the modern.

3 RENOVATION OF TRADITIONAL HOUSE AND NEW CONSTRUCTION

In Tangdu village, the residential building can be understood to comprise the basic building block of life in the village. Its principle function is to

[1] The research was supported by Chinese Academy of Cultural Heritage research program 2015-JBKY-01.



Figure 1. The village structure, 371 residents, a primary school, two clinics, six retailers, a private brick making factory, and an-other two festival sites. (Drawn by author, source village survey map in 2012).

accommodate basic human needs that embody the comforts of home, be they social, economic, or bodily.

The residence found in the village is very distinct from a contemporary urban house meant to provide the same function. Whereas the villager may express the freedom to draft this building according to their idea of efficiency or personal taste, the urbanite must accept the widespread structural choice as they find it; as these archetypal choices were cemented in place by the sheer complexity of mass culture. In this light, any



Figure 2. House AE031 in Dec 2014 (Source CACH investigation in Dec 2104).

change in normative procedure within the village itself may pass without being perceived as significant by residents. The new approach evolves out of old thinking as a matter of progression.

Renovation, demolition and reconstruction of housing occur at a variable rate during the life of the average villager, especially in the case of the wooden buildings. This series of activities began with the founding of the village and continue as a matter of course. During this process the accepted cultural norms may change with the passing of each generation and in turn influence those to come.

Contemporary issues or particular needs in a given timeline may impact local opinion and result in evolutionary changes to the building. Rather than regard the traditional building as having inherent style, it would be more accurate to regard it as the sum total of a people's collective expression of the immediacy of their way of life. Small changes in longstanding practices in architecture lead to exponential re-ordering of the entire societal schema.

3.1 *Repair of old wooden house*

Although wood is a natural source of stability in structures, it is nevertheless subject to organic decay and gradual degradation. The house made of wood ergo requires periodic maintenance to prolong its utilitarian functionality. This method of repair may take the form of applying a coat of oil or the occasional replacement of the decayed component. Different levels of change in local structures accompanied this process. The following illustrates an example.

The first image (Fig. 2) shot in December 2014 shows the former condition of a traditional wooden house AE031[2]. House AE031 presents the typical vernacular architecture in Tangdu village. As seen from the photo, the house was a dark brown in colour, the upper wall made of bamboo weaving and earth, while the lower wall was comprised of wood panelling. There does not appear to be any damage to the wooden structure.

[2] All the houses in the village have been codified during the field investigation of CACH in Dec 2014.



Figure 3. House AE031 in May 2015 (Source author investigation).



Figure 4. House AE031 in Sep 2015 (Source CACH investigation in Sep 2105).

The second image (Fig. 3) shot in May 2015 illustrates the owner has acquired the wooden panels and modified them to suit.

In September 2015, the repair was completed (Fig. 4). There is no change to the former structure and the roof. Several brown panels over the door are preserved. New wooden panels replaced the bamboo weavings. The most noticeable change is the augmentation of the dimension of the window. Before restoration, the house had just four windows: two in the middle wall and two on the each side of the lateral wall. By contrast, the house after restoration added four windows, which altered the rhythm of architectural order, emphasizing the horizontal line.

We can define this case as "repair and restoration" because the house was not dismantled and the structure has been still preserved. However it is difficult to distinguish if the renovation of house AL014 (Fig. 5) and BC024 (Fig. 6) is still restoration activity. The preservation of the wooden structure and use of brick both appear on the same building. Without diachronic study, an argument could be made as to whether to describe this case as it "replacing the woods with brick" or "insertion of a formerly wooden structure into a newly constructed brick house". Furthermore, the length of the distance between the houses AE031, AL014, and BC013 (Fig. 7) is arguably indeterminate. Even through the basic layout of the house does not



Figure 5. House AL014 in Dec 2014 (Source CACH investigation in Dec 2014).



Figure 6. House BC024 in Dec 2014 (Source CACH investigation in Dec 2014).



Figure 7. House BC013 in Dec 2014 (Source author investigation in May 2105).

change in these cases, the demarcation dividing what is to be considered traditional maintenance and modern change becomes ambiguous.

3.2 *Construction new wooden house*

The continuing construction of new wooden houses remains in the village (Fig. 8). This is somewhat the result of the geographic condition of the region that results in limiting the depth of a traditional wooden house. New construction techniques and the use of



Figure 8. New wooden house AM010 in Dec 2014 (Source CACH investigation in Dec 2014).



Figure 9. House AG036 in Dec 2014 (Source CACH investigation in Dec 2014).

rivets for connecting pieces have contributed to the increase of building height.

According to the local records, 52 new wooden, two-story buildings, 51 of them present "|" form. The increase of volume does not change the traditional symmetric layout or the entrance space with a porch.

A notable innovation is the placement of stairs arranged inside the house, whereas traditionally the vertical connection afforded by ladder was the preference. Certain additions suggest changing sensibility about a home's relationship to society. Glass covering has been added to windowpanes suggesting preference to keep certain elements of nature from contact with the interior setting. Also of note is the addition of a sturdy metal plank used to bar the door against unlawful entry (Fig. 9). These changes are clearly motivated by a perceived need to offer a psychological reassurance of complete security at home – a physical and symbolic barrier against the world outside.

There is only one house among the 52 new wooden houses has changed the traditional layout: house AC011 (Fig. 10) uses "[" form. The new house contains elements of synthesis or combination of a classical symmetric floor plan with two perpendicular parts by each side.

According to interviews with locals, they are very satisfied with the improvements demonstrated in the



Figure 10. House AC011 in Sep 2015 (Source CACH investigation in Sep 2015).

new wooden house. The carpenters of the village are proud of the arrival of a new signature style, saying that "the old traditional house is backward, now the new wooden houses, with two-storey, are ideal". Not only are the residents assessing new directions for their buildings, but also creating a synthesis resulting in a pride of mastery over a new local style.

The significance of new wooden buildings in functional terms is the increase of average living space afforded to residents with a second story addition. Although the innovation that made a second story addition possible did not originate in the village itself, an "immigrant" from a nearby county brought the concept with him. As progression takes its course, the construction operations have been handed off to commercial building companies. The company gives the villagers a price including all the cost of material and manpower. Once the client accepts, the house can be completed within several months.

3.3 *Construction of modern concrete-brick house*

Since the enforcement of the "Rural Homestead Regulation" from 1986, it is a matter of law whereby villagers are restricted to a sole domicile for the purpose of a homestead. In practice this means in order to build new house, the current residence must be demolished to proceed. This law accelerates the disappearance of the older vernacular styles and is replaced with something nascent.

Fixtures and other aesthetic flourishes in the new brick housing show colour palettes unusual to this region (Fig. 11, Fig. 12). For example, the colour of the facade and ceramic tiling was not familiar. Seen from the photos, the modern buildings appear to seem out of place here that makes outsiders wonder how the local's rationale calculated the outcome.

In several cases, we also noticed the "citation" of occidental architectural elements (Fig. 13) at Tangdu village. It is supposed these elements were introduced by the villagers who possessed knowledge of cultural trends in larger cityscapes. The decorative elements introduced a sense of de-contextualization



Figure 11. House BE031 in Dec 2014 (Source CACH investigation in Dec 2014).



Figure 12. House CB031in Dec 2014 (Source CACH investigation in Dec 2014).



Figure 13. House CE008 in Dec 2014 (Source CACH investigation in Dec 2014).

within the village and suggest a wholesale assimilation into mainstream Chinese culture will follow.

Despite the symbolic gesture, the modernized residences remarkably demonstrate traditional features found in the village design. Comparing the 107 multi-floor buildings, the "|"-shape with symmetric layout accounts for 75%, "L"-shape accounts for 23% , the rest are of "[" shape. In regard to the "L" shape residences, the only added feature is the external stairs. The essential layout did not change. Minor aesthetic flourishes

aside, these buildings still exemplify the same design principles as the traditional structures with the village.

4 HOUSEHOLDS' CONSIDERATION

As outsiders of the village, we have no reason to criticize the choice of local habitants or laugh at their taste. If we look at it from the standpoint of the villagers, we can see what is desired in a new residence. The following lists the principle considerations of the local people according to the interview.

4.1 *Housing requirement*

4.1.1 *Augmentation using area*

The need to increase household living space is a principle need of the local habitants. The wooden house can support two storeys and remain structurally sound. Surpassing two stories would mean adopting new technology or new materials, which are still not feasible by local economic conditions. By contrast, the modern concrete-brick house can reach three stories without structural problems, which is real an advantage for local habitants. Since in the mountain area the flat space is limited, the addition of another story means augmenting usable living area, especially for the precious terrace on the top of the building. This space is ideal for the drying of grain and clothes, for example.

However, if the increase of volume surpasses the basic utilitarian need, it becomes cost-prohibitive for both for construction and maintenance concerns. As the average family unit is 4.5 people[3], it would be pragmatic to determine if a third story is needed at all. The answer to this question can be discerned by surveying the local people.

4.1.2 *Improvement of security: prevention of fire and burglar*

The problem with wooden structure is the increased incidence of fire. The density of residences is high in the centre of the village, meaning the likelihood of a single residence fire spreading from house to house is a high risk. For example, a nearby village named *Huangmao* was totally destroyed by fire. The traditional wooden housing was destroyed and then rebuilt using brick. In Tangdu village, a fire destroyed house AG017 and AG018 in September 2015, increasing the villagers' concerns about are the dangers of fire (Fig. 14).

Besides fire incident, other feedback from the interview is burglary has become of increasing concern. Several wooden houses are now installed with security doors or iron bars. Nevertheless, the safer way is rebuilding the entire house with solid material. The alteration of materials shows the instability of the community in general and growing suspicion between villagers.

[3] This information is given by the head of the Tangdu village.



Figure 14. the fire in September 2015 (Source author, date Sep 2015).



Figure 15. the factory of brick (Source author, date May 2015).

4.1.3 *Consideration of comfort*

Regarding the comfort, it is the irreplaceable advantage of wooden house according to the local habitants. Compared with the wooden house, the concrete-brick residence with flat roof leads usually to higher humidity.

Nevertheless, another deficiency of the wooden house is sound insulation performance. The noise is caused by people's movement, but exaggerated by wooden structure. This problem is not so serious for the family members but real troubles the guest.

4.2 *Materials and techniques*

4.2.1 *Availability of material*

If there were only demand for such residences but no access to the materials to build them, the popularity of brick residences would not have grown so quickly. These materials for the construction of modern house are available immediately in the village. A small brick factory opened in 2014 that makes it a matter of convenience for the locals and other nearby villagers (Fig. 15). Although wood can be found everywhere in the forests, it is seldom cut for building these days. Since the law has already regulated the preservation of forest, the habitants have to buy the wooden columns and panel from the construction firms.



Figure 16. the transportation of the material (Source CACH investigation in Dec 2014).



Figure 17. the construction activities in the village (Source CACH investigation in Dec 2014).

Nevertheless, there exists an uncertain factor: the cost of transportation. In the mountain area, the transportation of building materials is usually by human or horse (Fig. 16). The wood is relatively light, therefore saves money for transportation purposes, while brick is much heavier that increases this cost. That is the reason why the modern multi-floor buildings concentrates along the main route but the wooden houses remain in higher or lower altitude area where it is impossible to be reached by automobile.

4.2.2 *Convenience and efficiency of technology*

Constructing the modern concrete-brick house is not a complicated technique locally. Once the concrete pillar is formed, the masonry work begins. The entire family unit may participate in the construction process. Several structural components, the floor and beam, are prefabricated and accelerate the efficiency of construction (Fig. 17).

It is ultimately not a question of modernization, but rather it is a matter of financial concern. There is no significant difference between the cost of a wooden house and that of a concrete-brick house.[4] However, once one of them costs much less than the other, a decided prevalence of one over the other will take place.

4.3 *Personal experience and social cultural atmosphere*

If the above factors are the objective considerations of the villagers, the last one is relative and subjective, varying to individuals. As mentioned before, a lot of young people are working in towns, seasonally or temporarily. Inevitably, being influenced by urban contemporary culture, they are liable to bring the urban architectural style to their homeland.

In such atmosphere, the old traditional house is regarded as the "symbol of poverty". The people who live in the old wooden houses expressed frankly, "living in old house, you need not to worry about burglary, as there is nothing valuable in the house". In contrast to the sad situation of old house, the modern concrete-brick house becomes a demonstration of wealth. Driven by the community psychology, the construction of modern house is becoming a competition. The bigger the house and use of decorative flourish equate to the perceived value of the owner.

This perception creates an internal conflict within the villagers. Respect for one's ancestors is a central value with the region and extends to preserving the traditional family home. On one hand, the villager may be able to afford the new home, but on the other hand feels a cultural and family connection to the old house. It will be interesting to see how this conflict is resolved.

According to the interview with the local people about the style of old house, an interesting answer is "not in fashion". The definition of "fashion" is driven by the contemporary dominant culture. One of the local administers of cultural heritage made a metaphor for the houses in the village: "the house can be compare to the cloth of the people, when you need to look for a mate in marriage, will you dress the obsolete, worn-out cloth or the new cloth?"

5 CONCLUSION AND SUGGESTION

From the traditional wooden house in Tangdu village, we can notice the differences between east and west architectural culture. Unlike occidental historical masonry building, the wooden house needs periodic maintenance and replacement of decayed components. This process brings about the alteration of the house. By this mean, the traditional architecture can be seen as the accumulation of long-term renovation and local construction experience.

In contrast to urban construction activity, the village construction is characterized by the autonomy and spontaneity, usually without planning. The villager is the designer, the builder, and the occupant of the building. This autonomy has both an advantage and disadvantage: on one side, we should not overlook the villagers' creativity to improve the living conditions.

[4] According to the villagers, the cost of wooden house is around 100,000 rmb, which is the same or a litter expensive than the concrete-brick house.

On the other side, we should be aware of the impact the absence of city planning has on the totality of the village.

The choice between the traditional house and modern house is not easy to make because there are many aspects need to take into account: housing demand and financial comparison, as well as the cultural atmosphere. Influenced by popular cultural, the villagers are modernizing their homeland. The construction of modern housing is becoming a competition of the richer villagers, while the old traditional house is treated as the symbol of poverty.

However, when a community has enough cohesion and self-confidence about their original culture, such spirit can be expressed through architecture, instead of copying the modern style. This notion can be induced and stimulated. Political guidelines are one way, but if the policy propagandizes only a certain rigid style or emphasizes too much uniformity, ignoring local demand for development, the result may be cause resentment. Once their autonomy of changing the housing condition is removed and the living is without sufficient income, leaving the village and immigrating to the city maybe the most rational choice.

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Smart solutions in urban development: The medium-sized cities of Bydgoszcz and Rzeszow, Poland

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ABSTRACT: Smart cities idea grows more and more popular in Poland and smart solutions are used by municipalities to make cities more competitive. Also smart congresses, where municipalities and companies launching smart technologies debate about cities future, are organized. Missing side in this discussions are architects and urban planners. This is the reason why the most frequently used solutions are technological systems connected with monitoring, information and others. In theory smart city model characterise in holistic approach towards city growth in six basic directions: economy, people, governance, mobility, environment and living. Technological systems are, in this case, tools that make reaching goals easier. Urban solutions used in smart city model do not differ from solutions used in other modern city development models.

In the case of polish cities primary goals in city growth are development and improvement of infrastructure and application of technological systems connected with it. Bydgoszcz and Rzeszow are examples of medium-sized cities in Poland, which base their development on elements of smart city model. Bydgoszcz is located in north part of Poland at the Brda River. Municipality actions are not only aimed at growth of technological systems, infrastructure or revitalization programs, but also on awakening ecological consciousness in citizens. Rzeszow is located in south-east part of the country. The most well-known sight, which, according to municipality, is based on smart city model, is circular pedestrian bridge (based on the one in Lujiazui, China). Going in that direction municipality bases city growth on innovation, infrastructure development and progressive technological systems.

Due to backwardness caused by events from newest history, polish cities are now on the beginning of development path. The most funds are prioritizing towards infrastructure growth that was neglected during 44 years of communists' governance. Therefore actions taken up nowadays are sectional and they do not have holistic approach to development. Only in the future it remains to be seen how these decisions will affect the growth of cities.

1 INTRODUCTION

1.1 *The smart city model in Poland*

The smart city is currently one of the most well-known models of urban development. In Poland, the idea of a smart city is also often used by municipalities: on the one hand a holistic development model, or, on the other hand, as the foundations for the one-off decisions. In Poland there is no single definition of a smart city. Consequently, every potential beneficiary of this model of development formed its own definition. For this reason, a lot of investments or ideas promoted as 'smart' actually have little to do with sustainable and holistic development of the city. It is also worth mentioning that cities of all sizes in Poland aspire to become a smart city, from Warsaw and other provincial cities, to small towns, with less than 100 000 inhabitants. Despite many differences and inconsistencies in perception of the smart city, in each case its concept is based on the six main directions of development, namely: economy, management, environment, quality of life, mobility and people. In the case of Polish cities development takes place mainly in the field of mobility and communication. The investments that are carried out extensively in most cities are related to the renovation of the streets, the development of public transport (the introduction of new lines, stops, dedicated lanes, increased number of vehicles), the introduction of bicycle lanes (mostly related to street repairs), the construction of parking lots, and information and monitoring systems.

1.2 *How the smart city model is perceived in Rzeszow and Bydgoszcz*

These cities, discussed later in the paper, were included in the European Smart Cities ranking, conducted by the University of Technology in Vienna. Both cities were present in all three rankings carried out for medium-sized cities in the European Union (in 2007, 2013 and 2014). Bydgoszcz also appeared in the ranking in 2015, carried out for big cities. Both Rzeszow and Bydgoszcz emphasized developing a model of a smart city. However, the approach of the two cities varies.

As the first city in Poland to promote itself as being a smart city, authorities in Rzeszow heavily emphasized the development of this model. Rzeszow also is one of the few cities seeking inspiration for projects in emerging Asian cities (such as Masdar City in the United Arab Emirates). Highly visible among city authorities, mainly the president, is the desire to transplant so-called smart solutions, which worked in other cities, to Rzeszow. Despite the lack of coordination of certain activities, some elements of the smart development have been preserved. This is particularly apparent in the ongoing investments in infrastructure, energy, and communication between the residents and the city authorities. An important element of urban development, not only promoted in Rzeszow, but also other Polish cities, is the protection of the environment.

The approach to the smart city model by the municipality of Bydgoszcz is more balanced. Inspirations and development models are searched for throughout Western Europe. A smart city, for Bydgoszcz, is a kind of platform of agreement between the city and other European cities and business partners. Just as in Rzeszow, heavy emphasis is placed on communication between the municipal office and residents, communications, infrastructure, the introduction of smart technology – especially information and monitoring and environmental protection. Each city also strives to create good economic conditions – centres of innovation and technological zones. Another crucial element of growth is the cooperation between cities and universities.

2 SMART SOLUTIONS IN URBAN PLANNING IN POLAND

Despite a broad approach to development, the smart city model does not propose solutions to urban or architectural growth. This leaves them as somewhat subordinate to the main fields of development, where architectural design and urban planning are treated as a tool for solving other problems, not problems themselves. Through this approach there is some danger enhances spatial chaos. Polish cities may serve as examples in this case. Cities in Poland are, in comparison to cities of Western Europe, in the early stages of modern development. They have historical baggage still visible in the city fabric and unresolved spatial problems. These are both rifts in the urban tissue caused by World War II, demolitions that subsequently occurred, and unfavourable spatial solutions implemented during the communist regime (mainly post soviet architecture). An additional obstruction to development is inconsistent spatial policy, manifested both in the absence of zoning plans, and, uncontrolled by urban planners and city architects, the issuing of building permits. The above-mentioned problems, combined with the lack of guidance in architecture and urban planning in the smart city model, mean that some cities are no longer harmoniously growing spatially. Instead, municipal offices often partake in unrelated, single investments, which do not always improve the quality of the space.

Polish cities not only need infrastructure development, but also construction, especially in areas neglected and abandoned, often found in city centres or in their vicinity. In such cases, municipalities need to visualize long-term development and steady financing. Thanks largely to financing from the European Union, Polish cities have begun to change. Not all investments, however, bring the desired results. Often, they are individual projects inconsistent with the environment; sometimes the city does not even have the resources to maintain them.

3 THE EXAMPLE OF RZESZOW

The most famous investment of Rzeszow in recent years is the circular pedestrian bridge, built in 2012. Designed by the architectural firm MWM Architects, it was inspired by the Lujiazui footbridge in China, and is located at the intersection of Pilsudski Avenue and Grunwaldzka Street. Pilsudzki Avenue is one of the main streets of Rzeszow that surrounds the old city from the north. Grunwaldzka Street is, however, secondary, and a poorly frequented street. In addition, pedestrian crossings were retained for Grunwaldzka Street. Entrances to the footbridge are stairs on all four sides, two elevators located diagonally from the north-east and south-west sides, and one ramp from the south-east side, with a grade of 8% (according to Polish building law exterior ramps of such height shall have a grade of 6%). On the catwalk there are benches, flower beds and litter bins. On the internal barriers posters have been put up containing information about the city's history. According to the municipality, the footbridge is an example of innovative architecture, part of the development of a smart city model. The footbridge is used daily, year round, mainly by residents, but also visitors travelling from the train station toward the old town. Besides the location of the bridge, on this route there is also the Provincial Office nearby, and a number of bus stops. Despite the good location of the bridge it is not the easiest to use. This is due to the limited amount of space, because of the existing buildings. The presence of only two elevators hinder its use by people with disabilities and the elderly. Only one of the ramps allows the use by cyclists, and there are no cycle paths reaching the footbridge. The footbridge as an object is strictly functional; however, it is not the best communication solution: 150 meters to the east and 250 meters to the west are marked crosswalks with traffic lights.

The only urban project run by the municipality is a project for a new administrative and legal center, called the district of justice, which is located in the eastern part of the city. The idea is to centralize all courts of Rzeszow, main police stations, the Faculty of Law of the University of Rzeszow and the national archive. One of the stages of the project is to transfer the court from historic Lubomirski's



Figure 1. Rzeszow, district of justice, fot. Olga Gazińska, 21/04/2015.



Figure 2. Rzeszow, circular pedestrian bridge, fot. Olga Gazińska, 20/04/2015.

Castle. The castle, in accordance with administrative functions, would be adapted to serve a cultural function. Currently, the project consists of an access road, originating from Rejtan Avenue (one of the city's main streets). The entrance is poorly marked and accessible from only one direction. The access road finishes with roundabout, where eventually all objects will be built. Currently, there is one building at the district court. Both the road and the roundabout were adorned with street utilities (benches, trash bins, green flower beds, lighting). However, both the new object and the whole premise are incompatible with the environment. In the vicinity of the district there are housing estates, schools, and local shopping centres. Access to the court is designed adversely: car parks for visitors and employees are located outside the zone, with completely separate, equally unmarked, access that leads to it. The project of the administrative and legal centre, on one hand is very homogeneous. On the other hand its neighbourhood offers a variety of functions, although unrelated. The justice district will operate only during the institution's work hours, and both at the main street and the driveway there are no designated cycling paths. However, the facility can be reached by public transport, and both the judicial building and its surroundings are accessible for disabled people.

Other investments in Rzeszow, regarded by the city as innovative and designed in the smart city model, are a multimedia fountain and two heated bus stops. A characteristic feature of Rzeszow investments is their inconsistency. Although the city government is very enthusiastic about the idea of a smart city there is a lack of vision for the whole proceedings. For this reason, the city seems more chaotic than it is. Rzeszow is not the only example of this approach to the smart city model, although it is especially visible because of the accumulation of such investments, and the way the city promotes itself.

4 THE EXAMPLE OF BYDGOSZCZ

In contrast to Rzeszow, the Bydgoszcz approach to the smart city model is more conservative. The city authorities are using smart solutions in the development of communication and mobility, and as a platform for establishing international cooperation. Urban projects, which are carried out in Bydgoszcz are presented as revitalizations based on sustainable development. The project at the forefront is the revitalization and development of the Brda River quays. It has been divided into five separate projects, the first two concerning the design of the water system and sewage (from 2002 to 2013). The next three are revitalization projects (since 2006), dealing with both the revitalization of the cultural and natural environment. Investments also include communication within the Brda River: the creation of boulevards, walking and cycling paths, reconstruction of the transport system, construction of pedestrian footbridges over the river, and the introduction of the water tram.

The biggest changes are visible within the old city. Walking boulevards were created on both sides of the river, and bicycle paths were introduced on the north shore. The quays were mostly excluded from traffic, but there are still parking grounds, partly undeveloped, in these areas. Most of the waterfronts have been developed for cultural functions. In 2006, construction of the Opera House was completed, which is a landmark for the whole project (the opera is located on the north bank). The northern quay, at the height of the Old Harbour, is the most neglected part of the downtown area. Facing the river there are neglected apartment buildings that require revitalization, banks, and the back of the post office building. Old Harbour Street is passable for cars with parking spaces located alongside. The boulevard there is rarely frequented by locals. One of the characteristic features of this area are richly decorated street lamps. Unfortunately, they do not provide sufficient illumination, which makes this part of the waterfront a very uninviting place by night. The separation of the boulevard from buildings, and a small diversity of functions, make this part of waterfront unattractive.

The northern quay, at the height of the Opera Nova, primarily serves this solitary function. In addition to the opera house and two above-ground car parks in the area, a green square and riverside boulevard with cycling lanes have been designed. Access to the



Figure 3. Bydgoszcz, Brda Riverside, Old Harbour Street on the left-hand side, fot. Olga Gazińska, 01/09/2015.



Figure 4. Bydgoszcz, Mill Island and view at Opera Nova, fot. Olga Gazińska, 31/08/2015.

opera is easy and clear, and it is also accessible by busses and trams. At the height of the opera, by the river, there is an amphitheatre-like staircase descending from the opera to the boulevard. This is the second place, beyond the green square, designed as a public space. Unfortunately both function mostly as part of the communication line, and at most as sitting areas. Small architecture (benches, litter bins, lighting) in this part of the waterfront is completely different than ones in the Old Harbour area. With that amphitheatre-like descent the view of Mill Island is spansive and stunning On the island there are branches of the national museum, located in converted granaries, a hotel with a marina for canoeing, and a big recreational green square. In addition to the facilities on the island there is still one decaying granary. The grounds of Mill Island, however, are unvaried functionally, and the green square, designed as a meeting place, is not very flexible, and it serves only a recreational function.

Other characteristic buildings of the city, located on the southern shore near the old town, at the height of the old harbour, are historical eighteenth-century granaries, now housing a branch of the national museum, and the so-called "glass granaries" bank building , completed in 1996. The last property located on this part of the waterfront is a hotel. This passage of the waterfront is the most inconsistent. The boulevard does not run through the entire waterfront, and surrounding buildings do not correspond (with the exception of the historic granaries) with the urban fabric of the old town.

The area of the Brda River quays, although planned as a coherent whole, impress chaos upon onlookers. In each section, buildings and spaces that require regeneration and function changes can be found. Thanks to the proximity of the old city and downtown, the riverfront seems to be functionally diverse. However, the riverside areas themselves are mainly pedestrian and bicycle routes, with the addition of recreational, mostly green, spaces and cultural sites. Another drawback in the implementation of waterfronts is their low accessibility for disabled people, via spatial barriers, in this case stairs and uneven surfaces. According to the organization Project for Public Spaces, a well-designed waterfront should have ten core values. Unfortunately the waterfronts of Bydgoszcz are not meeting these values. Buildings located along the quays are not open to them, and are functionally homogeneous. Likewise, the quays and public spaces are neither flexible nor easily adapted. Activities in which users can participate are also limited. Waterside spaces do not provide activities throughout the year or around the clock.

Compared to the implementation of Rzeszow, investments in Bydgoszcz are carried out more comprehensively. This approach fits with the holistic aspect of the smart city. Projects in Bydgoszcz are trying to meet the needs of both residents and visitors, taking into consideration communication, and the quality and welfare of residents. It is, despite its minor failures, one of the better examples of the vision of urban planning in Poland. It is important that although urban projects of the waterfronts in Bydgoszcz are not referred to as smart, by their more holistic approach, fit more into the model of a smart city than singular projects introduced in Rzeszow.

5 CONCLUSIONS

In the smart city model architectural and urban solutions are treated more as tools, used to solve other development problems. For this reason, the model does not have a separate category for architecture and urban planning. The approach to development and the chosen model proposed by the city, however, does not work in Poland, where the problem is the lack of, or poor quality of, architectural and urban planning. Smart solutions introduced in Polish cities mostly boil down to a kind of ornament, which often try to disguise bigger problems. It happens that some projects are called "smart" just to emphasize their high level of innovation, gain the support of residents, or present the city in a better light in the national arena. To take full advantage of growth opportunities, which the model of smart city provides, the city must undergo a high level of development. Therefore, in the case of the Polish model, smart city is not the best choice. Without a solid base of infrastructure, and well-developed urban

fabric, smart solutions do not meet their intentions. If a smart city is considered to be the next level of development, it is important not to skip any lower levels. In this case Polish cities, needing urban solutions, should still be using sustainable development models prior to other types of growth – especially when the sustainable model and smart city model have many similarities. The hype surrounding the smart city model in Poland is strong nowadays, and it is sometimes difficult for municipalities to think outside of the box. Fortunately many examples show that the smart city is not only a meaningless trend, but it is integrated into city development. The example of Bydgoszcz shows that a city doesn't need to use the newest technological systems to be perceived as smart, but it needs to know how to connect the best parts of different development models to establish its own creative growth.

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Africa: The urban challenge

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ABSTRACT: Today more than 50% of the world population lives in cities, and in 2050 it will reach 75%. For this reason the issue of big cities is becoming more globally relevant. The big cities challenge concerns the control of large numbers of people, of pressure of migration from rural to urban areas, of poverty and of social stress linked to it. In particular the African continent is undergoing an unprecedented phase of urbanization. The short-sightedness about African big cities dynamics have consequences, not only for urban planning across the continent, but also for the understanding of twenty-first century urbanization. This paper explores main specific characteristics of African cities, their exceptionalism, past and present governance policies and future chances.

1 URBANIZATION PROCESS

Widespread urbanization is a recent phenomenon. In 1900 just 15 percent of the world's population lived in cities. The 20th century transformed this picture, as the pace of urban population growth accelerated very rapidly in about 1950. Sixty years later, it is estimated that half of the world's people lives in cities.

UN projections predict that urban populations in developing countries will be growing by more than 65 million people a year between 2000 and 2030 (UN 2006). It is projected that in around 2050, about 70% of the world's population will be urban (UN DESA 2011).

1.1 *Urbanization and growth*

Urbanization and growth go together: no country has ever reached middle-income status without a significant population shift into cities. Urbanization is necessary to sustain (though not necessarily to drive) growth in developing countries, and it yields other benefits as well. But it is not painless or always welcomed by policymakers or the general public. Managing urbanization is an important part of nurturing growth; neglecting cities – even in countries in where the level of urbanization is low – can impose heavy costs.

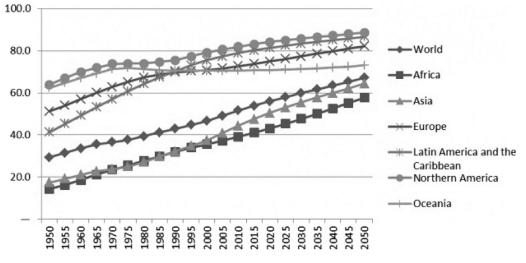


Figure 1. Percentage of urbanization by region, 1950–2050. Source: UN DESA/Population Division, 2011.

The relation between urbanization and income across countries is striking, but it is not necessarily accompanied by the rapid and steady growth that, for example, China and India experienced. Urbanization is far from being a sufficient condition for continued rapid growth.

In Africa there are a lot of countries that are experiencing urbanization without growth, in particular small African countries at low levels of urbanization or failed states. The World Development Report 1999/2000 (World Bank. 2000: p. 130) describes this phenomenon as follows: "National governments have often tried to influence the pace or location of urbanization. Often these efforts consisted of shifting resources from agriculture to finance the expansion of "modern" economic sectors – usually manufacturing – which were concentrated on cities. Urban workers in the formal sector benefited from food and housing subsidies and government-sponsored unemployment and pension schemes, while rural populations received low prices for their crops and had little access to government support. Such misplaced efforts are part of the reason Africa has seen urbanization with very little economic growth".

1.2 *From rural to urban economy*

In the African context, urbanization levels will also increase due to the reclassification of settlements from rural to urban. In some case is merely a bureaucratic task but, especially in Africa, cities do expand through encroachment, as former peri-urban areas are incorporated into the town or urban jurisdiction.

Africa with its tradition of return migration, oscillating migration and circular migration, is characterized by a not linear urbanization process, making very

difficult to detect or measure patterns of population settlement change over time (Parnell & Pieterse 2014).

The rapid growth of sub-Saharan African cities is caused less by rapid migration than by high rates of natural urban population growth, linked to poor education, inadequate healthcare plus the dominance of patriarchal values.

Africa has followed a specific path through the urbanization. There are some common themes regarding drivers of change on the continent. At the point of colonial independence, most of Africa was predominantly rural. Most urban centers were either small colonial towns, or traditional villages. Although the antecedents of Africa's urban revolution can be traced to the second half of the twentieth century, it is only now that the size and importance of urban Africa are becoming widely apparent. Increasing level of urbanization are probably inevitable and must be confronted.

In Africa this great urbanization process, accompanied by very low growth, is concentrating poor people in cities rather than the countryside.

1.3 *Urbanization benefits*

Two main reasons to explain the urbanization process are: efficiency gains and consumption benefits. Furthermore, agglomeration effects in cities affect knowledge sharing. By bringing together large numbers of people, cities facilitate the kinds of face to face interactions needed to generate, diffuse, and accumulate knowledge, especially in industries that experience rapid technological change. This aspect of urban agglomeration economies has received less theoretical and empirical attention, but it has promised to be one of the more significant drivers behind dynamic growth in developing country's cities.

Countries that are highly urbanized have higher incomes, more stable economies, stronger institutions. They are better able to withstand the volatility of global economy than those with less urbanized populations (UN-HABITAT).

Cities are so much more successful in promoting new forms of income generation, and it is so much cheaper to provide services in urban areas, that some experts have actually suggested that the only realistic poverty reduction strategy is to get as many as possible to move to the city (UN-HABITAT 2003).

1.4 *Urbanization criticality*

Urbanization, on the other hand, nearly always involves a multitude of chaotic problems – unsightly, unsafe, or unhealthy development; congestion; skyrocketing land prices; and highly questionable real estate practices – at least at the beginning.

Many of these problems are perceived as failures, although they often emerge in the face of economic success. To make modern cities work, a transformation in fiscal and administrative institutions is more needed than an incremental change, and it often comes in response to a crisis of some kind.

2 OVERVIEW OF AFRICAN CITIES TODAY

2.1 *African urban exceptionalism*

Though African cities are quite different from one another, there are main struggles, linked to previous features, that most African cities share: overcoming colonial inheritances of poverty, underdevelopment and socio-spatial inequality; dealing with informal sectors and settlements and governing justly.

Edgar Pieterse and Susan Parnell in their book *Africa's urban revolution* and Garth Andrew Mayers, in his book *African Cities. Alternative visions of Urban Theory and Practice* identify several distinctive features of African cities. First of all they are integrally connected to rural areas through the practice of circular migration, a strategy for maintaining multiple bases so as to optimize livelihoods and mitigate the risks of settling permanently in economically, environmentally, socially or politically precarious African towns. Second, there is the sponge of the urban fringe or peri-urban edge; this is often a porous settlement boundary which is neither urban nor rural in its character or governance. What is also distinctive in Africa is the phenomenon of urban primacy: one large capital city serves as the center point of national settlement system and is typically three to four times larger than the second largest city in the country. In many African countries this is a direct hangover from the colonial era. Colonial regimes attempted to restrict migration to cities from the countryside or even to exclude Africans from the legal right to live in cities. Under colonialism, rural-to-urban migration seems to have been fueled as much by the pull factor of perception as by actual opportunity, and by the push factors of rural landlessness, poverty and lack of employment. The end result in many countries was large numbers of the rural poor becoming the urban poor. This conundrum only became more extreme in the independence era in many countries.

Another distinctive feature of urban Africa is the predominance of informal modes of urbanization. African cities are characterized by overlapping and even competing system of power. Learning where power lies in the city can be as challenging as persuading those in power of the need of change.

Poverty, informality and the absence of a strong local state with a clear and unchallenged mandate to manage the city are arguably the leitmotifs of African urbanism today.

2.2 *The African urban legacy*

African cities inherited from European colonialism some material problems that demand urgent and clear solutions, first of all social and spatial inequalities.

Urban form thus reflected at least four ideological concerns: 1) separating out who could and could not be in the city; 2) devising a map for who belonged where among those allowed to be urban; 3) providing for and reinforcing spatial expressions of the hierarchy of colonial rule; 4) enabling the accumulation

of resources by the colonial regime, the metropolitan power and elites associated with both (Garth Myers 2011). South African apartheid represents perhaps the most extreme example of this on the continent.

Post-colonialism and geography are intimately linked. This meant that after independence, African countries had to come geographically "after" colonialism, in the sense of attacking or contesting its legacies.

The urban hierarchies of most former colonies remain highly imbalanced, and the political and economical dependence that characterizes many larger cities does not seem to be withering away.

In the contemporary city, formerly white or elite areas are increasingly full of exclusive and infrastructure-rich gated communities and fortress compounds, and the "dirt-poor habitats" at the other end of the segmented plan of the colonial order are even more overcrowded and destitute. Postcolonial regimes have often improved upon the strategies of colonial administrations, becoming even more exclusivist, authoritarian, and segmented.

2.3 *Informal city*

If we are looking for postcolonial urban thought, meaning truly attempts to move past colonialism, the places to look at are probably not necessarily in government planning offices or the posh campuses and gated compounds of expatriate donors. Instead, it may be found in the "ingenuity with which African urban residents have developed novel strategies" to face the "structural and social crisis confronting them" (Demissie 2007) in places like the crowded informal market.

Postcolonial regimes have struggled to subvert the internal urban form, segmentation and inequality inherited from colonialism. But truly postcolonial cityness seems to have more potential to emerge in informal settlements that increasingly dominate cities. Under current trajectories urbanization will see informality emerge as the definitive feature of life for urban Africans.

In the next 20 years, African cities will more than double in population, and their spatial extent could more than triple. What form will this growth take? The current planning regime in African cities focuses on Comprehensive Master Planning, a slow and costly methodology. Many of these plans are never built, but the cities continue to grow rapidly in the absence of a framework. Recent evidence indicates that this growth is highly informal and poorly laid out, lacking a network of arterial roads.

Already 61 per cent of urban Africans live in informal settlements and 60 per cent is engaged in informal work that precludes mortgage finance or progressive livelihood strategies (World Bank. 2014).

Africa had the fastest rate of urbanization of all regions in the world between 2005 and 2010. Since the majority of urban dwellers presently live in slum conditions, it is reasonable to assume that by 2030 the majority of them will still live in slums because most African cities and towns lack institutional, financial and political resources to deal with growing levels of urbanization.

Demographers talk about "push" and "pull" motivations driving the migration to cities. "Push feels like this: Life in your village is dull; backbreaking impoverished, restricted, exposed, dangerous, and static. You work like hell; then the weather changes, and you don't have crops to eat or sell. Visit your relative in town and you see what "pull" means. In the city life is exciting; work is less grueling; you're far better paid; you're free to move around and change jobs; you have some privacy; you're less vulnerable; and you have upward mobility. Will you put up with slum conditions for all that?" (Brand 2009).

Slum life represents a lack of access to a number of essential services and securities that make productive modern life possible.

Extreme richness exists beside extreme poverty, creating contradictory situations making cities sprawling and almost illegible places with a great diversity of experiences, activities and lifestyle.

This bifurcation of the economy finds its spatial equivalent for many observers in a neat separation of informal from formal residential settlement areas in cities. Between this two sectors however there are many connections. Some took this argument about connectivity to claim that the formal sector depended upon keeping certain facets of the informal sector going in order to further extracts profits from the majority economy.

Like Achille Mbembe and Sarah Nuttall say "we need a more complex anthropology of things, forms and signs in order to account for life of the city in Africa" and "the informal is not outside of the formal, […] processes of formalization and in-formalization work together". They argue that what ought to be the focus of the research is "how they work together and how this working together ends up producing city forms and urban economies" (Myers 2011).

We need to know much more about the interrelationships of informal settlements with formal visions of urban order if we are willing to develop an agenda of practical usefulness in order to improve African cities conditions. Some critics argue that informality is unproductive and raises the costs to the formal sector, crowding out agglomeration economies. In fact, the little evidence available on agglomeration economies in the informal sector suggests that it also benefits from agglomeration and that informal operators generally have a positive impact on their formal sector counterparts. The Challenge of Slums, 2003 UN-Habitat, report that 60% of urban employment in the developing world is in the informal sector and that the informal economy has essential links to the success of the formal sector.

The ideas of alternative planning generated from indigenous informality can be quite inspiring and stirring.

Let no one romanticize what the slum conditions are. Usually new squatter cities have no facilities at

all for sanitation, water, electricity, transportation. A typical squatter city, which may stretch for miles, has grown without a plan or government, in an area generally deemed uninhabitable. But the squatter cities are vibrant. The magic of squatter cities is that they are improved steadily and gradually, increment by increment, by the people living there. They look organic (Brand 2009).

According to urban researchers, squatters are now the predominant builders of cities in the world.

Maliq Simone (Simone 2006) – the most prolific and provocative urbanist working on Africa – speaks about "pirate towns", to describe those cities where order is essentially underfunded. Ordinary citizens turn to piracy as a mean to negotiate everyday urban life, in the absence of genuine state or formal private sector engagement. Informal sector is characterized by small, creative urban practices that are attempts by the poor to claim for "equal rights of membership" in a global urbanity that is not only "spectacularly unequal" but highly uneven in its capacity to acknowledge such requests.

The heart of the concerns with what informality means or what to do about informal settlements focuses on the land: uncertainties surrounding rights to occupy, control, and build on land are fundamental to understand why informal settlements are so often considered a problem for state and citizens.

Residents of informal settlements generally lack formal legal security of tenure.

In contrast to the logic of land reforms that aim to formalize the informal systems, in their daily struggle for survival urban dwellers develop their own rationality and logic of behavior, which often do not comply with externally imposed visions of the city or wouldn't be enforceable in modern courts of law, but they sustain people's livelihoods in a context of widening material poverty. The systems are often highly reliant on informal social networks which are themselves built from kinship and friendship.

Even if we assume that regularization of tenure is pro-poor, most states do not have the central or local government institutional capacity to facilitate the regularization in a fair and equitable manner. Some form of hybrid governance over urban land would appear to be the most viable option, but the route to it or capacity for it is bound to vary by city and context.

Informality, therefore, does not seem to inevitably disappear in the urban land development process under neoliberal reforms – the outcomes are highly variable. Generally, planners see informal or shack housing as unacceptable and in need of replacement by formal housing projects', with the goal of "extending the grid of formalized and regulated development" (Myers 2011). Crossroads case study showed that the splitting of extended families into individual, formal housing units is breaking social and family networks and destroying social capital built up in stretched households of shack settlements which connect rural and urban relatives.

Therefore, in order to plan and produce viable solutions to the problems, shack settlements represent for residents and planners a transformation of consciousness.

"The poor have time but no money, and the rich have money but no time; and so they deal. I find what needy people do with surplus time more interesting than what un-needy people do with surplus of money." (Brand 2009).

2.4 *Public and private actors*

In Africa the recent cities growth is linked to the development of infrastructures and economic activities that have been financed by the private sector.

Both foreign donors and local leaders have heavily emphasized strengthening the private sector, opening the door to transnational capital, enabling democratic, municipal governments, and empowering community groups by creating at the same time new networks and partnerships for urban development across the whole landscape of city management, from land and water to transport, electricity supply and solid waste services.

The Cities Alliance/Habitat/Western donor line of approach has involved making and remaking state institutions that can work in partnership with a new array of private sector and civil society entities in facilitating the delivery of urban services, but the evolution of implementation processes varies on the ground.

Unfortunately, often, the private investment, coupled with a shortage of coherent taxation and planning system, is superficially modernizing urban structures that are fractured. The resulting cities, planned through mega-scale power plants but with low levels of grid connectivity, are pre-disposed to long-term failure.

It seems that the new private sector actors have a real impact on the landscape policy, outstripping the influence of scholars, civil society pressure groups and the old-style development industry. It is not immediately clear why there has been such a noticeable shift with regards to who sets the intellectual agenda on African development, but it may be related to the growing volumes of highly targeted and partial foreign direct investment flowing into African countries, investment that is contributing to the further distortion of African urban landscapes.

3 AFRICAN URBAN GOVERNANCE

3.1 *The role of the state*

Today much of the debate in Africa centers on the degree and character of change in the role of the state, with the theorized shift from government to governance. There are plenty of professional place-makers among African urban planners and architects seeking to develop and implement imaginative, alternative, postcolonial urban visions.

3.2 *The failure of modernist planning*

Modernist legislation and urban standards, a system of management that was intended to protect elite colonial interests rather than provide for universal application in postcolonial African cities, continue to serve as a template for urban planning, land use regulation and public housing provision during the post-independence era.

The lack of transparency in urban management law and practice has not until recently, been challenged or reformed, possibly because of the lack of demand for effective, or transparent urban government from developers.

Concerted efforts continue to be made to govern cities through zoning, cadastre, property and administration. These efforts not only fall short, they also fail to eradicate the unruly yet dynamic intersections among differences of all kinds to which the city offers both setting and cause.

Real reform would require poorer groups having the power and voice to change their relationship with government agencies and other groups at the local level, like donors in urban Africa, making them invest money into pro-poor sustainable urban development via government agencies, that the vast majority of urban poor are alienated from and marginalized by.

Poverty cannot be tackled without addressing problems of power relation and the cultural and social interests that sustain unequal access to economic opportunity and social resources.

3.3 *Institutional problems*

The incapacity of African States to address the inevitable consequences of increased urbanization boils down to fundamental institutional problems, such as a lack of coherent urbanization policies and ineffective decentralization.

Most African governments continue to execute their functions without any explicit national urbanization strategy that can inform and guide strategic investments. This stems from a broader political sentiment that the economic future of Africa lies with improving its agricultural performance through a so called second green revolution that will allow the continent to take its rightful place in the globally connected international economy.

Agriculture is, of course, a vital component of a long-term development strategy, but it depends heavily on well-functioning towns and cities to get commodities to market and to absorb the produce. In other words, to plan for agricultural success without planning for effective connectivity and infrastructures and for the development of cities and towns is short-sighted.

In most Africa, urban local governments were unimportant during the colonial era (with a few exceptions), and generally became even weaker and more insignificant in the first few decades after independence.

Elected local councils had been put in place by the end of the colonial period, but their performance fell far short of their responsibilities and growing demands, and their political autonomy and physical base were progressively eroded during the 1960s and 1970s. Central governments generally failed to give local government adequate funds or revenue-raising powers to ensure that they had sufficient decision-making powers and trained staff to address the urban challenges they faced.

From the 1980s there was a shift towards decentralization in Africa. Decentralization is essentially any act with which central government formally cedes powers to actors and institutions at lower levels in a political-administrative and territorial hierarchy.

The key theoretical motivation behind the promotion of decentralization was to bring decision making closer to the people, helping ensure that programs and services better addressed local needs. Local governments were therefore established or re-established in many countries in an attempt to enhance local democracy and service delivery.

By 2000 it could be claimed that "There is not a single country in Africa in which some form of local government is not in operation" (Oyugi 2000). The implementation of decentralization in Africa has, however, been very uneven and partial.

In some case the aim of decentralization reforms was merely to reinforce vested interests in existing pattern of patronage and central-local linkage, thus having no impact on furthering a pro-poor development agenda. In addition, sometimes the motivations behind decentralization were driven by self-interest, for example to shift the responsibility for unpopular structural adjustment programs away from central government to urban local governments, which in many cases were controlled by opposition parties. Tension between national local governments and urban local governments controlled by opposition parties has continued to be a common characteristic of governance in Africa.

Currently, the status, power and functions of local government vary considerably across Africa. Only in a few countries local government is enshrined in the constitution and has at least some responsibility for important services such as water supply, roads and electricity.

Simultaneously with the increased decentralization of recent decades there has been a shift in the way in which local governments operate. In the "Anglo-Saxon" tradition, decentralization also includes the devolution of powers and resources to local non-state bodies, such as private companies and non-governmental organizations. In much Africa decentralization has been accompanied by a strong shift towards corporatization, privatization and partnerships. This has been linked to global shift to such institutional models in local government.

In addition, in many countries in Africa, most urban development and redevelopment projects are now structured as public-private partnerships.

4 NEW AFRICAN URBANISM: IS IT POSSIBLE?

4.1 *Africa in the global framework*

In the aftermath of the global financial crisis (2008-09), the rising awareness of the devastating impacts of climate variability, and a renewed commitment to systematically eradicate poverty, in the form of the Millennium Developments Goals (MDGs), the importance of sustainable urban development has attracted significant attention across the world. The emerging development consensus on the centrality of sustainable urban development is good news for Africa because it offers an opportunity to address the institutional failures discussed above.

Central to such national policy framework are two issues: sustainable development and clarity on the appropriate division of powers and functions across the various levels of government.

4.2 *Sustainable urban development*

It is a time in which there is a widespread recognition that the resource-extractive model of economic development is no longer viable. Cities are particularly important sites in responding to climate change, both in terms of mitigation and of adaptation.

The environmental crisis coincides with a profound social and economic crisis, and it is clear that mainstream economic activity and measurements need to be redefined. Again, cities and urban centers emerge as key sites of economic development because the dynamics of globalization reinforce agglomeration imperatives and because innovation, competitiveness and productivity all depend on the advantages offered by dense settlements. Lastly, following the realization that globalization dynamics had been accompanied by rising levels of poverty and inequality, the global community of states committed to significantly reduce physical poverty by improving access to basic services and political voice. Again, in the context of rising urban poverty, cities are seen as key to make significant progress in attaining the MDGS, although the profound challenges associated with rural poverty should not be neglected. In the wake of the sustainability critique and the worsening of urban inequalities, there is a growing consensus that the spatial form of cities and towns matters a great deal for the realization of more sustainable urban development outcomes. Specifically, greater density through compaction is encouraged along with much stronger emphasis on mixed land uses to facilitate greater efficiency and pluralism. In a context of limited resources and limited state capacity, it is vital that local governments work closely with civil society organizations and the private sector to co-produce development strategies and to ensure participation in various elements of the service delivery value chain. It is for this reason that institutional frameworks for decentralization are so central to how we redefine and activate urban development processes at the local level.

4.3 *Urban development strategy*

Very few African states have explicit policies to deal with urbanization and intra-urban development challenges.

System of planning law are necessary to provide a framework of rules to mediate and regulate competing pressures and interests.

Practical steps are required to institutionalize an effective policy agenda to deal with the complexities of uneven urban development in Africa. First step is to improve the quality of data, information and analysis about urban system and, in particular, settlements that play a major role in the national economy. A number of considerations should be taken into account. Most basic is the need for accurate and reliable data in the form of a periodic national census. It will be important for national statistical agencies to work closely with local government associations and urban development bodies to develop a shared approach to the collection and collation of data. A second dimension of the data agenda is local institutional data. It is vital to develop an overview of what data exist, their robustness and how they can be related to other data sources. Some recent technological advances in democratizing access to spatial data platforms, such as Google Earth, create substantive opportunities for data pooling and comparisons. In recent years, various grassroots organizations have adopted various enumeration processes to underpin their claims and strategies. This source of grassroots intelligence and information, typically from neighborhoods and contexts that are difficult to access for the state, is a vital component of an overall urban data system. It also offers promising opportunities for government officers to better understand, from a different angle, the contexts they are seeking to impact. Recent improvements in geospatial representation of various data sets have the potential to provide the glue to relate multiple categories of data. Moreover, geographic information system (GIS) representations can support administrative decision making processes to improve prioritizing and targeting, as well as potentially helping to facilitate the public's engagement with the data.

Another step to institutionalize this policy agenda is to build an infrastructure investment strategy and plan. The central role of infrastructure for economic, social and environmental development has become a focus of attention during the past few years. These investments aim to kick-start economies, create a new generation of green jobs and form the foundation stones for a much more wide-ranging transition to low-carbon economies. The world bank's authoritative Africa Infrastructure Report suggests that investment in infrastructure can both guarantee sustainable urbanization and social equity and improve productivity in the modern sector and connectivity with and across locations. It is simply not possible for African governments to leave infrastructure planning and management in the hands of sectoral interests that benefit from status quo. A strategic national policy framework on infrastructure is required. Traditional privatization

models tend to reinforce a sectoral approach and produce extremely negative social environmental consequences.

The last step is the decentralization policy and operational strategy. There is no single recipe or formula that can be applied to all African contexts. What is required is a strategic understanding of how limited resources can best be deployed to advance the national development project in the context of specific urban and rural settlements, correlated with local state capacity and the institutional modalities of service provision. A sensible approach to the division of powers and functions across different levels of government and across different institutional forms cannot be achieved without the awareness of the unique developmental roles of various local settlements. In developing decentralization policy framework is also important to have an explicit focus on democratic enhancement tools that foster state responsiveness, legitimacy, accountability and enrolment of civil society and citizens in development programs.

Genuine bottom-up interventions, appropriate division of powers and capacity across all levels of governance system are finally the ingredients for a good development strategy.

The imperative is to recast all of the conventional aspects of urban development – decentralization, infrastructure investment and local economic development – from the perspective of empowering the urban poor as an integral part of the urban development agenda.

4.4 *Obstacles to urban democratic development*

Modernist planning in Africa persists, as in many parts of the world, and particularly in developing countries where it was frequently inherited from colonial powers. Governments appear to be reluctant or unable to reform their planning systems that place a great deal of power in their hands. Modernist approaches are often land dependent, and authorities in many developing countries would not be willing to give up their control over land-related matters, as this would seriously weaken their position.

Furthermore urban areas are covered by rigid and outdated planning regulations that are only partially or intermittently enforced, and this opens the door to corruption. African political elites have systematically exploited their positions in order to line their own pockets. The political elites that took over African countries in the 1960s thus saw government as a source of power and personal enrichment, undermining the international perception of the continent.

In fact if on one hand African states are viewed as "more important than ever to the security and prosperity of the international community" (White House, 2012) and perceived as a major source of great natural and mineral wealth; on the other hand inner protests and strikes often reach the headlines in the international press, leading many to believe that the country is in consistent deadlock or economic paralysis. To make things worse, during 2015, several main African currencies have taken a significant hit, as economic growth slows, and falling prices for major export commodities reduce the flow of dollars into the continent.

Yet, despite substantial progress and even greater potential, various challenges remain, in terms of human development, inequality and poverty, economic diversification, productivity and infrastructure, institutional capacity, public management, and transparency.

5 CONCLUSION

In summary, Africa displays the fastest rate of urban growth in the world, albeit from low base level.

Optimists see a grand opportunity for reshaping the continent, envisioning vibrant, productive urban centers that can drive higher standards of living and create wealth. Pessimists look at the state of African cities today and they see failure, decline, collapse, and decay. However, at the moment most African countries are not able to capitalize on this demographic shift, because urban residents are structurally trapped in profoundly unhealthy conditions that impact negatively on productivity, economic efficiencies and market expansion.

Yet the global economy is shifting its axis to the emerging powers and, at the same time, there is a broader shift towards fundamentally different, much more resource-efficient economy. Technological opportunities are emerging to fuse citizenship and urban living. Within this context the African urban transition could be truly revolutionary. A new planning methodology is needed – one that is simple to prepare, cheap and easy to implement, and able to address the challenges of rapid urbanization. It must also be flexible enough to match the technical capacity of the local planning authorities, so that the people designing the plan will also be the ones implementing it.

It will allow governments to move beyond the confused and costly plans of today, toward a nimble, affordable, intuitive strategy.

In this framework there is a need to continue increasing participation of relevant actors at all level of urban development and specifically the marginalized and disadvantaged. Even as citizen participation is promoted, it is crucial to couple longer-term visionary planning with short-term upgrading of neighborhoods and to ensure that such processes are adequately anchored in appropriate planning institutions.

Further emphasis is required on inadequacies in the built environment professions, even though this demands a different scholarly agenda to what has been the norm for some time. The rise of Africa's cities shall not be ignored. How the revolution is navigated will depend on how well the forces of change are understood and taken up. In this regard the role of the continent's intellectuals in framing the debate about cities must be underscored.

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Adaptable structures for emerging socio-cultural changes in Africa

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ABSTRACT: The developing countries are experiencing extremely fast and unique urbanization processes brought by a rapid increase in population (UN-Habitat, 2008), which in turn has produced a boom in the construction sector (Donath D., 2012). Currently, the situations that Africa is facing with regard to infrastructure provisions has also been in Europe decades ago. The article presents the individual and real built case studies and forwards series of recommendations to advocate new conceptual methodologies in the design and construction process for Africa as well as Europe. In response to the current situation, we needed to develop fundamentally new concepts that are socially responsive, spatially and functionally open and flexible structures which, in addition, employ innovative building techniques with a low maintenance requirements. Between 2012 and 2015, three different building prototypes were planned, built and tested as a potential model for flexible housing in emerging cities. The professional focus of the three different projects lay on different but intersecting areas in the field of architecture and construction innovations: the introduction of a new building material and corresponding working methods (SECU), the use of highly-prefabricated building elements to achieve short construction time (SICU) and the provocative use of state of the art production techniques using parametric planning systems (MACU). The design and implementation of all prototypes were carried out by the shared laboratory for emerging cities (ECL) which lays its foundation on a collaboration between the Institute of Experimental Architecture (ifex) at the Bauhaus University Weimar and the architectural institute (EiABC) at the Addis Ababa University. Various partners and parties have also been involved from the industry. Beside the research component, a strong educational objectives were hooked up throughout the project period. These real "design built" projects are a prelude to a whole series of full-scale experiments that the ECL has already constructed. They also paved the way for further and more holistic projects in the field of integrated infrastructure and industry based rural urbanization; projects that started in 2015 and 2016 consecutively.

Keywords: prototype, practical teaching, architecture, prefabrication, Africa

1 INTRODUCTION

1.1 *Background: 'Well Come Africa' Project: Academic research exchange through prototypes*

The "welcome Africa" project 2012–2015 at DAAD (German Academic Exchange Service) was an international academic research project between the Ethiopian, South Sudanese and German universities. Its objective was to strengthen the collaboration in research, practical experiences and competency to bring together contemporary building technologies with real circumstances. In a way, the program also aimed at introducing new method of teaching or interaction between teachers and students of architecture. The research program included the realization of three experimental prototypes in 1:1 scale between these years.

All the three prototypes had different theme and involved different batches of architecture students from the three countries. SECU – Sustainable Emerging City Unit was the first and material oriented prototype which was built in three months. SICU – Sustainable Incremental Construction Unit was the second prototype which took only 10 days to assemble. It was meant to enlighten students with the process of designing, manufacturing and assembly. The third and the last prototype which had the motive to provoke the existing design and construction industry with state of the art production process is called MACU – Mobile Automated Contemporary Unit. All the three projects are described and discussed with their added values in the teaching process of architecture and construction.

More than 40 students and teachers have participated in each project from the three countries.

1.2 *Teaching through experiment: architecture is a craft*

For every design problem, there exist always reasonable and possible options of solutions for design is not an exact science. In design studio classes, comprehensive problem is given to students who first analyze it and then reach a design scheme through synthetic process.

However, the way we have been teaching our students in the studios usually isolate the design problem from the context of a real design process. Numerous professionals with distinct background and different sets of values are involved in the design process to interpret and judge the design outcome (Y. J. Grobman, 2010). Therefore, it was believed that, creating serious of experimental 1:1 scale projects as part of the curriculum exposes students to more domain of knowledge if not to all. In addition, they learn effectively though making. This is because they are deeply involved in learning, if they construct something public and useful. The more they build structures, the more they are close to architectural realities (Beaumont, R., 2009).

There is no question about the importance of the introduction of experimental works into the educational stage. Experimental learning is necessary to transfer the theory into the practice and to get involved in the process. Experiments help to show up the difficulties, the details on site, to get prepared for all the stage of design and construction. Architects always need to '*be there'*. The involvement in the realization of prototypes leads to a new level which cannot be replaced by something else.

1.3 *Objectives of the research program*

Though all the three projects had specific objectives with regard to the technology and knowledge they have transferred, their collective objective in the teaching program was to combine theoretical architectural and construction knowledge with practical training for higher education, specifically at the EiABC (Ethiopian Institute of Architecture, Building Construction and City development). Therefore, the general objective of the program in addition to introducing new methods of planning, design and construction, is training students of architecture with real parameters of site situation, material and building construction systems.

2 THE PROTOTYPES

2.1 *SECU (Sustainable Emerging City Unit)*

SECU can be seen as the pioneer to introduce an alternative building material for the construction industry in Ethiopia, while the country is struggling to have

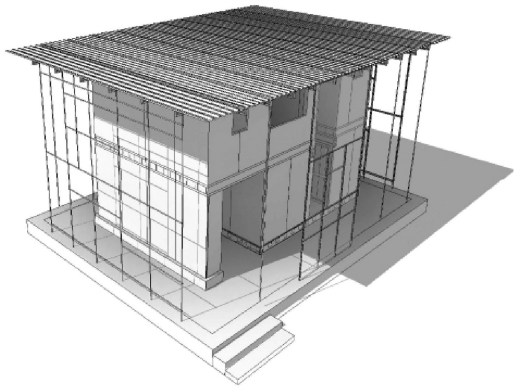


Figure 1. BIM model of SECU.

standards of its own for natural building materials. As the use of more sustainable and environmentally friendly building materials and techniques is increasing (Calkins, M., 2009), the research group felt that it is their task to experiment with new but pre-processed material and introduce it to the industry in line with the plan and wish of the government to do so.

Therefore, with the support of the STRAWTEC Company from Germany, the research team had the courage to further develop implementation methods for straw panels in load bearing applications. The research investigated construction elements and their necessary connection systems and details. Serious of architectural and engineering tests were done both by students and the team to identify possible challenges and qualify the material as a load bearing robust element ready for two story house.

The determining parameters influencing the design of SECU were the provided material properties, the systematic modular construction approach, and design principles coming out of the unique cultural and social settings in Ethiopia. In order to respect these settings, SECU proposed a balance between open, roofed and semi-private outdoor areas for economic activities and enclosed private spaces, which also functioned as structural core elements. This arrangement allows for further upgrading or extensions to be implemented by the inhabitants and gives them the opportunity to contribute in the creation process of their home (Fig. 4a & 4b).

All main building elements – walls, slabs and roof – are made of single or double layered compressed straw panels (6 or 12 cm thickness), joined by threaded rods and casein-based glue. A secondary structural system was not required. It is calculated to be earthquake resistant for two-story buildings (Donath, D., 2012). The individual panels are produced in a continuous prefabrication process where the straw is compressed under heat to form an end product resembling a material comparable to soft fibre board. The significant roof overhang and green screen of climbing plants give the unit its own character and protects the straw panels from rainwater.

Table 1. Parameters for SECU.

Building	
Location	Addis Ababa Ethiopia
Year	2012
Construction time	3 months
Total floor space	96.00 m^2
Floor dimensions	9.60 × 5.00 m
Height	5.20 m
Ground floor area	48.00 m^2
First floor area	48.00 m^2
Extension space	0.00 m^2
Max. no. of floors	Ground level + 01
Material	compressed straw panels (1200 × 2500 × 60 mm)
Foundation	Grid of natural stones bedded in gravel
Ground floor	Straw panels (double layer, 120 mm)
Slab	Hollow core sandwich plate, strawboard, prefabricated
First floor	Straw panels (double layer, 120 mm)
Roof	rib slab, strawboard
Cost	8,500 USD (as of late 2012) (includes sanitation, all finished first floors)

By introducing industrially manufactured strawboard panels as structural as well as infill material for the first time in Ethiopia, SECU rendered separated and usually expensive frame structures obsolete. For all vertical wall elements, a double layered, glued panel system proved to be the most adequate solution. The homogenous and compact material also allowed for a flexible location of openings such as windows and doors. A hollow core structure guaranteed the necessary load bearing capacity of the ceiling, considering the desirable double story application principle. One-sided ribbed panels were suitable for the roof structure, given the mild climate conditions in Ethiopia (no snow load).

Inspired by the results of SECU, the Strawtec Company has started to construct houses of a different model but with the same concept in Kigali, Rwanda since 2015 ranging from single story to three story residential as well as commercial buildings (Fig. 5).

2.2 *SICU (sustainable incremental construction unit)*

The second and process oriented experimental building prototype dealt with participatory design. It was constructed in one of the highly dense neighborhoods of Addis Ababa in 2013 as a show case where the team of students with their tutors researched and explored possibilities of designing and realization of an incremental housing unit in an urban context.

SICU had a very strong social strategy both at the design and construction phases. Because of which, maximum involvement of users and decision makers (authorities), was promoted started from the inception period. This brought a good solution in design and construction and created sense of ownership by the user.

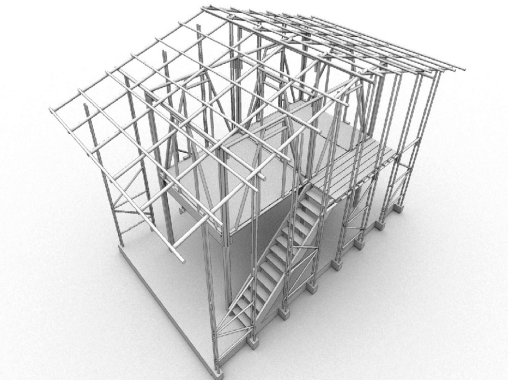


Figure 2. BIM model of SICU.

It also had to be affordable through the use of optimized and modular construction systems and locally produced prefabricated building elements with standardized dimensions. Therefore, its cost efficiency was checked at every level before construction using BIM technology (Karen M., 2014).

Because of its incremental concept, SICU has very open and conventional spaces that give room for further change and appropriation by users. There is an interface space (the shaded space at the ground level and the terrace at the top level), which is to accommodate future needs of the inhabitants as the public private transition is a very important aspect in traditional Ethiopian living domains (Fig. 4c).

The construction comprises of prefabricated concrete lower structure and lightweight eucalyptus frames for the upper floor inspired by few local cases in the countryside of Ethiopia. Close to 90% of the building parts of the house are prefabricated in a workshop.

The experiment will be far from over even after the construction of the main prototype building, as the structure needs to be appropriated and finalized by its prospective dweller. Therefore, further steps and scenarios concerning the incrementality and socio-economic questions have to be investigated and addressed before full evaluation and assessment can be done on the approach as well as the results and findings of the research. Additionally, an important observation will be provided by the adaptation of the house to different users and settings as well as continuous testing and monitoring of the proto-typology over a longer period of time.

2.3 *MACU (mobile automated contemporary unit)*

The research team wanted the last project to introduce a different but applicable construction system that allow the transfer of technology from developed countries to both Ethiopia and South Sudan, in a way

Table 2. Parameters for SICU.

Building	
Location	Addis Ababa Ethiopia
Year	Two units: 2013 and 2014
Construction time	ten days
Total floor space	86.00 m^2
Floor dimensions	9.40 × 6.40 m
Height	6.40 m
Ground floor area	28.00 m^2
First floor area	28.00 m^2
Extension space	30.00 m^2
Max. no. of floors	Ground level + 01
Materials	
Ground floor	Pre-fab elements from concrete foundations and column
Slab	Eucalyptus ribs with plywood sheets
First floor	Light timber frames and claddings, prefabricated
Roof	Eucalyptus frame, prefabricated
Cost	5,000 USD (as of late 2014) includes the finished first floor and an open ground floor

Table 3. Parameters for MACU.

Building	
Location	Addis Ababa Ethiopia
Year	2014
Construction time	ten hours
Total floor space	25.00 m^2
Floor dimensions	5.40 × 5.40 m
Height	3.60 m
Ground floor area	28.00 m^2
First floor area	28.00 m^2
Total floor space	56.00 m^2
Total floor space	2 × 35 m^2 + 25 m^2 extendable space
Max. no. of floors	G + 1
Material	Eucalyptus plywood, 18 mm, 1.20 × 2.40 m
Number of sheets	159
Number of individual parts	834 parts without wedges & connectors
Ground floor	Columns from customized eucalyptus plywood sheets
Slab	Waffle grid from customized eucalyptus plywood sheets
First floor	Columns from customized eucalyptus plywood sheets
Roof	Waffle grid from customized eucalyptus plywood sheets
Cost	10,000 USD (as of late 2014) (includes the full system and wall elements)

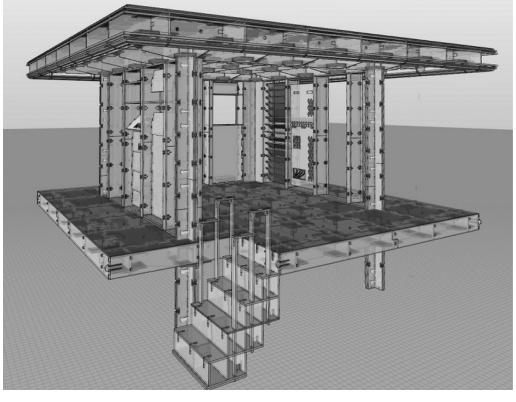


Figure 3. Parameterized model of MACU.

to Africa at large. Inspired by the potential of digital planning and manufacturing techniques of CNC (*computer numeric controlled)* machines, the project aimed at exploring their full potentials and acquainting students and practitioners with current state of the art.

The design of MACU was based on a parameterized computer model controlling a computer which again controls a milling machine for producing the individual building parts. This means a total flexibility can be achieved by changing the parameters of the individual building parts instantaneously. The result is a fully described building system which can be provided in various design layouts.

The prototype is fully made out of Plywood except the four small concrete pads on which the columns rest, as it is not logical to allow the connection between the plywood and the ground. The plywood has 18 mm thickness and is made out of eucalyptus wood by the company Heng Sen Lumber Manufacture PLC located in Addis Ababa and which also sponsored the project by providing us half of the plywood the project required.

The assembling of parts intentionally avoided the use of any other connecting materials including nails and glues due to the very fact that the project was meant to be mobile in addition to its automated features. Of course, this feature added a huge challenge in the overall design for involved students and research team until it looks impossible.

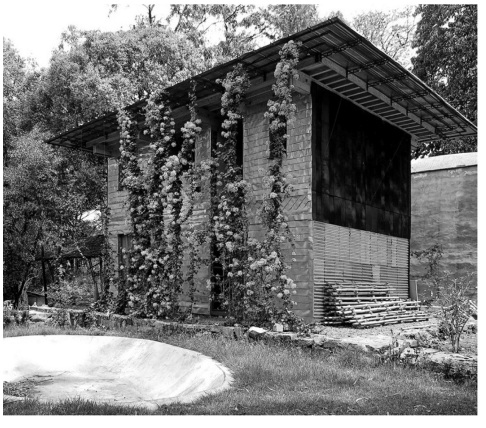
3 ADDED VALUES

3.1 *Give practical insight to students*

While the three experimental building where planned to be executed, parallel teaching courses were also designed mostly by the two universities (EiABC of Addis Ababa University and Bauhaus University) and more that 35 selected students had to work on each project for at least a semester. They have worked from inception up until assembly with almost seven involved teachers from both universities each year. There were also student excursions and exchanges which exposed students of different worlds to different culture and technology in addition to motivating them to conduct practical researches.



(a)



(b)



(c)



(d)



(e)



(f)



(g)

Figure 4. Pictorial illustrations of the three houses.
a: Prefabrication of SECU elements in workshop
b: SECU in its setting
c: Assembling of SICU in the neighbor
d: Inauguration of SICU with the presence of Ministers and Ambassadors
e & f: Assembling MACU
g: MACU as it stands.



(a)



(b)



(c)

Figure 5. Developments of Strawtec in Kigali, Rwanda inspired by SECU. The research team became favorite consultant of the company.
a: Model house in the workshop at STRAWTEC Rwanda, 2016
b: Demonstration Project, Kigali STRAWTEC Rwanda (G+0), 2016
c: Demonstration Project, Kigali STRAWTEC Rwanda (G+2), 2016.

3.2 *Technology/knowledge exchange*

The exchange of technology/knowledge in addition to culture between students and teachers worked both directions. Ethiopian and South Sudanese students acquired some technological training from German teachers and students like the application of computer modelling systems and the usage of CNC machines. In the other direction, German students and teachers got the platform to work on different but real architectural challenges. They needed to be coached and guided by their counterparts from Ethiopia for the full understanding and analysis of living and spatial situations as well as construction material and other realities. These mutual benefits have initiated a sustainable cooperation between the universities and led them even to the creation of a new joint laboratory whereby students and researchers benefit from after the completion of the program.

3.3 *University industry linkages*

There have been many attempts recently by the country to resolve the problem of technological under development by creating a strong linkage between universities and industries. Undoubtedly, such activities and interactions would be of benefit to both industry and university by enabling them to:

- Establish multidisciplinary programs that are responsive to industrial needs,
- Carry out specific company-sponsored projects,
- Strengthen team-based, cross-disciplinary, problem-solving industry-university exchanges by placing faculty and students at industry sites and industry scientists/engineers at the university,
- Provide a real world and a high-caliber educational experience for graduate students.

4 CONCLUSION

These prototypes were not meant to replace any kind of existing construction system. They were supposed to provoke the industry to come out of its comfort zone by enlightening it with alternative approach to design and produce building elements. In this regard, the research program has met its objectives to a higher extent. However, a coordinated effort in publicizing the potential of it is required for making the maximum out of it.

The parallel but major academic objectives linked to all the three projects were successful example of learning by doing. It has given students and their mentors the confidence to do further academic but problem solving researches which can get recognition by Authorities and the industry than ever been done before in addition to its advantage of exposing students to practical knowledge. Enriching such courses in interdisciplinary way requires further polishing of the curriculum after careful study and analysis is done with the effect and impact of these newly designed practical courses on the overall teaching and learning process of architecture students.

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Temporary commercial spaces: Celebrating the 'right to the city'

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ABSTRACT: Aware of the inseparable relationship between public space and commercial space, this paper aims at reading Lefebvre's concept of a "right to the city" through a survey of urban places for commerce.

Commerce and the city have always been complementing and constituting one other, generating spaces that are built up on the complex synergy between social practices, physical space and its modes of use. However, this centuries-long ability of commerce to contribute to the "making of the city" began to be questioned when commercial settlements started to close in upon themselves, turning into structures that are no longer open and permeable to urban life. Lately, though, we are witnessing different transient urban phenomena, such as "temporary" commercial occupancy of space: ordinary people producing space – not necessarily physically, sometimes just transfiguring its meaning and value – through the pursuit of their own needs, transgressing the formal spatial and temporal boundaries of the lived spaces of everyday life.

In some way, temporary commercial spaces celebrate Lefebvre's idea of a city that is accessible to everybody, making it possible for inhabitants to regain control of the city's decision-making and space creating processes.

1 ABOUT LEFEVBRE'S "SPACE"

City air makes you free
(Stadtluft macht frei)
Max Weber, Die Stadt, 1920[1]

Commerce and the city are both located in the deep core of the idea of an urban body, complementing and producing one another, in an inextricable bond. Open spaces and traditional commercial spaces are mutually enriching, they becoming more and more appealing and fascinating, together contributing to the production of an animated, colourful, perfumed, resonating and surprising urban texture, in which interchange is not limited to goods trading.

Retail spaces can be read as relational spaces by excellence. The act of exchanging goods implies building relationships, which is a step toward integration and social cohesion.

Integration and social cohesion generate "space of freedom" (Weber 1921).

Some commercial forms can then be read as spaces of freedom, built up on the complex synergy between social practices, physical space and its modes of use.

A space of freedom is far more than the individual liberty to access urban spaces or resources: it is, more likely, the same idea of a space of freedom which French sociologist and philosopher Henri Lefebvre introduced in his *Right to the City* (1968), with which he would challenge or replace current rights of all to the urban space.

The *Right to the City* has recently re-gained prominence in academic and political-activist debates on urban matters. In some ways, the "right to the city" has become something of a slogan that reshapes decision-making processes in the city, giving urban inhabitants a central role in any decision that contributes to the production of urban space. Instead of democratic deliberations made just by the state, Lefebvre imagines this right to apply to *all* decisions, fundamentally shifting control away from capital and the state toward urban inhabitants.

This idea comes from Lefebvre's notion of space, which contains what he calls *perceived* space, *conceived* space and *lived* space. Perceived space is the tangible or physical space people encounter in their daily environment. Conceived space is the mental construction of space, the representation of space. The combination of both, perceived and conceived space, results in the lived space: a person's actual experience of space in everyday life. And because, according to Lefebvre, social relations and lived space are inevitably related in everyday life, creating urban

[1] In 1920s, reflecting on the issue of the city, German sociologist Max Weber defined the character of the medieval town as being essentially free, thanks to the widespread presence of commerce. A city that welcomes commerce within its public spaces is a place of economic and social freedom. And granting space to economic and social freedom is the basis for social integration. At the end of his analysis, Weber quoted this writing seen on the door of a fortified town in Upper Rhineland: "City air makes you free".

space necessarily involves "reproducing the social relations that are bound up in it and therefore entails much more than just planning the material space of the city; it involves producing and reproducing all aspects of urban life" (Lefevre 1991). For Lefebvre, then, "the *right to the city* is like a cry and a demand for a transformed and renewed *right to urban life*" (Lefevre 1991).

In other words, it is a kind of re-appropriation of the decision process and of the city's production spaces and facilities by its inhabitants. This also implies the right of inhabitants to physically access, occupy, and use urban space so that it meets their needs. The use value aspect of urban space must therefore be the primary consideration in all decisions that produce urban space.

2 COMMERCIAL SPACES AND THEIR BOUNDARIES IN THE LIGHT OF LEFEBVRE'S THEORY

Good examples of spaces that are charged with a deep sense of all that Lefebvre states are those places which are dedicated to public traditional commercial activities: these are shifting and flexible settings which constitute a background to the complex network of relationships and social practices, as well as space and the way this is perceived, conceived and lived. Indeed, spaces of freedom where is celebrated the right to urban life.

Nevertheless, when tracing a brief history of trade, we realize that commercial spaces gradually lost their quality of being spaces of freedom. In a tangible way, this is proved, among other phenomena, by a clearer and clearer definition between the physical boundaries of open public spaces and those of commercial spaces. The progressive limitation of these boundaries results in concentration and commercial specialization, and, consequently, in a separation between the spaces for commerce and urban public life. Commerce gradually lost its ability to act as binder of urbanity, failing in its centuries-long tradition of contributing to the "making the city", while providing accommodation for everyone.

That was still true in the medieval town, which was heavily marked by the presence of spaces for trade. These were the result of an open and unlimited system created by the synergies between the different spaces that had been designated for living, socializing, representing, producing and exchanging. A system such as this did not seem to question the right for different kinds of activities (which might range from commercial activities to residential or administrative functions) to coexist in the same space, side by side. These manifold functions and activities, which were not necessarily all related to commerce, but did have some proximity to it, seemed to find the reason of their good functioning in the varied composition of the system itself: an articulated system which, at the same time, preserved the specific nature and character of the different activities it was made of. It was a network of inter-connected and inter-communicating spaces, which all belonged to the same urban public and commercial system.

In this case, public space coincides unmistakably with commercial space, in a situation where there are no definite boundaries. Commercial areas, like scattered points in a larger spatial system, are not formally defined or fixed (even though we might find a factory, or a specific architectural project), and do not appear as closed and definite units. We are referring, for example, to the simple result of the relationship between the workshop (or the small shop) and the empty space that is in front of it, or to the single architectural work, which hosts many more spaces on its inside, or – and that is a much more frequent occurrence – to a group of spaces, which have been built at different times and with different techniques, materials and styles, but which are organized in a coherent whole or path (Pevsner 1986). Anyway, it is the continuity or, we should say, the physical interference among the different urban spaces that constitutes the true identity of the communal and commercial aspects of the medieval town, together with the relationship between the various activities and the ever changing needs of its inhabitants/traders. Throughout many centuries, a busy multitude has been physically meeting and mixing up here, while carrying out their manifold activities. This multitude took possession of these spaces – which could be built upon or empty, with no clear boundaries, different in shape and function, separate but contiguous, connected but open – and thus actively participated in the actual building of the city.

Commerce and the areas in which it takes place also contribute to the shaping of the experience of urban life when middle classes begin to emerge. Open urban spaces become *Passages* (arcades): covered commercial streets with elegant settings, whose nature continues to evoke their original status. This is that of the street which, in close continuity with the network of the various blocks of buildings, appears as a natural extension of public space. Despite their reduced scale, as well as their complexity and multiplicity if compared with the market town, the arcades continue to encourage urbanity.

However, at this point, the physical boundary between open public spaces and the arcades begun to be less blurred, although remaining quite ambiguous. The arcade model eludes a fixed and univocal definition, it being, at the same time, an architectural work and an urban building typology, with the ability to sew together different parts of the fabric of the consolidated city. It is precisely this ambiguity – between solid and void, between open and close, between building and urban, public and private – which gives it the role of connective element and virtuous factor of urban vitality. More than the market hall or the department store, which are clearly defined and independent containers, the arcade creates a space which is constantly projected toward its outside, directing the flow of the intricate walkways of the dense fabric of the city center.

The ambiguity of the limits of the arcades contrasts with the clear definition of the department store, which, in the mid-Nineteenth Century, began to become a widespread model for commercial activities in established city centers. This is an accomplished urban unit, the value of which lies precisely and emphatically in the clarity of its limits, which are defined by monumental, compact and linear façades. Nevertheless, the department store continues to have a lively and direct relationship with the urban context, providing a gathering point for the flows of pedestrians, capturing them with fabulous displays and creating synergies with other types of functions.

The gradual loss of relationship between the public space and commercial space announced by the irremediable and increasing definition of physical limitations ends in the Twentieth Century, when the city turns into something radically different from the city of the middle and industrial classes. With the explosion of mass-society and the increase in peoples' mobility, as well as with the invention of new technologies and new media, the city begins a process of differentiation: a separation of the various urban organisms from one another and a specialization of functions that become more and more obvious. A new city is born. A sort of urban sprawl where the different urban functions are more and more separated – a separation encouraged by the growing use of private cars – and where, as a consequence, traditional forms of housing and buildings are abandoned in favor of a huge increase in the size and amount of infrastructures. The result of this process is an "erratic and scattered urban context, (…) atopic and discontinuous", where "squares and arcades, *avenidas*, plazas, and also the streets and roads themselves seem to have lost all identity and meaning" (Desideri 1997). Instead, commercial spaces, now trying to present themselves as ideal surrogates for all forms of traditional public space, acquire new status and meaning, as communal and social spaces. The department store, now "detached from the urban context and taken out of the city, sheds its osmotic architectural form, to become impermeable to the system of open spaces, choosing for itself a dimension that is more related to the definition of its interiors" (Gaglio 2007).

Today's big-box stores, retail parks, shopping malls, etc. all confirm this process.

Paradoxically, historical tissues are also victims of liberalism without rules. When faced with more and more aggressive competitors, traditional forms of local commerce and city organization seem to collapse. The only reactions to this process are, in many cases, projects of urban remodeling that, in the end, are not much more than *urban restyling*, focused on marketing purposes, often including renovation, communication and promotion strategies aimed at highlighting the "consumable" features of a specific place. This trend often results in a phenomenon of gentrification, which does not differ much from those processes of social and space segregation typically produced by extra-urban commercial systems (Rabbiosi 2013).



Figure 1. Typical car boot sale at Saint Augustine's Car Boot Sale in London. Source: A. Allegri.

3 TEMPORARY COMMERCIAL SPACES: POSSIBILITIES IN URBAN LIFE

But the changes do not end there.

Probably mostly due to the contemporary global financial crisis, we are now witnessing new and varied transient urban phenomena, such as "temporary" and "informal" commercial occupancy of space. As a matter of fact, side by side with the building of large premises for shopping or with the "marketing" of the old cities' centers, there is another notion of commerce and use of public space which is now spreading further and further: this includes things as diverse as leftover-stock market stalls in some disused warehouse, food tracks, pop-up stores and pop-up restaurants, sale of Panini stickers at subway exits, underground restaurants, sale of homemade products in some unusual itinerant stalls, and even poetry sold between the tables of a bar at dusk or *botellones* (street drinking).

If the food track is a vehicle equipped to cook and sell food in a quick and low cost way – even if a modern-day food track offers gourmet menus and can easily be a respectable venue for aspiring chefs to launch careers – a car boot, literally car selling items from the car's boot, is a form of market in which private individuals come together to sell any kind of goods, from household to books.

The popularity of car boot sales has grown enormously since their beginning in the UK in the early 1970s. Listings on websites suggest that hundreds of sales happen weekly in many countries, even if the larger number continues to take place in England, with over 25 in London alone (http://www.carbootsales.org/county/london.html; http://www.carbootjunction.com/complete-carboot-listings.php?qsearch=London&; accessed 24 January 2016). Car boot sales originally occurred on greenfield sites in the summer months. However, in a growing trend, they are now held all year in the grounds of schools, parking places (sometimes in the parking lot of a hypermarket), road junctions, and squares in the inner suburbs or even in the smaller interstitial public spaces of the compact historical city. Indoor boot sales are now appearing too (it is the case of car boots in some community building).



Figure 2. Street vendor at Palo Alto Market in Barcelona. Source: A. Allegri.



Figure 3. The farmers 'market at Principe Real in Lisbon. Source: A. Allegri.

Much more of a North American concept, the yard sale, also known as "garage sale", is an informal event for the sale of used goods by private individuals, in which sellers are not required to obtain any kind of business licenses or collect sales tax. The idea has moved beyond the individual front yard or garage and now includes neighbourhood sales. The Highway 127 Corridor Sale, promoted as "The World's Longest Yard Sale", encourages private individuals and professional vendors to conduct simultaneous yard sales along a 630-mile (1,010 km) corridor spanning five US states (http://www.127sale.com; accessed 24 January 2016).



Figure 4-5-6. 'Pop-up Stores TMN' in Praça Camões; Street vendor at Lx Factory; Flowers seller by bike, Lisbon. Source: A. Allegri.

In a similar vein, a new wave of street markets is emerging, although we must not forget that this is the most resilient and remarkable form of temporary commerce. Giving new life to many run-down urban

areas, a lot of declining markets have been able to reinvent themselves by introducing new and original variations such as car boots, yard sales, night markets and farmers' markets.

The recent interest in healthy food and more sustainable lifestyles, as well as the promotion of organic or homemade products, led to the rebirth of one of the oldest forms of exchange. Indeed, farmers' markets have existed since mankind has begun to produce a surplus from farming the land; since then they have been a vital factor for the economy of many cities. Nevertheless, with the growth of urbanization, intensive farming, the advent of supermarkets and a number of technical innovations, such as the refrigerator, farmers' markets had lost their strength. Apparently, however, the decline is over. In the US, for example, they grew from 1.755 in 1995 to 5.274 in 2009. In Los Angeles there are more than 100 farmers 'markets in operation (http://www.laweekly.com/restaurants/the-ultimate-la-farmers-market-guide-google-map-2895133; accessed 24 January 2016). The idea of fresh food produced locally seems to have caught up with Europeans too; in many European cities farmers' markets are a pivotal aspect of life. There, people shop for dinner, check in with farmers, taste some homemade product and grab a coffee or a fresh fruit juice with friends. Moreover, farmers' markets help farmers (normally small producers) stay in business, thus also helping to re-establish important social ties between rural and urban population.

Even if farmers' markets often offer relatively expensive products, which not everybody can afford to buy, they prove, as much as car boots or yard sales, that street vending is now widely accepted, and seen as a space for bustle, surprise, business opportunity and leisure pursuit. Likewise, temporary commerce is an interesting phenomenon not just for the sheer variety of its forms, but also for its power as a feature of urban life representing a consumer's world, where the limits between public space and commercial space are no longer clear-cut. History repeats itself, once again.

4 CONCLUSION

In the name of capitalistic freedom, the excessive power of the market has imposed its rules on the social relations and material organization of the city and territory. Freedom of economic initiative, which had contributed to making the city the area par excellence of tolerance and civil liberties, has become, with time, an element of social division and a primary factor of aggression to the body of the city itself.

"If the city has been enriched and made complex and fascinating by retail, now, in some parts, it is impoverished by it" (Consonni quoted in Gaglio 2007).

Yet, even if belatedly, the latest commercial models, with their temporary, "weak", spontaneous and unorganized quality, seem to stem the phenomenon of aggression to urban complexity and quality, giving new forms, new meaning and new value to places, some of which are often not expected to accommodate actions of trade.

Those who carry out this type of commerce, those who perform these actions – the traders –, are normally "ordinary" people, the inhabitants of these places. Sometimes, to even see these spaces, people, – the clients –, have, somehow, to participate in their dynamics.

Consequently, these are spaces that are directly created by people. As Lefebvre pointed out, here, people (the city's inhabitants) have the right to participate in first person, in collective ways, to the process of urban creation, as well as the right to have sufficient access to urban public spaces, which they should be able to make full use of. So, temporary commerce reflects the response of individuals in having to rethink established practices and consolidated spaces.

This new commercial dictionary, identifying a diversified geography of commerce, shapes alternative and important hubs of urbanity and becomes the engine of interesting spatial, social and economic dynamics. Urban space is no longer moulded through decisions originating from a few centres of power, but rather through a polyarchic and ever-changing model, where diverse uses and situations legitimately overlap, in opposition to the growing pressure for homogenisation of the city, understood as a place of consensus and consumption.

The phenomenon of temporary commerce represents a fundamental shift in the use of the city, impacting even on how public space is considered, with deeper implications for urban life, policy and practice. For this reason, we believe that any action that seeks to promote quality and equality in our cities should not ignore the issue of transient occupancy as a powerful emerging urban dynamic.

Therefore, research in this field is greatly needed, because a better understanding is essential in order to act and build urban strategies that ensure a reading and planning of the city through the prism of the individual, ensuring quality of life for all within the urban space.

In the specific case of the temporary commerce, if it is through consumption that people's activities and everyday lives and the physical and mental organization of the city are bound, then it is important that retailing is planned in accordance with the role it plays in the urban fabric and in people's everyday lives.

As Lefebvre puts it when he talks of a "right to the city", in this constellation of spaces, which are continually "lighting up" and "going dark" (La Varra 2007), every day public life in our cities seems to contribute to the production of urban spaces, transforming them in an even richer place for encounter and possibility.

This is why we should view these forms of temporary use of urban space as increasingly legitimate and important in their own right.

At the same time, different transient urban phenomena alert on the necessity of seriously thinking about what changes in society, culture, technology and economy are now driving urban processes, as

well as, inevitably, raising questions about the emergence of a new approach in urban planning and design. This is maybe a more dynamic or flexible one, where the city is becoming more responsive to the new needs and demands of its users, faced with economic uncertainty and rapidly changing possibilities.

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South Africa's new challenges: Planning inclusive connection spaces

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ABSTRACT: The purpose of this paper is to define whether and how it is possible to create inclusive connection spaces through planning, by analysing some of the most segregated cities in the world. The starting point is an overview of the current urban situation in South Africa, twenty years after the first democratic elections. Scholars argue that, due to a history of colonialism and apartheid, cities there are increasingly segregated and fragmented. At the same time the political agenda is struggling to address the process of transformation in order to mitigate spatial inequalities and promote urban integration, while on the other hand taking global interests into account. Through the examination of three examples this work attempts to identify some progress in the creation of inclusive spaces, while looking at the complexities involved in operating in a South African context.

1 INTRODUCTION

1.1 *African and South African context*

In Africa urbanization is becoming increasingly widespread. Since Africa has the fastest rate of urban growth in the world, it is constantly facing new challenges. The rapid urban growth in Africa is peculiar because it is not combined with a corresponding economic development (Parnell & Pieterse 2014, Albrecht 2014, Floris 2007, among others). This characteristic is straining the policies of most of the newly formed independent States. The rapid urbanization must be considered not only as a problem to face but also as a new chance to improve African cities. Indeed corruption, political instability, lack of economic resources, unemployment, growing poverty, crime, AIDS, segregation and inequality are common topics in the agenda of the last decades. All over the world, but specifically in the South American and African metropolis, inequality between the rich and the poor has increased dramatically. At the same time extreme wealth and poverty often coexist within the urban space. Conflicts may (and often) happen in these spaces. People concentrate in cities attracted by employment possibilities and global opportunities. Meanwhile cities become more and more divided within its boundary to limit or avoid crime generated by contrasting social and ethnic groups. Especially in South Africa, racial inequality requires specific attention in the fields of architecture and city planning. It is not only a social and economic problem; it also includes political and urban issues.

According to some authors, South African cities are the most segregated in the world, described as invariably twin cities, one white and the other black; one privileged the other marginalized (Bruyns & Graafland 2012, Noble 2011, among others). The segregation patterns and the inequitable environments have been inherited from colonialism and apartheid, and the new development patterns have not diverged significantly from them. The transformation of the fragmented urban reality has been the aim of government policies in the period after the first democratic election in 1994. Now twenty years on from this historic moment, it is time to reflect on what has been done and what future projections exist. South African cities' dual ambitions have been concentrated on the global competition while also looking at local problems (Bekker & Fourchard 2013, Lemasky 2007). "Whilst the pro-poor approach adopted in the early post-apartheid era proved to be fiscally unsustainable and unable to deal with macro-forces shaping the city, the urban efficiency and global city agendas for later years are likely to prove unsustainable in their inability to support social cohesion." (Harrison 2006). The result is one of the highest levels of income inequality, measured in terms of GINI coefficient as shown in the World Bank estimate (Bonaglia & Wegner 2014) and as stated in the African Progress Report, 2012. This growing gap is intertwining with the burgeoning urban transformations, where townships and informal settlements surround the city centres and the empty spaces between the formal settlements.

1.2 *Point of view*

Most studies are still built on theories utilizing US or European cities to stand as universal models, or measuring non-western settings by the models and metrics of the West (Myers 2011). While the theories of how cities function remain rooted in the developed world, the urban growth is happening in the developing world, where these rules are incompatible with the reality. Therefore, the role of the architect in these contexts needs to change.

It is essential to underline that a western approach has been imposed to the African territory since hundreds of years. This long-time domination does not

justify an approach that is not respectful of the identity of a place. Unfortunately nowadays defining identity in Africa is very complex because of the history of the continent. During a long period of time colonization, apartheid and globalization have modified profoundly Africa. In this paper the starting point is to realize the inadequacy of dualistic models, dividing the world between North and South, western countries and developing ones. If is accepted that planning tools based on developed western cities are inappropriate to the characteristic of the developing city (Roy 2005), then the expression city of the South needs to be abolished (Balbo, 2012). Therefore the approach must be analytic, without preconception. One possible approach is to learn from Third World cities, stressing the importance of acknowledging overlapping networks of interaction within the city, going beyond the geographical division of global cities and megacities (Robinson 2002). This is why the author decided to look at some case studies, learning from them.

There are different narratives about African reality, from afro-pessimism to afro-optimism (from "hopeless Africa" to "Africa rising" as defined by The Economist) that tend to generalize a complex and diverse reality throughout the continent. It is true that some recurring features occur when discussing urbanization in Africa, but the African continent is a set of specific realities and with differentiated histories. The challenge for researchers is to realize that it is possible to imagine a rebirth not linked or influenced by the spread of western models of development (Lucia 2007). In fact some opposite approaches are coming out, and they invert the vision, conceiving African development as an alternative to capitalism and globalization (Latouche 2009, Robert 2006).

1.3 *Data and boundaries*

The paucity of reliable data is one of the problems to be aware of dealing with urban Africa. Many times it can occur that the data available are out of date (Parnell & Pieterse 2014, Roy & Alsayyad 2004) or simply the reference source is unique, then is not possible to compare the results. When the area of interest is limited, it is easier to define the framework and the background of the research and it can be easier to find the needed information and a particular scientific production.

This paper defines the boundaries of the research within the Republic of South Africa. Some assumptions and conclusions may be also acceptable for other part of the continent, but the focus of this work is to understand a specific area, with specific history and geography. The City of Cape Town, where the author spent two months of fieldwork, is particularly significant for the topic of this paper. As a matter of fact the metropolitan area, also defined "Unicity", is a starkly polarized area where inclusion and integration are huge challenges to face.

Accepting, as some authors suggest, that some African cities are becoming or are aspiring to become global (Lemanski 2007; Crankshaw 2012), makes it possible to learn from the South African experience, and perhaps to generalize these ideas in a worldwide context, even if is not the main purpose of this work.

2 ANALYSIS

The aim of this research comes from the concept that contemporary fragmented cities need greater linkages to avoid the on-going division. Since the level of inequality in the South African cities is the highest in the world (Bruyns & Graafland 2012), an observation of the architectural and city-planning strategies to face these problems could be useful to build the framework in which architects and planners can operate.

The first assumption is the consideration of a society with peculiar characteristics in which people are in search of a local identity. As many other African states, the path toward the emancipation and specification of a new South African identity starts with the independence conquered in 1961. The first democratic election occurred in 1994 marked an historic shift for the state. The following twenty years are the focus of the analysis because they represent a crucial moment for the state, which can count on the ruling African National Congress (ANC), with unrivalled power and popularity since the outstanding political work of Nelson Mandela (Baarlaam & Nola 2010, Bonaglia 2014). Noble in his recent book tries to find the link between five South African public architectures and the search of an African identity, trying to answer to the irresolvable question of black identity described by Fanon (Noble 2011, Fanon 2008). The key question is for sure how to forget and overcome the stereotypes of the west applied to the "south". The role of the cities and of the urban landscape is essential, trying to define the African identity, as much as the consciousness of a non-uniform, but hybrid concept.

The wanted identity must ensure the coexistence between African ethnic groups and their community systems, a colonial past, an outdated apartheid system and the global influences. The common use of the prefix "post" in front of the words colonialism and apartheid implies a connection that is still current and not easy to go beyond. In fact all these factors have had a strong impact in the social structure and, further, in the organization of the spaces (especially in the city areas).

The apartheid city was carefully and minutely planned. In South Africa, the legislation criminalizes urban migration and through the Group Areas Act defined exclusively white areas, where black Africans, Coloureds and Indians were uprooted. Almost one million people of colour were evicted from properties in areas designated as "white only" and were forced to move into segregated townships, divided by race groups. Ultimately, however, this ideal of "white cities, black homelands" collided with the labour-market needs of big capital (Davis 2006), as demonstrated in the following example. Haller and Ngqulunga explained well the apartheid city structure describing

the pattern of segregation and the resulting disarticulation of Durban's spatial structure. Four concentric circles of racial segregation mark indeed the city: a first white core area of growth centres; a semi-periphery populated by Indians and Coloureds; a periphery of black townships; and a liminal zone of informal settlements (Bruyns & Graafland 2012). Such a strong division in the spatial level is attenuated by needed economic exchanges between different parts of the city. The centre needs the low-skill provision from the second area, while the third provides cheap wage labour for industry and domestic services for the white economy. The last area represents the recent immigrants, struggling to find their place in the economic circle. Socially the division are stronger and the connections are scarce, even if the informal economy processes cut across the whole social structure and not only the poor are involved (Castells et al. 1989).

Dealing with social problems is one of the main goals of the policies of the last twenty years. The segregated patterns that characterized Cape Town during the apartheid period have not been totally overtaken. Interracial income differences have remained almost unchanged; even if some deracialization has occurred in education, job opportunities and spatial redistribution. Even if the "desegregation is largely limited to formerly white-only or coloureds-only neighbourhoods" (Crankshaw 2012), it is still a promising signal. Despite policy and intention, most housing and service delivery has not been complemented with adequate social services. The social relations can not be simply deducted from spatial facts and common contribution of foreigner professional does not help to address the problem correctly. Architecture also exists for people only when they occupy a space. It belongs to people only when it is being used. Therefore, successful projects have to follow social movements, to respect community needs, rather than coerce people into new spatial patterns within the built envelope. Part of the challenge of contemporary social architecture is for its designers to become readers (Bruyns & Graafland 2012).

Globalization and capitalism influence the ongoing transformation process, often exacerbating already existing issues. Social and spatial polarization is a consequence of a dual ambition. On one hand, investments in city centres try to attract foreign and private interests, and focus on the international image of the city. On the other hand subsidised housing and pro-poor strategies take place in the townships and suburbs. Limited resources and overlapping of interests may inhibit the effectiveness of both actions (Lemansky 2007).

3 FORMAL AND INFORMAL

3.1 *Outdated dichotomy*

One of the most common definitions of informal settlement refers to the illegal occupation of a land. The land ownership is a big and unresolved issue in Africa. The reason is that in Sub-Saharan Africa land ownership was based on the concept of common property. The land belonged to the community and was administered and managed by the elders. Taking into account this fundamental point, it is easy to understand how big the impact of colonialism has been. The most radical shock has been in the city, where the "land ownership" was imposed and controlled by European models (Floris 2007) and exacerbated by segregation forms. For Soliman, in Egyptian context, the regularization of informal housing areas is the way to tackle the problem, thus formally integrated the informal settlements into the cities. For sure an implementation by stages that include the confirmation of land tenure should take place. At the same time the core question is instead the understanding of the squatting as a cultural and political construct (Roy & Alsayyad 2004).

Informality exists because formality concept has been conceived. Without the western definition of formality, it doesn't make sense to talk about informality. Of course differences exists between the two, but they work as counterparts. They need each other, especially if the term informal refers to the economic sector. A dichotomous approach refers to the polar extremities that separate "haves" from "have-nots", as a consequence of capitalism and the human desire for (individual) consumption and accumulation (Bruyns & Graafland 2012). The idea of the urban poor as responsible for their own poverty and failure to enter formal job and housing markets is outdated. The squatters are no more considered just as "other" and not part of the "normal" city. Therefore, the public policies of removal are no more justified a priori. On the contrary the government declaration states the opposite, affirming the clearance of all the informal settlement in South Africa would be abolished and replaced by formal settlements within 2014 (Slum Act, 2007), later modified to a strategy of upgrading. The marginality of the poor has the ideological-political function of preserving the social order which generated them (Perlman 1976); the myth of marginality, its passive and negative features has been dismantle looking closer to reality and learning from informality. The struggle of the poor to survive and the inefficiency of the formal sector to give an answer to a big part of the population force people to live, own property, and do business extra-legally. The informal entrepreneur is here considered has an economic hero who manages to survive despite the state's continuous controlling measures (De Soto 1989).

As Castells and Portes were claiming "there is no clear-cut duality between a formal and an informal sector, but a series of complex interactions that establish distinct relationships between the economy and the state" (Castells et al. 1989). The same thing is happening not only in the economic sector, but also in the housing one, where formal and informal are connected by a series of transactions and the physical border between them is not easy to identify. The provision of housing remains one of the biggest issues to solve in

relation to a South African "democracity". Alternative models are possible. Soliman specifies that informality represents a failure of official socio-economic and political programs to meet the basic needs and requirements of majority of people. When such programs fail to meet the requirements of society, informality takes place. Informality just allows people to obtain what they need at a lower cost. (Roy & Alsayyad 2004).

The challenge of this work is to investigate and outline the limit between formal and informal spaces, as a means of interpreting contemporary African cities where inequality and disparity are particularly evident. The edges are not only the areas of separation, but also spaces in which connection, integration and inclusion can happen.

3.2 *Gated communities*

In Africa the so-called gated communities are an answer to a fragmented and unequal environment that is perceived as dangerous and antagonistic. Somehow is a voluntary segregation, it is an extreme form of socio-spatial separation (Albrecht 2014). The perimeter is as close as possible with high walls and electric fences to reinforce security and to minimize contact with the exterior. Services, such as schools, library, markets, and pool may be designed within its boundaries. In South Africa gated communities are pretty common, probably because of the great inequality that distinguish the cities. The increasing form of urban gating is modifying new portion of the city into the sum of enclaves, more and more heterogeneous and fragmented.

Lemanski's analysis that compares a gated community in Cape Town to its poorer – but formal – neighbour is interesting. The spatial separation intertwined with social exclusion. The South Africa's post-apartheid urban planning has favoured compact city designs, using the city's empty spaces rather than expanding city edges. Policy focusing exclusively on preventing urban sprawl and spatial inequality at the city level increases the development of other urban phenomena (such as gated communities) that restrict micro-level desegregation. In this case the master plan development scheduled a requested secure place for a rich or middle-class community, answering to the common NIMBY attitude (Not In My BackYard). The Westlake village answers just to the request of housing for poorer people. Socially and functionally the areas are isolated (Lemanski 2006). Looking at this example, the formality or informality of the build environments is not relevant, even if it is a common to think that crime was confined to black townships during the apartheid years. Nowadays urban gating is one solution to avoid contacts with different groups (economically and socially different), it is a new form of segregation not directly connected to ethnicity or race. Gated communities are the best way to weaken the creation of a post-apartheid identity and integration in spatial terms.

3.3 *Contact space becoming connection space*

The dramatic and symbolic description of some African cities compares them to an archipelago of island cities, living in two different levels not communicating to each other except for economic reasons. The first one acts in a vertical way, linked through the network with the rest of the world. The second one is much more connected horizontally and is attached to the earth, occupied informally (Floris 2007, Bini & Ney 2012). Cities are becoming places of separation instead of places of exchange and integration. Here comes the need of research to concentrate the attention on the contact area of these two realities that coexist in the urban context.

This work aspires to examine some particular South African projects, which have tried (succeeding or failing) to address the challenging of a changing society. In South Africa where segregation and apartheid became more and more entrenched, interactions in the urban environments are even more complicated. The objects of analysis are spaces considered as "grey areas", places where different cultural and radical groups already live together. The multicultural feature represents a characteristic that is not typical in the apartheid segregationist plan, but it is closer to the concept of a cosmopolitan town. For this reason multiculturalism and the coexistence of different cultures can be determining to read existing connection spaces; and then to be able to design and replicate them, being respectful of socio-economic and geo-politic framework of the context.

3.3.1 *District Six Museum, Cape Town (Bennet et al. 2008, Minty 2006, Mceachern 1998)*

District Six is an inner-city suburb on the border of the historical centre. It was the last and sixth District of the city, formally recognized in the late 1800s. It was a heterogeneous, religiously and racially mixed area (white, Coloured and African working class people) with a vibrant cosmopolitan community. This unique multicultural quality made it a target for the apartheid policies applied by the National Party. The notorious Group Areas Act in 1966 defined the district as "white only", imposing its destruction. By 1982, the



Figure 1. Interior of the District Six Museum.

entire area where around 60,000 people were living was physically destroyed. Many were relocated in the townships out of the Cape Flats, divided by race. The consequence of this forced removals left the mark not only in previous inhabitants' lives, but also in the creativity and vital energy of the city centre. The area has become the symbol of the dislocation and harmed caused by the Group Areas Act.The government managed to build on Zonnebloem (new name of the neighbourhood), some houses for state employees and the Tecnikon, a controversial educational institution. "The rest is emptiness and ruin, in sharp contrast to the overcrowded, urban past". Despite the local struggle and the international mobilization, the return to the area is still complex and difficult. The Hand Off District Six campaign opposed strongly the suggested development plans, and became the only way to keep the contact with the past and to overcome the pain. Only a few churches and mosques remained and one of them, the Buitenkant Methodist Church, became the District Six Museum.

In 1994, this space was used the first time for a temporary exhibition called "Streets: retracing District Six", then it became a permanent museum thanks to the refusal of ex-resident community to close it. The space turned into a possible connection between past, present and future. Former inhabitants recognize in this space the possibility to remember their identity, asking the community to contribute tracing their physical destroyed past. The floor space is a huge map of the original District, where people wrote their addresses, notes and pieces of their histories. Participation and interactivity made the District Six Museum an award-winning model of a community museum, as much as powerful inclusive connection space. It provides a service to the city, working with children from schools, people interested in understanding the history of the city and common people. "A change of mindset is needed, people have been forced to live without connecting with other races for decades. A new approach is possible just if we will look each other as culturally different, understanding that we can learn from our differences" (interview with Joe Schaffers, worker at the museum as others ex-residents of the district). Despite the success of the museum the district area is still a contested zone and it has just been partially urbanized.

3.3.2 *Langa, Cape Town (Bruyns & Graafland 2012; Kjeldsen & Seeberg 2015; Contal & Revedin 2009)*

Langa is the oldest surviving former black township in South Africa and then is considered as a heritage site in the historic fight for freedom and democracy. As the first "model township" constructed in the country it can be regarded as one of the experiments in creating a segregated city. Between 1927 and 1959 Langa was the only formal housing area for black people in Cape Town and it was close to the Cape Town's Central Business District (CBD), making it an attractive location to live. Thanks to the economic growth of the city Langa was soon absorbed into the city limits and urban fabric, and the pressure on land has enforced a radical densification of settlement. Not only backyard shacks mushroomed, but also the so-called Joe Slovo informal settlement occupied the buffer strip between the suburb and the N2 highway, attracting more people. This is, as many of slums, rich in communal and social relationship, but poor in terms of the quality of its housing units, infrastructure and urban layout. It has become soon a conflict area between the inhabitants and the state. The site has been chosen for the N2 Gateway Project, occupying a portion of the Joe Slovo informal settlement. In 2004 the project was launched, aiming to build more than 200,000 units to replace shacks. In 2006 first occupants moved in, and the rent immediately jumped. In 2008 just 705 units have been completed and the Phase 2 (even less affordable for poor people) was about to start. In 2016 the process is still on going, without clear positive results and with a controversial political involvement. The concern with this project is about creating a neo-apartheid design, economically, politically and socially unsustainable. Some critics refer to an insufficient consultation and participation of the local population; as a result a portion of the residents have been forced to move further away from the city economy since the new flats were too expensive for them.



Figure 2. Guga S'Thebe Cultural Centre.

At the same time Langa has a positive example of an upgrading project inside its borders.

In fact in the corner of Washington and Church street is has been built the Guga S'Thebe Arts, Culture and Heritage Village by the architect Carin Smuts (CS Studio Architects based in Cape Town), considered a post-apartheid public building and an example of sustainable design. The realization of the project lasted from 1996 to 1999 and it has been built with a limited budget. The significance of the site and the community's need were taken into account during the design phase that investigated different schemes. The 820 square meters building is composed by various separate components around main circulation paths, generating a number of indoor and outdoor spaces. Ceramic artworks done by local artists decorate the forecourt, walls and floors.

Despite the fact that the Centre has become an attraction for researchers, students or interested people, the area around it remains a township, with all



Figure 3. Guga S'Thebe Theatre.

its prejudices. The creation of the adjacent Guga S'Thebe theatre, built between 2013 and 2015, is proof of the ongoing process of becoming an inclusive connection space for the neighbourhood and the city. The local community was involved together with CS Studio Architects, the University of Cape Town, other international faculties and companies (www.designdevelopbuild.com). The multipurpose centre is addressed particularly to children and young people of Langa, and answered to their need of a space for learning and performing, but it is open for external events too, bringing people from other parts of the city into Langa.

The design language is very different from the existing cultural centre: the construction method and materials (old shipping containers and panels made by recycled wooden crates or straw and clay) are responding to the need of affordable materials, but they are used in a contemporary way. This shift of language is deriving probably by the international team involved into the design process. The creation of new connection space around the cultural centre represents a success: a good architectural project aspires to generate an improvement in the surrounding context. It will take some time to understand if the Langa community is benefitting from the new theatre space both as a community space and as attraction for the Cape Town citizens in general.

3.3.3 *Red Location Museum, Port Elizabeth (Noero 2010, Msila 2013, interviews with architects)*

While the District Six Museum was created, supported and maintained by the local community, something different happened in the case of Red Location Cultural Precinct in Port Elisabeth. In this case the community occupied and closed the museum built by the government.

In 1994 The Nelson Mandela Bay Municipality decided to build in the Red Location Precinct some public facilities and a new museum with a liberatory function. The area has a long history starting from the First South African War when it was a Boer concentration camp with rusty huts. The new cultural precinct is planned in one of the oldest township in Port Elisabeth, in a place considered as a national site of struggle. Noero Wolff Architects won the competition in 1998, and was required to challenge conventional views of museum design. The project was organized in three phases. The first stage included the contemporary museum completed in 2005. The second (but last one) included the library, the city archives and the art gallery completed in 2011. The Museum comprises a series of 12 unmarked, rusted boxes offering a set of different memories of struggle in South Africa.

The project was conceived as a space of memory, and was an opportunity to trigger the transformation of the area, to change people's attitudes, building the cultural infrastructure of the township. Even if the community was involved in the design process and the project won international awards, the Cultural Precints is closed "due to community protest" since October 2013. The story soon became a political issue. Local communities transferred their housing problems to the Red Location Precinct, using the new buildings to extort the local government for their housing rights. "We are living in shacks which get flooded each time it rains . . . and yet the municipality spends millions of rands building a museum" (quotation from a News24's article dated 31.07.2014).

The decision to build such a modern attraction point in a poor black community is symbolic like many other similar interventions in South Africa, and its impasse situations show the great challenges and contrasting interests involved. Some improvement for the neighbourhood have been made through the construction of streets, sewage and lighting, but the unsolved problem of housing and the complex context involved contained the positive result of such an investment, limiting the potential upgrading for the community.

3.4 *Urban scale*

The awareness and the identity of the new South Africa, of the "rainbow nation" (De Readt 2012) are crucial in defining urban transformations. "Man both influences his environment and total man (physical, economic, cultural, social, psychological man) is influenced by that environment" (Dewar & Uytenbogaardt 1977). The two are strictly linked together; therefore the South African Constitution based on human dignity, equality and freedom is the goal to be achieved primary through urban transformations.

More has to be done at the urban scale. Cape Town urbanization is still exemplary, identified by a strong division between the rich tourist city centre, some intermediate neighbourhoods, and a huge quantity of townships and informal settlements surrounding it. As Crankshak confirms, the desegregation of many formerly-white areas in Cape Town is happening, creating some mixed neighbourhoods. Their strategic position between the city centre and the suburbs, the easy access to public transportation (trains, university shuttle, local and MyCity buses) and the vital economy is helping the transformation process of these areas. However the Reconstruction and Development Programme (RDP) started in 1994 did not change the planning rules and recreated dormitories and ghettos.

As an example, Du Noon settlement was built between 1996 and 2001 to answer to city's housing



Figure 4. Du Noon: example of an RDP house with a backyard shack in the front and brick extensions in the back.

needs and it should represent the vision of a multicultural Republic. Nevertheless the government subsidised houses are similar to the township's ones; the small space formally planned is surrounded by a spontaneous development: brick extensions and a great number of backyard shacks. Walking around Du Noon is considered dangerous as walking around Langa or Kayelitsha; and the spatial traits are comparable. The urban environment does not reflect the efforts in the implementation of policies illustrated by SACN 2014 ("from housing to sustainable human settlements").

4 CONCLUSIONS

If the South Africa government keeps building housing without considering the existing context, densification, job opportunities – both formal and informal – access to facilities, functional mix and community involvement, it will be difficult to include the urban poor and minorities sufficiently into the city's progress.

The examples described in this paper are significant for a starting process of transformation that needs to be strengthened and supported within a bigger network. If they are not connected in a bigger scale their impact will be minimal at the urban scale. Professor David Dewar states the importance of public transportation at the urban scale to help this process and the need for "street design" versus "road design". The street is a public space where people meet, work, pass, share . . .; while the road just provides basic services (water, sewage, electricity). It is a matter of understanding if it possible to accommodate and help the development of quality urban spaces or simply to provide services. This paper aims to demonstrate that some projects may be taken as good examples for connecting spaces, making them inclusive and equal. Single projects will not solve the entrenched segregation of South African cities, but can produce a shift toward a more inclusive, connected and less fragmented city for both physical and social points of view.

I believe that deeper research is needed to reaffirm and reconceptualise the importance of public spaces in South Africa, defining how and whether public spaces can become the backbone infrastructure for the rainbow nation. Only a network of public spaces – inclusive by definition – can create a greater urban integration and make the contribution of already existing connection spaces truly effective.

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Smartphone application for long-term urban lifestyle and mobility monitoring

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ABSTRACT: The mobility of people can be monitored using a simple smartphone application that maps their movement. Sensors in smartphones are a low-cost source of information which can be interpreted and subsequently used as a dynamic indicator of urban life. By using this wide spread and accessible tool, we can collect data about the lifestyle in urban structures. However, it is necessary to develop an appropriate marketing strategy for a successful acquisition of the data. We can gain access to the data through crowdsourcing or by offering attractive and gripping benefits. The data could be used for intelligent and smart urban planning, as well as for commercial and marketing strategies.

The proposed application "UrbanFit" for Android-based smartphones introduces an innovative technology, which monitors the daily exercise habits and caloric consumption of individuals through smartphone sensors. The UrbanFit is designed as a long-term source of mobility data for the Czech Republic.

1 INTRODUCTION

Cities continuously produce large amounts of information. The validity of some of the information is only very short. However, by using this volatile information, we can monitor and document the processes which are going on in a city. By combining these fragile and unstable "maps" and city plans, as we know them today, we can achieve a more comprehensive imaging and modelling of a city.

Information about on-going events and processes in the city is easier to obtain, but the full potential of the data from mobile technologies for spatial planning and crisis management has not yet been fully recognized in the field of city management [1], [2].

Currently we have technologies, which can acquire data very easily, because these technologies are already implemented in cities. In 2010 in the Czech Republic, 90.6% of people older than 16 years used mobile phones and 30 per cent of these people owned a smartphone [3]. Moreover, the marketability of these devices is showing a long-term upward trend [4]. Most smartphone devices have built-in sensors that continuously monitor and share different types of information [5]. Some of the information can be interpreted as dynamic indicators, which are useful for cities. Getting to know a city's dynamics better can provide better conditions for sustainable living in the city.

2 STATE OF THE ART

2.1 *Mobility sensing*

Two questions are crucial for the monitoring of life in urban spaces: How many people use the space and what they do there [6]. Worldwide mobile-phone penetration is increasingly turning the mobile network into a gigantic ubiquitous sensing platform [7], [8]. The quantitative question can be answered also by using mobile phone distribution analysis. The movement of citizens can hardly be tracked by this method, because it is difficult to recognize the exact path and way of movement due to the long period of registering of the devices and low location precision [9].

The potential of smartphone mobility sensing by using the location and acceleration data is already used by various applications. The CO2go project (http://senseable.mit.edu/co2go/) uses this method of analysing acceleration data in combination with GPS location to detect the trajectory and transportation mode, suggesting more eco-friendly routes and transport alternatives [10].

"A Crowdsourcing Urban Simulation Platform Using Mobile Devices and Social Sensing" uses data gained by the "CITYing" application (http://www.citying.ethz.ch/#). The application reveals CO_2 emissions produced by the user and shows how well the city is designed to meet the commuting requirements of its inhabitants. This application improves the location detection method – in order to reduce energy consumption, it uses network-based location sensors instead of GPS location [11].

2.2 *Impact of urban life on human health*

From beginning of the 20th century the incidence of lifestyle diseases has been on the rise [6]. Their causes include office work, stress, air-conditioning, inappropriate diet and a lack of physical movement on a daily basis [12]. The need to commute to work by car

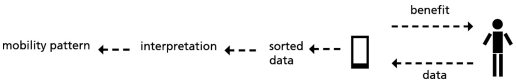


Figure 1. Scheme of data minig.

minimizes the natural opportunities for other forms of physical movement – walking, cycling etc. It has been proven that proximity of good-quality outdoor areas and possibilities for physical activities has a positive effect on your movement habits [13], [14]. Proven connection between health, social life and spatial structure [15] makes smartphone sensors – due to their ability to detect information about an individual's life and enviroment – powerful tool for both urban, sociological and medical research [16].

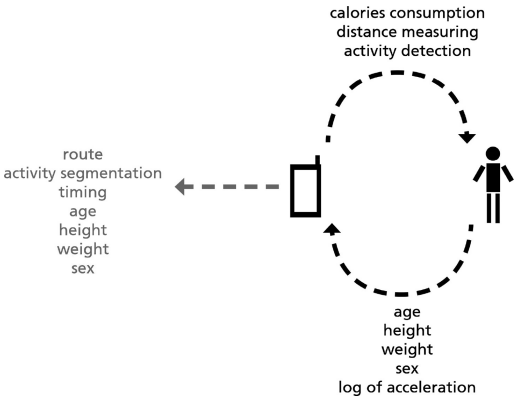


Figure 2. Applications benefits.

3 DATA MINING

3.1 *Aims of the application*

In relation to the collection of data from smartphones, the key element is the motivation of users to provide the data. It is essential to offer to them an attractive benefit which will turn the information they provide into a form they need.

UrbanFit focuses on gaining data from the broadest range of users possible, aiming at the collection of mobile data from urban units of different sizes and from different topographic profiles, while still maintaining a representative sample of the population. Unlike crowdsourcing-based data mining, which relies on a positive perception of the project goals, UrbanFit offers a benefit focusing on a broader range of users (Fig. 1).

The application will be collecting data on a long-term basis, enabling us to monitor changes in the-mobility patterns of the respective samples of the population.

3.2 *Data mining strategy – focus on health*

The type and duration of people's movements observed over a longer period of time reveal a lot about their physical condition and lifestyle [17]. The application monitors the type and routes of their movement including time data (i.e. the same kind of data which is monitored by sport testers). The data about the user's movement, combined with information about their age, sex, height and weight can be interpreted as their daily calorie consumption caused by their ordinary movement. The application is able to distinguish running, cycling and walking; however, it will not record other sports activities (see Fig. 2).

Apart from mobile data, the application will provide us with information about the user which will increase the informational value and data processing options. For example, it will be possible to compare the mobility habits of different age groups, men and women, or overweight individuals and those with an average BMI.

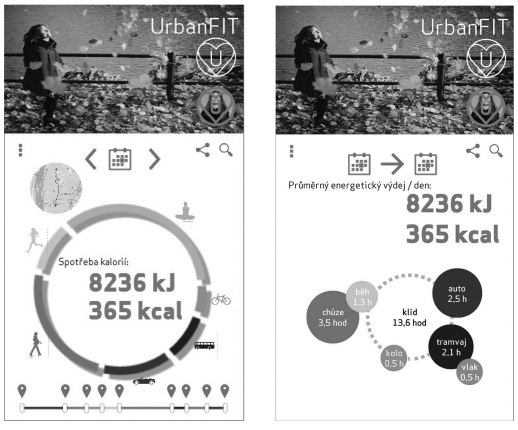


Figure 3. Interface of UrbanFit.

3.3 *Marketing strategy*

According to Google Play (https://play.google.com/store/apps/category/HEALTH_AND_FITNESS/collection/topselling_free), sport testers are popular and wide-spread software for smartphones in the field of health and fitness. This means that it will not only be necessary to provide marketing support for the application and to launch it in the Czech language, but that it will also be essential to offer another benefit which will be particular to the application.

Calorie consumption – as a piece of information gained through the application – becomes relevant for the analysis of lifestyle quality only when combined with the information about the individual's calorie intake. That is why the application will be compatible with the most downloaded smartphone application monitoring the calorie intake available on the Czech market – "Calorie Charts" (original Czech name "Kalorické tabulky", http://www. kalorictabulky.cz/). The "Calorie Charts" does not include a daily calorie consumption function; we therefore expect that UrbanFit could be a practical supplement to the "Calorie

Charts". The "Calorie Charts" enables the users to fill in their sports activities and it is therefore not necessary to add this function to UrbanFit.

Food and eating patterns significantly influence people's health and thus also the quality of their lives. At the same time, food and eating patterns are often specific for individual countries. "Calorie Charts" focuses on typical Czech dishes and that is why the combination of UrbanFit and "Calorie Charts" offers an advantage in comparison to commercial and international applications such as Strava (https://www.strava.com/), Endomondo (https://www.endomondo.com/), and others.

UrbanFit's user interface has been developed with an emphasis on a clear graphic structure and an easy design of the application (Fig. 3).

Appliaction UrbanFit will be advertised in professional environments as well as in the media dealing with nutrition, health, lifestyle, sports and medicine.

3.4 *Data mining method*

The method of collecting data from smartphone sensors is based on a mechanism which was described in "Lightweight Crowdsourcing: Monitoring Urban Travel Behavior Using Mobile-Based Sensing" [11].

The transportation mode detection will be based on data readings from smartphone acceleration sensors. Acceleration sensors show typical values when moving in different means of transport; these values are the basis for the distinction of the movement type (car, train/tram, bus, bicycle). Acceleration values enable primarily a very precise detection of walking and running. Walking is characterized by a very typical variable acceleration curve and it is always the linking element between other transportation modes [11].

The application will monitor the movement trajectories through the network-based location sensor. The precision of this method may be poor outside of urban areas with lower density of Wi-Fi networks. In longer time intervals, the movement will be logged through GPS as well, but only when this function is switched on and allowed.

4 RESULTS

The application aims at aggregating and storing mobile data. However, the main point is to provide the users the information about their daily physical activity.

4.1 *Classification of the application's outputs*

The database will store trajectories, divided into segments by transportation modes, as well as the starting and finishing time of the respective movements. The individual categories are: car, train/tram, bus, cycling, walking, running and the resting phase. The information will be stored with a specific ID generated and assigned to the individual application users. Information about the user's age, weight, sex and height, as

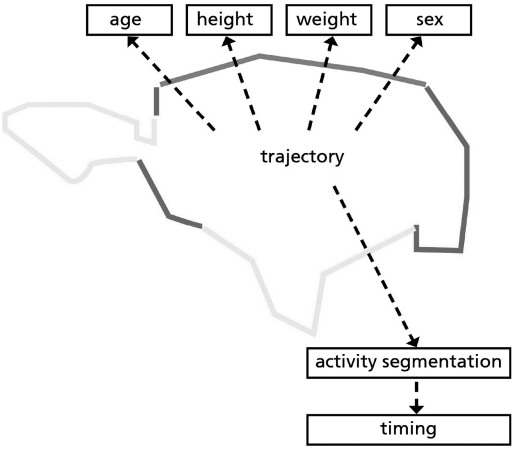


Figure 4. Scheme of sorting data.

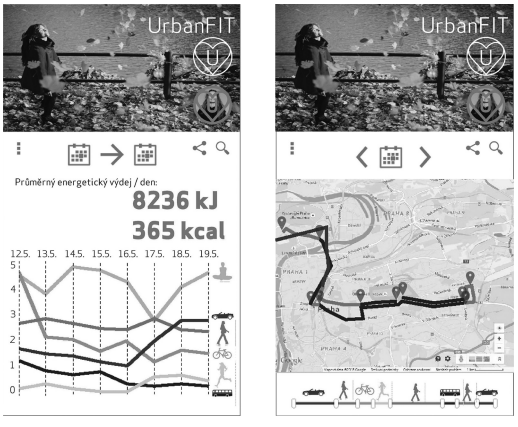


Figure 5. Users diary.

entered by the user into the system, will be attached to each ID (Fig. 4). Further information entered by the user will not be stored in the database.

UrbanFit will provide to the user a schematic visualisation of the trajectories travelled throughout the day, with the individual transportation modes graphically distinguished. The visual presentation of the daily statistics, including the numeric values measured and the actual energy consumption, will be available online. In the history section the user will also be able to look back at individual days from the past (Fig. 5).

By analysing the location of the ID at night, it is possible to determine which urban unit is most likely the user's place of permanent residence [1].

4.2 *Possibilities of data utilization*

Unlike data from mobile phone logs, data from mobile applications provides samples with only a limited quantitative informational value. This handicap is partly compensated by the informational density and precision of the data. Individual IDs are linked with the information about the users' age, weight and sex.

This information cannot be legally obtained from the big data of mobile network operators.

The possibilities to use and interpret aggregated data for the purposes of further research include:

- impact of urban structures and their infrastructure on the population's health;
- comparison of selected anti-stress factors (ASF = time spent walking/biking) in different types of urban structures;
- comparison of ASF in different topographies;
- comparison of ASF in connection with the time required for commuting and with the quality of public transport;
- comparison of mobility models according to the following indicators: age, weight, height, sex;
- monitoring of long-term mobility trends in selected user groups.

5 DISCUSSION

The big data of mobile network operators is not a publicly available source – the data is provided by the companies on a commercial basis which makes their availability for research difficult (interview with J. Novobilský, December 2015).

The application is currently at the stage of software development. A possible complication in the data collection can occur if the sample of inhabitants is not representative. Based on the application's focus, we expect that it will attract primarily people interested in healthy lifestyle. We assume that the oldest generation, i.e. people who use smartphones only rarely, will not be represented in the sample. An open point is also the possible connection with the commercial sector (cooperation with the "Calorie Charts" application).

The data will be accessible also for other research teams and thus remain available for further interpretation.

6 CONCLUSIONS

The data about people's everyday physical strain and mobility patterns obtained through the mobile application reveals how we behave in various urban areas. The data proves how our behaviour influences the environments in which we live. An evaluation of this data may give impetus to municipalities and, in consequence, help introduce measures which will foster diverse movement possibilities and support smart transport solutions.

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Neighborhood design and children's active travel to/from school

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ABSTRACT: Children's active travel (AT—i.e., walking, bicycling) has declined substantially especially for independent active travel (IAT). An increasing number of studies have examined walking behavior of adults to test the new urbanist hypothesis that design features support pedestrian activity. More neighborhood adult walking has been reported in new urbanist communities than in conventional suburban neighborhoods. However, study of children's AT in new urbanist settings is under represented. This study investigates the association between neighborhood design and children's active school travel (AST) in conventional and new urbanist neighborhoods. A group-administered survey was conducted with 4–5th grade children (N = 367). Built environment (BE) variables including distance to school, children's population density, mixed land use, street density, intersection and sidewalk density, and physical activity (PA) locations around home were measured within a quarter mile buffer of each participant's home in ArcGIS. Analyses of a further 254 students living within 2 miles from school with opportunities for walking were also conducted. T-test confirmed all BE variables were significantly different between conventional and new urbanist neighborhoods. New urbanist children engaged in twice the number of days of walking and 5–7 times more days of biking compared to children in conventional neighborhoods. Results suggest the need for further tests of new urbanist design principles in relation to children's AT to support development of neighborhood design policies and interventions that may provide health promotion benefits to children.

1 INTRODUCTION

Children's active travel (AT) (i.e., walking, bicycling) has declined substantially. Especially in the case of active school travel (AST), the decrease is significant for US children (McDonald, 2007), especially for independent active travel (IAT). Degrees of freedom for children to move around independently have diminished during the last decades (Gaster, 1992). In a similar vein, walking or bicycling to or from school has consistently declined (Sirard and Slater, 2008). Auto-centric environments have become one of the most important factors influencing children's daily, physical activity (PA). In 1969, approximately half of all U.S. school children walked or bicycled to or from school. Among children living within 1 mile of school, 87% of those walked or bicycled (DOT, 1972). In 2000, fewer than 15% of children and adolescents used active travel to or from school (EPA, 2003).

Recent policies and programs have targeted the built environment as a primary factor in discouraging children's AT. An increasing amount of literature examines how the built environment (BE) supports or restricts children's AT. In the domain of community design, studies have begun to examine walking behavior in association with new urbanist design principles that hypothetically provide supportive design features related to pedestrian activity (Rodriguez et al., 2006, Brown et al., 2008). These principles have been termed the 5D framework, including *Distance* of home to school, child *Density*, land use *Diversity*, pedestrian friendly *Design* and *Destination* of PA facilities such as parks. When homes are located on small lots near amenities, the resulting compact development and proximity make walking trips more feasible. Mixed use increases proximity (shorter trip distances), and thereby supports active travel. Streets with well-connected grid designs provide more direct and pleasant AT. Recent investigations comparing new urbanist neighborhood with conventional suburbs have focused on adult health outcomes, including BMI and walking behaviors (Rodriguez et al., 2006, Brown et al., 2008). To the authors' knowledge, only one study (Stevens and Brown, 2011) examined children's AT, in this case using accelerometer-measured PA to compare outcomes from a new urbanist community, a mixed community, and a less walkable community. The current study compares the BE and AST patterns by neighborhood type (conventional vs. new urbanist). Empirical evidence on neighborhood design is essential to inform design and policy interventions.

2 METHODS

2.1 *Research design and site selection*

North Carolina, Chapel Hill-Carrboro City Schools (CHCCS) elementary schools, local government, a national program, Go! Chapel Hill, and Active Living

Table 1. Participants by neighborhood type.

Schools	Neighborhoods near Schools	# of Children Participating Survey
School 1	Conventional	152
School 2	Conventional	10
School 3	New urbanist	10
School 4	New urbanist	195
Total		367

by Design collaborated to encourage the safe route to school (SRTS) program. Many Chapel Hill residents are health-conscious and proactive regarding health and physical activity, thus encouraging partnership for SRTS. Reflecting this background, Chapel Hill sites participating in the SRTS program had the advantage of community awareness of students engaged in walking programs and related activities.

Participants were recruited through four elementary schools participating in the SRTS program (Table 1). The neighborhoods around the four selected schools had similar 6-11 year old population and socio economic status (2010, U.S. Census block data). Schools 1 & 2 were located in conventional suburban neighborhoods, and schools 3 & 4 were located in new urbanist neighborhoods. The attendance school zones of schools 3 and 4 also include residences outside of new urbanist sites; thus, those participants were classified as conventional suburban residents. Each participant's neighborhood was defined as a quarter mile crow-fly buffer around each participant's home.

2.2 *Participants*

4th to 5th grades (9-11 year-old) children are at the stage of development of increasing independence and are relatively advanced in their spatial-cognitive skills. According to (Piaget et al., 1963) AT is crucial for the development of cognitive representations of the environment. Exploratory activities are especially important for children to learn to walk around the neighborhood with a coordinated system of reference. The period of approximately 10–12 years of age often marks a steep decline in physical activity and coincides with the transition from primary to secondary school. This is also a period when parental license for children to engage in physical activity without adult supervision increases (Jago et al., 2009).

2.3 *Children's survey*

4th and 5th grade elementary school children (N = 367) in four schools participated in a group-administered survey at the schools. During the information session, questionnaires were administered in group settings, and each respondent was asked to complete it while in the room. If the respondents were unclear about the meaning of a question they asked the researcher or teachers for clarification.

AST frequency and modes were developed from the "Active Where" parent children survey (Joe et al., 2008). Two sections include school travel mode and independent active school travel questions, as follows. First: "In a normal school week, how many days do you go to/from School in the following ways?" Options are walk, bike, go by car, and go by bus and participants are asked to circle one row for TO school and one FROM school. Second: "If you walk or bike to / from school, how many days do you walk or bike without an adult?"

2.4 *Built environment variables*

To account for the how neighborhoods' characteristics around homes are associated with children's AT behaviors, BE variables around each participant's home were measured within the quarter mile crow-fly buffer. In this study, BE variables were framed within a modified 5D model (Cervero and Kockelman, 1997). Except for the distance to school, all variables were measured within the home neighborhood BE, derived using ArcGIS 10.1 (Environmental Systems Research Institute Inc., Redlands CA).

The 5Ds were: *Distance* from each participant's home to school, estimated as the shortest route possible along a road network measured by Network Analyst 10.1 in ArcGIS. *Density* of child population measured as the number of 6–11 years old children (2010 U.S. census block data). When a buffer around a participant's home was not fully contained within a census block polygon, the data were assigned in direct proportion to the area of the polygon contained within the buffer. *Diversity* of mixed land uses within the neighborhood and was coded using a binary variable; equaling 1 if the neighborhood had at least one parcel (entirely or partially) with a retail, institutional or office land use code designation, and 0 otherwise. *Design*, included connectivity, which comprised length of road, number of intersections, and sidewalk density within the buffer. *Destination* measured PA facilities such as parks, greenway, trails, stream, pond, sports field, YMCA, school, shop, indoor sports facilities (martial arts, dance), cemetery, and bike lane within the quarter mile buffer.

2.5 *Analysis*

Descriptive statistics were calculated for days of walking/biking for the entire population. T-tests for BE was performed to examine the possible differences between neighborhood types. The sub-population of participants living in a 2 mile-buffer with the opportunity to walk was selected. T-tests for AST were performed to examine the possible differences between neighborhood types.

3 RESULTS

3.1 *Built environment and individual characteristics, and active school travel*

Table 2 presents descriptive statistics of BE, individual and household, and PA variables. One third of

Table 2. Descriptive statistics of built environment and individual characteristics.

	N	Percent	Mean	SD
BE characteristics (N = 367)				
Neighborhood				
0 = Conventional	254	69.2		
1 = New Urbanist	113	30.8		
DistToSchool	367		1.71	1.76
PopulationChildren	367		4.34	2.87
Diversity			0.27	0.44
0 = No mixed use	269	73.3		
1 = mixed use	98	26.7		
Streetlength	367		16.34	16.71
Intersection	367		33.91	25.93
Sidewalk proportion	367		1.03	1.06
PALocation	367		1.26	0.81
Individual Characteristics (n = 367)				
Age			10.16	0.71
9 years old	67	18.3		
10 years old	174	47.4		
11 years old	126	34.3		
Gender				
Male	186	50.7		
Female	181	49.3		
Ethnicity_white				
Non white	165	45.0		
White	202	55.0		
Motorvehicle				
0	8	2.2		
1	74	20.2		
2	177	48.2		
3 and above	108	29.4		
BMI	367		19.11	3.79

participants (30.8%) lived in new urbanist neighborhoods. Mean distance to school from home was 1.71 miles. Mean population of children was 4.34 per quarter mile buffer. Only 27% of participants lived in mixed use neighborhoods.

Mean street length in quarter mile buffer was 16.3 mile. Mean number of intersections in quarter mile buffer was 34. Sidewalk density was defined to include not only sidewalk but also paved space from the sidewalk to the front porch; the ratio was 1.03, larger than one.

Almost 50% of participants were 10 years old (M = 10.16, SD = 0.71). Proportions of male and female students were similar. Proportions of white and non-white students were similar. Almost 50% of participants reported having two family motor vehicles (M = 2.05, SD = 0.76). The mean of BMI was 19.1 (SD = 3.79). Two thirds of the students (67.8%) reported having parental permission to go out on their own.

Table 3. T-test of BE variables by neighborhood type.

	Conventional M	New Urbanist M	t	p
Distance To School	2.16	0.72	**10.1**	.000
Population Children	4.52	3.92	**2.4**	.017
Diversity	0.15	0.52	**−7.0**	.000
Street length	7.02	37.28	**−22.6**	.000
Intersection	20.72	63.54	**−17.6**	.000
Sidewalk Density	0.43	2.01	**−18.6**	.000
PA Location	0.94	1.97	**−13.7**	.000

3.2 *Difference of built environment variables by neighborhood type*

T-test indicated all BE variables (distance to school, children's population, mixed land use, street length, # of intersection, sidewalk length and PA locations) were confirmed to be significantly different between conventional suburban and new urbanist neighborhoods (Table 3). According to the design principles of new urbanist, new urbanist neighborhoods in the current study provided more walkable environments; distance to school was significantly shorter ($t = 10.1$, $df = 365$, $p = .000$); number of mixed use was higher ($t = -7.0$, $df = 166$, $p = .000$); street was longer ($t = -22.6$, $df = 134$, $p = .000$); number of intersections was higher ($t = -17.6$, $df = 135$, $p = .000$); sidewalk was longer ($t = -19.2$, $df = 114$, $p = .000$); the proportion of sidewalk to street was higher ($t = -18.6$, $df = 139$, $p = .000$); and there were more PA locations ($t = -13.7$, $df = 364$, $p = .017$). Against the new urbanist design principles, the children's population density was higher in conventional neighborhoods ($t = 2.4$, $df = 364$, $p = .017$). This may be attributed to the housing building types. Almost all new urbanist participants lived in single-family units (only 2 participants lived in multi-family units comprised of apartment or condominiums). Many conventional neighborhood participants lived in apartments, which results in higher population density.

3.3 *Differences in active school travel by neighborhood type*

Distribution of distance to school showed that after 1 mile from home, the number of students gradually decreased. Further analysis included only the students living within 2 miles from school who had opportunities for walking (n = 254).

For these 254 students, to understand association with the built environment, t-test of AST (days of walking/biking) was compared with conventional and new urbanist neighborhood types (Table 4). Since predicting variables were ratios, t-test was used. In days of walking and biking to/from school, new urbanist

Table 4. T-test of days of AST by destination, mode and neighborhood type.

		Conventional M	New Urbanist M	t	p
Days To School	Walk	1.10	1.78	−2.7	**.008**
	Bike	.25	1.49	−2.7	**.008**
Days From School	Walk	1.23	2.36	−4.3	**.000**
	Bike	.26	1.45	−5.7	**.000**
Days To School without an Adult	Walk	.71	1.52	−3.4	**.001**
	Bike	.31	1.33	−4.8	**.000**
Days From School without an Adult	Walk	.74	2.28	−6.0	**.000**
	Bike	.30	1.35	−5.0	**.000**

Note: Conventional: N = 144, New Urbanist: N = 110.

participants had a higher number of walking and biking days. New urbanist participants had approximately two times more days of walking, and approximately 5-7 times more days of biking.

In both conventional and new urbanist neighborhoods, the number of walking/biking days to school was lower than days from school. Generally, children and family had busier schedules in the morning, so fewer children walked in the morning than after school. It is noticeable that the difference between to and from school is larger in new urbanist neighborhood than conventional neighborhood types. This may indicate that more free time and increased walkable space affords conditions where children are more likely to be engaged in walking/ biking to/from school.

4 DISCUSSION

4.1 *Built environment characteristics*

Significant differences were discovered in neighborhood form and active school travel (AST) between conventional and new urbanist neighborhood types. Overall, the new urbanist neighborhood appears to better support a pedestrian friendly school travel environment with shorter distance, increased street connectivity, and positive sidewalk networks. Two previous studies reported higher PA of adults in new urbanist neighborhoods (Rodriguez et al., 2006, Brown et al., 2008). One study indicated that walkability of community related to more MVPA minutes of children during the half hour before and after school. (Stevens and Brown, 2011).

From school travel provided valuable opportunities for children's PA considering their busy schedule. The difference in the number of children between *to school* and *from school* was larger in the new urbanist neighborhood. This may indicate that with more free time and walkable space, children are more likely to be engaged in AST. One study of temporal active school travel patterns (Mitra et al., 2010) found that more BE variables were associated with walking in the morning than the afternoon. Due to parental/caregivers' schedules, working parents may not have time to pick up their children. This may lead to the mode shift from passive to active travel (Wong et al., 2011). For child pedestrians, routes to/from school using minor roads with less traffic volume and lower speed limits tend to be chosen (Duncan and Mummery, 2007).

4.2 *Comparison between walking and biking*

Neighborhood type was consistently associated with both walking and biking. For utilitarian travel, walking and biking are considered to require nearly identical BEs, indicating that short distances are better (Frank et al., 2003). However, beyond distance, other features influence pedestrian travel different to bicyclist travel. Pedestrians require good sidewalks and crosswalks, while bicyclists need either specialized bike paths or dedicated on-street bike lanes. Pedestrians desire interesting adjacent "eyeshot" spaces along the route (store fronts, building facades); bicyclists may not require them. For recreational bicycling and walking, these differences are more critical. While recreational bicycling is suited to low-traffic conditions with few stops, recreational walking is suited to either a social environment, where individuals can stroll, or an environment allowing fast walking (e.g., parks or neighborhoods with sidewalks). Thus, separate consideration of planning and design policy for walking and biking to/from school is necessary.

5 CONCLUSION

Neighborhoods exemplifying new urbanist design principles may support children's active school travel more than conventional neighborhood designs. Further examination of the association of these factors with *objectively* measured children's AST is required to improve understanding of correlates, mediators, and moderators to more confidently support policy development and design interventions to increase children's AST.

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The experimental project of spread "social housing" of Real Estate Fund Ca' Granda. Construction of a synthetic index for the implementation of the mobility plan

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ABSTRACT: The "Real Estate Fund Ca' Granda" was born in Milan in 2014 with the objective of financing the construction of the new headquarters of the Ospedale Maggiore Policlinico of Milan, through the ethic enhancement of the real estate assets owned by the Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico. The financial instrument for the development is a social housing contribution fund. The Real Estate Foundation IRCCS Ca' Granda Ospedale Maggiore Policlinico in Milan consists of 1,390 residential units in 65 buildings, including 44 entirely owned, for a total of over 110,000 square meters, of which 53% were built between 1870 and 1900; 29% between 1901 and 1940; 18% after 1940. The construction of a new hospital pavilion through the establishment of a larger project of spread "social housing" in the city of Milan, provides an important connotation of social and ethical purpose of the project as a whole. Implementing the plan of valorization of the heritage requires the management of a mobility plan of the tenants, who currently occupy the property for various reasons, that could lead to redeployment, so as to be able to offer a housing service for those who cannot find an adequate response in the market, while enhancing a significant real estate heritage through the sale of some existing buildings. Specifically, the paper describes the case relating to the creation and the management of the Real Estate Fund Ca' Granda Hospital, with particular reference to the definition of a project for the operation of the mobility plan, the implementation of which is a necessary condition for the development of the real estate owned by the Fund. The study presents the construction of a synthetic index of characterization of the tenants, with the aim of providing, through a preliminary evaluation of the situation of each household, a useful tool to identify cases of social fragility, for the implementation of an experimental project of spread social housing, ever made in Italy.

1 INTRODUCTION

The Real Estate Fund Ca' Granda Hospital consists of 44 detached properties primarily for residential use for a total of 905 apartments (as well as offices, shops and outbuildings, for a total of 1,243 residential units) and 21 portions of buildings for a total of 81 apartments (as well as offices, shops and outbuildings for a total of 142 housing units). The heritage overall is largely decrepit, without elevators and appropriate facilities. About 53% of the total area, in fact, includes a built heritage that dates back to the last decades of the nineteenth century, while only 18% of the portfolio are buildings built after the '40s.

From the point of view of the rental, the residential contracts account for 63% of total fees, with a profile of maturities ranging from 2013 to over 2016, with a particular concentration of contracts expiring in 2015 and 2016 (respectively 45% and 12% of square meters leased).

It is therefore evident that the maturity profile, the amount of the already expired contracts for employment indennity and the presence of average rents lower than market rents, represent an opportunity for enhancement, but at the same time, if not properly managed, a potential problematic of social impact, political and media.

It is also true that the Real Estate Fund Ca' Granda is an ethical fund and represents the most significant Italian experience of valorization of public heritage, and for this it was awarded the Best Practice Public Heritage Award 2015. It differs from classic social housing projects primarily for two reasons. First of all from the technical point of view, because the Fund, large

sized, arises from the transfer of a real estate existing portfolio to be retrained.

While most of the social housing funds deal with interventions of real estate development called "Green Field", the Fund Ca' Granda involves the construction of social housing with no soil consumption, by regenerating existing buildings. The other peculiarity has got a social nature: the Fondazione IRCCS Ca' Granda has brought its owned buildings in the real estate fund to finance the construction of a new hospital pavilion with the revenues coming from the sale of part of the property in portfolio. Hence, therefore, the dual social purpose of the project: by strengthening the supply of social housing in the territory of the city of Milan, the construction of an asset to the service of all citizens is financed.

A key role in the realization of this unique project in Italy is covered by the management of the tenants whose main objective is to maintain the current tenants within the portfolio in social housing arrangements, subject to verification of possession of the access requirements, as well as the detailed analysis and evaluation of situations with particular discomfort. The management process includes the development of a mobility plan able both to carry out the plan to dismiss part of the buildings portfolio, and to implement the social housing project.

The paper describes the model of the mobility plan management, within which assumes the construction of a synthetic index of tenants characterization, with the aim of providing, through a preliminary assessment of the situation of each household, a useful tool for the identification of cases of social fragility for the realization of an experimental social housing project spread on built heritage.

2 THE MOBILITY PLAN

2.1 *The strategy for social management*

In the recent experiences of social housing in Italy (ABI, 2015) the financial structuring strategy of the entire real estate fund must be accompanied by an innovative management strategy that also considers aspects of social management already been tested. The design of correct social mix, creating sustainable communities, the selection criteria of tenants also based on motivational aspects, are all innovative responses on the basis of which it is possible to consolidate and maintain the long-term real estate value (Cassa Depositi & Prestiti, 2014).

The partnership with the third sector and housing cooperatives can ensure the most effective and innovative management of the community, with the identification of solutions that allow its management, mitigating shock and conflict. The great attention to the social impact generated by the sales process is also derived from the risk of generating a slowdown or a prejudice for the expected returns.

The management of rental properties, as either continuous relationship between the properties and tenants, is one of the sensitive issues of the administration of the constituting Fund. Therefore, the answer to two basic conditions has to be given: the good management of real estate assets spread with non-homogeneous characteristics; managing relationships with tenants through a coherent approach, with the aim to offer a housing service for those who cannot find an adequate response in the market.

The governance model foresees the cooperation of the SGR with Social Housing Foundation ("FHS"), in its role as technical and social advisor of the Fund, and it has decided to operate according to a model of social management of the property portfolio, based on the collaboration with the social manager and the involvement of tenants in the several stages of the process.

The implementation of the valorization plan of the Foundation's assets requires the proactive management of a mobility plan of tenants that allows the repositioning of the people and facilitates thus the enhancement of total volumes.

In implementing the social project, great care must be taken to families who, unable or unwilling to purchase housing where they live, they intend to stay in lease; it is expected that these households have priority in renting empty apartments of the portion of the inheritance for the long-term lease, and that in the process of mobility must be accompanied in all aspects of the transfer.

Through the detailed study of all the different personal and living situations, it proceeds with the preparation of a comprehensive plan that addresses the different needs and solutions, with the aim of optimizing the relationship between characteristics of housing and real needs of families, considering in such a scenario the presence of particular classes of tenants, such as the elderly and historians tenants who risk losing their personal network of relationships.

2.2 *The characterization plan for the existing tenants*

Understanding the composition of tenants is essential to the success of the operation and to enhance the buildings portfolio. It is therefore essential to set a characterization plan that takes into account the different phases of the operation and that it is structured to further investigations. During the "structuring of the plan", the analysis refers to the documented bases made available by the Foundation, only after the definition of the communication plan with tenants; during the "plan management" phase, it may be required to provide additional information, including questionnaires and interviews, only addressed to tenants set to remain renters or to those households interested in purchasing an apartment with different characteristics than that currently inhabited. The purpose of the "characterization plan" is to make an overall assessment of the situation of each family unit (dimensions, assessment of the new requirements, presence of young people or particular weaknesses) in order to identify

the housing needs and the requirements for particular services, which may also become a defining element of the social management project (Ferri & Pacucci, 2015).

Among the main activities for the analysis of the types of tenants, preparatory to the definition of the Mobility Plan, it is possible to identify a phase of analysis of the database provided by the Policlinico.

> with the main elements of the contract (nominee, contract type, application of special clauses, starting date, deadline, pending litigation, etc.) and a phase of analysis of procedures relating to the tenants.

From this analysis it emerged the following data macro areas that complete the picture obtained from the database:

- locative seniority (in view also of the contract transfers in favor of spouses or children living with, and lodging change, etc.);
- composition of the household residing in the accommodation;
- age of all of the family members;
- total household income (available for the year 2008/2009 only stated if that were asked for special treatment using the social clause or clause save-guard);
- interviews with the charge of the rental contract management to identify situations particularly fragile or critical (ie health issues, dependent persons that are followed by family members or neighbors, lack of family support networks, people followed by social services or people with disabilities);
- evaluation of the types of contracts and the requirements of access to housing defined by ac-territorial agreements;
- evaluation of the preliminary results of the technical due diligence.

The tenants' heterogeneity of this portfolio in relation to the income level, the sharing of the local roots in the reference district and the potential to find alternative solutions in the free market, are mainly factors due to the different ways of finding tenants that the Policlinico Foundation has adopted over the years; in the presence of both tenants historians who can say they live in the Policlinico homes since they were born and of tenants who have arrived in recent years; the different forms of protection of the most vulnerable families taken by the Foundation through specific clauses as defined by the territorial agreements.

3 THE DEFINITION OF A SYNTHETIC INDEX FOR THE MOBILITY PLAN

In the complexity of the above described scenario, it has been necessary to put forward a hypothesis that had the main objective to govern the complexity of the tenants in the management of the assets transformation process, without neglecting any aspect of social vulnerability.

For this purpose it has identified a numerical index, called synthetic index of inertia to mobility, able to allow a classification of the families of the real estate portfolio of Real Estate Ca' Granda Fund's, given in terms of social vulnerability and resistance to the displacement.

This is to measure a multidimensional phenomenon, not measurable in a linear way, whose valuation is still influenced by arbitrary choices. The methodology used for the synthetic index includes the following steps:

- definition of the phenomenon under study;
- selection of basic indicators;
- normalization of the primary indicators;
- weighting and aggregation of standardized indicators.

This analysis starts from the work of characterization and understanding of the current resident tenants' condition (hereinafter referred to as "tenants") achieved through the examination of the available documentation and the interviews with those responsible for the management of the real estate portfolio of the Fondazione IRCCS Ca' Granda.

The preliminary analysis, conducted during the phase of the structuring the initiative has allowed to collect a large amount of information about the general condition of households, as shown in the table (Table 1).

The great heterogeneity of this information must necessarily be related to synthesis, with the primary operational objective of identifying those specific situations that have to be taken into account in the preparation and implementation of the mobility plan.

3.1 *Selection of basic indicators*

During the selection of basic indicators it was considered appropriate to proceed with the identification of three different thematic areas corresponding to the main dimensions of the phenomenon under study:

- mental and physical health;
- socio-demographic vulnerability;
- displacement resistance.

3.1.1 *Mental and physical health*

The first thematic area has the aim of identifying within each family unit the number of individuals affected by both psychological and physical character discomfort. In particular, four basic indicators have been selected:

- psychic distress, is calculated by adding the number of family members with mental health problems;
- physical discomfort, is calculated by adding the number of family members with mobility difficulties, minor disability, walking problems, low autonomy;

Table 1. Information about the general condition of households.

Categories of information	Specific information
Personal data of the members of the households	– names, – age, – etc.
Household characteristics	– single-parent families, – number of minors in the household, – extended families, – families with familial network in another accommodation.
Contracts	– types, – clauses, – deadlines, – date of the first stipulation.
Income	– household income, – per capita income.
Factors economic difficulty	– loss of job or unemployment, – death of the only component with income, – subsistence through aid from third parties, – irregular employment.
Factors of psycho-physical discomfort and vulnerability of some tenants	– difficulty in movement, – psychic distress, – disease, – low autonomy, – people >75 and >65 years old.
Living story	– households from lodging change, – households from eviction, – households with other real estate properties, – households that have carried out restructuring, – households living in the accommodation for over 25 years.

– discomfort from serious illness, is calculated by adding the number of family members with serious illness, severe disability, diseases that cause bed rest;
– discomfort from other difficulties, is calculated by adding the number of family members with little other physical and psychological problems.

3.1.2 *Socio-demographic vulnerability*

The second area aims to identify families with "fragile" members, young and old, with special reference to situations of families made up with single parent and elderly people living alone. In the specific, four elementary indicators have been selected each of which is associated with an indicator:

– households with elderly, whose indicator is calculated by adding up the years of family members over the age of 65 years;
– elderly people living alone, each family composed of one component over the age of 65 years (binary variable);
– households with children, whose indicator is calculated by adding the number of household members under 15 years of age;
– single-parent families, each family composed of a single parent with dependent children (binary variable).

3.1.3 *Resistance to displacement*

The third and final topic area, however, is intended to identify potential families who, while not presenting any particular health conditions psychophysical or socio-demographic vulnerability, could make more difficult to move to another accommodation. To express this theme, four elementary indicators have been identified:

– attachment to the house, where the indicator is expressed through the number of years from which reside within the apartment;
– renovations, each household who performed renovations inside the apartment, these works of customization may be a deterrent to the movement, both for economic and affective reasons (binary variables);
– coming from lodging change, every household from a change of internal accommodation to the heritage of the Polyclinic and for this reason hardly willing to exchange for a new accommodation within the same assets (binary variable);
– coming from an eviction, each household that entered into the Polyclinic as a result of a procedure for eviction (binary variable portfolio).

3.2 *Normalization of the indicators*

The work of normalization of the indicators has the aim to make comparable the variables chosen to represent a specific phenomenon, bringing them to the same scale of measurement.

The normalization also allows to analyze the presence of any outliers, and to correct strongly skewed distributions. There are different procedures of data normalization and it is important to choose the most correct one with respect to the theoretical framework and data properties. One of the most used methods for this purpose consists in the transformation, within the same category, of the value of the individual observations in a new value compared to the maximum value expected by the series.

The positive aspect of this method is represented by the possibility of being able to bring back the values for each series to the range of variation (0; 1), thereby obtaining an amplitude of the same scale, and then the immediate comparability between different indicators considered. The inherent problem with this type of standardization process, however, is related to the strong influence of the presence of outliers in the sample, in fact these observations are not very useful to be compared because they are difficult to imitate.

To overcome the possible presence of outliers it was decided to compare the values of the individual observations to a benchmark, arbitrarily identified with the help of experts.

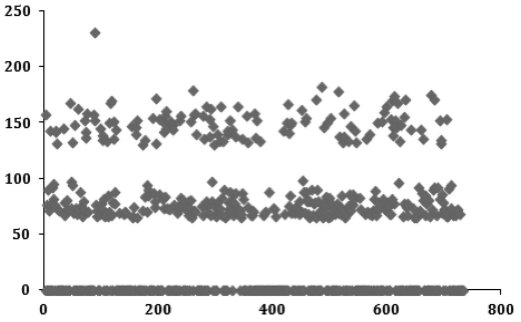


Figure 1. Indicator distribution: households with elderly.

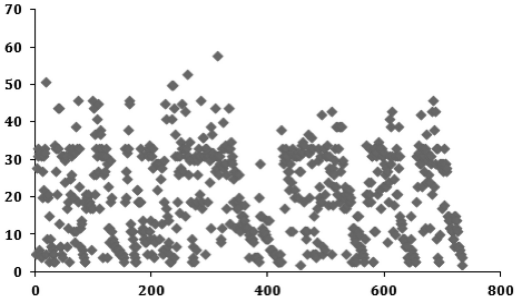


Figure 2. Indicator distribution: attachment to the house.

Given the matrix $X = \{x_{ij}\}$ $n = 733$ lines (families) and $m = 12$ columns (basic indicators), switch to the matrix $Y = \{y_{ij}\}$ where:

$$\mathbf{y_{ij}} = \frac{\mathbf{x_{ij}}}{z_j}$$

where z_j is the benchmark for each primary indicator. Finally, with the aim of maintaining the values within the same scale (0; 1), it has been decided to assign the value 1 to the indicators that are placed above the target value. It is therefore important to set a suitable benchmark so as not to incur a problem of information loss, since observations that are much above the target value or slightly higher will assume the same value.

For most of the basic indicators it has been decided to maintain as benchmark the maximum value reached by the reference sample, and only two indicators are excluded from this type.

3.2.1 *Benchmark indicator households with elderly*
Looking at the distribution of the basic indicator values it was decided to apply a value of 200 bench-mark.

3.2.2 *Benchmark indicator attachment to the house*
Looking at the distribution of the values of the basic indicator has been decided to apply a benchmark value of 50.

3.3 *Weighting and aggregation of indicators*

To get to the synthetic index, once normalized, basic indicators must be aggregated: the first step is the identification of a weighting system to assign a weight to each component, so as to reflect the characteristics that marks. The choice between different approaches to the definition of weights is not always easy to deal with and very often it is the result of subjective assessments, which become particularly complicated in case of the analysis of complex phenomena, where many variables interact. It is important to note that there is an established methodology for weighing the basic indicators.

Synthetic index of Inertia to mobility					
Synthetic index of Mental and physical health		Synthetic index of Socio-demographic vulnerability		Synthetic index of Resistance to displacement	
Psychic distress	0,20	Households with elderly	0,20	Attachment to the house	0,40
Physical discomfort	0,30	Elderly people living alone	0,30	Renovations	0,30
Discomfort from serious illness	0,40	Households with children	0,20	Coming from lodging change	0,15
Discomfort from other difficulties	0,10	Single-parent families	0,30	Coming from an eviction	0,15

Figure 3. Set of weights for synthetic indices.

The reasons on which is based the choice of a weighting system rather than another one are different. The underlying logic with which the weights are selected must be in accordance with the reference template on which the index is built, so as to obtain an overall structure as much as possible organic, transparent and conceptually consistent. The intent of the weights is to provide guidance relative importance of each elementary aggregate indicator in the indicator: in this way the weights represent the meaning and the basic indicator contribution to aggregation, and they are value judgments.

It has been therefore decided to use, as indicators weighting system, the method of weights allocation known as Budget Allocation Process (OECD, 2008). This method requires the intervention of experts in a given subject, who are asked to assign a "budget" of a hundred points for the set of basic indicators based on their experience and their own judgment.

You can then identify three distinct phases of the Budget Allocation Process:

– selection of experts for the evaluation;
– budget allocation to basic indicators;
– calculation of the weight of the basic indicators.

Specifically, it has been decided to involve, as experts for the evaluation of the phenomenon, the Social Housing Foundation team and the Fund Management team of the Real Estate Fund Ca' Granda.

The partial summary index for the h-th subject area will be calculated as a weighted average of the individual basic indicators:

$$\overline{\mathbf{y}}_{ih} = \frac{\sum_{j=1}^{4} \mathbf{y_{ij}} \cdot \mathbf{w_j}}{\sum_{j=1}^{4} \mathbf{w_j}}$$

Synthetic index of Inertia to mobility					
Synthetic index of Mental and physical health	0,40	Synthetic index of Socio-demographic vulnerability	0,35	Synthetic index of Resistance to displacement	0,25

Figure 4. Set of weights for synthetic index.

Similarly, it has been decided to allocate an additional budget for the balance of the synthetic indices of the subject areas.

The synthetic index of inertia to mobility will therefore be calculated as a weighted average of the synthetic indexes of the different thematic areas:

$$\mathbf{I}_{\bar{y}_i} = \frac{\sum_{h=1}^{3} \bar{y}_{ih} \cdot w_h}{\sum_{h=1}^{3} w_h}$$

4 CONCLUSIONS

Currently, the management phase of the mobility plan has started with the first cognitive interview made by the Social Manager with all the tenants of the property assets. During these first conversations it was not given information about the destination of the buildings and the tenants management.

The first cognitive interview has the purpose of:

- checking the information on the tenants in possession of the Social Manager derived from the database provided by the Policlinico and from the reports with the status of contracts;
- completing the missing information such as the number of family members living together, mode of use of the apartment, the apartment status, etc.;
- checking the situation of fragility or discomfort reported by the Policlinico during the interviews conducted by the Social Housing Foundation and possibly other existing warnings;
- reporting situations that might create conflicts with the Fund during the negotiations for the liberation of the apartment and/or tenants' displacement;
- assessing, as far as possible, the apartment suitability to the needs of the family unit in order to obtain useful information to its relocation, or to identify underutilized housing to be made available;
- assessing any predisposition of the tenant to buy housing;
- identifying the problems relating to functionality of the building and/or the apartments to provide useful guidance to the staff of designers and construction company.

The data are collected and summarized by the Social Manager in a special report that will be updated with future meetings or in case of additional information received by other means.

After the first interviews, the Social Manager, following the instructions provided by the Fund Manager and Social Housing Foundation, holds a second informative interview with the aim of:

- informing tenants about the destination (sale or lease) of the property where they reside;
- informing the tenants about the social housing project that will cover the portfolio of the Fund dedicated to the long-term lease, in order to verify the access possibility.

Those who find themselves in an apartment going for sale, can decide whether to purchase the apartment or to join the social project and move to an apartment intended for social housing.

Those who live in an apartment intended for social housing, will check the requirements to see if they will be entitled to continue the tenancy within the fund portfolio.

At present, the first interview has been carried out on approximately 70% of real estate and the second interview for approximately 10% of real estate.

The sample is thus not to be complete and therefore it is not possible to properly apply the index on the whole of the fund sample.

It is currently undergoing a working group for the mobility plan with the participation of:

- the Social Manager (which carries out the interviews)
- the Social Housing Foundation ("FHS");
- the Fund Manager.

During the working group (which is held every 15 days) the cases deemed critical by the social manager are discussed to find a solution to implement the mobility plan in the best way.

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Austerity, subverted

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ABSTRACT: The possibility of a subversive version of the Lacanian enjoyment of the counter-action of joy, which is the equation of the regulation of pleasure with the pleasure of regulation, is assumed as a proposal for the adaptation of austerity as a counter-measure to the politically imposed austerity. Although intimately connected with the capital, architectural space can also constitute an alternative approach within extreme conditions. The research aims to trace upon the moments in architectural history that counter-culture developed a strong spatial dimension, investigate their reasoning as well as their manifestation and results, and draw the parallels between the era of the case studies and the current era. Architectural design can, in this way, inform and be informed in a reciprocal condition within which it can both survive itself and the people.

1 CRITICALLY AUSTERE

Austerity has made an appearance in the civic vocabulary as the politically imposed counter-measure to the recent collapse of the economic systems, briefly referred to as *crisis*. Consequently, the use of the term became more frequent, as it became intertwined with the negative sign of recession and lack of resources. Apart from a dictated series of rules, living within the limits of dwindling means can also be an adopted – either for reasons of preference, of necessity, or, of fashion – attitude, or, likewise, an inherited lifestyle. Therefore, to define austerity, one needs to spread the magnitude of its categories by tracing the associations of its occurrence. In so far as the interest of architectural design is not solely oriented toward matters of fact, but also involves matters of concern, as put by Latour (2007), the discourse of austerity is both timely and important. Otherwise the term will continue to suffer from unilateral and monochromatic interpretations, and will, subsequently, compromise architecture within the boundaries of the regime that initially conditioned it.

2 AUSTERITY

As a political framework, austerity is considered to be the outcome of the ideologies of neo-liberalism (Till, 2012), that acts as the mechanism for commodifying the non-commodified, or the semi-commodified (Goodbun et al, 2013). The very etymology of the word in its original language implies the maintenance of a set of rules without deviation. However, the meaning of the word fluctuates between positive, neutral and negative in different cultures (Suryawinata & Maas, 2012). The self-imposed austere lifestyle of the Zen Buddhists, for example, is definitely different in agency, expression and content to the austerity that a prisoner experiences in their cell. A house with an area of a hundred square metres is considered small in Greece and the USA, as it is considered average in Japan and Spain, at the same time that it is considered large in England and Hong Kong (Wilson, 2016). It becomes apparent that a mere number cannot be a criterion of austerity. Although a set of limitations, numerically expressed scarcities, or reductive acts can be inevitably connected with it, its occurrences and, subsequently, its contributions are the result of the performing of an extended list of actors, as dubbed in *Actor-Network Theory (A-NT)* (Latour, 2007), as a durable entity.

Society is the source and the recipient of the performances in discussion. The current situation the European Union (EU) is in has enabled a manifestation of austerity that is closely related with economic and political measures. These include a series of rules, dubbed as *memorandum* of understanding, which are agreed between a part that will go through a path that the other parts – the International Monetary Fund (IMF), the European Central Bank (ECB) and the EU – agree that will not quite conclude to the required results (Eliot et al, 2013).

The paradox concludes, or rather continues, with harsher measures of the same kind and with similar capacity for change. It becomes apparent that the final receiver of the failed policies is the society and its contents. A call for voluntary adaptation of spatial and personal austerity, i.e. the creation of a counter-culture, to resist the violence of political austerity may raise various objections, however it should not be completely rejected, as it has proven its resilience at the past

and appears to be gaining ground again at present. The latter is certainly not irrelevant with the timely coincidence of events.

3 LITERATURE REVIEW

The subscription of some, if not all, of the EU countries to the neoliberal policies of the 2000s and the subsequent burst of the mortgage bubble can be step-by-step understood as a legacy of the development decades that 'ritualised the end of necessity and reconstructed desires into needs' (Illich, 2010). Will for equality in the image and the likeness of the 1950s, 1960s and 1970s capitalist declarations and the 'economic catching-up' and 'narrowing the gap' slogans (Lummis, 2010) enabled similar conditions anew. The narrative of development might be well dead, but the 'propagators of need' are continuously reconceptualising their discovery, at the same time that they are redefining humanity (Illich, 2010). Neoliberalism is the living proof of this mutation. Žižek (2012) maintains that in such political systems new demands are continuously manufactured to replace the existing ones, in order to feed them back, expand and reproduce them. Therefore, the current mutation is probably not going to be the last one. An attack to capitalism per se appears as a rather painful solution to the matter, as the shock will probably re-appropriate it in its worst versions, i.e. authoritarian regimes, absolute control and the like. The gradual development of pockets of resistance to its violence within its urban boundaries, i.e. the coining or enabling of parasitic alternatives of dwelling or being together within the city, provides an option not widely applied, but definitely timely in its momentum and its precedents.

3.1 *Austerity shift*

One could argue that the 'less is more' doctrine is the core aesthetic and ethical principle of austerity in design. Indeed, it has been the frontispiece of the movement of Minimalism and its affiliations like Modernism, or Functionalism. The current shift of interest toward simplicity in architectural design, as a reaction to the blissful 'baubles' of the past decade (Till, 2012), has renewed the interest in collaborative living, communal spaces and the like, as it has renewed the interest in the 'less is more' design frame. A lot of architectural practices are criticised because of mere formal translation in an attempt to align their designs with the ethos of austerity (De Graaf, 2013). Aureli (2013) maintains that 'both the "less is more" attitude in design and the ethos of austerity politics seem to converge within the tradition of asceticism, which is commonly understood as a practice of abstinence from worldly pleasures.' A definition of austerity can therefore be looked for through the examination of asceticism and the subsequent subtraction of the elements that assign the 'less is more' attitude with capitalistic connotations. Put in form, or, rather, in equation: if *'less is more'* + *austerity* = *asceticism*, then *austerity* = *asceticism* − *'less is more'*. An attempt to define the contents in each of the factors of the subtraction would be an attempt to define austerity itself.

3.2 *Ascetic contemporary*

Aureli (2013) sees 'a means of oppression and form of resistance to the subjective power of capitalism' in asceticism. He combines asceticism in monasticism to reveal the virtues that the place of performance per se, i.e. the monastery, becomes the perfect coincidence of space and time, leaving behind nothing as a product but the performance itself (Aureli, 2013). The same principles can be found in spaces that are inspired by secular living, such as the hospital, the garrison, the prison, as well as the factory, the hall of residence, or housing estates. Immaterial labour (Dogma, 2014) and proliferation of technology added to these spaces renders the division between work environment and the living environment obsolete. Asceticism outside the religion is therefore possible, etymologically sound – its original meaning incorporates practice and exercise – and may still become a pocket of resistance against the oppressive forces of society. In the Genealogy of Morals, Nietzsche (1999) comments that withdrawal is yet another occurrence of a man's will to power, as it becomes self-preservation through self-negation. Žižek (2009) goes one step further in insisting that asceticism is the outcome of the demand for equality in pleasure, and names aspects of the lives of yuppies, i.e. exercising, healthy eating and the like, as ascetic. This culture of asceticism is no longer confined within the monastery, no longer refers to traditional religion, but it maintains its cause: self-improvement through self-limitation. Withdrawal might acquire a metaphoric quality, however the cell, the singular dwelling, the quintessential representation of interiority according to Barthes (2012) is still relevant as the space where the body can take care of itself.

3.3 *Less is more*

Aureli (2013) criticises the branding image of austerity and its reduction into fashion and formal language. In his book *Less is Enough* (Aureli, 2013) he renounces the 'perversion of austerity' and calls for art and design to play a fundamental role in defining a way of living that is beyond the promise of growth and the threatening rhetoric of scarcity. In the same manner, Till (2012) spots a number of architectural practices that are celebrated for their austere buildings that 'typically aspire to an aesthetic of minimalist decorum and tectonic rectitude' but are in no way financially, or otherwise, austere. It is precisely this sort of factor that the equation suggests to subtract from asceticism in order to define austerity.

3.4 *Visionary expressed austerity*

Theoretical proposals can be free of practical details, or application issues, however, perhaps it would be

a missed opportunity to consider certain visions as utopian and therefore unrealistic. Their suggestions and implications on issues of contemporaneity in relation with austerity are investigated in the five models of domestic space discussed next.

3.4.1 *Ito, Pao dwellings*

Access to the network of information within minimal shelter and the subsequent dissolving of the rest of the domestic functions in the metropolitan tissue are the main concerns of the projects *Pao I* and *Pao II*, 1985 and 1989 respectively, by Toyo Ito. The increasing price of homes in the urban metropolis and the simultaneous advancing of technology pushes the urban nomad to inhabit a light and ephemeral architecture, reduced to a series of objects.

3.4.2 *Meyer, Co-Op Zimmer*

Simplicity and cellular living within a communal environment are the ideas underlying a 1924 exhibition project by Meyer dubbed *Co-Op Zimmer*. It is intended to be the private part of a shared dwelling, aimed to provide the occupant with the opportunity of solitude and reflection. Contents are limited to a bed, two chairs, one of which hangs on the wall for when the visitor will arrive, a shelf and a small folding table with a gramophone on top. Aureli (2013) compares it with the monastic cell in the sense that it is the space that allows the person to live. 'The gramophone is important because it shows that the minimal living of *Co-Op Zimmer* is not only dictated by necessity, but is also a space to reclaim an element of "unproductive" time', he claims (Aureli, 2013).

3.4.3 *Absalon, living cells*

Ascetic and isolated existence, combined with a nomadic lifestyle and protection from an oppressive society are the underlying concepts of Absalon's *Living Cells*. Despite their deductive form and their white appearance, the cells – with a surface ranging from four to nine square metres – are conceived as fully functioning dwellings with electricity and running water. The artist was only able to complete the first out of six. Absalon is filmed to perform various functions in *Cell 1*, notably eat, drink and sleep with the use of minimum resources added to the ones existing in the space (Absalon, 1993). 'These homes will be a means of resistance to a society that keep me from becoming what I must become', he states in an interview for the exhibition of his cells in 1993 (Lucarelli, 2014).

3.4.4 *Antonas, the house for doing nothing*

Withdrawal from the burdens of contemporaneity and adaptive reuse of existing entities, i.e. buses, caves, or even buildings as dwellings is where Antonas focuses his writings and speculative projects. He maintains that networked screening, i.e. the inclusivity and the connectivity of the screen, has revolutionised the way of living to such extent that everything that is needed for contemporary living is a cave and a connection to the web (Wachtmeister, 2013). He even goes a step further by insisting that society is becoming simpler by the years. His *House for Doing Nothing* is a vision that exemplifies his approach on finding yourself by making new values inside a dwelling that may resemble a prison cell, but does not give you the idea of being somewhere small. It implies a space for temporary withdrawal on the premise of responsibility to discover the self, to make decisions and to finally be able to resist. The Internet connection is, in this case, the means to create dispersed interconnected agorae (Antonas, 2011). Co-habitation outside the virtual is also a possibility in this project.

3.4.5 *Malka, self defence*

In favour of the marginalised groups or individuals, architect Malka champions the utilisation of in-between spaces and parasitic architecture to create a new social scenario. *Self Defence* is a project that suggests a modular parasitic architecture installed within the void that the Ministry of Defence building in Paris prescribes. Although he admits that his proposal has issues of legitimacy, Malka (Wachtmeister, 2013) claims that building a city within the city creates a pocket of resistance against capitalism and an architectural hijacking. His vision takes the form of a modular scheme that uses existing modules, i.e. ship containers, to fill in the empty and the unclaimed spaces in the city.

3.5 *Subversive dwelling*

Simplicity and cellular living, ascetic and isolated existence combined with a nomadic lifestyle and protection from an oppressive society, withdrawal from the burdens of contemporaneity and adaptive reuse of existing entities, access to the network of information within minimal shelter and the subsequent dissolution of the rest of the domestic functions in the metropolitan tissue, and, the utilisation of in-between spaces and parasitic architecture to create a new social scenario, are the concepts in the works mentioned here. The possibility of a subversive version of the Lacanian enjoyment of the counter-action of joy, which is the equation of the regulation of pleasure with the pleasure of regulation, is assumed as a proposal for the adaptation of austerity as a counter-measure to the politically imposed austerity. This emergence invites for an alternative design-driven approach within extreme politically imposed conditions. The inclusion of historical, philosophical, sociological and political references certainly benefits the discussion around austerity, as the inclusion of visionary expressions of it does. The speculation that a misinterpretation, or rather, a 'perversion' of it endangers its possible salutary associations enabled an attempt to define its nature via a case study.

4 CASE STUDY: FLAT GEMK

Bought in the prime time of the bliss of the local economy *Flat GEMK* is an example of a small – for Cypriot standards – and expensive – for contemporary real

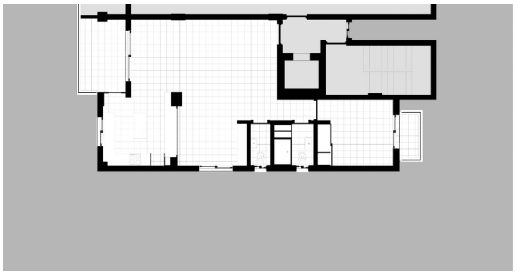


Figure 1. Flat GEMK. Plan. Lineal.



Figure 2. Flat GEMK. Plan. Montage on Lineal: Contents.

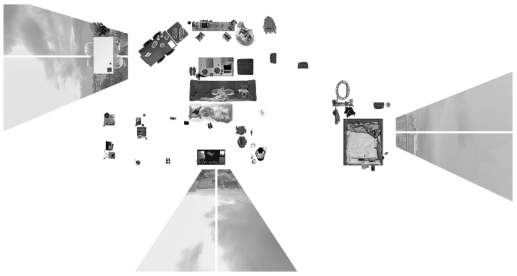


Figure 3. Flat GEMK. Plan. Montage: Contents.

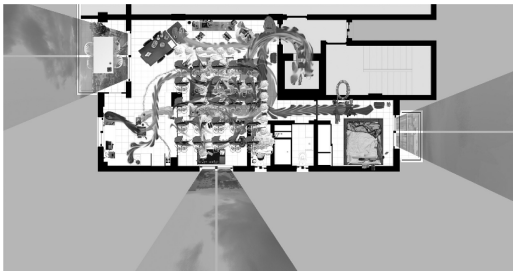


Figure 4. Flat GEMK. Plan. Montage on Lineal: Paths.

estate prices – home in the centre of Limassol (Figure 1). It is inhabited by a married heterosexual couple, both with demanding work and academic schedules. Although it is basically used only during night-time and a portion of the weekends and it was meant to become the permanent home for the dwellers, the couple is in the middle of a controversy at the moment, whereby one partner insists on moving out of the flat to prepare a space for a potential baby, whereas the other partner maintains that the existing space can accommodate such an addition while the time schedules and economic situation cannot (Figures 2, 3, 4).

The flat's use pattern reveals that only half of its area is used in the daily routines and an additional portion during crisis scenarios, i.e. the guest toilet doubles up as an isolation area during an argument (Figure 5), and the currently not in use office area doubles up as a guest bedroom. There are several indications that the couple is indeed undergoing a crisis which does not seem to necessarily be economic in nature, and that some forms of austerity are present which are not necessarily measurable in numbers or expressible in absolute terms. Perhaps the most obvious aspect of the co-habitation which reveals that the couple perceives their lives as going through a crisis is the way it deals with the tight time schedules and the allocation of jobs that need to be done around the flat such as grocery shopping, bill payment and the like.

Case study *Flat GEMK* findings do not necessarily justify an austerity condition, at least in the manner it is sought after. However, it has provided certain clarifications for future reference. A call for austerity in order to be aligned with the current flux is not applicable to everyone, and not everyone is willing to adapt to conditional counter-measures. In so far it is accepted that an austerity shift is evident in society, it needs to be understood that its acknowledgement will come from some, not from everybody. Furthermore, a phenomenal crisis, namely a family crisis and the like, might be partially associated to the subject matter, but, at the same time, it should not be assumed as a direct effect of it. The enablement of an actor-network (Latour, 2007) reveals more ties and mediators than previously assumed.

In the case of the *Flat GEMK* inhabitants, if being immersed in the situation, they can use means of communication sharable by both, a research examining the situation needs to develop the media of analysis more suitable to capture the nuances of the setup. This is where the present research has most felt the lack of appropriate means not only of representing but also of framing the concept of austerity in the first place. It seems that a closer investigation into the framing and representing not necessarily austerity but, perhaps firstly dwelling, is needed.

Another important part of this research is the one related with the observation of realised practice, be that case studies of already built spaces, that will be used to trace the nuances between the various austerities reported. These can include precedents of secular, or otherwise austere dwelling, such as a monk cell, a student hall room, the room of a prostitute, a prison cell, or more inclusive examples such as dwellings for larger groups of people, i.e. a family house and the like. The accumulation of entries describing the topic invites a reciprocal practice within which the device, i.e. the entry template, used for their inclusion is a work in progress that is being updated and re-appropriated by the very information that it contains. The acknowledgement of relevant information, its retrieval and the



Figure 5. Flat GEMK. Plan. Montage. Zoom. Guest Toilet.

subsequent appropriation in order to acquire a shareable form are the main targets for the future of this research. Keeping the entities, or rather, the tasks of taking into account and putting into form, separate is paramount for the public accessibility (Latour, 2007) of the research output.

5 CONCLUSION

Counter-cultures of resistance have been known to have managed to alter conditions of oppression in the past. Their spatial dimension is the living apparatus within which the catalysts of societal change can occur. Withdrawal and self-negation within the urban tissue are possible paths for the subversion of a systematic violence. Austerity can be central in this effort only outside the boundaries of the reasoning it has been reinvented. The process of subverting austerity toward a solution, rather than a condition, requires openness in means and methods, but, first and foremost, it requires the will to change. The latter is also the main ingredient of meaningful architectural design.

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The Guggenheim effect and failed public investment in architecture

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ABSTRACT: During a long four decade period, from the 1970s until 2008, Spain went through a dramatic economic growth, in which the construction sector played a crucial role. Following the success of the Guggenheim Museum Bilbao, several City Halls embarked on enterprises investing in culture with projects designed by renowned architects, hoping it would attract visitors and promote the local economy. The 2008 global financial crisis was felt deeply by Spain, where years of austerity measures plunged the country into recession, causing stagnation in the construction sector. The purpose of this study is analyzing examples of failed public buildings in recent years, relating the motivations that encouraged ambitious programs with the causes of its incompleteness, for better understanding the underlying issues that caused high public debt. The political concern with popularity along with the dazzling effect of world-famous architects turned out to be a source of public expense in many cases. The expected result is a contribution for a greater social awareness, so that conclusions can be drawn and a lesson learned for the future. This study highlights the successful example of the Guggenheim Museum Bilbao, the years of the property bubble as a source of indebtedness, the consequences of the Great Recession and, last but not least, three cases that demonstrate the problem: the City of Culture of Galicia (in Santiago de Compostela) by Peter Eisenman (Eisenman Architects), the Alcorcón Centre for Creation of the Arts by Javier Camacho and Pedro Bustamante (cmA Arquitectos (Madrid metropolitan area), and Córdoba Congress Centre (for Córdoba, Andalusia) by Rem Koolhaas and Ellen van Loon (OMA).

1 THE GUGGENHEIM EFFECT

1.1 *An ambitious program*

In 1991, the Basque government took the initiative of proposing to the Solomon R. Guggenheim Foundation the creation of a Guggenheim museum in Bilbao, the largest city of the Basque Country (Fig. 1).

The government financed the construction and funded a substantial fee, ensuring that in return the Foundation would manage the institution, provide the annual budget, organize temporary exhibitions and rotate parts of its permanent collection. The chosen place to build the museum was previously occupied by a decrepit port and shuttered factories, remains of the former glory of Bilbao as a manufacturing centre.



Figure 1. Guggenheim Museum Bilbao ©MykReeve 2005.

This project was a part of an ambitious redevelopment program, made possible because of Spain's economic recovery after joining the European Union in 1986, that included also a new main terminal for the airport (designed by Santiago Calatrava and opened to public in 2000), a metro system (by Norman Foster, approved in 1988 and began operation in 1995), and a footbridge across the Nervión river (also by Calatrava, known as Zubizuri and opened to public in 1997) that links the hotels directly to the Guggenheim museum. According to this strategy of engaging expensive architects, the Solomon R. Guggenheim Foundation selected Frank Gehry and encouraged a daring design.

1.2 *The instant hit*

The political and economical strategy was disguised behind an apparent cultural phenomenon, by raising a museum for exhibiting works and installations by contemporary artists. In reality, culture played a secondary role, because the intention behind the building was, not its content, but attracting tourists and re-launching the local economy. It served its goal, with its colossal deconstructed shape that became a huge hit, and Guggenheim Museum Bilbao received international acclaim, now having a flow of over one million visitors every year. The building cost was recouped within three years and, because visitor spending in the city jumped, five years after construction its impact in the

local economy was an estimated €168 million, meaning an additional €27 million into Basque government tax coffers, the equivalent to adding over 4,000 jobs.

According to Iñaki Esteban, author of *El efecto Guggenheim* (Editorial Anagrama, 2007), the building can be considered an "ornament" in the sense that political institutions and business entered a new phase of an aesthetical and globalizing capitalism through the symbol of urban development. The cultural function is therefore an ornament for the political initiative to embellish an ugly city, and put it on the map. The futility associated with the ornament is replaced by "a strategic inversion to promote urban evolution", since the building is a resource that "creates urbanism, image and communication, economic activity and political loyalty". Its purpose is, therefore, communicating the city's new status as a touristic attraction.

1.3 *Generating resources*

The enthusiasm aroused by the international success originated an atmosphere of prosperity and economic growth that became expressed in an increase of consumption, which in turn legitimated the ornament, giving it an active role in generating resources. So, the main core of the museum is, undoubtedly, the capacity to project a strong identity through a powerful image, making the city more competitive and able to attract tourists at a large scale. From the economic point of view, Bilbao went from the manufacturing sector to the era of services and know-how, where leisure and culture are turned into business. Its cultural interest is relegated to a secondary role.

The museum's value is not mainly measured for its content but for its consequent urban, political and economical benefits. The ornament is legitimate and has prestige because it is, in one word, profitable. It is a business model, not reliant on government funding, able to promote commercial attractiveness and private investment, to publicize the support of companies, to attend the demands of politicians and to know how to preserve its image by using wisely the media (Esteban 2007).

1.4 *Illusion of luxury and merchandising*

The Guggenheim Museum Bilbao is, not only a work of art, but also a spectacle that creates an illusion of luxury, contributing to the image of a city open to novelties and in fashion. It is a setting that communicates prosperity, in which the content is less important than the appearance, because tourists desire distraction and amusement. The sensorial stimulus is carefully taken to the limit, provoking a wow factor, essential to capture attention in a society saturated with image and publicity. At the end, the impact of a strong ornament turns it into a resource generator, a profitable objet that ironically becomes useful by its apparent futility. Consequently, all activities associated with tourism increase and promote the local economy.

1.5 *Urban regeneration for political purposes*

The symbolism of a new era of prosperity and the luxury exhaled from the iconic building provides a positive sense of innovation, progress and trust in modernity, promoting cohesion and consensus among citizens. Politicians use that success in their own benefit, by associating themselves (and their political party) with the iconic ornament. The creation of an infrastructure that has such power gives prestige and appeals to citizen's loyalty. In exchange, the general public demanded more than the basic welfare; in a society of appearances and illusion, it required a luxury according to a society of abundance. And the answer to that appeal was Frank Gehry's astonishing Guggenheim.

The ornament is also a "machine of public relations", given that converges the political and economical interests, performing as a projection screen for the image and the message of political parties, institutions and private companies (Esteban 2007). As a museum, Guggenheim Bilbao is clearly one more branch of a Foundation headquartered in New York, focused on reducing costs. It doesn't have a permanent collection that provides identity to a proper museum, since the most profitable are temporary exhibitions that generate publicity and a sense of novelty. The art becomes openly merchandise and the visitor is considered a consumer.

1.6 *The Guggenheim effect*

The Guggenheim "effect" is an example of how architecture has the power to become a symbol and provide identity. The building is not so much relevant for its use but as a source of consensus among the citizens of Bilbao, a meeting place and scenery for illusions and dreams. The infrastructure goes beyond the regeneration of a decayed area of the city. It is an ornament controlled by politics and not by market; an example of urban innovation based on culture, claiming the involvement of citizens, that turn out to be the beneficiaries.

2 CONTEXT: THE BOOM YEARS

2.1 *The property bubble*

In the decade between 1996 and 2006, the property market in Spain increased at an astonishing rhythm of 8.3% per year. The purchase of housing (new and pre-existing) went from 400.000 units in 1995 to 955.000 in 2006, and the construction sector contribution to the GNP (gross national product) increased from 7% to 12.5%. The number of construction permits granted by City Halls for new housing reveals that same growth: from 270.000 in 1995 to 737.000 in 2006. As a result, house ownership in Spain is near 90%, a percentage superior to wealthier countries in Europe (Blanco Losada 2013).

If the housing market was growing, then also the construction sector was launched, starting a period of

great prosperity. The impact in the economy was huge: 14% of employees worked in the sector and 25% of the employment growth was due to this increase. The property boom had a decisive role in the Spanish economic growth of the twenty years preceding the Great Recession. The times were in high spirit: the growth seemed endless, the rise was taken for granted and prosperity allowed a frenzy of consumerism. Nothing predicted that the fall would be sudden and come to be sooner than expected.

2.2 *Rise of investment in housing*

The dramatic statistics of housing purchase and construction can be also explained by the fast rising of the price of housing. In 1995, the necessary investment to purchase a property was €671 per square meter and in 2001 the same effort required €1000, which corresponds to an increase of 5.8% per year in that period. Between 2001 and 2008 the value increased even faster at a rhythm of 13.3% per year (Sotelsek Salem, Zack & Senra Diáz 2013). Purchasers seized the opportunity to invest, causing an overbought of housing and consequently contributing to price rise.

This scenario was made possible by a predominant idea that markets and banks are able to self regulate, which lead to great facility in providing loans. The system turned out to be efficient and competent, but the risks became higher and the indebtedness of citizens and governments casted a shadow of a possible collapse. The government encouraged the purchase of housing through tax regulation that discourages renting and benefits buyers (mortgage payments are partly deductible from personal income taxes). Finally, when Spain became a member of the European Union in 1986, the government itself became provided with funding and able to have access to loans. With more investment, the economy growth was fast yet fragile. And in the case of Spain, the property bubble was a motor of the economic bubble.

2.3 *A sudden collapse*

During the decades of abundance, the Spanish government failed to collect reserves for challenging times to come, taking the stability of tax revenues for granted and allowing a major indebtedness. The increase in spending created a fiscal bubble that busted when the income from taxes over the construction sector decreased dramatically, since its contribution was reduced to 6% of the GNP. Consequently, the fiscal deficit became excessively high from 2009 onwards and the government was forced to withdraw fiscal stimulus. Between the years 2007 and 2012, the purchase of housing decreased 13.7% per year, from 955.000 to 361.000, of which new housing suffered the greater impact: 410.000 sold in 2006, 115.000 in 2012. The construction sector underwent a drastic slowdown and the number of unsold new housing reached 700.000 units in late 2011 (Blanco Losada 2013). With the slowdown in purchasing, the price of housing suffered a blow, decreasing 23.6% in the following five years, to 5.5% per year. The crash in the sector is responsible for half of the new unemployed (Sotelsek Salem & Zack & Senra Diáz 2013).

2.4 *The phenomenon of ghost-towns*

The 2008–15 financial crisis in Spain ended the property bubble of 1985–2008, causing a phenomenon of *ghost-towns*, large housing developments built during the boom years in the country that are now being abandoned and the houses offered for sale for almost half the original price. One of the most glaring cases is the town of Seseña, known as the Manhattan of Madrid (due to its proximity to the capital), with the capacity to accommodate at least 30,000 people in 13,000 dwellings already built, but of which only 5,100 are occupied. Most are uninhabited and the owners try to sell them with great loss.

Another example is Ciudad Valdeluz, in the town of Yebes (in the region of Guadalajara), an urban intervention program (*Programa de Actuación Urbanística*, PAU), promoted by the construction on site of a railway station for the high-speed train (AVE, *Alta Velocidad Española*). The location of the railway station would predictably be in the center of the city of Guadalajara, but the promoters seized an opportunity for real estate speculation and in 2004 begun the construction of 9,500 dwellings for an estimated 30,000 inhabitants. In late 2014, only 2113 people were residents and many signs for sale indicated that the migratory flow is back to Madrid. At a distance of a 30 minute travel between the two cities, the railway company charges unaffordable prices for a daily rhythm.

3 CASES OF FAILED PUBLIC INVESTMENT

3.1 *Córdoba Congress Centre*

The project for Córdoba Congress Centre (*Palacio del Sur de Córdoba*) begun in 2002, with an estimated cost of €80 million, and two years later escalated to €158 million, in a total of €171 million including taxes. An amount of €3 million were invested in the initial design by the famous architect Rem Koolhaas. It would include a Congress Centre, an auditorium, a luxury hotel, a commercial area and parking. But in 2008, the private construction company Ferrovial announced that it was not possible to gather more than €70 million in funding and the project had to be reformulated. Another €5 million were invested in a new design by Koolhaas. After ten years and €10 million spent, in 2012 it was canceled. Two years later, the City Hall had to pay €6 million, by returning a €5.5 million funding provided by the Government, aggravated by interests for late payment. In the end, the decision was to restore and expand an abandoned building, belonging to Cajasur.



Figure 2. City of Culture of Galicia ©Certo Xornal/ 2009.

3.2 *City of Culture of Galicia*

The Project for the City of Culture of Galicia (*Ciudad de la Cultura de Galicia*), in Santiago de Compostela, was launched in 1999 with the ambition of transforming the city into a cultural reference (Fig. 2).

The competition was won by the famous American architect Peter Eisenman, for a €108 million project. In the following phase, the budget increased to €475 million. The goal was attracting visitors and encouraging the local economy.

With the crisis, the project became unsustainable and, in 2013, was revised to cut costs. In consequence, two of the six buildings initially planned were embargoed. With €287 million already invested, it will cost another estimated €20 million in compensations for contract termination with construction companies. It is currently open to the public, but only half the annual budget is intended for cultural events. The other half is for administration departments that were transferred to two of the buildings. The annual budget in 2013 was €10 million, €3.6 million just for expenditure with electricity, gas, cleaning, security and maintenance of infrastructure. The project first announced as being profitable, became a heavy expenditure.

3.3 *Alcorcón Centre for Creation of the Arts*

The Alcorcón Centre for Creation of the Arts (*Centro de Creación de las Artes de Alcorcón*, CREAA) is a project launched in 2007 and today 70% completed (Fig. 3). Predicted to be inaugurated in 2011, the futuristic buildings are abandoned and have become a symbol of overspending.

Alcorcón is a city at a distance of 13 km (or 15 minutes by subway) from the center of Madrid. In 2007, the Mayor decided to transform the suburban residential area into a well-equipped and a pleasant place to live, with affordable housing, in hope to attract the younger population. The Centre for Creation of the Arts was intended to be the "Guggenheim of Alcorcón", a reference at European scale, putting Alcorcón on the map. The initial project, covered an area of 66,000 square meters over 9 buildings, including an auditorium (with over 1400 seats), a circus, 4 professional technical schools, a conference space and a restaurant. So far,



Figure 3. Alcorcón Centre for Creation of the Arts ©Zarateman/ 2013.

€94 million were invested and it would take another €40 million to complete but, in 2012, due to a €120 million indebtedness of the City Hall, the new Mayor decided to embargo the building, spending €5 million in compensations for contract termination with construction companies.

4 CONCLUSIONS

The high spirits lived in the 1980s, 1990s and until 2008 had a strong voice in society, through a generalized feeling of overconfidence in the economic recovery. The wealth of those years was assumed as a logical result of neo-liberalism working well. The *laissez-faire* nourished greed of companies, politicians and families, which saw an enrichment opportunity like never before. But the fast expansion of the economic welfare was based on a fragile system, soon proved to be particularly harmful for governments and families.

Economic liberalization policies were adopted with confidence and the immediate results seemed to confirm its efficiency. Free trade, privatization, fiscal austerity, and reductions in government spending were applied to strengthen the private sector in the economy, a strategy introduced by Margaret Thatcher in the United Kingdom and by Ronald Reagan in the United States. But in Spain, these policies were implemented in a recent democracy (after 1977) and, at the same time the society was trying to develop a previously non-existent welfare state, resulting in a contradiction.

The construction sector played an important role in the economic recovery of Spain and, as expected, also caused a heavy loss after the Great Recession of 2008. During that time, public investment in architecture was used as a political strategy by several local governments, some successfully, and others failed. The example of Guggenheim Museum Bilbao started a trend, but the unsuccessful cases show us that many different circumstances must be gathered in order to produce a positive outcome.

The first lesson to be learned is that a large-scale investment in a building, even when promoted by a City Hall, must have the capacity to sustain itself without being dependent on government funding. This means that Guggenheim Museum Bilbao is a success because it is an operating business: its annual budget is provided by an international institution, obtains funding from private companies and a well studied merchandising, and generates profit. The failed cases mentioned in this study demonstrate how fragile it is an enterprise that relies mainly on government funding: if the times are prosper, all goes well, but soon as austerity imposes its restrictions and costs are reduced, the consequent collapse is inevitable.

This conclusion leads to a second, which is the negative consequence of unclear motivation for investment in a public building: if it is a business, where users are consumers and services are for sale, or if it is public service, provided for benefits of citizens, regardless of profit. All the examples mentioned above demonstrate that, during the bubble years, both strategies were combined, even although it is a contradiction. The Guggenheim Museum was supported by a strong business strategy, camouflaged as a cultural phenomenon, but even being an ornament (rather than an actual cultural public service) it turned out to benefit local citizens through economic gain and a powerful image. The failed examples were ideologically ambiguous, in the sense that they were publicized as public service and as a profitable business as well, and came to be a great expense for the government, even when canceled, before beginning (like the Cordoba Congress Centre, because of the large amount already spent in the initial design and funding that had to be returned with interests), when partially embargoed and partially functioning (as in City of Culture of Galicia, where the income from the number of visitors is far from being sufficient to cover the building maintenance costs) or even canceled half way through construction (as Alcorcón Centre for Creation of the Arts, that even not open to the public is spending funds, in compensation claimed by the investors and indebted the local government for years to come). If the investment made was intended for public service, then profit should not have been expected as if it were a business, and so ambition had to be restrained.

A third conclusion is that, during the boom years, little attention was given to return on investment in the construction of a public building. The question if a building for cultural purposes should be a business, public service, or if it is possible to find a perfect balance was avoided during several decades, because tax revenue provided the amount necessary to endure large-scale buildings, its construction and its maintenance. But looking back, if those buildings are no longer sustainable in a less flourishing economy, then the return on investment was clearly overestimated and miscalculated, which reveals that the purposes were not financial, but political.

In the end, is possible to take a fourth conclusion, concerning the role of publicity in riding a wave of enthusiasm around, for which contributes hiring well-known architects. In comparison between the Guggenheim Museum Bilbao and the City of Culture of Galicia, the second can be considered to have fallen short of expectations. The main difference is that, in the first, Frank Gehry's project was another element in a well-structured plan, while in the second case the expectation was created around Peter Eisenman's project. But the architect's celebrity alone is not enough to generate other resources or even to ensure the maintenance of the building itself.

The charm of the well-known architects, during the prosperous decades, placed architecture in the spotlight, but also associated it with a business attitude, that has been ruthless. Guggenheim Museum in Bilbao is an example of how even a cultural experience, like visiting a museum, can be turned into a serious large-scale enterprise. Even being a success, it is a warning about the capacity that capitalism has to quantify, regardless of quality. The fact that the same few well-known architects are chosen based on their popularity tends to dehumanize architecture, community life and puts pressure on individuals to seek fame at any cost. The cases of failure of large-scale public investment in architecture are, not only financial, but also ideological and social, a symbol of ethical decadence.

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The "Iron Curtain" as urban observatory of the contemporary social contradictions

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ABSTRACT: The expression "Iron Curtain" indicates the borders dividing Europe in two distinct areas – from Stettino in the Baltic to Trieste in the Adriatic.

Since the beginning of its dissolution, started on the border between Austria and Hungary, until the fall of Berlin Wall, several transformation of earlier militarized territories took place and led to the discovery of a new landscape, extended for kilometers in length and depth. The study of which therefore is a favourite and fruitful observatory regarding the different phenomenas of border areas transformation, as well as their context as the result of spatial effects of division or integration of European citizens. Studying these phenomenas can help us learn more about these kind of inbetween contexts and more about some possible strategies and actions for the conflicts resolution, so frequent, not only between the countries, but also within the city, and local comunities.

"(…) It is my duty however, for I am sure you would wish me to state the facts as I see them to you. It is my duty to place before you certain facts about the present position in Europe.

From Stettin in the Baltic to Trieste in the Adriatic an iron curtain has descended across the Continent. Behind that line lie all the capitals of the ancient states of Central and Eastern Europe. Warsaw, Berlin, Prague, Vienna, Budapest, Belgrade, Bucharest and Sofia, all these famous cities and the populations around them lie in what I must call the Soviet sphere, and all are subject in one form or another, not only to Soviet influence but to a very high and, in some cases, increasing measure of control from Moscow" (Churchill, 1946).

Churchill's speech is considered the ideological foundation of what we call Cold War. With his words, Churchill stated the end of the anti-fascist coalitions and decided de facto the new world alliance against the Russian enemy. The enormous influences deriving from WWII had had a drastic impact on the political and economical structure of each involved country, collapsing the great European powers. Germany had been defeated, France and England had been deeply weakened, USA were military and economically stronger than any other country, and Russia, despite being a winner, was also exhausted: still, these two countries were aiming to conquer the role of unique superpower in the world. In 1945, with the conference of Yalta, the Soviets accepted the limitations imposed on the superpowers in procedural terms; afterwords the representatives of 50 countries provided the 111 articles at the conference of the United Nations about the international organization to grant the world peace and promoting the economical and socio-political development of every people in the world. USA definitely aimed at re-establishing a stable order for the world, as they enjoyed the first place in terms of economy, the Soviet Union, instead, demanded the price of their victory in political and economical terms, especially since it had suffered serious loss because of the war.

Since 1946 it had become clearer and clearer that the tensions between the Soviet Union and USA were so high to start that world involving political phase later called "Cold War", a silent war, which was never fought by using weapons, but was carried on almost exclusively in diplomatic terms.

The clash counterposing their cultures had been rooted in the extremely different ideological grounds at the base of their two political-economical systems: capitalism and communism, as they were clearly inspired by opposed geopolitical interests. In 1947 Tuman Doctrine was affirmed, to control the Soviet dangers in defense of the rights of liberty and of the autonomy of peoples, thanks to which USA were concretely committed in sending economical and military aids to those nations that resulted internally fragile and particularly exposed to the communist propaganda and to the expansive aims of Russia, such as Greece and Turkey. In those countries, such as Poland, Hungary, Romany, Albania, Yugoslavia and East Germany, where the Soviet influence was prevailing, the political-economical structure was reorganized according to the Soviet model.

The birth of regimes controlled by the communists became more and more common, quite alarming the USA. Emblematic was the German Issue: since the end

of WWII, Germany had been divided in four zones of occupation forces, the French one in the South-West, the British one in the North-West, the American one in the South and the Soviet one in the East. The city of Berlin was split in two zones, belonging each to one of the two influence worlds, the American one and the Soviet.

The political tensions taking shape during the Cold War proved the impossibility of any agreement regarding the future of the country and what was supposed to be a temporary situation led to the constitution of a liberal-democratic government in the West side (occupied by the forces of USA, Great Britain and France) and of a communist regime in the Est (occupied by the Soviet forces). In 1949, the three Western zones of Germany united and the Federal German Republic, founded on a democratic and parlamentar Constitution in the capital of Bonn, was proclaimed; in the Eastern zone, with Pankov as the capital, the Democratic German Republic, supported by a regime of communist imprint. In 1961, to contain the continuous flows of Germans moving to the West side, the construction of a fortified concrete barrier was ordered, completely isolating the two sides of Berlin, the Wall.

The terms Iron Curtain, then, indicate the border line dividing Europe in two distinguished zones since the end of WWII in 1945, until the end of the Cold War in 1991. It represented the ideological and physical split and symbolized the Soviet efforts to stop the contacts with the Western world and those areas which weren't under Soviet control. This line used to cross Europe along the political borders among East and West Germany, Czechoslovakia, Austria, Hungary, Yugoslavia and Italy.

The Iron Curtain was built in order to defend the borders between West and East Europe: the closer areas to the line used to be highly militarized and were crossed by double enclosures, while in the urban areas the barrier constituted of a high concrete wall, like the one in Berlin. Many villages were destroyed because of their over-proximity to the border. Those people who lived within 15 kilometers from the line, in the so-called "border-zone", had to obtain a special permission to enter in the zone within 5 kilometers from the border. There were ground mines in the space between the two enclosures; the minefield was later substituted by an electric enclosure and by another barbed wire enclosure, with guard towers and a belt of sand in order to recognize eventual border violations. To prevent any escape attempt, the squads used guard-dogs and were allowed to shoot the runaways.

The dismantlement of the Iron Curtain began along the borders between Austria and Hungary on May 2nd 1989 and was carried on through several initiatives, such ad the Paneuropean Picnic and the exodus of thousands of citizens from DDR to West, which led to the fall of the Berlin Wall.

The abandonment of these highly militarized no man's lands has led, today, to the development of large natural reserves and has created the wildlife corridor through the entire Europe.

1 ACROSS THE LIMINAR LANDSCAPES OF THE IRON CURTAIN

Therefore the Iron Curtain was generated by a line which marked the territorial and ideological split between Eastern and Western European countries. An officially recognized border, a geo-political boundary, which counterposed two adjacent realities. Their modification cannot be restricted to the physical presence of an impassable border, but it is to find in many larger-scale geographical, morphological, economical and social adjustments, related to the surrounding territories. Adjustments that were necessary to shape a new balance for both the situation after the construction of the Wall and the situation after its removal.

The definition of border itself, indeed, refers to two Latin words, limes and limen. The first one is connected to the idea of limit, delimitation, demarcation of boundaries, frontier: limes indicates a horizontally traced line cross-cutting any surface or the ground, with the function of excluding, delimiting and marking the place of a difference. Limen, on the other side, means threshold.

Sergio Crotti defines the threshold as the outline of the shape between background and figure, but also between a subject and the set of objects constituting the physical world, and pushes its meaning up to several notions of architecture and urban design. In the multiple acts of building, the threshold appears quite fragile, uncertain, variable from case to case: it isn't something stable, instead it is a dynamic and variable element, both when intended in its spatial and in its temporal meaning.

Quoting C. Magris in Come i pesci il mare: "Borders die, revive, move, are deleted and unexpectedly re-appear. They mark the inhabiting space, politics and its often absurd cartography, the ego with the plurality of its fragments and their hard recompositions, society with its divisions, economy with its invasions and its retreats, the Thought with its maps of order" (Magris, 1991). Just the same way, during its formation and with its demolition, the Iron Curtain has transformed itself from impassable border to porous threshold that enables the territories to be crossed and used again, through new laws of appropriation of land, which are highly different from those readable before its construction. Once again, this reveals how the demarcation of a border, both in the intent of dividing and in the one of opening, generates an interesting process of change, which can be understood through the Entropy principle from Physics, if we take it as a measure to such variations. Entropy (from ancient Greek, $\dot{\varepsilon}\nu$, inside, and $\tau\rho o\pi\acute{\eta}$, transformation) is a physical quantity used in statistical mechanics as a measure of chaos in a physical system. To explain it, a typical example is the behaviour of two gases at first separated into two airtight chambers and then put in touch: the two gases mix up together and gain chaos, or increase disorder, entropy.

The entropy principle though is valid if we assume the universe as an isolated system, a system where

matter and energy are irreversible, so it's impossible to exchange them with an external environment. When referring to open systems instead, such as those concerning life and social science, we should rather appeal to Ilya Prigogine's studies about dissipative systems, structures which are far from order and open to the exterior, where the fluctuation of energy can produce "order from chaos". We shouldn't only take into account this type of phenomena: society itself can be defined a non-linear system; treating social phenomena means somehow to found a physics of people.

As it shows different orders before and after its construction and new ones even after its demolition, the case study of the Iron Curtain seems to come across this fascinating opportunity to find a new order to change. Order that is not only to distinguish on a temporal base, but also in relation to the considered territories and their morphological, social and economical characters. Thanks to the discovery of its liminar landscapes we can outline a few principles or mutation categories about the urban fabric and its inhabitants, which are particularly useful to understand the characters of resistance and resilience of a territory. Such characters are extremely important in establishing the new paradigms to define the evolutionary directions and the re-generational strategies which should support the urban and architectural design processes.

The etymological considerations concerning the meaning of border, the application of the Entropy theory in reference to the definition of the different categories of mutations represent the theoretical frame that this paper attempts to clarify, giving a background to several descriptions, especially to photographic descriptions from various surveys, such as the books Cortina Verde and La Linea inesistente, which appear to be the most incisive in telling the places, their atmospheres, and people, well depicting the complexity of these territories.

So today, along the ex Iron Curtain it's possible to find three different typologies of spaces: from the vast green areas, conserving the line through the Green Belt, inhabited zones, where the exploitation of land by man has taken place continuously, follow one another generating a greater status of chaos and indifferentiation. Analyzing those spaces, three main descriptive categories of their mutations arise: preserved spaces; abandoned spaces, re-generated spaces.

Some spaces are preserved because of their strong monumentality or their deep attachment to past, so that the border becomes a well-marked sign, especially for the collective memory, despite being crossable and permeable. Thus the substantial maintenance of the status of division preserves many of the morphological and cultural characters, reducing the interaction between the two sides. The exchange, in fact, is minimal and the territories present a rooted dishomogeneity despite the restored freedom of movement. A key example is represented by the little town of Modlareuth, on the border between Bavaria and Thuringia.

When Europe was split in two blocks during the Cold War, the Bavaria side re-joined West Germany, while the Thuringia side was annexed to East Germany. The border had crossed the country for forty-one years, at the end of which the two sides allowed all the inhabitants to cross from one side to the other, although without ever losing their own identity, which was either appeared or consolidated during the Cold War. The town, then, regardless the formal liberty of transit between the two sides, finds in its inhabitants the actual obstacle to reunification: the consolidation of the habits has always guaranteed people two distinct churches, two distinct schools, two ZIP Codes, two telephone prefixes and two typologies of license plates. A segment of the border has even stayed intact until today because of people's will: this highlights how the history of those years has greatly intensified the certainty of the separation and of the countless chances that could arise inside one unique urban centre.

A similar condition, or perhaps even more evident, concerns Gmünd and České Velenice, two cities divided by the border between Austria and Czech Republic. Their division during the Cold War has led to a strong differentiation in the two municipalities: Gmünd is a touristic town, thanks to its historical centre and its famous baths; České Velenice is a poor small city surviving because of low-profit activities. Gmünd counts 5.376 inhabitants in Lower Austria, while České Velenice is part of Jindřichův Hradec district, in the region of Southern Bohemia (Czech Republic). At the beginning, these two towns used to be joint as a unique urban centre in Southern Bohemia, but when the European cartography, after the WWI, was completely reshaped, the Northern part, Gmünd, passed to Czechoslovakia, modifying the name and the nationality of its inhabitants. The consequences of the split through the construction of the Iron Curtain have been affirming their division until today. The two urban centres, in fact, are characterized not only by morphological differences, but also by sharp political, cultural and social counterposed positions: if the image of Gmünd, with its baths, the historical centre and the natural park of Blockheide, is the one of a touristic city, České Velenice offers a mosaic of small casinos, blocks built during the years of Communism, red lights clubs and similar low-profit activities. The split at the two sides of the borders is severe and even violent, however both towns don't appear to be willing for their own regeneration, but are just strengthening the division imposed by the borders (Austria-Czech Republic).

The same preservative character, if considered through an ecological and naturalistic perspective, takes into account such a completely different background that we can even define it transformative. It is precisely thanks to the Iron Curtain that several extended parts of the territory could maintain their original natural condition intact, within each different country. Since 1989, indeed, after the demolition of the Berlin Wall, more than 300 environmentalists from the

German Democratic Republic and the German Federal Republic had activated the first projects for the protection of the curtain, which later became of European interest. This conservative plan turned into the European Green Belt, a political movement of people supporting nature maintenance and the sustainable development of the ex Iron Curtain, promoted by the International Union for the Conservation of Nature. This new green belt has defined a new buffer zone with a high capability of openness and integration of the two zones, both along its length and horizontally.

Nevertheless, it's worthwhile to consider the case of Lake Schaal, in the Northern part of Germany, between the Bundesländer of Schleswig-Holstein and Mecklenburg-Vorpommern, located in the middle of a wide triangular area among Hamburg, Lübeck and Schwerin. During the Cold War, those areas were almost abandoned and hardly populated; nature grew uncontrolled all along the territory. Until toady, it has developed a specific vegetation characterizing the bio-park (UNESCO site since 2000), which has represented an important attraction for tourists and has re-activated the surroundings of the lake, earlier abandoned because of the war.

The entire bio-park and the banks of Lake Schaal enjoy the presence of natural vegetation, as during the Cold War the routes via water and via land had been reduced, facilitating its little-controlled and dense growth, which today, instead, is well-protected and conserved in its beauty. Here, the Iron Curtain had been placed right in the middle of this basin to prevent the boats from crossing the lake bank-to-bank and from modifying the trade shipping routes of the zone. After the demolition of the curtain, the administrations decided not to return to the habits preceding the Cold War, but to maintain the newer routes, implementing them for the eventual lacking connections.

So the conservative character is evident here to describe both the conditions, on one side related to the preservation that redefines new landscapes for future scenarios, on the other side related to the maintenance of the structure of the shipping routes, leaving an invisible trace of the past. The will to remember as well derives from a preservative character, despite it has led to the re-conversion and the maintenance of the military equipments along the curtain for museum purposes.

Concerning this, Checkpoint Alpha is another interesting example: it's the largest passage of the German border, it's been preserved as it used to be and it has a museum host inside. Even if also in this case the exterior appearance has remained intact, with a precise intent to maintain these places as they used to be in order not to forget, this very action somehow turns division into integration and pacification.

On the other hand, in a degenerative way of preserving as lack of attention and lack of management by the administrations, we can find some abandoned places such a Priwall, in Germany, where the ex control-area of the beach and its control tower are today completely abandoned. Completely deprived of its military role, the construction appears almost out of place in such a natural context, but it still testifies the memory of the ex Iron Curtain.

When referring to the regeneration of these liminar landscapes, we certainly think about the symbol of this process, Berlin, with its important architectural, infrastructural and urban reconstructions, among which the project for the Museuminsel, Potsdamer Platz and the East Side Gallery are the most meaningful examples. The East Side Gallery in particular is considered the longest art gallery in the world, risen up towards the part of the Wall along river Sprea, in front of East Berlin. Potsdamer Platz, instead, Western to Friedrichstadt, one of the central places of the city, since the beginning of 1900s, has recovered its full value becoming the keystone of a meaningful wider operation of urban renewal.

Besides, there are also other smaller and less popular examples, such as Chvalovice (Czech Republic), Excalibur City, today turned into an amusement park near the border between Czech Republic and Austria. During the war, it used to be part of a military controlled area close to the Iron Curtain.

Or such as Gorizia, Italian city historically connecting the Latin world to the Slavic and German ones, where the construction of the curtain had as a consequence not only the division of the city in two parts, but also the foundation of a second city, Nova Gorica. This new city was supposed to be the symbol of the counterposition of progress according to the communist world against the one brought on by the capitalist world.

Nowadays, the two cities are part of two different countries and share only Piazza Transalpina, one of the most significant places of political and ideological separation between Western and Eastern Europe. It's interesting to notice how this place, which was born as destination point and railway station, crucial node of exchange and cultural connection for people, was re-invented after the end of the war as a square, a symbol of birth and new birth, of memory and cradle of civilization, a symbol of the new link between peoples, to emphasize how different cultures, separated by the Cold War, have now a new opportunity to reconnect and reshuffle themselves while maintaining their own particular identity.

2 CONCLUSION

This description seems to suggest how the social, economical, political and morphological context can change according to various directions and how it can offer different results despite, in the beginning, the conditions appeared similar. Since our objective is to use this type of analysis to understand deeper the changes that are occurring and to direct the future scenarios of the places where we live, it's clear that the idea of resilience needs to be the foundation to conceive strategies and tactics for the articulation of their renewals and later adjustments. This implies two main



Figure 1. Moudlareuth: diagram with the Iron Curtain.

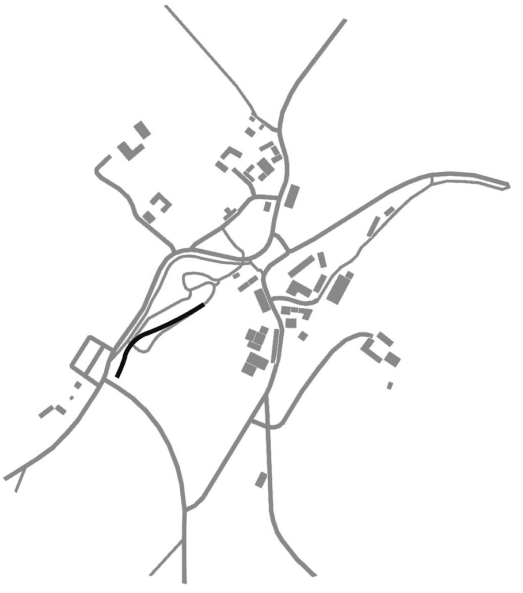


Figure 2. Moudlareuth: diagram after the Iron Curtain.

relations inside the architectural and urban design process, both of which are part of the notion of landscape: the relationship space/shape and time, as the necessary condition following eventual changes, and the relation to culture, or to cultures indeed. The notion of landscape contains both the interlocutors of this relationship, time and culture, as it differs from the idea of territory that was developed during the second half of the XX century as "a system to measure space". Just like the concept of architecture itself, the term territory relied on the idea of eternity, stability and of a unique culture. "The idea of landscape instead asks architecture for undefined time, it asks to have a chance to age together, to keep changing" (Ricci, 2013).

To design while taking the characteristics of time into account leads to activate strategies that are more connected to the idea of design as a process, either in the definition phase and in its actual development through a piece of architecture, and in the preset and eternally stable result.

There are three operating methods applicable to this relationship, and they can overlap and multiply the effects. The first one concerns the inclusion of time, determined by the idea of design as participatory process; the second one, instead, implies a more direct association of time and spatial solutions, including the variation of the project shape, of its use and of its material through time. This operating method refers to the particular concept of open work ("opera aperta"), defined by Umberto Eco: "The poetics of opera aperta tends to promote the performer through "acts of conscious liberty", placing him at the active centre of endless networks. (…) The opera aperta as a proposal for a range of interpretative opportunities, as the configuration of substantially undetermined impulses, so that the user is led to a serie of continuously variable interpretations; structure as constellation of elements



Figure 3. Gorizia: diagram with the Iron Curtain.

that arise according to different reciprocal relations" (Eco, 1967). The last operating method is more literal, since it purely refers to temporary projects, which, in some cases, are introducing interesting relationships between advanced technologies and architecture.

However, landscape isn't only a spatial condition, but it's also the cultural reflection of a place. Thus, this is something extremely important to wonder about in our historical period, as it is quite difficult to state which cultural reflection our landscapes should be made of. It's likely to be appropriate to address the panorama of the design process to those strategies involving cultural diversity, which can find the capability not to homologate nor dilute, but to usefully



Figure 4. Gorizia: diagram after the Iron Curtain.

interact and to imagine new possibilities for different worlds right in the structural resilience of the project's spatial character.

The frame we get is "an ethnic panorama (…) not only constituted by refugees and exiles, but by tourists, seasonal workers, and other crowds moving" (Appadurai, 1996).

The social and spatial processes that were born after demolishing the Iron Curtain show the capability of public space in taking the main role towards this direction. Both on a territorial scale, such as the project of the Iron Curtain Trail, which defines a cycle path from Scandinavia to Turkey, crossing 20 countries and extending the previous line of the wall further than its actual existence; and on an urban scale, recalling the square belonging to Nuova Goriza and Gorizia.

Both the projects are a landscape, despite the different scale, as they are both regenerating places as well as offering a new idea of citizenship, continuously changing. They serve as large containers, not only because they represent a compensation for a tragic past – if they had only such objective, they would only become monuments, useless for the future processes – on the contrary, because they are able to welcome diversity and mutations. With their spaces, they give a contribute in response to a functional condition and, more properly, they build common spaces, in their wider meaning.

This result can be only be reached by re-centering the actual needs of society and people, towards a new picture of what it means common good. Thus, common good doesn't rely only on material and economical aspects, but it has an immaterial side depending on the relational and emotional world: it is linked to the relationships between us and the others, just as well as to the places where these relationships are developed. Also the anthropologist A. Appadurai, in his studies about slums in Indian cities, explains how life in such places allows some important processes for the development of the planet – for the future of the Western world, too – to take place. Even in those places where the "traditional" public space isn't provided of any useful historical precedent, the presence of in-between spaces can be considered the image of a collective space. A collective space characterized by parallel and simultaneous activities, instead of the space of interconnected and common purposes. Dispelling any doubt about the capability of public space to be still useful for our cities, this truly confirms how addressing the perspective to these very principles is beneficial and fruitful.

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The social [il]logic of [sub]urban exodus: The rise and fall of Nasr City and the evolution of the Egyptian middle class

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ABSTRACT: The main focus of this paper is Nasr City, one of Cairo's largest residential districts. It examines the forces behind its inception in the early 60s, its boom throughout the 80s and 90s as the hub of the Egyptian middle class; and its rapid decline as such since the mid 2000s. Through an encapsulated review of modern Egyptian socio-economic history, this paper aims to prove that each of the aforementioned instances in Nasr City's evolution directly corresponds to a major political and economic shift that resulted in significant social change. Such discourse would then be used to understand the psychological drive and sociological logic, or lack thereof, that fuel the rise and fall of urban attractors.

1 INTRODUCTION

Since its inception, the urban growth of Cairo has been largely a byproduct of major political and economic shifts that in turn prompted instances of significant social change. Such instances, which favored either an already existing social group or a newly introduced one altogether, typically manifested in a new urban attractor outside the city proper that served said favored social group. Eventually, that urban attractor would merge with the city proper either by virtue of the natural growth of the city, or – more often than not – due to the fast growth of the urban attractor itself as members of other social groups, who aspired to liken themselves to its inhabitants, gravitated towards it. Such fast growth usually happened on the cusp of one of the aforementioned instances of significant social change, which once it stabilized, a new urban attractor for its subject societal group would emerge, and the whole cycle would start again.

Cairo itself owes its existence to such dynamic. It started as an exclusive walled capital for the Fatimids – a foreign dynasty that had conquered Egypt, and which was rather ideologically different from the country's general population. As such, it was situated north of its precursor, alFustat, where Egyptian urbanites dwelled, and it was only after the fall of the Fatimid dynasty that Cairo exhibited significant growth as said native urbanite population started gravitating towards it. Since then, Cairo's thousand-year history has been dotted with many similar manifestations of such dynamic – from Khedive Cairo which marked the consolidation of the Muhammad Ali Dynasty that ruled Egypt from the early 1800s to the mid 20th century, to suburbs of Heliopolis and Ma'adi which marked the increasing European influence in Egypt since the late 19th century.

This paper, however, is primarily concerned with Nasr City – the latest, and arguably the clearest, manifestation of such dynamic, as it closely mirrors the evolution of the modern Egyptian middle class since the mid 20th century. It aims to examine the forces behind its inception in the early 1960s; its boom throughout the 80s and 90s; and its rapid decline since the mid 2000s. But most importantly, it aims to pose the argument that in numerous cases, the decline of Nasr City is at best premature, if not unwarranted altogether.

2 A BRIEF SOCIO-ECONOMIC HISTORY OF EGYPTIAN SOCIETY AND THE PROMISE OF NASR CITY AS A MIDDLE CLASS UTOPIA IN 1960S

For the first 160s years of its history, the modern Egyptian middle class remained a very homogeneous social group of well-educated professionals and bureaucrats. Its origins date back to the early 19th century when Muhammad Ali, a high-ranking Ottoman army officer who was actively establishing a feudal dynasty in Egypt at the time, elected to equip a small portion of the native Egyptian population with a modern education in order to run the various industries and administrative bodies of the country's agrarian economy which he had consolidate under his control. Due to its inherent feudal nature however, the socio-economic system established by Muhammad Ali was rather rigid and allowed for little to no social mobility. As a result, the budding Egyptian middle class remained a rather small social stratum throughout the 19th century and the early 20th century, as evident by the fact that, in 1914, the Egyptian middle class constituted a little under 10% of the country's population that was polarized between a lower class of peasants that amounted

to 90% and an upper class of aristocratic landowners that didn't exceed 1% (Amin, 2001).

However, thanks to the efforts of Egyptian middle class pioneers during the early 20th century, which aimed to make all education stages prior to university level free, and allow members of the peasant class to enroll in the Officers' Academy, the middle class exhibited a noticeable and steady growth starting in the 1940s while maintaining its longstanding homogeneous structure. Those reforms had allowed an increasing number of lower class individuals to get an education and subsequently become employed in the government or join the officer ranks in the Egyptian Army, which effectively helped them attain middle class status. As a result, by 1952, the Egyptian middle class had doubled to about 20% of the country's population (ibid).

In July of the same year, the Free Officers, a group of middle class Army officers who had attained such status during the 1940s as a result of the aforementioned reforms, staged a coup d'état within the Army, which then quickly developed into a fully fledged overthrow of the Muhammad Ali dynasty and the declaration of Egypt as a republic in 1953. Under the presidency of the Free Officers' key figure – Gamal Abd-alNaser, the regime that emerged in the aftermath of those events implemented a number of socialist-inclined policies which centralized all aspects of the economy under the control of the state in hopes of bringing about social equity. It stripped the aristocracy of its mass agrarian holdings and redistributed them in smaller parcels among the vast peasant lower class; it nationalized all large scale foreign and private companies and used their revenues to fund large scale national projects and the establishment of a national industrial sector; it embargoed all foreign investment and brought the private sector under extensive regulation, and at the same time, it augmented and expanded both the size and scope of public sector establishments, all of which effectively installed the public sector as virtually the sole economic agent in the country. The Nasserist regime also adopted a number of welfare policies that saw the state heavily subsidize the prices of goods and services offered through the public sector; it further extended the scope of free education to university level; and it put into effect employment policies which obligated the government to provide job opportunities for all university graduates.

In effect, the socialist reforms of the Nasserist regime resulted in a socio-economic system that not only championed and catered to members of the middle class, but also installed their characteristic hallmark of acquiring an education as the primary means of social advancement, and created the favorable circumstances to do so. Thanks to the extension of the scope of free education, and with the economic hardships of peasant farmer alleviated due to the agrarian reform laws, an exponential number of lower class individuals enrolled in the public education system to earn a professional degree, after which they were offered high paying jobs in the rapidly growing public sector, and henceforth enjoyed comfortable life styles thanks to the added convenience of government subsidies. As a result, the Egyptian middle class exhibited an unprecedented exponential rate of growth throughout the 50s and 60s while still maintaining its longstanding homogeneous makeup.

Arguably however, the greatest testament to the Nasserist regime's commitment to the middle class came in the late 1950s with the establishment of Nasr City, a suburban settlement on Cairo's eastern desert periphery. In many ways, Nasr city was the legitimate 'urban' child of the era. For one thing, it was Cairo's first ever high-end urban settlement to be purposefully dedicated to the middle class from the outset. The other four Cairene high-end residential neighborhoods at the time – Zamalek, Garden City, Ma'adi, and Heliopolis, which all predated the 52 revolution – originated as suburban settlements for the social elite and foreigners. They were also originally planned and developed by foreign entrepreneurs and private companies. Nasr City, on the other hand, was the first to be fully developed by a national public sector body. But it was Nasr City's modernist urban scheme that really set it apart. Its orthogonal grid planning seemed to perfectly embody the socialist zeitgeist of its time, and was quite a departure from the late 19th century planning trends of Cairo's other high-end residential districts. That very same modernist character was also carried on to the brutalist architecture of the various government buildings and model neighborhoods that were constructed early on in Nasr City, which eventually set the tone for the residential architecture of the settlement as a whole.

Although Nasr City seemed poised for an urban boom, shortly after its detailed urban planning was finalized in 1966, its development came to an abrupt stop due to the outbreak of the Six-Day War in June 1967. In the years that followed, the government's military spending to rebuild the army and maintain attrition warfare flung the Egyptian economy into stagnancy. As a result, the pace of all public sector works of construction and infrastructure in Nasr City dropped drastically. Also, middle class individuals who had purchased lots in the settlement were facing difficulties building their residences, and those who hadn't were either reluctant or unable to buy property there altogether. And so by the early 70s, Nasr City was far from being the Utopian middle class community it was meant to be. The majority of the settlement was nothing more than desert landscapes with empty road networks cutting through, and such grim character didn't change much over the following ten years.

During the 1970s and 80s however, the Egyptian society continued to exhibit rapid social mobility, arguably at a much higher rate than the 1950s and 60s. And while the trends of social mobility during both periods manifested mainly in a considerable growth of the middle class, they were however hardly induced by the same factors. That period saw a radical change to the socio-economic system that was established during the 50s and 60s, and the middle class that emerged by

the end of 80s as result was far from the homogeneous class which had endured for almost a 160 years.

The change of the social landscape in Egypt during that period was brought about by three interrelated factors. Those were the ruling regime's adoption of the Open-Door Policy; the migration of Egyptians to work in Arab Gulf States; and runaway inflation. The Open-Door Policy was essentially an economic platform which sought to shift the 50s and 60s' state-controlled economy towards free market capitalism. It was introduced by Anwar alSadat, Abd-alNaser's successor, in early 1974 and was intended to "open up" the Egyptian economy to the foreign and private sectors in hopes that they would displace the public sector as its primary engines, and in turn jump-start the war-crippled Egyptian economy and bring prosperity to society as a whole.

Despite the strong overtones of Capitalism inherent within the Open-Door policy however, the Sadat regime retained some of the 50s and 60s' socialist policies – most notably the subsidization of basic goods and services provided through the public sector, universal free education, and the employment policies obligating the government to provide job placements to all university graduates. Those policies were essentially kept in place in order to avert social unrest. And while they might have served such purpose, the state's otherwise full compliance with the Open-Door policy rendered them far less reliable than they were during the 50s and 60s. As a result large portions of the Egyptian society found themselves in considerable economic hardship.

Such hardship in turn prompted scores of Egyptians to temporarily migrate to the Arab Gulf States during the 70s and 80s in pursuit of high-paying jobs. At the time, those states' new and thriving oil economies had a high demand for professionals, and an even higher demand for labor of all sorts. Moreover, they offered hefty salaries and wages that by far trumped those offered by any of the domestic sectors in Egypt. Given the multitude of difficulties they were facing at home, many Egyptian professionals therefore opted to leave the country altogether and migrate to work in the Arab Gulf States for a number of years in order to support their families back in Egypt and amass enough savings to secure their futures. However, the greater majority of Egyptian temporary migrants were semi-skilled & unskilled workers, craftsmen, and peasants who hailed form the poorer, less educated masses. They were essentially hired as cheap labor; nevertheless, the wages that they were offered in the Arab Gulf States were still quite high by Egyptian standards.

Although migrating to work in the Arab Gulf States offered a lot of Egyptians a way out of their economic troubles, such a trend had quite the adverse side effect on Egypt's economy. The sizable remittances of Egyptians working in those states to their families back home was chief among a number of factors which brought about a rampant rate of inflation that burdened the Egyptian economy for the better part of the 70s and 80s. Needles to say, such runaway inflation made the already strenuous economic hardships of a great many Egyptians even more difficult. But at the same time however, entrepreneurs who dealt in and took advantage of the surging market value of highly sought-after items benefited immensely from the 70s and 80s' rampant inflation. During that period, many Egyptians were able to make fortunes virtually overnight by anticipating the price fluctuations of those items; and accordingly knowing when to buy them at a relatively cheap cost and when to sell them for a sizable return once their value had surcharged. Interestingly though, not all of those Egyptians were originally tradesmen or businessmen by profession. That sort of opportunistic entrepreneurial activity was particularly common among the Egyptian workforce returning from the Arab Gulf States, as well as craftsmen and workers who capitalized on the rising cost of services and the shortage of labor precipitated by the mass migration of the Egyptian workforce to those States.

Ultimately, the Open–Door Policy; the Egyptian workforce's migration to the Arab Gulf States; and runaway inflation, along with their various effects throughout the 70s and 80s, had a number of significant social outcomes. For one thing, the introduction of new veins of generating income, and the subversion of others, induced very high rates of both upward and downward social mobility, which – once again – translated mainly in an exponential growth of the Egyptian middle class. By 1991, such growth was quite evident in the stratification of the Egyptian population according to income. Over the span of almost 40 years since the July Revolution of 1952, the relative volume of Egyptians receiving a middle class income more than doubled from 19% to 45% of the country's total population (Amin, 2001).

Unlike the 50s and 60s though, the social mobility during the 70s and 80s deeply altered the long-standing homogeneous makeup of the Egyptian middle class; and as a result, by the early 90s the middle class had become hardly the same harmonious stratum of well-educated, public sector-employed bureaucrats and professionals that it had always been ever since its genesis. Among those involved in that drastic social transformation were small-time public sector bureaucrats and clerks, who found themselves up against insurmountable odds starting in the mid 70s and quickly fell down the social ladder. With them out of the mix, the middle class that emerged by the early 90s consisted of two very distinct groups. Professionals – such as doctors, engineers, lawyers, accountants, university professors, and teachers – accounted for one of those two groups, and as such, they were essentially the only remnant of the original middle class structure that survived the socio-economic upheaval of the 70s and 80s, but have since been finding it exceedingly difficult to maintain their middle class status. The second group on the other hand was made up of the influx of entrepreneurs who hailed from the lower classes and quickly ascended through the social hierarchy during the 70s and 80s to become the other major component

of the Egyptian middle class. That social group was basically comprised of all the lower class individuals who amassed considerable financial gains by capitalizing on the unstable economic circumstances in Egypt at the time and adopting the aforementioned opportunistic entrepreneurial activities as occupations and primary sources of income. Their newly found large incomes in turn saw them attain middle class status, and in some cases even upper class status, accounting for the majority of the increase in the relative size of both those classes between 1952 and 1991.

But perhaps the most significant social outcome of the 70s and 80s was the drastic change in the values of Egyptian society. With the rapid social rise of the entrepreneur class, acquiring an education was no longer the hallmark of the Egyptian middle class or the main method of attaining a higher status within Egypt's social hierarchy. Instead, starting in the mid 70s, size of income and wealth – regardless of their source – became the main criteria for societal stratification in Egypt, and the most common means of climbing the social ladder.

Thus, the Egyptian middle class that emerged by the end of the 70s and 80s, and which is largely the same stratum that still exists today, was a class divided. Neither of its two factions shared the same values or sources of income, and they were basically lumped together as one class solely on the basis of an abstract range of how much income they generated annually.

3 THE SOCIAL LOGIC BEHIND THE RISE OF NASR CITY AS AN URBAN ATTRACTOR SINCE THE MID 80S

In the context of such divide, a phenomenon that could be best described as *social emulation* became rather prevalent within the Egyptian middle class as its newer members resorted to imitating almost every aspect of its older members' lifestyles, often in an ostentatious manner, in order to assert their newly attained middle class status. This peculiar phenomenon manifested itself across a number of different domains. For instance, members of the new middle class were preoccupied with acquiring the same grade of goods and products typically consumed by the old middle class. But most importantly, they were also quite keen on situating their residences in the same neighborhoods where large populations of the old middle class were known to dwell. In a sense, such behavior was essentially a social form of a compensation mechanism. At that time, and despite the relative decline of their economic status, members of the old middle class – namely professionals – were still considered to be a social ideal to aspire to in the collective consciousness of Egyptian society. The members of the new middle class on the other hand had just attained their middle class status; and they had done so over a very short time span and not through the long-standing tradition of acquiring an education, but rather by accumulating wealth through practices that were then widely regarded as unscrupulous. It was therefore only natural for them to feel the need to associate themselves with that old, more established faction of the middle class. From their standpoint, a visible display of their ability to match the material attributes of the old middle class using their newly found wealth served such purpose; and proved to themselves, as well as to the rest of society, that they had indeed become part of the middle class.

The main argument here is that this notion of social emulation, as outlined above, played *the* central role in the urban boom of Nasr City which began towards the end of the 80s. Both this argument, as well as the outlined understanding of why and how social emulation operates, draw primarily on the works of Abraham Maslow and Jean Baudrillard.

Maslow's 1943 paper entitled "A Theory of Human Motivation" holds the key to comprehending the psychological drive behind the tendency of the members of a rising class to imitate the archetype of the class into which they have been newly introduced. In this paper, Maslow identifies five basic human needs and arranges them in an ascending order of satisfaction priority as follows: the physiological needs; the safety needs; the love and belonging needs; the esteem needs; and finally the need for self-actualization. Basically, he argues that an individual is typically preoccupied with satisfying the needs found at the lowermost tier of this hierarchy; and that once such goal is reached, he or she then moves on to the next, higher tier and seeks satisfying the needs it entails, and so on. This hierarchy of human needs is a rather popular concept, and its tiers are self-explanatory for the most part. What is of particular relevance here is the third and fourth tiers of this hierarchy; namely the belonging needs and the esteem needs.

The belonging needs are defined by Maslow simply as a condition wherein "[a person] will hunger for … a place in his group, and he will strive with great intensity to achieve this goal" (Maslow, 1943). His definition of the esteem needs, however, is a bit more elaborate:

> *"All people in our society … have a need or desire for a stable, firmly based, high evaluation of themselves, for self-respect, or self-esteem, and for the esteem of others. By firmly based self-esteem, we mean that which is soundly based upon real capacity, achievement and respect from others. These needs may be classified into two subsidiary sets. These are, first, the desire for strength, for achievement, for adequacy, for confidence in the face of the world, and for independence and freedom. Secondly, we have what we may call the desire for reputation or prestige (defining it as respect or esteem from other people), recognition, attention, importance or appreciation."* (ibid)

In the same paper, Maslow also points out that the hierarchal arrangement of the five basic human needs is not all that rigid; and identifies satisfying the esteem

needs before the belonging needs as the most common reversal within the hierarchy (Maslow, 1943). He argues that, for some people, satisfying the esteem needs takes precedence over satisfying their need to belong mainly due to the notion that a person who is most likely to be considered as part of a certain group is one who inspires the same kind of respect reserved for the members of such group. These people therefore seek "self-esteem and its behavior expressions more as a means-to-an-end than for its own sake". That is to say, they seek respect for the sake of belonging rather than for sake of esteem itself.

Extrapolating Maslow's arguments to the social context in Egypt during the 70s and 80s explains why social emulation was such a prevalent phenomenon at the time. By imitating their old middle class counterparts, members of the new middle class were, albeit indirectly, satisfying an innate human need to belong. As discussed earlier, despite the fact that their newly found wealth categorized them as members of the middle class, the then unconventional means by which they came to posses it casted doubts on their status as such. Acquiring and exhibiting the same material attributes as the old middle class was essentially their way of commanding the same kind of respect and prestige that society reserved for its members; which in turn gratified their desire to feel and be recognized as true members of the Egyptian middle class themselves.

Moving on from the realm of Human psychology and onto the field of sociology, Jean Baudrillard's 1970 book "The Consumer Society: Myths & Structures" offers a material understanding of how social emulation takes effect in a modern consumer society – which is precisely the sort of social structure that the Egyptian society was developing into during the 70s and 80s. In the section entitled "The Social Logic of Consumption", Baudrillard states that in a consumer society "you never consume the object in itself (in its use-value); you are always manipulating objects (in the broadest sense) as signs which distinguish you either by affiliating you to your own group taken as an ideal reference or by marking you off from your group by reference to a group of higher status". This explains why the members of the new middle class developed such a voracious appetite for acquiring the same goods and services as their old middle class counterparts. Their visible consumption of such "objects" was basically a "social signifier" that distanced them from the lower classes they had risen from, and associated them with the members of the old middle class who were the ideal reference of the higher-status group they had recently become part of.

In that same section however, Baudrillard also argues that given the very nature of manufactured goods and services, the visible act of consuming them is bound to become the least effective of social signifiers (Baudrillard, 2008). His argument is this: because those consumer objects are by definition mass-produced, they are therefore abundant and readily available to all. This in turn will make them "less and less expressive of social rank", and instead of being a means of social distinction, they will eventually have a completely opposite "homogenizing" social effect. From there, Baudrillard then postulates that "consumption (taken in the sense of expenditure, of the purchase and possession of visible objects) will gradually concede to other criteria and other types of behavior the preeminent role it currently plays in the variable geometry of status"; meaning that it will be replaced by new, more effective social signifiers. In that respect, he identifies *habitat* as the most important emergent means of social distinction in consumer societies. He states:

> *"Segregation by place of residence is not new, but . . . it is tending to become decisive, in terms of both geographical segregation (town centers and outskirts, residential zones, rich ghettos, dormitory suburbs, etc.) and habitable space. . . . Objects are less important today than space and the social marking of space. Habitat thus perhaps has an opposite function to that of other consumables. The latter have a homogenizing function, the former a differentiating function in terms of space and location."* (ibid)

In light of this statement, it is easy to understand why members of the new middle class fervently pursued residing among their old middle class counterparts. It was mainly because a *dwelling* and its *urban context* are by far the most visible, and least accessible, of consumer objects; and therefore the most expressive of social signifiers. It allowed members of the new middle class to communicate their association to the middle class ideal in a rather conspicuous manner by situating their residences in the same neighborhoods where their old middle class counterparts were known to dwell. Such an act amounted to putting up a literal social façade that concealed their lower class origins and showcased their new, higher status against a comparable middle class backdrop – *it basically assimilated them into the social milieu of the middle class by helping them physically blend in a middle class urban environment.*

Of all the residential neighborhoods in Cairo at the time, the use of a *dwelling* and its *urban context* as a tool of *social emulation* was the most prevalent in Nasr City – and it was such prevalence that fueled Nasr City's rapid urban development towards the end of the 80s. As it was discussed earlier, Nasr City was the only Cairene residential settlement that was conceived as a middle class neighborhood from the outset; and it continued to live as such in the collective consciousness of Egyptian society even after its development came to an abrupt stop towards the late 60s, and as it remained undeveloped throughout the following twenty years or so. The status of Nasr City as the quintessential middle class neighborhood, along with its underdeveloped character, were essentially what made it the most fertile urban medium for the manifestation of the abovementioned variant of social emulation when the demand for "middle class" residential property surged around

the mid 80s. As a result, by the early 90s, Nasr City had grown into one of the biggest middle class habitats in all of Cairo, and in such a way where its architectural typologies closely mirrored the deep social differences that divided the Egyptian middle class.

The socially driven demand for Nasr City was quite evident in the fact that, between 1986 and 1996, Nasr City's population grew at an annual rate of 8.2%; the highest of all of Cairo's high-end residential districts (elBahrawy, 2015). With professionals accounting for 55.5% of its 256,000 inhabitants in 1996, the highest percentage and one of the highest residential district populations in all of Cairo respectively, Nasr City was truly *the* residential hub of middle class professionals (ibid). Given the high real estate value in Nasr City at the time, it is safe to assume that the entrepreneurial new middle class accounted remainder portion of its population, making it truly the residential hub for the middle class as a whole.

A combination of residential ownership census data and urban observation in Nasr City strongly suggest that the settlement is also the hub of an architectural phenomenon unique to its professional middle class inhabitants. It is rather evident that the greater majority of Nasr City's bylaw-abiding apartment buildings, which stand at a maximum of 5 storeys, are in fact the extended family households of middle class professionals. Within that typology, each of the nuclear families of the household's different generations has its own apartment unit. Also, owing to their simple post-and-beam structure systems and their very modernist modular arrangements, the units in those apartment building–extended family households would typically undergo multiple alterations as the needs of their inhabitants change over the years.

Despite being the most prevalent in Nasr City, the apartment building–extended family house typology constituted only a fraction of the settlements' residential structures. The greater majority of said structures were towering condominiums that were in violation of Nasr City's building bylaws, and which housed unrelated nuclear families of both professionals and the new entrepreneurial middle class. Such condominiums were essentially the architectural manifestation of the socially driven demand for Nasr City. However, given that Nasr City's infrastructure was designed to serve residences of a 5 storey maximum height, the prevalence of the condominium typology soon took its toll on the urban quality of Nasr City as a whole.

4 THE SOCIAL [IL]LOGIC OF THE MIDDLE CLASS PROFESSIONALS EXODUS OUT OF NASR CITY SINCE THE MID 2000S

Starting in the mid 2000s, there seemed to be a mass exodus out of Nasr City towards New Cairo – a suburban settlement on Nasr City's eastern periphery which boasted a planning scheme that marked a return to the curvilinear and deformed grids of Cairo's late 19th century residential districts. This exodus is quite evident in the fact that between 1996 and 2006, New Cairo posted an annual population growth rate of 13.4%; the highest in all of Cairo (elBahrawy, 2015). Many of those existing Nasr City are middle class nuclear families that dwelled in its condominium typology, and who are seeking to establish extended family households in New Cairo. But given that the percentage of professionals dwelling in Nasr City dropped to 46.2% by 2006, as well as the rampantly growing trend of demolishing bylaw abiding apartment buildings in Nasr City, a considerable number of those abandoning Nasr City are extended families of middle class professionals that dwell in Nasr City's apartment building–extended family house typology. And while the move of the former group is justifiable, the move of the latter group makes no logical sense at all.

For one thing, there is little difference between the architectural typologies of Nasr City and New Cairo. When middle class professionals relocate their homes to New Cairo, they still construct those new homes as extended family houses. Although they are dubbed 'villas' in New Cairo, the internal organization of the villa typology is still comprised of apartments, each of which is typically assigned to a current or future nucleus family of their decedents. These might not be as typical as those in Nasr City's typology, but they are still apartments nonetheless. The only difference of note between both typologies is the architectural style of the building facades. In New Cairo, the prevalent architectural style can be best described as a gaudy derivation of Neo-Classicism, while the apartment building–extended family houses in Nasr City hardly boasts any style due to their very bland outward appearance. This is usually cited by middle class professionals as one of the primary reasons for relocating to the suburbs of New Cairo. Setting aside any commentary on taste and style, their justification is inherently flawed because of the very adaptable nature of the Nasr City typology. It is relatively easy to alter the outward appearance of an apartment building–extended family house so as to resemble the same prevalent style of New Cairo without the need to relocate there.

There is also the issue of how the villas of New Cairo are constructed. The floor plans of those villas more often than not follow a non-modular structural grid and employ structural systems, such as hollow block slabs and flat slabs, that maximize spans and in turn allow for larger, more open interior spaces. The prevalence of such structural systems is primarily driven by a desire for a more grand and luxurious character to the home. The downside to utilizing those systems, however, is that floor plans are much more difficult to alter. In comparison, the simpler and modular post and beam construction system of the Nasr City apartment building typology endows it with a very adaptive quality. That is to say it is far less likely for the villas of New Cairo to accommodate the changing needs of the extended families that live in them as opposed to the Nasr City typology which has done so for multiple

generations, and has the potential to continue to do so for generations to come.

However, the aspect in which the Nasr City typology has a clear advantage over the New Cairo equivalent is how many generations they can house simultaneously. With a maximum building height of 3 storeys for the villa typology in New Cairo, an extended family house can't even fully accommodate 3 generations simultaneously. Assuming that each floor has 2 apartments of a decent size, and that each generation has two descendants; that would leave 1 grandchild with no accommodation. And that is not taking into account extended families in which each generation would have more than 2 decedents. Whereas in Nasr City, where the original building bylaws allowed for 5 storeys, an extended family house for the same extended family can easily house 3 of its generations simultaneously with 3 apartments to spare. In other words, middle class professionals are essentially trading down when they relocate to New Cairo and, in turn, are compromising an inherent architectural characteristic that defines them as a social group. Not to mention, that leaving their extended family houses in Nasr City usually involves breaking up the extended family as most commonly each of the siblings of a household's second generation will construct their own extended family house, since if they were to build an extended family home together, the home would only be able to accommodate 2 generations simultaneously.

Finally, and most importantly, there is the question of the cost for middle class professionals to relocate their homes to the suburbs. Although real-estate value in Nasr City is still much higher than in New Cairo, when one takes into account that the value of their extended family home in Nasr City is going to be divided amongst its inhabitants, as well as the construction and permit costs of their new extended family homes, more often then not they hardly break even, or even end up losing money with their new acquisition. Such high costs have a deep impact on their economic standing as a social group, and in turn their status in Egyptian society, in which currently money is the main determinant of one's place in the social hierarchy.

The tragedy here is that most professionals are fully aware of all the abovementioned shortcomings of relocating to the suburbs. Yet, they are still resolved in their decision to move there. That is mainly because such a decision is not based on any rational reasoning, but is rather socially driven. The ideas of Norbert Elias concerning the social role of kitsch in a modern society, holds the key to understanding such drive:

> *"If we leave aside obviously utilitarian forms, any aesthetic work has for the "public", for the mass of the working population, the function of a leisure dream. This function gives our arts a very different face, compared to those of court, patrician or church hierarchies. The need of mass society for leisure pastimes . . . is supplementary to the primary needs for work and bread. It is never as vitally important as these, and the form it takes is determined by them – for example, by the constant strain of professional life, the desire to discharge feelings heavily suppressed in working life, or the tendency to seek in leisure substitute satisfactions for wishes not fulfilled by work. In face of the compulsive way in which professional life pushes the leisure activities of the industrial man in a highly specific direction, the individual art specialist is powerless. He may poke fun at such activities as much as he likes, deriding the leisure dreams and the taste of souls deformed by work pressures as 'kitsch', and mocking the 'sentimental' manner in which feelings pent up and damaged under the constraint of work are expressed. The need for that which is here called 'kitsch' is socially imposed, while kitsch itself, in the negative sense of the word, is the faithful reflection of a state of the soul engendered by industrial society. This endows the problem of kitsch with a seriousness with which it is not normally credited."* (Elias, 1998)

Although Elias' ideas apply to the abstract realm of art, they are quite pertinent to the contemporary social dynamic in Egypt. Those whom he refers to as "the working population who's souls [are] deformed by work pressures" are essentially middle class professionals, and what he refers to as their "leisure dreams" is their desire to relocate their homes to the suburbs of New Cairo. Their strong desire to move there is the outcome of the "constant strain of professional life, the desire to discharge feelings heavily suppressed in working life, or the tendency to seek in leisure substitute satisfactions for wishes not fulfilled by work."

Today's middle-aged Egyptian Professionals grew up in the 50s and 60s, at a time when professionals were revered as a social ideal, and were guaranteed a comfortable lifestyle and economic standing by the socio-economic system of the era. Accordingly, this generation worked hard and excelled in the realm of education in order to become professionals themselves. However, when they started their professional careers in the mid 70s, the socio-economic landscape in Egypt was drastically shifting in the wake of the introduction of the Open-Door Policy. Instead of leading the comfortable lifestyles they were expecting, professionals struggled to maintain their middle class status and a decent economic standing, and they continued to do so over the span of the last forty years. Now, they believe they are entitled to feel and project that they have indeed retained their middle class status in the face of such adversity. This is where relocating their homes to the suburbs of New Cairo comes in as a tool of achieving such a goal.

Forty years after the Open-Door Policy has been introduced, the radical change of the value system of Egyptian society has been firmly established, where size of income and wealth are the sole basis for societal stratification regardless of their source. In turn, the

much more affluent new middle class entrepreneurs became more socially confident. They no longer felt the need to reside in the same urban context as the old middle class in order to prove their worthiness of a middle class status. Accordingly, they relocated to the suburbs of New Cairo, making it the new urban mainstay of social status. This prompted the middle class professionals whose middle class status had been hanging by a thread for so long, and who now feel entitled to be recognized as still being a part of the middle class, to move to the suburbs as a means of social validation. That is to say, much like the social emulation by place of residence has contributed to the rapid growth of Nasr City throughout the 90s, it is now contributing to the rapid growth of New Cairo – only the role of who is emulating whom has been reversed. It is now the middle class professionals who are seeking the respect of others in order to feel that they indeed belong to the middle class. They are the ones whose sense of self worth is becoming more and more dependant on other people's opinions of them.

5 CONCLUSION

As Elias pointed out, it is futile for any critic to argue against the trend of middle class professionals abandoning their apartment building – extended family houses in Nasr City with the hopes of countering it. Any such arguments would fall on deaf ears, for the social [il]logic behind that move trumps any rational reasoning. Nonetheless, it is sad to see such typology, which – given its concrete structure – has an average life span of about 70 years, be abandoned before realizing its full architectural, not mention its generational, potential; and in turn witness the demise of Nasr City as a hub for a characteristic portion of the Egyptian middle class.

This issue is presently all the more pertinent given the recent announcement of the New Capital – a massive urban project to the east of New Cairo which seems to be slated to become the urban attractor of the post-Uprising Egyptian society. Much like Nasr City's ongoing demise 20 years after its urban boom, it seems like New Cairo is going to meet the same fate, deeming the premature disposal of architecture and urban attractors the new norm in Egypt.

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Social and political agency of architecture: Performativity and the contemporary global city

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ABSTRACT: This paper proposes an approach to recent events taking place in urban spaces across the world that challenge the social and political frame that present-day globalization set up as a given fact. Some of this events, as different and variegated as they are, nevertheless hold in common an aim to regain for architecture its role as an operative frame, relying in its social and political agency rather than in its built aesthetical form. This paper will try to approach those events as the result of a certain performative agency of architecture, one that allows architecture to regain its original condition as the source of the political. To do so, we will discuss what performativity is and in which sense architecture is performative, to later briefly review its historical performative agency, ending with a contemporary example of this regained active condition of architecture in the city of Madrid: El Campo de Cebada.

1 FORE-WORD

1. There are some recent urban phenomena in different places across the world that deserve a close attention and that are in need of theoretical conceptualization.

2. These phenomena are multifarious, adopt many different faces, but can be joined under the general umbrella of *shared urban practices*. They involve the creation of powerful (though limited) social networks independent, if not directly at odds with established powers. Practice (and agency) are their key words.

3. They claim for, and demonstrate, the viability of a different "use" of public space. In doing so, they redefine terms as "use" or "public", since the way they work deconstruct common and established assumptions of what public, private, use, shared, common, consume and other similar worn words mean. In fact, they "create" "new" "public" "space" (the use of quotation marks is not trivial, or a mere figure of discourse, but essential: it marks the redefinition those terms suffer under the agency of these practices).

4. Although they are usually small scale interventions, bounded to fairly limited spaces and with experimental vocation (which should not be diminished as experimental, but appraised because its "experience" content), they have an infrastructural ambition. This infrastructural ambition points both to built infrastructure (ranging from ephemeral interventions to "street collaborative furniture" to more formal constructions) and to a more immaterial understanding of infrastructure: they produce relational networks and shared knowledge aggregators providing social infrastructure.

5. They work (but not always) in an ambiguous space regarding political, economical and even legal frames, hence its potentialities (and some of its difficulties). For example when wi-fi pro-common open networks are laid to connect people inside city areas, overlapping established telecommunication networks they push to its limits the concepts (and the legal definitions) of the public and the private, legal and illegal, business and agitation. If they are allowed to exist by the ruling power it is mainly because they are seen as "avantgarde artistic interventions", but they nevertheless contain very powerful and risky potentialities for the neoliberal-global capitalist practices (to be exploited).

6. They put together many different kind of actors and "intelligences" ("collective intelligence practices" is one of its possible definitions; there is also a very interesting platform of architects, designers, artisans and common people in Spain and Latin America called "Inteligencias Colectivas" http://www.inteligenciascolectivas.org/), regardless its background, technical knowledge and so on. The only requirement to participate in this practices is to be a citizen (not necessarily according to legal documents, since they will, of course, include illegal immigrants, people without fixed residence and so on) and to be eager to engage in a shared activity that produces, in turn, better urban environment and renewed community engagement.

7. Of course they promote, produce, and enhance people empowerment.

8. Environmental questions are significant: environmental regarding "green practices" (urban gardens,

clean and autonomous energy systems, recycling), but also environmental because they create new physical and especially social environments.

9. A shared, common language is needed for all those so different actors to engage in fruitful work (performativity). A composite language, one linked to spaces and sites ("placemaking"), to the actual places where these practices happen and to the end they address, the contemporary city (and its socio-political regime) and to the many actors they involve. A language open to recyclability and reuse (compost). A language worked with words but also with hands, since many of these practices involve common handwork to produce things and networks. A language close to the body, and to the lived body, but also a supplementary, prosthetic language, in which *techne* joins theoretical knowledge and the senses. An ordinary language that produces instead of a language that merely describes or states.

10. Our proposal is that architecture is this composite language. And this language is in the form of performativity.

2 WORD

What we try to propose from now on is an attempt not exactly to provide some answers to the questions and statements mentioned above (although some will be elaborated and even exemplified) but to offer a foundational ground, some theoretical remarks that allow us to understand those phenomena and to explore its operativity and the sustainability of its practices (i.e. its soundness, since are not foundations intended to be sound?) in the context of a different politics of spaces and bodies. This situations are in fact part of a widespread net of actions and happenings developing in Madrid and other cities in Europe but also (although with different and not necessarily the same local overtones) in other places across the world, including especially Latin America. In that sense it is a phenomenon that in many ways challenges the actual political dominion of global capitalism in favor of distinct collaborative alternatives of political representation and social constitution. Of course it is not our aim to address the full complexity of this phenomenon in the space of this paper, but to point to the key role architecture plays in these processes, to its regained condition as source of the political, and to explore some of the ways in which architecture and architectural design allows (or even enforces) this processes (its performativity).

To begin with we need to introduce first and provide some basic account of the term intended to act as this foundational ground from which architecture (and the following mentioned practices and situations) take its agency. So a short summary of theory on performativity and performativity concerning architecture follows. As performativity, precisely, performs, it does so in its intermediate condition, in the friction and resilience of bodies, in the relationships that arise in the borders and surfaces in which architecture opens up space to fields of signification. Therefore we will focus briefly in the in-between spatial condition in which meaning arises and in the necessary engagement of (historical) architecture and users in transformative practices. Finally, and to return to the foreword, we will focus briefly in a particular experience taking place now in Madrid ("El Campo de Cebada") that emerge as perfect example, in its always double condition of individual example and paradigmatical (*iterable*) dispositive.

2.1 *Performativity*

According to philosopher J.L. Austin (1962), there is a particular kind of linguistic utterances, that he came to name performatives, different to those that describe a fact or a particular state of things or make a statement about something, that put in motion some (original?) condition of language as action: so to say, they *produce* what they *say* by way of saying and acting *at the same time*. In that sense they are self-referential (there is no such thing as a referent that is outside and prior to the actual utterance – the speech act – to what they can refer). But more important, they imply a particular medium or context in which they are to be uttered to produce the desired action: they need a community to address and a formulary or ritual environment to be framed in. A very determined context. They need, in that sense, to be staged, immersed necessarily in theatrical drama. Using a topical example, for the words "I pronounce you husband and wife" have its full effect, the performative act of joining together two persons into the legal form of marriage produced by a celebrant, it is necessary on the one hand that the community context is determined and on the other that the utterance is produced following a strict set of rules (the first of one is its repeatability) in the form of a ritualized ceremony. Both conditions, then, try to determine as much as possible the circumstances that allow the utterance to have its effect, circumstances that need to be closely related with a particular and determined set of acts. It is not only the utterance, the actual words, which make the effect, but the especial way and place (medium) of saying that words, the act that goes along with them. In short: words and acts are knitted together in the performative act, and that should be made according very precise community rules. The relation with theatre performances is important, since action (body action) and speech both together produce the effect when adequately staged.

There is another important point that Austin makes clear: those kinds of utterances cannot be true or false, but they simply can be "infelicitous" or "unhappy" (or not). They are not related to truth, they are not laden with truth values, but rather they are judged according the effect they produce *a posteriori*. If truth (in the positivist tradition form which Austin comes) is permanent, *a priori*, independent of the context and unaffected by acts, performative utterances introduce a much welcomed stir. Welcomed because it moves the focus toward the event, toward the unexpected and

toward what is to be construed. Toward what is to come (French *l'avenir*). Performatives (or *illocutionary acts* as later Austin called them) imply producing something that does not exist before, and in that sense not only produce a new state of things but also put together the different actors implied in the utterance in a particular relationship of community. A relationship that is necessarily political, in the sense that on the one hand it implies an established political frame that set the rules and on the other in the sense that it proposes a certain relations of power that should be managed within its very relationship.

As is known some of the basic premises of Austin theory had been challenged, say deconstructed, by Jacques Derrida (Derrida, 1988), but nevertheless, the ambiguous relation between acts and meaning still is a productive one. In that sense, one of the most interesting consequences of performatives is that they highlight the close knit between what exists before and after the utterance, the agency of the act and the motion (bodily motion), but also that they imply the cohesion between the one who talks and the one who listen at a level beyond the aural, in a kind of politics of the performance.

Derrida's analysis focuses in part in the situations in which a performative utterance is quoted (as, for example, in theatre) and hence transported to another context. If Austin diminished those *parasitic* situations as unessential ones, Derrida asks himself rather if those apparently extemporary occasions do not present a serious challenge to Austin's theory, to the point of invalidating it, since in fact it is the general possibility of citationality the one which guarantees the very existence of performative utterances (Derrida 1988, 17). In any case, what these parasitic occurrences consistently show is the close relation with theatre of performatives. What happens, for example, when this performative utterances (or illocutionary acts) are produced *inside* (in the context) of a theatrical representation as part of it? They still produce their effect? The answer, we think, is not as easy as may seem at first, and may lie, precisely, in this *parasitic* condition. Of course, it is usually taken for granted that a marriage celebrated as part of a theatre play does not have effect in "real" life (although some plays and movies use to play precisely with this confusion, the *cinema inside cinema* condition), but the things are not so clear when we consider contemporary theatrical performances, in which the limits (the context) between what is theatre and what is not blurs. Think in the performances created by Marina Abramović in the 1970's (for example *Lips of Thomas*, 1975), in which the ambiguous condition of what is "theatre" and what is "real life" produces a dark in zone in which Austin's definition of performative fails. The interesting things is that, by failing, succeeds. Succeeds in the sense that, as Erika Fischer-Lichte explains, "the actions are self-referential and actually constitute reality, and therefore are capable, in whatever the manner, of producing a transformation in both the artist and the audience" (Fischer-Lichte 2011, 51. *Our translation*). So to say, they *perform* something, precisely by the transgression of the very *parasitic* condition they are the result.

What obviously interests us is this capacity of transformation, of production of new connections between people (and thence new meanings) of performatives, of engaging people in new relationships, that is to be crucial in understanding the operativity of the new urban practices addressed in this paper.

Finally, we cannot end with this point without addressing, although very briefly, another important development of the concept of performativity, the one undertaken by Judith Butler in the context of sex/gender relations and constitution of subjectivity. For Butler, what is important is "the understanding of performativity not as the act by which a subject brings into being what she/he names, but, rather, as that reiterative power of discourse to produce the phenomena that it regulates and constrains" (Butler 1993, 2). Departing from the strict context of the philosophy of language, Butler produces an important statement setting clear that performative acts not only produce something (and what produce is a relation), but that at the same time they produce the rules that regulate this same production (that nevertheless are subjected to the transformations derived from the very act they produce), setting the frame for its repeatability and variation (*iterability*) and in so doing opening the space to new relationships and meanings.

2.2 *Performative architecture*

How performatives relate to architecture and to the production architectural space? How they relate to the construction of public space and to its political condition? How architecture does what it says by way of its agency? What is architectural agency? Maybe too many questions to answer.

Our proposal here is that public space (the question that can be asked now is: "all space?"; a preliminary answer will say yes, although further elaboration is needed) is constructed through performative actions that came into existence through the very architectural framework they put in motion, creating a new set of relations (the phenomenon produced by performativity) defined by the architectural interventions actually built. In that sense, architecture or better saying architectural space (its *meaning*) defies its usual condition as an stable and pre-existent object, whose meaning is given as something that can be apprehended from the outside – by an individual or a collective subject – and from before, to be understood as the "frame in motion" that is built in the very moment is constituted (even in phenomenological terms) by (and in interaction with) a subjectivity. That subjectivity, in return, is constituted at the very same moment it confronts architecture -as Judith Butler (1988) explains, there is not a preexisting subject as such, but subjectivity that is produced in the friction with the very object it apprehends. Nor that architecture exists in a fixed way as an object, neither there is a social subject formally

constituted that apprehends intentionally this object as architecture, but is in the performative acts it promotes that "the phenomena that it regulates and constrains" are produced.

The question now is to trace the correspondence between performance (the play of the social actors in space, the constitution of this very social-political space) and built architecture. And this should be made in two directions: on the one hand architecture should be understood as the physical, built frame (not necessarily pre-existent), that allows performative acts to take place -of course this frame is not a neutral frame and imposes, like it or not, a certain discourse, enforcing some behaviors and preventing others as always happens with designs (Domínguez Rubio and Fogué, 2015). On the other, architecture as performativity itself: as the set of relations that arise in a certain space at a certain moment, iterable (but not repeteable, see Derrida 1988, 7) as the shared experience of meaning that springs in the shared experience (use) that constitutes architecture.

And since architecture is never a completely private affair, performativity produces always not a private space, but a public one (though with different levels of publicity, of course). In that sense, it is not the constitution of individual architectures that is at stake, but the constitution of the shared space in-between them, and then the constitution of a community for which this experience is meaningful. In public space this community is the social body that, in fact, represents itself to itself in this staged performativity. But how is in essence the constitution of the public space at large, in its political condition?

Public space is political, as architecture is (always political). Since public space depends on, relies upon, and is constructed both as a result and a confrontation of given socio-politico-economical conditions at a particular moment, it is necessary modeled by the existent political regime and by the one it promotes. But apart from that, public space as appears when performativity is at stake is rooted as political space, since it produces a shared common practice that generates effects of governance at the level of the city, the civic (the *polis*), and we can say it even constitutes the political subject within an architectural frame, proposing a different politics of community. This situation reminds us how democratic politics appeared in the Greek city-state (Athens as its real locus) in the slippage from the aristocratic power of the few (exercised form the Castle and the Temple) to the deterritorialized power of the *demos* (played in the unbounded, in the sense that is unfortified, open architectural space of the *agora*) and how the role played by architecture was determinant. As we proposed in another place (Del Santo Mora and Vela Castillo, 2013) it was the "architectonical construction of a certain type of space, a 'multipurpose' space that the community could feel as their own precisely because is empty, useless, *free*" the one which allows the *political* to appear. And is this space, in turns, the one which allows the community to recognize itself as community, providing with visibility in an open stage: the people can be reunited in a shared space, an "isotropic" space in the sense that it is not influenced, overshadowed, controlled by any particular power or institution, and plays freely a new set of relations and shared meanings.

2.3 *The (historical) performance of architecture*

We are used to think of architecture as an abstract operation far removed from the imitation of reality, as an art that belongs not to the figurative realm but to the abstract one, and as if instead than describing Nature it imitates Nature's way of doing. In that sense, architecture more than produce a fixed image of the existing environment puts in motion the possibility of understanding itself as environment, or what is the same as saying that architecture performs environment.

When G.E. Lessing in his *Laocoon* (1766) proposes his own system of the arts, he tries to establish how arts are related with time and space (with the concepts of duration and extension). He established that some arts were closer to space (meaning extension), to simultaneity and even to instantaneous-ness (say a picture) and that others are closer to time, in the sense that they are linked with duration, with development of actions along the course of time (for example a musical piece, a play or dance). Nowadays this strict division is difficult to maintain, but for us the important point is that this highlights the evidence that space-time is involved in art, that in different degrees and even in an unpredictable way it is the progression of acts framed in space-time conditions what allows meaning in arts to appear; and that it is even in such a ways that the process opens the way to the event, to the unexpected appearance of the new. Then, at the beginning of modern aesthetics, it is this eventful and productive condition of art what is established, and especially the discovering of the in-between space of friction between spaces and between space and time as source of meaning.

In this in-between space and time is where performance and art as performance appears. Since we apprehend reality through time and space, understanding art as perfomance (as what happens in-between space-time) is closer to our nature than understanding it as a fixed object apprehended from outside. In other words, this sense of performativity involves a tight connection between human being and world, making possible that very relationship from the in-between. Hence the realm of the interrelationship between in and out is opened, which is then transposed into the relationship between body and community. As an entangled system of inner and outer spaces in which bodily borders are crisscrossed, we can effectively find correlations either across vast distances and vast times or across minuscule distances and minuscule times, from the nearer of the body relations to the amplified relation of the social community. Performance opens the door, curtains drawn back, performance begins.

Although architecture has been almost always understood as the art closer to space (remember the

known statement by A. Schmarsow in his *The Essence of Architectural Creation* 1893: 'the very essence of architecture is space') than to time, it is clear that the opening to performativity and to the event implies the in-between of time and space, neither space or time alone, but the friction between them. The existence of the in-between demands, at the same time, that the understanding of space be made in the course of time and that time be apprehended traversed by space. But how this space-time notion affects the realm of architecture? Why this *performative* turn allows us to state that architecture itself performs?

In answering the initial point the first and straight consequence of this turning point in architecture is the challenge of how to introduce space-time in it. Attending to this, an immediate classic vision of the relation between space and time presents motion as the simple result of that connection. In this context came the idea of providing motion to architectural artefacts as done in the avantgarde proposals made by the Constructivists and Futurists at the beginning of 20th century. In them we find that either their proposals introduce in the 'artifacts' they produce elements driven by mechanical systems of movement or the artifacts in themselves were properly designed as objects that have the capacity to move in time across the space. Accordingly, the replacement of an inert stable object with the interactive one was a natural consequence of this turn to the space-time approach and to the performative experience. And consequently in this way architecture begins to express with clear evidence its potential agency to perform, and even to perform itself.

By the 1960's, clearly assimilated those previous efforts, new proposals came, with, of course, a greater technological display. Designs by Archigram, Cedric Price, or Haus Rucker-Co are well known in this sense. But what is relevant in them is not the advanced technology that the proposals clearly manifest but the use of this technology at the service of its performance, at the service of the ways in which architecture interacts with subjects, transforming both architecture and the subject alike in the interaction. Cedric's Price *Fun Palace* (1961–64) is especially interesting in this respect. Architecture ceases to be an utilitarian object set in front of the user-subject and transforms itself in an in-between *constructo* that interacts with the user in unexpected, ways producing unexpected results and, of course, unexpected meanings. Architecture is therefore shaped by people at the same time it is being used, or in other words, architecture, opened itself to the event. It is configured in each of the moment it is being used and consequently architecture depends on the user to acquire its final form, a final form that is final only till the moment that new users interact with it in different ways producing ever renewed meanings. In its constant mutability architecture is configured in ways that allows the interruption of time into space (interval) to appear and reconfigure the relations between architecture and its limits. What matters now is not the existence of an object in front of a subject (say user) but the constant interaction between them, the ebb and flow of its borders shaped as deepened surfaces in constant shift. In this way architecture unfolds its possibilities as appropriately framing the active agency of performance.

Of course this active agency as the proper (*oikios*) of architecture has been identified as an effective force of shaping reality across the past 20th century, as is evident in the frequent demand for new times to come in the avantgarde manifestos of nearly every modern architect, from Bruno Taut to Le Corbusier, from Walter Gropius to El Lissitzki. Nevertheless architecture is not only the supplier of what a user of the new times needed in his daily life, but it is an effective agent that activates in the user the real capacity to transforms himself into a new citizen and by extension, to transform the community which he partakes of into a new social structure. And this is also what we see today when architecture presents itself as an effective and qualified agency within space in cities to challenge cultural, social and political established assumptions.

2.4 *El Campo de Cebada*

After the conceptual basis are set and historical trajectory discussed, let's move, finally, to a contemporary example of those performative practices and languages that construct the shared public spaces of contemporary cites in its political constituency and that demonstrate, in action, de performative agency of architecture.

The experience of El Campo de Cebada in Madrid is a good example of those practices. El Campo came to life when some members of the architectural platform Zoohaus (in which different collectives as Todo por la Praxis, Zuloark or Basurama participate) joined an association of residents that lived around Plaza de la Cebada in La Latina distric of Madrid. It was around 2010, almost a year after the City Hall of Madrid demolished an existing structure and produced a vacant lot in an otherwise densely built quarter of the city that the initiative started (Lozano Bright, 2014). Owing to the world financial crisis that began in 2008 and the explosion of real state bubble in Spain in the same period, intended construction of new facilities, parking lot and new housing was halted.

After the initiative presented by this heterogeneous platform (christened El Campo de Cebada owed to the historical square, an old barley market – cebada meaning barley) the lot was finally handled by the City Hall to this citizens Platform for its use and management during a year, since then annually renovated.

Within this frame, conditions for the use of space, access, exploitation and so on were established by the collective "El Campo de Cebada" as a shared and participative enterprise, with only minor public funding. The space was then devoted to cultural use, developed in a free frame in which local residents and general public alike joined forces in such activities as theatrical performances, sports (the demolished structure was the only public sports facilities in the district), the growth of a communal garden (although tree growing



Figure 1. El Campo de Cebada, a vacant lot in the center of Madrid (Source: El Campo de Cebada).



Figure 2. El Campo de Cebada, during a weekly assembly for the coordinated use of space, 2013 (Source: El Campo de Cebada).

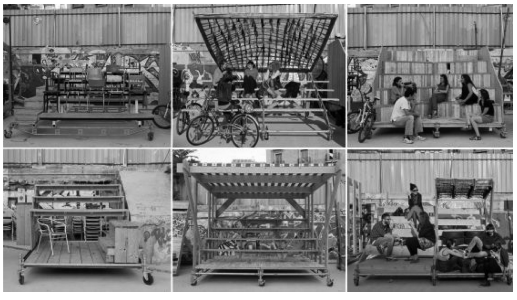


Figure 4. El Campo de Cebada, different architectural artifacts in use (Source: El Campo de Cebada).

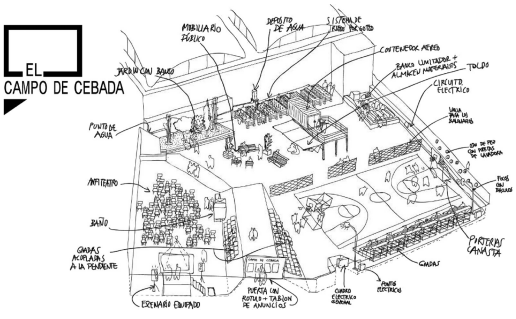


Figure 3. El Campo de Cebada, shared infrastructures, 2013 (Source: El Campo de Cebada).

was specifically forbidden in the site, recycled wooden planters were set and a small urban garden sprang), different workshops (for example one called "handmade urbanism" in July 2013) and cinema projections, activities for children and so on, excluding nevertheless commercial uses. They even run a Summer University in 2013, with conferences from morning to midnight during a whole weekend, with great success.

Within this framework, different collectives of architects participate developing a series of experimental urban strategies, including the building of self-made structures under open source conventions (Corsin, 2014), following the Inteligencias Colectivas ("Collective Intelligences") strategy to distribute the designs freely through internet. They organized different workshops to develop, from design to actual construction, objects/prototypes of expanded urban "furniture", which they call "handmade urbanism", engaging both local residents and visitants alike, that later populate El Campo.

Of course these objects were used to infrastructure the space, and many of them still are there, but beyond that, they serve to demonstrate the performative character of architecture and architectural design: in that sense, what interest us of this experience in the context of this paper is the ability of architecture to produce meaningful spaces through the very agency it puts in motion, collaborative construction and use alike. Those artifacts, beginning with the collaborative design and the collaborative construction (using mainly waste materials, reused wood slats, pallets, rough building materials and so on), engaged people in new dynamics concerning the production and use of public space, appropriately staging their designs from its very inception, and hence developing new communal and political bonds. But they also introduced performative dynamics in the open space of El Campo (transplanted to other places, since similar designs were also build as different places as Matadero Madrid, as for example the designs called "Offffficina" or "Mamut" by Zuloark), acting as mobile devices (even physically: some of them had wheels) that enable transformative collective spaces to be ready for use. Spaces that in turn allow people not only use them, but transform and adapt them to the necessities of the



Figure 5. El Campo de Cebada, plural and singular alike (Source: El Campo de Cebada).



Figure 6. El Campo de Cebada, plural and singular alike (Source: El Campo de Cebada).

moment: stands for watching performances, small parliamentary structures, stages, tables, and so on. What is important is not what they are, but how they are used, how they interact and engage in fruitful changing relations, how they act or perform a certain play inside the open stage of El Campo. A play whose rules are staged at the very moment people engages in the play. Its performative capacities, then, charge the space with new meanings, meanings that are in constant transformation depending of the particular use at particular moments, creating a new set of architectural relations that, nevertheless, are in obliged change and negotiation. In that sense, performative architecture is strongly political, since it imply, even encourage, constant confrontation and negotiation, positing more democratic political environments. Human and architectural bodies, then, engage in new politics of space, constructing new meanings and sharing them at the public stage El Campo presents.

Curiously enough, given its alternative orientation and the "low" quality of the intervention (judged from conventional architectural parameters), El Campo de Cebada has been awarded with some architectural and artistic prizes, which points to one of the dangers inherent to these initiatives: its paradoxical demise by the ruling powers as mere "artistic interventions", consequently deactivating its political and transformative potential. But that was already posited by Manfredo Tafuri (1976) more than forty years ago in the context of historical *avantgardes* and contemporary *neo-avantgardes*. As said, it has been selected among the finalists in 2012 for the European Price for Urban Public Space, and awarded with the prestigious Golden Nica (Prix Arts Electronica) in the category of Digital Communities in 2013 and with one of the prizes of the XII Spanish Biennale of Architecture and Urbanism also in 2013.

At the moment, El Campo de Cebada is still sailing at cruise speed, though the City Hall recently (June 2014) reactivated the original building project for the site. Nevertheless, the experience, ephemeral as it should be, demonstrated crystal clear the performative capacity of architecture and the possibility, rehearsed in full fledge, of a different politics of space.

3 AFTER-WORD (CONCLUSIONS)

Performative architecture, as outlined in this paper, probably opens up more questions that the ones it answers: what seems to be important, in any case, is the operativity of the tool more than the actual and particular responses it can provide. In the context of recent architectural experiences in contemporary cities that challenge the established political, economical and social facts in the era of global capitalism, we tried to eschew different possibilities for political governance through architectural actions in shared urban contexts. The proposal of a performative architecture, one that through (but beyond) material practices would propose new exigencies and promote different social and political relations is not new, as in the brief historical summary we have shown, though maybe the emphasis in the understanding of architecture less as physical frame and more as the "subject" of some shared agency is. What arise would not, in any case, a set of examples of different single political constructions, but the capacity of architecture to articulate a new frame for politics itself (hence the reminder of Greek *agora*), through the opening up of space to new relations and meanings that can construct, in turn, a different politics of space.

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WWW (mainly Madrid based practices)
http://www.todoporlapraxis.es/
http://elcampodecebada.org/
http://www.inteligenciascolectivas.org/
https://www.facebook.com/plataforma.zoohaus
http://www.zuloark.com/campodecebada/
http://ecosistemaurbano.org/
http://issuu.com/gsdharvard/docs/networkedurbanism/3?e=0/9171572
http://gabinetecrisisficciones.tumblr.com/
http://mataderomadrid.org/ficha/3004/we-traders.html

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Twin cities as urban laboratory of the contemporary social contradictions

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ABSTRACT: There are more than 16 twin cities in today's Europe. We call them twins since they were either born as urban entities next to each other, yet mostly with different administrative domination, or due to socio-political alterations they were detached throughout their growth histories. Despite their adjacent geographical location, different languages are spoken and diverse economic conditions are faced in those cities. The term "Twin Cities" was coined for the first time to describe the geographic condition of Minneapolis and Saint Paul. In Europe we can consider like a model of this twin phenomena, Tornio (FI) and Haparanda (SV). This comparison can represent a stimulating laboratory to trigger new collective figures of urban space, in order to discover better strategies and spatial devices of architecture and urban design. These devices will activate a process of effective integration along and through the border lines.

1 USA/EUROPE: DIFFERENT SCENARIOS

Although important changes have always occurred throughout history, it is evident that they have surged during this historic period, in particular Europe's geopolitical situation appears, in this sense, to have exposed all its weaknesses and the uncompleted elements. Its victim is the project of the Schengen area, born with the European Union, established in 1985, as a zone for the free movement of persons, is an extremely important result.

The Schengen Treaty establishes the abolition of border checks in 26 countries – 22 European Union member states and other countries including Iceland, Liechtenstein, Norway and Switzerland. Recently however this treaty is being undermined by acts of terrorism and substantial immigration flows: current news features extensive coverage of worries and potential action. Towards the end of January this year, six European states: Germany, Sweden, Denmark, Norway, France and Austria, reintroduced checks at their borders and requested the European Commission to suspend the Schengen Treaty for two years.

If we shift our focus from general international problems and attempt to reflect on the impact such events have on our cities, Z. Bauman's definition of contemporary cities as rubbish bins becomes clear: places where "global powers dump their problems so that they are resolved. For example: mass immigration is a global phenomenon, caused by global mechanisms. Not a single mayor of any city in the world has ever caused the migration of persons in search of bread, drinking water and other similar resources. (…) The problem arises from the outside, but must be resolved inside, for better or for worse. (…) cities are becoming laboratories where the best way to handle these issues is being studied." (Bauman, 2013).

Such issues stem from cultural differences, the ways and places of this coexistence of first emergency situations, but not only. Apart from Cittaslow mentioned in Bauman's text, so-called Twin Cities are extremely interesting laboratories and there are at least 16 in Europe alone. "Twin Cities" refers to a specific urban phenomenon where two cities are established in close proximity and forge relations of cooperation and completion. This particular urban conformation was theorised by the European Council which defined its characterising elements in a study, in order to render it classifiable under specific categories.

For two cities to be defined as Twins, it is essential that they share both morphological and economic-administrative aspects. They must be located on a national border, share a common historical evolution and their cooperation must be based on institutional foundations governed by standards. Often such cities are located on opposite banks of a river which has historically represented a territorial border. International relations permitting, the bond between twin cities may culminate in the elimination of state borders and the merging of two cities into a single body with a merely apparent administrative division.

It is evident that such cities are affected by aforementioned changes to an even greater extent and as such constitute a laboratory for research and the mutual comparison of experiences on how to handle similar situations, even in non-border cities. Therefore, as well as an interesting laboratory, in the sense described by Bauman, their location in the vicinity of borders means that they are constantly exposed to a greater degree of change; they also rapidly acquire characteristics inspired by resilience, also in terms of urban strategies which define new scenarios for the future.

This essay aims to compare two different yet equally paradigmatic cases: two American cities, Minneapolis and St. Paul, in the State of Minnesota, where the term Twin Cities was first applied (although neither possesses all the requirements to be defined as such), and what is defined as the European model: the cities of Tornio and Haparanda, respectively in Finland and Sweden.

It will be evident from this description that even though these two cities are twins, they both possess characteristics which appear in part to contradict this definition, not least their history, but also many others. Elements which tend to define a more or less extensive common project are contrasted by others which render this impossible.

On the one hand the definition of the term is etymologically unambiguous, however on the other hand, whenever it is used to describe their highly complex realities, it becomes somewhat ambiguous and less clear, although cities in the USA present considerable advantages and greater possibilities for cooperation in comparison to the European ones, where their differences will be more convenient to direct the future scenarios scenarios on this richness, which, as emphasised by H. Gadamer, can be spent as a school or laboratory from which the world can draw lessons.

In this respect, it is interesting to note the opinion of G. Steiner, who urges us to stop perceiving Europe as a potential economic, military and technological force in competition with the United States. According to the scholar, Europe should be valued for other qualities and therefore potential destinies and future tasks, deriving from a unique condition which is not even present in demographically varied cities in the USA, with striking linguistic and social differences often observable at a distance of 20 km.

2 MINNEAPOLIS AND ST. PAUL

Minneapolis and St. Paul were established approximately ten miles from each other, on opposite banks of the Mississippi river.

St. Paul was the first to be founded, originally as a natural port at a point where the river became navigable. The upper part of the river was inaccessible due to numerous rapids and the St. Anthony Falls which prevented ferry transit. In contrast, Minneapolis, originally known as St. Anthony, was established in the vicinity of the homonymous falls, the only ones along the entire river. Indeed their potential as an energy source to power mills constituted the most favourable condition for settlement for productive businesses in the area.

Over the next few decades, in the mid 19th century both cities established scarce contacts, insofar as they were separated by a vast, non-urbanised area which rendered their connection practically impossible. They continued to grow isolated until the early 20th century, when their reciprocal and individual expansion lead them to occupy the interstitial space which separated them. This qualified them as Twin Cities. This condition is truly remarkable for two large cities in the United States, insofar as they tend to be distant from one another and grow independently through the extension of peripheries and suburbs. The only other examples similar to Minneapolis and St. Paul in the United States are the so-called “Quad Cities” in Iowa and Illinois, and to a lesser extent, Dallas and Fort Worth in Texas.

Throughout the evolution of both cities, the territorial morphological factor is to be considered an element of separation which was gradually overcome by other factors.

The Mississippi river has always constituted a limit in the unification process of both cities, an obstacle to direct connection, its insurmountability proportionate to its width, the marshiness and inaccessibility of its banks. During the cities’ earliest historical phases the development of the road network was conditioned by the river’s course; later, urban development abandoned this reference and assumed a new regularity. Initially both cities developed in virtue of the presence of this natural element which determined their position, however this bond withered away upon the development of new means of transport and the transfer of production towards the periphery.

When modern technologies overcame the barrier of the falls, both cities were able to establish a connection across the river and in turn this required the common coordination of waters, through the establishment of a Metropolitan Council, one of the first steps towards Twin City status.

This inversion enabled both cities to emerge from isolation and grow in close contact with each other, evident in the morphological structure of connection networks, consisting of a regular road grid, transport infrastructures, as well as connecting bridges, without interruption, with the sole exception of areas along the river and near the historic centres, characterised by an irregular morphology.

Indeed from 1888, the area occupied by both cities had extended to such an extent that they converged, creating a need for a unified system of infrastructures for smooth access and transit, resulting in a common network of transport and services. Minnesota’s first ever electric tram line was opened during this period.

The term “inter-city” was used for the first time in 1890, designating the intercity tram line which connected Minneapolis and St. Paul; it went on to be used throughout the country to describe linking operations between cities.

Road and tram networks were a homogeneous, powerfully unifying force. The railway network, dating back to 1857, underwent a more complex development and still features distinctions today, given the sheer number of access points to both cities. This has been historically generated by the territory’s geological characteristics, not least the river.

The river valley at the confluence with the Minnesota river has always constituted a natural

barrier, preventing the crossing of lines from south to north. St. Paul is at the northernmost point of this valley and benefits from its vicinity to a break in the towering river side cliffs. Therefore it is the region's connection point with the south of the country.

In contrast in Minneapolis, which is closer to the wheat fields to the west and Nicollet Island, it was easier to cross the Mississippi river, an advantage exploited by northern routes. Therefore both cities initially developed as distinct railway centres.

It wasn't until later, with the fading of the distinct economic vocation of both cities – St. Paul for trade and its twin for industrial production –, that the need to connect them arose, with the addition of new railway lines while maintaining separate stations given the considerable distance between both city centres.

The development of a common public and private transport network was the very element which enabled expansion in areas which were yet to be urbanised, therefore it catalysed the union of both cities, not only from a morphological point of view, but also in terms of administration and economy.

Since the 19th century Minneapolis has held a considerable advantage over St. Paul in economic and demographic terms, however today, despite the persistence of a certain distance between both cities, this condition can be considered mostly psychological. In strictly economic terms, both cities constitute the heart of north-western America's economic system. Indeed this area is the second largest economic centre of the Midwest, after Chicago.

Both cities account for over half of gross domestic product in the state of Minnesota and are characterised by one of the highest concentrations of high technology businesses. The main economic activities of St. Paul involve the service, computer and medical equipment production, electronics and wholesale trade sectors. The city is also home to the nation's biggest meat farmers and is a centre of foreign trade thanks to its duty free services.

Unlike the railway system, both cities are served by a single airport – the International Airport of Minneapolis-Saint Paul, an essential hub for the management of trade and tourism. All of these changes would never have been possible without the will to define an administrative body to govern over potential conflicts. Indeed urban, economic and social evolution in both cities has understandably highlighted the impossibility of managing at least some important issues by local governments independently and separately. This awareness culminated in 1967 with the establishment of an administrative organ: the Metropolitan Council (Met). Its purpose was not only to coordinate government operations and planning for the Twin Cities, but also a wider area including the seven surrounding counties.

The Council has numerous functions: public transport, waste water treatment, territorial planning, city planning for municipalities, forecasting population growth and the maintenance of a system of regional parks and paths, as well as the definition of a reference framework for regional systems, including aviation, transport, parks and outdoor areas, water quality and the management of water resources.

Despite achieving remarkable progress, often the Council is unable to fully develop its own potential, due to its non-elective nature. The Metropolitan Council was established in response to common issues and offers an example of coordinated management, however each city has its own government which manages issues of a strictly internal nature.

Its actions are directed to arrage and manage specific problems rather than to provide a common scenario for both cities.

This ambiguity in the management system of both cities is also reflected in collective perception and therefore in social dynamics. Undoubtedly there are observable social divisions and the failure to recognise a unified landscape stems from a sort of historical rivalry linked to disparities in initial economic conditions. Perhaps the most obvious difference can be seen in the religious affiliation of inhabitants of both cities, palpable in the spatial and architectonic structures of the cities themselves: the large cathedral dome which dominates the hill of St. Paul, home to the Catholic Archbishopric, contrasted by the spires and towers of dozens of Lutheran churches dotted throughout Minneapolis, the zone's Protestant centre.

In any case, closer study of the origins of the population indicate that: three fifth of the population of Minneapolis is of German and Scandinavian origin, from the earliest migratory flow which occurred in the mid 19th century, followed by later immigration flows from Germany, Italy, Greece and Poland. Over the years the aforementioned have been joined by a large population of Somalis, approximately 40,000 citizens. In contrast, the first wave of immigration to the city of St. Paul dates back to the settlement of the Irish community on Connemara Patch along the Mississippi. From 1850, Swedish immigrants, who mostly settled in Swede Hollow, were followed by Poles, Italians, Mexicans and Afroamericans. Therefore other than those related to origin, it appears that there are not further or significant causes of divisions, nor linguistic or economic distinctions. This fragmentation appears to be the very cause of an inability to perceive both cities as integrated, and bound to a cooperative future of a collective reality, which has been achieved only in some aspects of management, such as water.

3 TORNIO AND HAPARANDA

Both cities originate from a single urban nucleus, identifiable as the city of Tornio. After the Finnish war between 1808–1809 (and Russia's victory over Sweden), Finland, until then Swedish, passed under Russian dominion, along with the city of Tornio. The city of Haparanda was thus founded on the Swedish banks of the Tornio river, to compensate for the loss of Tornio, which became a part of independent Finland in 1917.

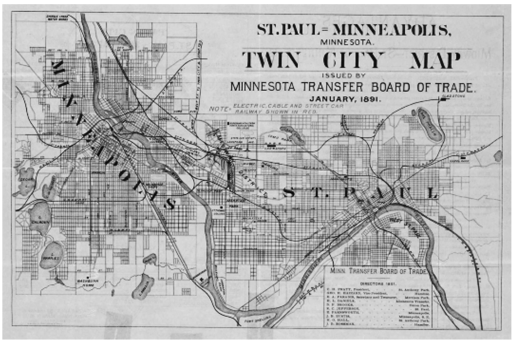


Figure 1. Minneapolis and St. Paul, transport map 1891. The two cities are called twin.

Despite these events, their borders were never really closed and both cities were only divided by the physical obstacle of the river mouth.

Today the population of Tornio is 22,000, mostly Finnish, whereas the population of Haparanda is 10,000, with a highly diversified linguistic component.

Today the border between Tornio and Haparanda is fully open, with an extremely high number of annual crossings, the extensive exchange of goods and numerous persons who cross the border every day, as though it barely existed.

Here too, the infrastructural element has played an important role in the permeability and rapid connection of various urban areas of both cities. Indeed from the 60s, both cities undertook the systematic planning of public and private infrastructure services, and more. Both have also forged cooperation in the sectors of industry, education and culture and after initial positive results, local authorities extended cooperation to other sectors such as the economy, tourism, trade and the environment. There is a vast array of agreements between both cities, from the definition of joint sports centre, to waste and water treatment, the construction, in 1987, of an institutional organ: the Bothniensis Province, which prepares and coordinates all cooperative activities between both cities and represents them in external relations. Numerous coordination activities are also linked to this official body, for the equal promotion of activities along the Baltic coast in order to exploit synergies of both cities.

Even though cooperation was active before the European Union, upon entry, there was an increase in the activities of the same cooperative policies, with the exploitation of specific programmes for their development. The "Pä Gränsen/Rajalla" project, which literally means "border", foresees the creation of a new joint city centre located on the border between both cities, works first began in 2003. The project was developed in an architecture competition launched in 1995, for the area's urban development through the construction of new residential and commercial buildings. After works had began, in 2006 the Swedish company IKEA opened a new store here, thus encouraging the arrival of many other commercial businesses.



Figure 2. Minneapolis and St. Paul, 1840 (Bettoni, Gerevini).



Figure 3. Minneapolis and St. Paul, 1860 (Bettoni, Gerevini).

This has bolstered the region's economy, with an increase in commercial activity throughout an extensive area of the territory, leading to a remarkable extension of the existing infrastructure.

It is no coincidence that the European road E4, which crosses the continent from Lisbon to Helsinki, passes through these two cities, creating an important trade corridor and facilitating exchanges between east and west. Both cities are also located at the centre of the European Union NEW10 corridor which passes from the eastern coast of the USA to Asia. Cooperation is not limited to economic development, indeed in 1998 a tourist office was opened, with the aim of improving the social integration of inhabitants and developing a sense of collective belonging in the cross-border zone. There are tangible results from aforementioned activities: an increase in cultural and educational exchange



Figure 4. Minneapolis and St. Paul, 1880 (Bettoni, Gerevini).



Figure 5. Minneapolis and St. Paul, 1930 (Bettoni, Gerevini).

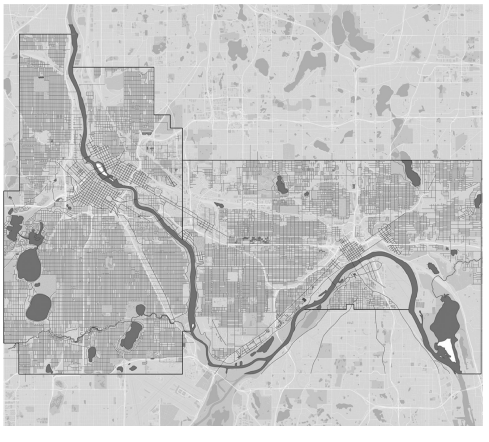


Figure 6. Infrastructural grid (Bettoni, Gerevini).

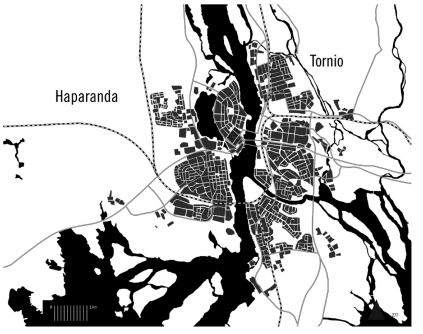


Figure 7. Tornio and Haparanda (Formaggio, Zanon).



Figure 8. Tornio (Formaggio, Zanon).



Figure 9. Haparanda (Formaggio, Zanon).

which perhaps more than other sectors, is crucial, in parallel with the construction of a shared urban space, for the development of urban solidarity, in terms described by Z. Bauman, solidarity of a "city per se" rather than a "city in itself".

An example can be seen in the school complex of Haparanda which contains a primary and secondary school, with students from both cities who learn the languages of both states. The next objective for university education is the creation of a cross-border campus for research and education, through the development of an extensive range of joint courses and exchanges (of personnel and students) between institutions.

This potential is evident in the case of Tornio and Haparanda, especially in this moment characterised by the continuous emergence of conflicts and new divisions (conditions which are absent in the USA). Although to a lesser extent, both cities are essentially an observation laboratory, where possible tools are being designed which are both necessary and experimental to social management as well as different urban scenarios.

Unlike Minneapolis and St. Paul, these two cities perfectly represent the twin cities model, indeed compared to other European cities, they may be considered the most evolved example of cooperating cities, in accordance with an envisioned future scenario which is collective and unified. As proof of the capacities and potential hidden within specific European geographic political conditions, there are remarkable distinctions between both cities in terms of history as well as their economic, demographic and social composition, the latter exacerbated by linguistic differences often reflected in exclusivist affirmations of identity.

In spite of this, the potential of transforming the border into a location of interaction and cooperation has emerged in some tangible projects.

4 CONCLUSION

We can easly affirm that the meaning of twin cities cannot be divided form the meaning of frontier, as a place, buffer, scene not a single line, but buffer and stage. So we can consider the entire urban fabric of a twin city an urban frontier.

K. Lynch, in his book The possible city, talks about the possibility to erect new border cities, either between states with a good relationship, or, in the opposite case, as international buffer zones where there is a conflict. Thus our challange is to think about those urban strategies that can best build common places along the borders, as "spaces where we can stretch our identity." (La Cecla, 1997).

In this case the reading of some writings Van Eyck is extremely motivating to understand precisely the potential to some points given by their nature interstitial, regardless of the dimensional scale.

A. Van Eyck explained the importance of considering the feature of twin within the process of project development: "To establish the in-between is to reconcile conflicting polarities. Provide the place where you can interact and re-establish the original twin phenomena." (Van Eyck, 2006)

This means that the urban project, dealing with the building fabrics, from a certain point of view is itself a unique space in-between, and not necessarily their edges. Hence, it should enhance the feature of by no means ignoring the differences, but rather activating multiple dynamics, functions and scales, which uniquely determinates the nature of space yet contains just the variety of existence and open future to surface. Then the architectural project can become the true spatial device: "It's an old forgotten truth: that diversity is not attainable through unity, unity only attainable through diversity." (Van Eyck, 2006).

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Lines, pipelines, and the contested space of transcontinental fossil fuel transport

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ABSTRACT: The North American continent is threaded with highways, rail lines, pipe lines, and shipping lines for the transport of extraction equipment and for the transport of fossil fuels from the continental interior to markets in Asia. These lines and pipelines are critical to the future of the global climate and, as such, are actively contested in terms of conflicting property, corporate, human, and ecosystem rights. This contest reinforces the critical importance of this category in a taxonomy of architectural space. In this study, we apply traditional modes of architectural site analysis to this non-traditional architectural site. The resulting body of work invites reflection on the role of architectural criticism and design practice for the future of fossil fuels and for the future of the global climate.

1 INTRODUCTION

1.1 *Background: Fossil fuels and the Pacific northwest*

The management of existing fossil fuel reserves is a critical variable in the future of global climate change. According to the International Panel on Climate Change, limiting climate change will require "substantial and sustained reductions in greenhouse gas emissions" and that "the burning of coal, natural gas, and oil for electricity and heat is the largest single source of global greenhouse gas emissions (IPCC 2015)." In order to keep climate change below 2°C, 75% of existing fossil fuels must remain in the ground (Vaughan 2015).

In North America, the Pacific Northwest region sits directly between enormous geological reserves of fossil fuels—coal mounts, oil shale, tar sands, and natural gas fields—and Pacific ports for export of these fuels to Asia. The expanding energy markets in Asia and the availability of these fuels in North America, has put pressure on existing fuel transportation infrastructure across the Pacific Northwest.

Five refineries are now receiving or plan to receive crude oil by railcar from the Bakken shale formation in North Dakota. Railroads are moving 40 times more oil now than in 2008 (EIA 2015). Since 2012, the Pacific Northwest has faced proposals for four new coal export terminals on the Pacific Coast, two new oil pipelines, eleven oil-by-rail facilities, and six new natural gas pipelines with liquefaction for export (de Place 2015).

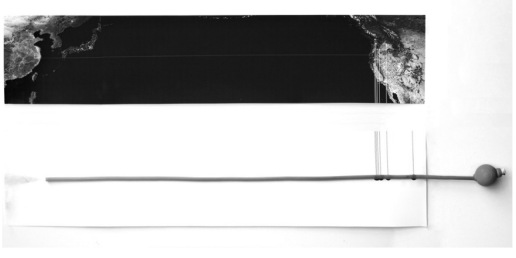


Figure 1. Coal line across Pacific Ocean by Susanna Davy.

1.2 *Site: Lines and pipelines*

In the United States, the primary focus of sustainability in architecture is on energy consumption in buildings. In the work described in this paper, we shift architectural design research "upstream" of buildings to the spaces of the *production* rather than the *consumption* of building energy. In this case, we are focusing on the Pacific Northwest as the "thin green line" between fossil fuel reserves in the North American interior and fossil fuel export across the Pacific Ocean to Asia.

1.3 *Design research: Morphology and manifesto*

In this study, we apply traditional modes of architectural site analysis to this non-traditional architectural site in a series of morphological studies of the space of existing and proposed rail lines, pipelines, and export ports. The morphological studies and the resulting

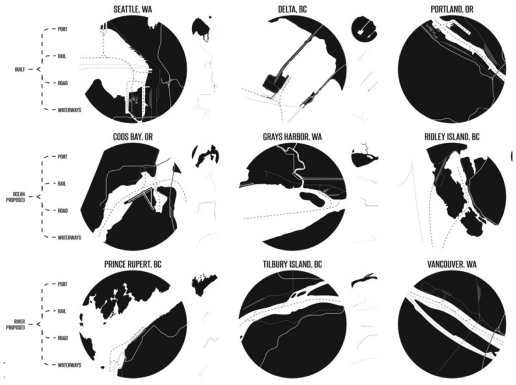


Figure 2. Morphological study of existing and proposed ports and river terminals by Will Searcy.

taxonomies are subjective constructions of new sites and are the groundwork for developing design manifestos for this new territory. The manifestos stand in for architectural program and drive the design for new ways of inhabiting the space of fossil fuel transport.

Using the format of the university architectural design studio as a vehicle, the process allows us to ask: What can a typological study of the space of fossil fuel transport in North America reveal about the nature of this territory as the location of one of the most critical contests in global climate change? How can such a study reflect on contemporary architectural practice and the role of architectural education and criticism to engage the issue of global climate change?

2 ANALYSIS

2.1 *Theoretical context*

2.1.1 *Analysis as product*

The work *Learning from Las Vegas* was the outcome of a studio that Robert Venturi and Denise Scott Brown taught at the Yale School of Architecture in 1968 that was called "Learning from Las Vegas, or Form Analysis as Design Research," that took a group of students to Las Vegas to investigate and analyze the city's forms (Venturi 1977). While the book was eventually a touchstone for postmodernism in architectural theory, the work it described was groundbreaking as it introduced and gave currency to 1) the idea of looking for lessons outside the canon of architecturally curated space, and 2) design processes based on analysis of formal or spatial typologies that conflate the process of analysis with that of establishing a point of view. In the case of *Learning from Las Vegas*, the book is simultaneously documentation and manifesto.

It is significant that a notable portion of design research that followed, including within schools of architecture, also attended to non-traditional space or *drosspace*, as designated by Massachusetts Institute of Technology (MIT) urban planning faculty member Alan Berger (Berger, 2006). Notable examples of studios in which the product was analytical studies of non-traditional architectural spaces that have also earned a broader audience include Rem Koolhaas' Harvard Project on the City in which teams of architecture students explored the spaces of shopping, Lagos, the Pearl River Delta, and Rome.

Like Venturi and Scott Brown's *Learning from Las Vegas*, Anuradha Mathur and Dilip da Cunha's investigations in the books *Mississippi Floods: Designing a Shifting Landscape* (2001), *Deccan Traverses: The Making of Bangalore's Terrain* (2006), and *SOAK: Mumbai in an Estuary* (2009) are rich compilations of drawings and photocollage in which the rich site analysis itself is the body of work. The work of Mathur and Dilip da Chuhna has been described as "notable for concentrating less on client-driven commissions than on issue-centered public investigations; they work to identify not conventional solutions but rather a range of possibilities, points of departure for transformative projects" (Pevzner, 2010).

The design work described in this paper is meant to uncover new perspectives on both the linear space of fossil fuel transport and the role of architectural design research in the context of climate change. The re-representation of the territory is meant to be both an end point—a body of work that stands on its own as documentation and manifesto—and a point of departure for future design.

2.1.2 *The expansive nature of architectural site*

Architect and writer David Leatherbarrow calls the broader influence that buildings have on their environment the building's "orientation." In *Architecture Oriented Otherwise* he explains his new use of the word in terms of a building's topographical, performative, and experiential context. In this way of thinking, the building is not an object but rather a place where things happen in relation to other things. A building's orientation is the influence it has on light, on an individual person or on a neighboring street (Leatherbarrow 2009, Moore 2013).

Climate change is a major disrupter of traditional notions of "site" in the practice of sustainable architecture. While ecosystem thinking has expanded the sphere of impact of building and community design decisions far beyond the localized site plan of modernist thinking, the definitively global nature of impacts of fossil fuel combustion blows past any existing boundaries of measured impact. Measured in terms of its carbon footprint, the impact site or the "orientation" of a building is the atmosphere.

This expanded site of architectural impact challenges the media and methods of architectural site analysis. What are ways of drawing site that account for the extreme local and global natures of environmental impacts? In the case of this study, the space of fossil fuel transportation is a space of both orientation and of impact. The design and use of this space has global repercussions and the physical nature of the site is a result of the way that the built environment is

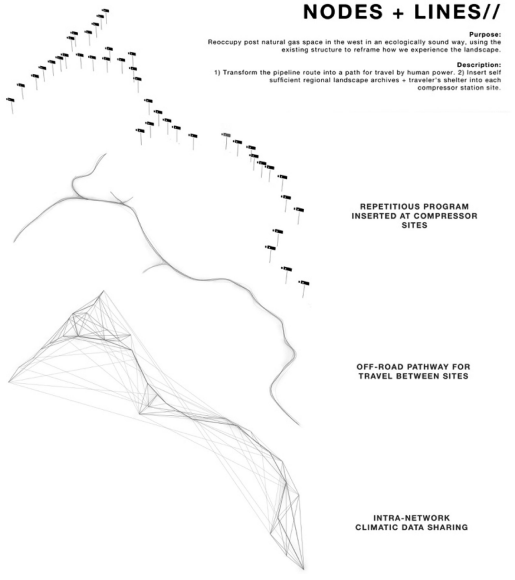


Figure 3. Reoccupation of post natural gas space by Jordan Frazin.

inseparable from the built infrastructure of fossil fuel transportation.

2.1.3 *The reflective nature of architectural site*

Lola Sheppard and Mason White, Canadian designers and founders of Lateral Office, conducted the architectural drawing and design project that became the project *Next North*. According to William L. Fox, curator of the Nevada Museum of Art Center for Art + Environment, who wrote in the catalogue for *Landscape Future: Instruments Devices, and Architectural Inventions*, an important exhibition that included the work of Lateral Office: "Next North" is "part of a program to help Artic communities understand where they live and design structures that interact in positive ways with the local environment. As a person working outside of the artic, my view of the work is the way it remaps the territory of the place, giving agency to matter and culture that is normally out of center of the cultural map" (Manaugh 2013).

MAP Office is another design practice that uses site drawing to give "agency to matter and culture." Referring to the title of their monograph *Where the Map is the Territory*, Robin Peckham of MAP Office in Hong Kong refers to the dictum of semantics that "the map is not the territory." As Peckham says, "we are looking at scenarios in which the map can actually become the territory as with the Boregesian case in which projects and attempts to map real space also affect what they purport to document and perhaps also vice versa" (Peckham 2011).

As in the work of Lateral Office and MAP Office, the act of drawing architectural space can be simultaneously the documentation of existing space and the construction of a new space. In this study, we are using architectural site analysis to draw "new" sites, or to demonstrate new ways of perceiving these sites and our role in operating within them.

In this study, the primary product of the design research should be insights into the role of fossil fuel infrastructure in conceptions of architectural space. The drawings should be reflexive—shaping the space and the perception of the space. As art critic, activist, and curator Lucy Lippard wrote about the role of art in *Undermining: A Wild Ride in Words and Images Through Land Use Politics in the Changing West*, there is use to asking questions that have no answers:

> *While entangling visual art with the cold realities of our current environment, some artists are realizing that they can envision alternative futures, produce redemptive and restorative vehicles with which to open cracks into other worlds, and rehabilitate the role of the communal imagination. Artists are good at slipping between the institutional walls to expose the layers of emotional and esthetic resonance in our relationships to place. They can ask questions without worrying about answers*. (Lippard 2013)

2.2 *Methodology*

2.2.1 *Studio as vehicle*

The work described in this study took place in an architectural design studio at the University of Oregon, using the studio model as a format to ask the research questions also listed above: What can a typological study of the space of fossil fuel transport in the Pacific Northwest of North America reveal about the nature of this territory as the of location one of the most critical contests in global climate change? How can such a study reflect on contemporary architectural practice and the role of architectural education and criticism to engage the issue of global climate change?

Overall, we asked each student to 1) develop a body of work in two and three dimensions to study the typological morphology of some category of the linear space of fossil fuel transportation, 2) develop individual manifestos connecting their personal convictions with their visions for the future of those spaces, and 3) develop a design or a series of design interventions with the strategies of "erasure," "disruption," and "daylighting" to make the visions in their manifestos manifest.

2.2.2 *Morphology*

The morphological studies took place over two to three weeks during which students were asked to research and document some category of linear space of fossil fuel transport, with a loose focus on the morphology and also the human relationships in the space. The resulting body of work included foci on 1) oil train transportation and oil spills through urban areas, 2) coal transportation rail, air born coal dust and air quality, 3) existing and proposed ports connecting rail lines to shipping lines, and 4) the relationship between residents' views on the coal industry and their proximity

to places of coal transportation and extraction. During this time, students read, drew, and carried out discussions in response to parts of Tim Ingold's *Lines: A Brief History* (Ingold 2007).

2.2.3 *Manifesto*

Following the making of their morphological studies, students were asked to develop a point of view about and an argument for what their "site" should be in the form of a short manifesto. Specifically, we asked the students to draft manifestos for the future of their particular site or for fossil fuel transport in the Pacific Northwest in general, considering that the manifesto would serve as the generating document for developing the functions of any design responses to the site. During this time, the students read the *Executive Summary for Policymakers of the IPCC* (IPCC 2015) and presented portions to their classmates. They also used the classic text *Programs and Manifestoes on 20th-century Architecture* (Conrads 1970) for reference.

In response to this potentially difficult challenge, students were very sure of and articulate about what their site should be in the context of climate change. On one end of the spectrum, some students argued for stringent mitigation—the immediate withdrawal of all natural gas pipelines and the use of only renewable resources that can be created regionally and shared among a network of buildings because, for example, "In this model, neighborhoods can be energy independent and will not have to rely on the greater, inefficient energy grid." At the other end of the spectrum, some students advocated for incremental divestment by not adding any more natural gas pipelines and optimizing the current use of existing lines, including by connecting people more directly to the sources of their energy. In nearly all cases, students were able to connect global issues of climate with a vision for the local inhabitation of the built environment of energy production.

2.2.4 *Design*

Following the revision of their manifestos, students were asked to do three one-week designs to bring the ideas in their manifesto to form. As a way of guiding the students in this broad task, we offered them three ways of operating on the morphological site with three design strategies: erasure, disruption, and daylighting. Some students chose to develop a singular proposal, using the three tools as ways to study the problem. Some students chose to offer three different small designs, using each strategy for one proposal. For "erasure," we encouraged them to imagine what could be achieved in the act of physical removal. For "disruption," we encouraged them to think of the way that linear space is defined by its disruption (in ports, borders or bridges). For "daylighting," we encouraged them to think about how design might bring new ideas to light.

As an example of how a student took on this series of assignments as separate but connected parts, one student (Hevey) developed a morphological study of the rail line that transports coal from the Powder River Valley in the Rocky Mountains to the ports on Washington's Puget Sound. Her morphological study documented the competition between the livelihoods that coal extraction offers small mountain towns and the threat that coal is to the future of the climate. Her manifesto affirmed that any design solution should offer alternative livelihoods for those currently employed by the coal industry and that simultaneously, coal should no longer be mined. For the design phase, she proposed that the rail line be repurposed to curate and make accessible the immeasurably valuable wildlands of the Rocky Mountain states along the rail line. To this end, she designed a full tourist guide to the rail line, including all trail, river, and mountain access by hiking trail, paddle, mountain bike, or horseback. For "erasure," she designed a stables train station for the coal mine for horse tours of the (future) historic mine. For "disruption," she designed a lodging rail station to connect to the continental divide trail. For "daylighting," she designed an overlook for the National Bison Park. In this case, this is three separate designs for one overarching idea.

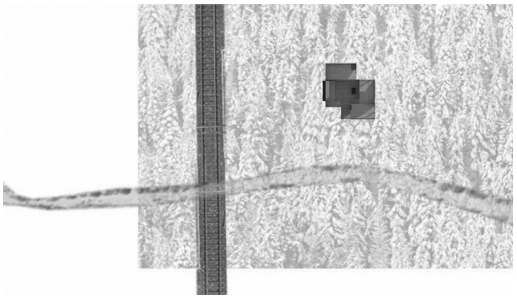


Figure 4. Coal rail ecotourism route by Gillian Hevey.



Figure 5. Disruption by Susanna Davy.

As an example of how a student took on these strategies with a single design, one student who did an impressive documentation and analysis of natural gas pipeline compressor stations (Frazin), proposed to removed a multi-state gas line (erasure), then to replace

the location of every compressor station with a lodging and archive (disruption), that serves to connect and to mark these locations in a way that taps into the depth of their landscape history and meaning (daylighting). In this case, these are three strategies applied to the same typological proposal.

3 CONCLUSION

3.1 *Findings*

I soon discovered, however, that it was not enough to focus only on the lines themselves, or on the hands that produced them. I had also to consider the relation between lines and the surfaces on which they are drawn. Somewhat daunted by the sheer profusion of different kinds of line, I resolved to draw up a provisional taxonomy (Ingold 2007).

3.1.1 *Morphological study*

The product of the morphological study is a large body of two and three-dimensional artifacts of architectural analysis of the space of fossil fuel transport. While the actual territory under study is infinitely complex, the documented and translated territory begins to reveal distinct commonalities and anomalies in the spatial typology. At the same time, the most important questions that were raised by the morphological studies were not about the forms of the fossil fuel transportation space as much as they were about the relationship between the transportation space and the people who live with this infrastructure.

While we expected that our choice to work with infrastructure space rather than so-called inhabited space was a choice to deal with human-less equipment, student work, such as that that takes on the physical bisection of a neighborhood by a large rail yard (Dominguez) or the project that studies the urban space of gas lines (Morales) revealed the degree to which our built environment in the Pacific Northwest is fundamentally shaped by the infrastructure of fossil fuel transportation.

3.1.2 *Manifestos*

While the compiled manifestos that the students wrote are not revealing on their own, they were very successful as tools for the students to shape their own design directions. It worked well for students to substitute their own ethical position for a functional program as a way of giving parameters to the design portion of the studio research. The manifestos continued to be important touchstones for reference during the critical development of the design work as the documents against which all design decisions could be measured.

This way of working in direct accountability to a moral position has potential for future work in teaching architectural design processes. The manifesto as design tool may serve as a partial answer to one of the initial design research questions: How can such a study reflect on contemporary architectural practice and the role of architectural education and criticism to engage the issue of global climate change?

3.1.3 *Design*

While the design work in response to the morphological studies and the manifestos continues, the structure of the design research has been effective in uncovering the space of fossil fuel transportation as the location one of the most critical contests in global climate change. Of the students' design proposals in response to the sites and ethical positions that they have established, all are profoundly relevant and thought provoking. In structuring this design research, we did wonder whether architectural design had a role in addressing climate change in terms of transportation space that is normally outside of the agency of architecture. In conducting the design research, we have found that there is a definitive role for architectural design thinking to be operating in this infrastructural zone.

Architectural design thinking, especially in using the tools of analytical site analysis and in programming based on established moral reasoning (manifestos), and creative design thinking has absolutely, in this case, generated new approaches to very challenging problems. The work reinforces the way that Lucy Lippard wrote, as above, that there is value in "slipping between the institutional walls to expose the layers of emotional and esthetic resonance in our relationships to place." And, as she writes, that there is value in "asking questions without worrying about answers." (Lippard 2013). In this case, we may have found answers, but only as a byproduct of truly plumbing the questions themselves.

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Unknown knowns of architecture: Reconstitution of vitality in Boston City Hall Plaza

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ABSTRACT: There is an expanding body of knowledge on architectural psychoanalysis seeking to penetrate the underlying unconscious processes which influence design. Certain realities about architecture are not directly evident through historical scrutiny or empirical observations. In investigating the grounds for what has been often referred to as the failure of the Boston City Hall Plaza in functioning as a vital public space, mere reference to evident facts is carelessly inadequate. What is needed, on the contrary, is a different lens revealing the "unknown" of the project. The unconscious of architecture is shaped through, and emerges out of, an intricate network of social and political underpinnings which—despite their manifest intentions—are structured by repressed desires. This latent content is not immediately accessible to those involved in the design decisions. The message embedded in the mute language of architecture therefore, could be in blatant contradiction with the initial, occasionally utopian, intention(s). Using Boston City Hall Plaza as the embodiment of conflictual expressions, this paper employs a psychoanalytic approach as a theoretical basis in interpreting the project. The Lacanian notion of desire through Fredric Jameson's *The Political Unconscious* and Žižek's *The Parallax View* serves as the theoretical framework to explicate the psychoanalytic dynamics influencing the life of the plaza. The failure of similar urban renewal projects of the 1960s resides precisely in an inherent contradiction between the official institutions' unconscious desire for maintaining their control over basic internal processes and the public's demand for a fully democratic system. Recently, the attempts to revitalize the space have been focused on re-naturalizing the plaza by providing more trees. Hence, the solutions have been directed toward stormwater ecology, rather than human ecology. Similar to the "democratic" spaces of the 1960s that were never truly democratic, the contemporary "sustainable" designs are occasionally limited to a cynical representation of sustainability. The return of the repressed of Victorian brick walls of Scollay Square along with the paradoxical nature of utopian politics of the 60s constitute two major discourses elaborated within.

1 INTRODUCTION

For the obsessively politically correct culture of the official institutions in the United States, tolerance is expected to be a customary trait. A tolerance which is well manifested on political and economic levels, but not so much on urban and spatial domains. Immigration as a legal concept is tolerated, but an immigrant neighbor not so easily. Similarly, when public spaces are meant to be welcoming to all, space managers cannot condone spontaneous encounters. Assimilating the presence of a homeless in a public space is part of managers' expertise. On the other hand, tolerance has shifted over to some form of ignorance. The impassivity of the general public to big crisis appears to be a protective shield against the perpetuity of crisis. Nonetheless, it is symptomatic of a cultural malady—particularly when it comes to civic engagement with public spaces (Giroux 2003). The repression of social antagonisms and the modulation of class struggle within a new political order have generated a conflict-free public domain where the promised security can only be disturbed by an external threat. Giroux is fully justified in postulating the idea of externalization of social responsibilities: "security was framed within a sense of shared resentment toward those on welfare or other forms of state dependencies rather than organized around a sense of shared responsibilities" (2003). Furthermore, obsession with security—border security, financial security, etc.—signals an internal insecurity. Henry Miller (1987) dramatizes the condition of a "conflict-free existence" using the metaphor of "a man who would chop off his limbs in order to have artificial ones which will give him no pain." The concern here is not with the extremes (the agonizing imminence of economic crisis, political deadlocks, ecological catastrophes, etc.), rather with those ostensibly insignificant disturbances evident in the form of the poverty of a neighbor or the presence of the homeless in a plaza. Increasingly, the task of space managers is to eliminate all signs of antagonism from public spaces, substituting them with sterile images. The result is the liquidation of unsettling realities into our politically correct

social constructs. As Giroux (2011) points in his theory of Zombie Politics—the tolerance is the surrogate for "coma-inducing ignorance," where the concealed political dynamics "make unjust and repressive power invisible." Paradoxically, all the supposedly unbearable encounters (economic crises, ecological disasters, terrorism, racism) are already mediated or distorted by Media, so they no longer sustain their shocking effects. This is precisely the central point of psychoanalysis. As Slavoj Žižek (2006) observes, within our permissive culture, the most elementary transgressions become the source of traumas: a stranger's gaze as sexual harassment, or a stain on a window as an unbearable agitation. Here, the sterile neatness of the Boston City Hall Plaza appears to be "fine," yet this eerie calm is achieved at the expense of repressions on multiple levels.

In the attempt to eliminate all possibly disturbing signs, architecture plays an ambiguous role. As an immersive medium, it can function as yet another source for distress by generating more disturbing encounters or, quite the opposite, it could provide a desirable respite. Respite, when it is able to embody the collective fantasy or creates another version of reality (covering up the social predicaments by adding a representational veil). But, architecture has another crucial function. When architecture resists, that is, when it insists on exceeding the limits of what official ideology desires, the relationship becomes far more bewildering. In the case of the Boston City Hall (BCH), the fact that official managers could not tolerate the sole subject of excitement in the plaza and paved the pool with concrete is the quintessential symptom of this perplexity. It was already Manfredo Tafuri (1976) who diagnosed how market economy abandons any architecture at the moment when it strives to be an agent of change: "when architecture resists … capitalism simply withdraws it from service." Here, the conflicting desires have produced an architecture which no longer functions as a progressive agent. BCH acts as yet another medium—blithely adding more layers of falsification so that things appear to be right. The predicament of the space is not that it does not resist or that it is neutral—the design of the plaza is revolutionary on multiple levels. The problem resides in the moments when spaces themselves are conducive to depressing experiences. How then can we position the BCH within a psychoanalytic discourse?

We need to think of the context in which this project was undertaken. Boston City Hall and its plaza belong to the pedigree of urban renewal projects of the jubilant and impassioned era of hope and optimism of the early 1960s (Neyfakh 2012). The masterpiece emerged at the intersection of political aspirations for a new Boston with the progressive vision of I.M. Pei's urban design; and the architectural prowess of Kallmann, McKinnell, and Knowles, the designers of the City Hall building. Despite this felicitous symbiosis, the project has faced dramatic crises. Evidently, the enterprise had in its disposal all the means for success: a political will, social enthusiasm, financial resources, acute strategies, and marvelous designers. Why despite all the good intentions and fortunate coalitions the project was not as well-received as expected? To disclose the origins of this failure, it is inadequate to rely on what is evident on the surface. What is required, rather, is a way of penetrating the underlying realities. We need to ask: what kind of incommensurability of drives, what sort of repressions of desires, and what modes of alienation are in play? Without recourse to any elaborate discourse on psychoanalysis, Žizek's (2003) ironic remark on Donald Rumsfeld's notorious aphorism exemplifies the type of speculation which reveal the latent truth about the plaza.

In 2002, to justify the urgency of invading Iraq, Rumsfeld, the Secretary of Defense, offers three synthesis between known and unknown: "There are known knowns. These are things we know that we know [Saddam has weapons of mass destruction]. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns–the ones we don't know we don't know [if Saddam has even more monstrous weapons]" (2011). But the fourth category—as Žizek (2004) noticed—was missing: the unknown knowns, "the things we do not know that we know." This is precisely the Freudian notion of the unconscious, that is, "the disavowed beliefs and suppositions we are not even aware of adhering to ourselves." We should ask similar questions about the plaza: what has been the unknown known of the space planner and design initiatives? But, how architecture can be psychoanalyzed?

As Adrian Johnston (2014) noted, Jacques Lacan affirms and frequently insists on Freud's discovery that the unconscious is not "an anarchic seething cauldron of unthinking animalistic instincts," but it is, indeed, structured. Later Lacan extends this claim through his famous dictum that "the unconscious is structured like a language" (Johnston 2014). Through linguistic structures, the analyst will be able to access the "intricate, labyrinthine web of ideational representations interconnected in multiple sophisticated manners" (2014). The unconscious "talks" and the analyst decodes its meaning through linguistic structures. Architecture, as a semiotic system, has a language where its signs are not necessarily bound to a predetermined meaning—its signifier is "enigmatic" (Jencks 2002). As Silvetti (1977) discusses, architecture is a "second-order semiological system," and the signified "is itself a signifying system." Architecture is not merely a frozen music, a medium of artistic expressions; rather, one could read through the mute language of architecture much deeper realities, namely, the concealed social antagonisms. This paper offers a pathology identifying the underpinning conflicts, unfulfilled promises, and repressed desires of this struggling space. It not only speculates the unconscious dimensions of the Plaza but also provides evident which affirm the subtle, yet determining, functions of such processes. Among many theoretical models expounding the psychoanalytic dimension of architecture, I will rely on modes of interpretations expounded by Anthony Vidler in

The Architectural Uncanny, Michael Hays in *Architecture's Desire,* and by John Shannon Hendrix, Lorens Eyan Holm, in *Architecture and the Unconscious*.

2 ANALYSIS OF BOSTON CITY HALL PLAZA

2.1 *History*

By the 1950s, Boston was in a state of economic decline and melancholic decadence. Troubled on multiple levels "residents, manufacturers, and businesses were fleeing the city, leaving behind acres of empty lots and boarded-up buildings" (Neyfakh 2012). Scollay Square, the district later named as the Government Center, was the apotheosis of urban deterioration. The city came to the conclusion that the neighborhood's unbearable condition had left no option but its demolition. Frustrated by the perpetual failure of partial solutions, "residents needed a 'new Boston"' (Wolf 2013). Revitalization of Boston, nonetheless, needed a physical framework. This new structure commanded new ways of thinking about space, but also about politics, civic relations, and social dynamics. Craving fresh ideas, Boston was ready to embrace a new spirit.

In 1961, the City of Boston commissioned the design for a master plan of the 64-acre district at central city's West End neighborhood and Scollay Square (Papadakes 1993). The urban renewal project, called Government Center Urban Renewal Plan, accommodated multiple governmental, civic, and municipal buildings as well as restoration of related historical sites (Cultural Landscape Foundation, CLF, 2008). Typical of such developments, the main buildings/functions have been backed up by infrastructures, notably new mass transit, and amenities such as hotels and retail facilities. The plan offered comprehensive guidelines including setbacks, open spaces, uses and heights. The new city hall was envisioned as the anchoring element connecting all the pieces. In late 1961, based on the master plan, City released the documents for City Hall competition—the first public competition since 1909 (Boston & Anderson 1961). When the jury received 256 entries, a controversial project by three young architects, Gerhard Kallmann, Michael McKinnell, and Edward Knowles garnered the most attention (Shand-Tucci 1999).

A paragon of architectural avant-garde, exhibiting an audacious version of brutalism and enriched by typological innovation, Boston City Hall was "often called the best public building of our time" (Eva 1974). Although architects have unanimously declared the building to be a refined symbol of the most paradigmatic modernist design principles, general public has expressed their relationship with the building very differently: "many regard the building as unwelcoming, cold, and ugly, while those who work inside complain about its poor lighting, ineffective heating system, and labyrinthine layout" (Neyfakh 2012). Despite their utopian intentions many of the projects realized in the 1960s were harshly criticized: predominantly they replaced the urban cores, the design solutions were not satisfactory. As Koolhaas claims, some have "devastated historic city centers" (1988). This might not be surprising. Attempts to superimpose the European piazza in an American context were particularly problematic, often leading to harsh, windswept places. As the landscape critic Daniel Jost (2013) has observed: "people hated them."

2.2 *Edge conditions and mismatched references*

Beyond scale and programming deficiencies, the predicament of the Plaza is primarily linked to its edges. To be precise, the problem of edge condition should be discussed within four mutually inclusive categories: proportions and heights (solid tall walls); immediate uses and programs (no activating function at edges); materiality and transparency (brutalist expression of brick and concrete walls and the scarcity of transparent surfaces); and finally, orientation and views (the disturbing configuration and rhythm of edges). The relatively steep slope of the plaza, "intended to recall Beacon Hill's historic brick streetscapes" (Cultural Landscape Foundation 2008) gives stairs a privileged position, rendering them as the primary means of articulating the land. Stair here function as both dividers and connectors. Since the vast terrain is not partitioned by specific uses, walls, or heavy vegetation, the only technique of subdividing the landscape has been the transformation of the terrain into series of stretched terraces. Shaped by continuously folding stairs, these terraces mediate the 20 feet of the grade change. As stairs rotate to form a series of terraces at the north end of the plaza, they direct the views. Although intended to target the views on City Hall, the overall implied orientation points out to the street steering attention from the plaza itself. Aiming at embellishing the plaza with its formal dynamism while distributing the energies and movements through the provided public domain, the indeterminacy of orientations—exacerbated by the seamless continuity of stairs—eventually betrays this premise. There is yet another paradoxical relationship between the stairs and their immediate corresponding surfaces. The indeterminacy of orientation along with the standstill dialectic between the stairs and their facing surfaces have dramatically vitiated the potentials of space as an active public space.

The views are terminated by the brutality of the solid brick walls with no opening or fenestration. Although the scale of the walls is not overwhelming (given the overall height of City Hall), and the horizontal spread of the stairs are for the most part in harmony with the dimensions of the surrounding buildings, nonetheless, the actual experience of space is indeed intimidating. As if the space has primarily been designed from an axonometric view rather than pedestrian's eye level experience.

Observations about edges and their problematic relationship with the space are analytical discourses, yet they provide clues for what cannot be seen through

mere observation. The plaza's mutually exclusive statements are analogous to contradictory statements in a dream which gives the analyst the means to interpret the unconscious symptoms. Later, the paper explains how the brick walls of the City Hall substantiate the return of the repressed of the Scollay Square's Victorian walls.

At the northern border, right in front of the John F. Kennedy Federal building's horizontal wing, the stairs stretch east-west—culminating in a gridded bosque of maple trees. The problem associated with this space is the immediate encounter between the building's base and the landscape as well as the suggested orientation. The paradox here is that precisely at the moment when an articulated edge is both appealing and much needed, it is missing. The space more than anything suffers from the dissolution of its edges. The Government building's facade, except for the central entrance as a vertical portal, is primarily a flat surface perforated by hundreds of modular windows—all equal in size and all equidistant. Again, building's connection to the ground instigated a problematic reference to that of City Hall where it sits on a solid granite base with minimum fenestrations and no visual penetration. Why such a grim countenance?

3 REPRESSION AND PROPER APPEARANCE

The desert of paved space at the middle of the plaza is problematic on multiple levels. While the northern part of the plaza is loosely defined by the surrounding buildings (partially articulated by the continuous stairs), and the south-west zone has been dedicated to the metro station, the middle part nonetheless, does not relate to any immediate use. A fact that should not be surprising: as a state-owned property, private enterprises are not welcomed.

The windswept desert of brick paving stands for nothing but a leftover space where all the indeterminacies and confusions of scale, proportion, orientation, and use are dramatically realized. Again the conflictual encounter of liberal democratic values and the desire for a proper appearance is evident here as if the space is intended to house the communist party's lofty speeches. The only difference is that the plaza is considerably bigger than the space facing the Palazzo Venezia where Mussolini delivered his propagandistic speeches in 6 June 1940 over his infamous balcony (Feinstein 2003). Except for some scattering music festival and a few sponsored events, the plaza barely witnesses the imaginary crowd it has been designed for—it does not have a life beyond those moments. Or, perhaps the collective unconscious of modern architecture, but also the ruling system, only condone the symbolic representation of democracy and not its messy reality.

The connection between the City Hall public plaza and the building's internal plaza reflects on the desire of architecture to reconcile social programs and governmental aspirations. Yet, the unconscious repression of real democratic expressions returns in the forms of those elements which their uncanny presence affirm an inner disjunction.

3.1 *Conflict of programming and the ideology of bureaucratic systems*

The plaza also suffers from the monotony of use and lack of supporting functions. There are no cafes, no activating uses associated with the space, no sheltering (except for the sparse trees), no excitement! The single entertaining feature, "a pie-shaped, sunken seating area with a large fountain in the northwest corner" of the plaza was taken out, "paved over with concrete in 2006" (CLF 2008). Again the conflictual nature of the ideology of bureaucratic system emerges where the formalities of an ideal institution (organized, rigid, and in some cases, machinistic) is in conflict with the playful and arbitrary nature of active public spaces. The space in front of Government Building exemplifies this incompatibility. As if the rectilinear open area is merely a leftover, putting up an appearance to symbolize the generosity of the official governing system in providing public space. The space is not necessarily expected to be crowded by an exhilarating and energetic public, it rather should remain empty—neat and clean. It is easy to read the mind of space managers as such: if the space would be inviting and comfortable to everyone, it means that it is inviting to homeless, too. Or do the city officials condone the "obscene scene" of adults sprawling on the benches, dipping their feet into the pool?

The quasi-utopian impulse has been reduced to a symbolic image. To follow Žižek's (2010) observation in the relationship between the class struggle and architecture, we could conclude that the city's official governing institutions with liberal/egalitarian values aims to represent democratic openness. The anti-elitist character needs to express generous openness to public. The representation of democracy, nonetheless, is provided by a realm of appearance where real hierarchies and exclusivities are dissimulated by an untroubled, sterile image of public space. With a psychoanalytic twist one can be skeptical of the basis of such conflict and ask a more radical question: are "average Americans" striving for real political commitments and civic engagement, or all that which is desired is this proper appearance? It does not come as a surprise that the campaign slogan, "Make America Great Again," has been so appealing to a thick crust of American culture. Make it great please! YOU do it—we do not want to be bothered.

3.2 *The return of the repressed*

Another way to analyze the contradictions of urban renewal projects' utopian ambitions and the unconscious desire of the established bureaucratic principles is through analogous conflicts between the modernist principles and the repressed elements of pre-avant-garde architecture.

Uncanny in Freudian definition refers to "familiar objects, once repressed, suddenly returning in unlikely forms" (Vidler 2003). As Anthony Vidler has already observed, "the uncanny of Surrealism was no more than the repressed of modernism." The Post–World War II version of modernism, nonetheless, bear radically different socio-cultural content from that of the 1920s and 30s. In contrast to the revolutionary nature of early modernism, the 1960's version camouflages the real of social antagonism and pathological conditions of its society. Žižek's (2010) reading of Claude Levi-Strauss on the structure of the Caduveo's facial decorations, an indigenous Brazilian tribe, reflects on the same relationship between the Real and a mode of representation which does not allow the reality to be seen. The tribe's facial masks and decorations have been "an imaginary solution to real contradictions," where hierarchy and class struggle have been concealed by the masks. These objects, similar to surrealist fantasy objects or modern architecture's stylistically confusing symbols, compensate for the "lack of properly functioning appearance" (2010).

But what has modernism repressed from the traditional mode of life? If "the uncanny is the rediscovery of something familiar that has been previously repressed" (Vidler 1992), what is the undead of the premodern architecture? Vilder identifies three domains for such repressions: 1) solid, bearing walls providing traditional privacy; 2) the bourgeois house and "its kitsch-like trappings of 'home"'; and 3) the object of everyday life which however mass-produced are still adorned with ornaments and "encrusted with historical references." To eliminate the damp basements and to dispose of stifling attics, Le Corbusier's Piloti raises the house in favor of clean and sterile spaces (1992). The unprecedented degree of openness and transparency provided by horizontal windows and Free Plan is antithetical to, and a surrogate for, the private interiors of traditional houses generated by thick walls and interstitial spaces.

One should add the fourth category: the solid masonry base. Functioning as a mediatory device between the ground surface and the main exterior walls. A disavowed concept abolished by Piloti. Nonetheless, it has returned in uncanny forms haunting the Pilotis. The solid podium and heavy base, which in their antagonism with the grid of columns disrupt the ground level's sterility, are emblematic of such a return. City Hall's heavy brick walls stifling the openness of the inner courtyard and thwarting the visual connectivity exemplifies the same phenomenon. To be in line with historic preservation concerns, many buildings feature red bricks implying the significance of the original "colonial or Victorian era sites" (Flint 2010). Yet, this presence and its unresolved inscription into the language of modern architecture are evocative of Deleuzian Disjunctive Inclusion (Žižek 2010). Characteristic of many urban renewal projects, they are obliged to include certain themes, memories, elements "whose existence are not part of its 'ideal-ego,' i.e., which are disjoined from its idealized image of itself" (2010).

Schabert (1989) traces the problem and finds the fictitious claim that "the Mayor's Office and the City Council Chamber [are] visible to all and directly accessible by a large stairway [from the entrance hall]." Elaborating on how transparency and unmediated access have been constantly filtered, he concludes that quite contrary to the premise, "architecture is used to protect the office of Boston's Mayor against the public's view" (1989). Disjunctive Inclusion finds its definitive expression precisely in this false representation of transparency when the Mayor's office was meant to be a metaphor for transparency, but the remote placement of windows in regard to the central public space doesn't allow visual connection to the internal mechanisms of the office.

3.3 *A psycho-pathological parallel*

The incongruous combination of traditional architecture's solid base and modernist's Piloti is analogous to Max Ernst's surrealist collages. Ernst's unsettling construct, "a horse gets mixed up with one's body" (Vidler 1992), finds its architectural parallel in City Hall's unresolved co-presence of the brick base and the slender concrete columns. The floating volumes hovering above the piers and the heavy fortress-like base pulling the building down follow two different formal principles. The two, nonetheless, have been held together by compositional prowess of the designers. This reconciliation of competing principles is central discourse in many canonical projects. Fredric Jameson (1991), interprets Frank Gehry's design for private houses "as an attempt to mediate tradition (old ornamented wooden structures) and alienated modernity (corrugated iron, concrete and glass)" which eventually and similarly to as Ernst collage painting results in "an amphibious" creature, as Žižek noted (2010). If Ernst's collages register sexual and mental ambiguities, here, the conjunctive synthesis of two architectural dispositions resulted in spatial ambiguity.

On a deeper level, the building embodies the incommensurability of a democratic, transparent system and a consolidated bureaucratic constitution, which despite its refined democratic aspiration, still function within the confines of rigid rules and hierarchies. Here the collision of the two underlying systems has found an external manifestation. Žižek (2010) reflects on a similar anomaly in the works of Daniel Libeskind and Frank Gehry: "their work often appears as a desperate (or joyous) attempt to combine two incompatible structuring principles within the same building … as if two principles are locked in a struggle for hegemony." Although Le Corbusier's Piloti was still the master-signifier for post-war modernism, by the 1960s a shift in architecture's big Other signaled a new historical epoch (Hays 2010). Not only did the return to Classical elements herald a stylistic shift, but, as Aldo Rossi observed and later Michael Hays (2010) echoed, this was the moment when modernism's socio-economic

relevance has subdued in favor of consumer society's new values.

3.4 *Spirit of the age and brutalism*

It is clear to see the project as a hybrid shaped by the symbiosis of two seemingly compatible styles: the emerging brutalism of the 50s—the official style of governmental and institutional clients—and a mode of expression inherent to the Russian Constructivist of the 20s and 30s. The project could be a conjunctive synthesis of two contemporary projects: Rusakov Workers' Club in Moscow by Konstantin Melnikov, 1927–28 and Lovell Beach House in Newport Beach, CA by Rudolph Schindler, 1926. On the formal level the three upper floors hovering above the slender concrete piers demonstrate a higher degree of similarities to the Sainte Marie de La Tourette, 1960, Le Corbusier's building. The point here is not merely formal, but ideological. The decision to design the building according to the style appealing to governmental institutions has been the emblem of architecture's political correctness. It is provocative to recall Paul Rudolph's insistence on engaging craftsmen in making bush hammered concrete finish. Does his advocacy for authentic labor share common ground with Marxist trajectory, disrupting or rather contesting the capitalist regime of development?

The interrelated notions of political transparency, democratic inclusivity, public service, etc., demand literal openness. For City Hall, if such a desire has not been physically denied, controlled or limited, the space remains too formal and too serious to be inviting. Both the building and plaza "were intended to create an open and accessible place for government, an exuberant statement of democracy and civic life. Needless to say, that's not the prevailing opinion today" (BSA 2016). The door is open but the gatekeeper is too daunting and intimidating.

4 DEFECTED DIALECTS

Is it possible to reconcile between the messy expression of democracy and the sterile representation of order? How could design provide a physical structure through which opposing tendencies interact without losing their identities and their distinct modes of operation? The predominant misunderstanding of dialectics finds synthesis as a middle ground, mediating between the thesis and the antithesis. Hegelian dialectics, on the contrary, does not abolish the differences to accede to a higher reality (Limnatis 2010). Rather, dialectic is the dynamic force allowing an asymmetrical coexistence of opposites. Similarly, the opposition of the two tendencies underpinning the plaza "conceals the fact that one of the poles already is the unity of the two—so, for Hegel, there is no need for a third element to bring the two together" (Žižek 2012). No wonder that instead of revolutionizing the antagonism between the new-liberal democratic capitalism and the pseudo-democratic architecture, the new design for the plaza is adding the third element: trees—the "synthesis." The main point in dialectics is the asymmetry of the relations where one of the poles is posited by the self-mediation of the other. The depressing spaces of the plaza are not a phenomenon alien from the utopian politics of the 1960s, on the contrary, it is the very symptom of liberal capitalism. The problematic space is the secondary reactive outcome. To escape the deadlock therefore, the solution does not reside in the third element, nor in the symmetrical balance between the two, but, architecture needs "to overcome the source of the problem, the antagonism at the very heart" of this conflict (2012).

5 PARADOX OF THE FUTURE PLANS

Within the ongoing discourse on revitalizing Boston City Hall and its plaza there are some explicitly design-oriented instances. The contributions are on two levels: first, provocations from open competitions, along with those voluntarily inputs and academic experimentations; second, the commissioned or sponsored projects. This is not to categorize these two genres as amateurish versus professional, but to characterize the differences in terms of time, budget, deliverables, and to some degree, their impact. Beyond the surface, nonetheless, the two type of projects are fundamentally different.

The projects designed through open/student competitions share the following traits: they have freely dismantled some of the basic principles underpinning the design of the plaza and city hall, such as spatial orders and functional structures; they also have questioned certain taken-for-granted assumptions such as the impossibility of appropriating part of a state-owned property for private use that might invigorate the space.

Originated by the Rotch Foundation, the 2010 competition called for the design of a history museum for the City of Boston (Rotch Foundation 2010). Despite their different design outcomes, all the competition finalists offered solutions to the same category of problems identified in this paper: the problematics of edge conditions, the brutality of solid walls, and the lack of activating uses. The recurring themes in all the schemes includes: the breaking up of the solid walls replacing them with transparent surfaces; attenuation of the threshold between the building and its surrounding; articulating edges and subdividing the unproportioned areas of the plaza; introducing small scale uses such as cafes and public facilities within the plaza itself.

On the sponsored contributions, in 2010, the U.S. Environmental Protection Agency (EPA) commissioned a comprehensive report to design a vision for City Hall along with incremental steps to realize the plan. The EPA also sponsored a three-day design workshop that brought together a remarkable number of experts from different fields to share their ideas on the reconfiguration of the plaza (EPA 2010). The report includes two scenarios, each dividing the public

space through slightly different configurations. The scenarios proposed by such "professional" coalitions have a radically different nature that of the students' inputs. Essentially conservative, two elements dominate in a majority of schemes: tree canopies and gathering spaces. All the existing elements and operations have remained untouched. In 2015, the City of Boston announced that the Property and Construction Management Department has commissioned three firms to collaborate on a "comprehensive roadmap for design and operational improvements to city hall and its plaza" (Boston 2015). Again, the design solutions did not go much further than promoting vegetation and lighting. Here comes the crucial question: why despite all the evident problems, the solution has been decidedly confined to stormwater management? Koolhaas (1988) argues that the residual which was holding the modern spaces together "was merely green," where "its controlled neatness a moralistic assertion of good intentions, discouraging association, use." Today nonetheless, the residual is "a hybrid of politics and landscape."

6 EPILOGUE

Despite all the affirmative evidence that the plaza needs a radical transformation, the collective unconscious of the official agencies and the mentality of design coalitions have not yet come to believe that the primary problem is ideological, not stylistic. Rather than the exchange of partial solutions, what is crucially missing is a radical reinterpretation of the underlying conflicts. Authorities put all their effort to serve the public—apparently engaging it in decision-making processes. But at the end it is the "City" who decides what the authentic needs are, but more importantly, what the public should desire. To serve, the ruling officials need an unbridgeable gap, an imaginary distance, between themselves and the public—externally organizing the flows of public desire within the provided physical and psychological structures. As Deleuze and Guattari (1983) argued, capitalism constantly generates new axioms or adds to the existing ones. This symbolic realm of rules, axioms, and predetermined structures is what in Lacanian psychoanalysis referred to as the big Other. If for the 1960s the axiom of the ruling ideology was a democratic state apparatus—where change can only be "a change within the regime of representation" (Nail 2012)—today the axiom is "sustainability." As Cohen and Naginski (2014) noted: "just as religion is the opium of masses, sustainability is now the opium of architects, policymakers and technocrats."

Recently, the attempts to revitalize the plaza have been focused on re-naturalizing the space. The fact that such a sensitive project was funded by EPA, an organization with an environmental agenda, reveals the unfortunate realities of funding issues. Sustainability, preservation, LEED, SEED, etc. are shaping the very horizon of our imagination. In his critique of historic preservation, Koolhaas (2014) argues how the concept of preservation has been used as a pretext to elude deeper questions about the urban life. Diverting the federal funds through a demonstration project has nothing to do with the real predicaments. Of course environmental predicaments should not be neglected. But, are water flows the central problems here or the concerns which the public could identify with?

To follow Althusser (1970), the predicament is not with Repressive State Apparatuses, but precisely with what he calls, Ideological State Apparatuses: those suppressive mechanism which we are not able to directly recognize. The design program for Plaza embodies a repressed desire for hierarchy and order. The transparency of the Mayor's office was meant as a metaphor for democratic transparency, yet its placement does not allow any views in. Rather than exposing the internal mechanisms in action, transparency simply provides a proper appearance.

To continue to live with the disturbing truth of the public domain is analogous to the enduring register of traumatic symptoms in the unconscious. I will conclude with a quote from Žižek (2014) which best exemplifies this melancholic existence: "What awaits me 'there' is not a deep Truth I have to identify with, but an unbearable truth I have to learn to live with."

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Indian (public) spaces. Transitions and cycles

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ABSTRACT: Transition of urban structures requires a careful reflection about the role of time in the description of urban phenomena. If the mutations, albeit quick, appear much more under control in Europe, in other parts of the world the situation is visibly different. Therefore, this research describes the changes in the concept of public and urban space in the Indian context, particularly in the city of Ahmedabad, Gujarat. This constitutes a particularly interesting case because it shows the signs of a change of scale and of use of the space itself that cannot be ignored, besides it reveals the relations between times and places that assume different quality and characters during a single day. The research aims to explain the changes and mutations arising in a wide range of Indian public spaces that become case studies useful to describe and compare the definition of public space in that context.

1 PREMISE. TO IMAGINE THE CHANGE

"India! The land of antiquity. Its heritage is not confined to historic accounts of events and objects frozen in their own time and space, but is perpetuated as cultural and architectural traditions" (Pandya, 2013).

The nature of contemporary public spaces affects and determines the quality of cities and urban places, favors meetings, opens to dialogues and enables to observe and to build different scenarios in which a series of commercial activities and exchanges can be overlapped, so that we can find interactions between different uses and forms of living the transitional space. The interstitial space, which divides and characterizes the private sector from the public one, is the object of study of this research: Jan Gehl, who investigated for a long time the mutations in the uses and forms of public places, supports the need to bring the glance to the 'life between buildings' as a framework of critical thoughts regarding the ongoing transformations in the life of public spaces.

"Life between buildings had been forgotten, pushed aside by cars, large-scale thinking, and over rationalized, specialized process" (Gehl, 2000). By building methods and tools to ask the change, it seems essential to wonder about factors that influence the processes of modification of public spaces and urban places. Jan Gehl's book "How to study public life" it appears fundamental to systematically question the variety of people and activities that animate public places: how many, who, where, what, how long are questions useful to classify the complexity of lives, forms and behaviors that define public spaces in different contexts, not only in Europe.

To describe and to design urban spaces implies an understanding of their lives that inhabit them, pass through them and determine their character. Too often we forget and lose the interaction between human beings and their own uses of open and public spaces. "But while architects and urban planners have been dealing with space, the other side of the coin – life – has often been forgotten" (Gehl, 2000).

Which spaces and activities and how can we observe to collect and to document the ongoing transitions and the changes taking place in the definition of shared places? The survey tools cannot be determined uniquely, but they change and adapt according to the contexts; indeed the uniqueness of places, cultures and habits requires a reading of the mutations of the concept of public space through new eyes. It can be argued, therefore, that it is each place that determines, implicitly, instruments, ways and methods of interpretation of the relationship between public space and its own uses.

2 SHARING FORMS: VARIATIONS IN THE CONCEPT OF PUBLIC SPACE

The research looks at the Indian context as a scenario of an epochal transformation and an unprecedented urban challenge in which public space conditions are constantly modified. In this country places, culture and traditions play a fundamental role in the understanding of characters, and differences of public space compared to the European context.

The aim of this essay is to investigate the transformation of the conditions of shared spaces, beyond the known paradigms already studied in Europe. In many European scenarios, shared territories depend on rules, rituals, the claim of various rights and the appropriation of marginal and abandoned spaces.

"Sharing simply goes where there is the chance to go: in the residual spaces of urban fringes or in the symbolic heart of the city." (Bianchetti, 2014). In the European context, public space is often controlled, measured and designed: it is the square, the market, the porch. However, at the same time, sharing grows and develops exactly where the space is disrupted and fragile, where we can capture new spatial and social implications generated by the economic crisis. It is thus crucial to find new ways to build and use the public space in which time plays a fundamental role given that the rapider and rapider change of urban phenomena implies the redefinition of survey and reading tools for public spaces. If, in the European context, mutation and change, albeit fast and due to abandonment processes and economic contractions, appear under control; the impulse to growth is far from stopping in other contexts, especially in India.

Therefore, it is significant to investigate the ways in which the concept of public and sharing space has been declined and consolidated in other areas. From this point of view, India represents a context in rapid transformation, marked by an intense economical and demographical growth, but at the same time, strictly bounded to traditions and habits practiced from generations.

The necessity to open our glance and reflection on the Indian context has begun after an experience of research and work conducted at the CEPT University, Ahmedabad, from July 2014 to June 2015. Impressed by the fascination for the Indian population and for their beautiful lands, I was unarmed in front of the inability to consolidate and last over the time, typical of these places. India is a country in continuous and powerful expansion, where tradition and innovation, past and future are laboriously trying to find difficult balances. There are contrasting scenarios, heavy cultural and social contradictions that constantly change the use and the definition of Indian public spaces.

How can the concept of public space be defined in India? Are there differences between north and south, between extended urban areas and small villages?

The Indian context declares its necessity to find new forms and tools able to describe changing shared places, extremely fragile and subject to sudden modifications of use, even in a single day.

Discovering the concept and the use of public space in India is a challenge that starts from the premises of the European tradition and arises important questions about the transformation of places where traditions, cultures and rituals define life and urban space.

3 (INDIAN) PUBLIC SPACES?

Interstitial places, temporary markets, large bazaars, squares, mosques and so on: the public space in India assumes different scales, sizes and conditions. First of all, it is a place of exchange, and meeting, but also of work, as a consequence it can change many times in different ways during a single day.

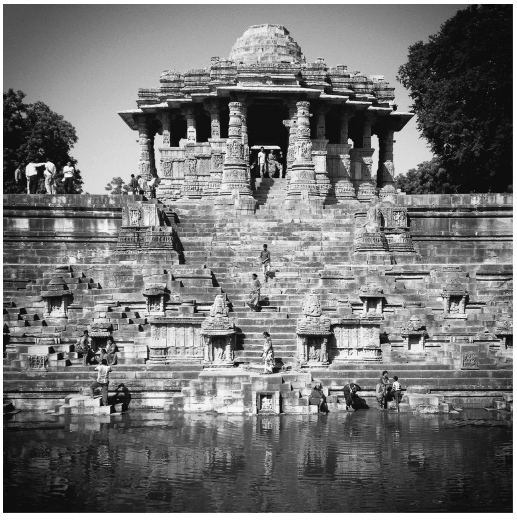


Figure 1. Modhera, Sun Temple: an example of a religious public space.

Transience and cyclicity of the concept of public space are its biggest qualities and, at the same time, its biggest exception that we can grasp comparing it to the European context. In India the urban space is vital, vibrant and dynamic, it undergoes continuous changes and transformations over a short period of time. This variable assumes a complex identity in the definition of spaces and urban fabrics: indeed, in the Indian conception, time is a cyclical phenomenon and an expression of a continuous chain of construction and deconstruction. From the belief in reincarnation, at birth and at death, most of the existence of men and cities is inextricably connected to the transformation of time and uses.

The research aims to document and interpret the intrinsic relationship between times and places in the definition of the urban character of the Indian context.

If, on one hand, the continuous and indispensable necessity of free spaces makes the unstable Indian context open to new interventions and grafts; on the other hand, the shortage of space shows the need of a continuous and quick change of what is already there.

The research will focus, with particular attention, on the city of Ahmedabad, Gujarat, expression of a rich mix of identities, times and uses of public space, as well as place of the coexistence of different cultures and religions. The research highlights the necessity for the architectural design to build new tools and strategies for the critical reading and analysis of the concept of public urban space.

Strategies needed to work in unstable and changing territories and to investigate dynamics in which religion, customs and spaces are blended together. The question, which goes through the text, is linked to the time of life and the use of cities and their spaces. What is the time of the public space in India? How do conditions and instances which define the limits for sharing places change?

Public spaces are essentially characterized by an empty or open space that is structured thanks to its urban built and settled edges; this is what we know from the European history. "(…) the void [in the natural environment] is unitary, closed and secret; in this [urban area] it is diversified, open and collective. Therefore, the public space is conceived as an urban void in which movement and variation are produced, which the passage of time and the human action are made explicit" (Espuelas, 2004).

In India, the void that should be seen as public space is, instead, a place full of activities, relationships, exchanges, temporary and permanent structures that constantly change places in few hours. It is an alchemy that overlaps time to places and defines the concept of Indian public space as a dynamic expression and cyclic transformation. "(…) constant juxtaposition of time over space is the essential premise of Indian architecture. This is a creative resolution under scarce resource conditions" (Pandya, 2013).

Indian public space lives and feeds from the dual concept of uniformity and differentiation, which involves an interpretation of the open and interstitial space, as a sap able to connect and bind different parts of a single system. We take into account the street as an element able to show the uniform heterogeneity of the Indian urban space. The road crosses urban centers, marked by the continuity of the urban facades, from the rhythm of the openings and the coordination of masses and volumes. At the same time, however, the continuity ensured by the settlement rules allows a careful and continuous variation in the use of colors, addition and subtraction of volumes, actions that emphasize the identity of each context. Similarly, public open space varies with great dynamism to allow an overlap of different activities and events, populate their margins and transforming the urban section in a vital and fascinating space.

4 AHMEDABAD: TRANSITION AND CYCLES

4.1 *Understanding a changing urban scenario*

Why Ahmedabad? For many, India is condensed in few places of great history: Mumbai and its cosmopolitan charm; Delhi, a place of contradictions and traditions; the spirituality of Varanasi that dips into the banks of the river Ganges. In my view, embarking on the journey to the discovery of India has been an experience that no description can convey.

It was the discovery of a varied, extreme, fascinating continent, the discovery of a unique idea of sharing, exceeded in Europe, which leads to share the housing space and the courtyard, where private life is concentrated into few, precious moments of solitude.

Mostly, India is chaos, it is the superimposition of urban layers, people, noise, traffic, car, sounds, smells and colors. Find your own way when you land in India, in any city of India, is complex because you are surrounded by smells and noises, by the cities that never cease to live and mark their time. The succession and the cyclical overlapping of events prevent you from breathing and you need occasionally to stop. It is exactly when I stopped that I learnt to observe India and, in particular, Ahmedabad.



Figure 2. Ahmedabad, Sunday Market. Temporary and permanent use of public spaces.

I learned to observe the use of its spaces and to question the value of public space in similar contexts.

What does it mean to understand or try to grasp the Indian space? That is a difficult question to which the text of J. Nehru, The Idea of India can try, perhaps, to give an interesting answer and a great suggestion. "India was in my blood … And yet I approached her almost as an alien critic, full of dislike for the present as well as for many of the relics of the past that I saw. To some extent I came to her via the West and looked at her as a friendly westerner might have done. I was eager and anxious to change her outlook and appearance and give her the garb of modernity. And yet doubts rose within me" (Jawaharlal Nehru, 1946).

Therefore, India needs to be understood, it must enter to undertake a critical reading and interpretation of its own spaces. The essay reads, through the city of Ahmedabad, some paradigmatic spaces in the Indian context by essence and structure, trying to find ties and conflicts with the paradigmatic figures in the European context.

4.2 *The square and bazar: Manek Chowk*

Manek Chowk is the most interesting transposition of the concept of urban plaza in the Indian context and, in particular, the expression of the public vitality that will be experienced in the city of Ahmedabad. The metamorphosis of the space of Manek Chowk is cyclical and continuous, because it develops during a whole day. Here the space changes dramatically beyond the time, it is a metamorphosis that embraces urban life and built-up system, which determines its borders. Its

high rate of transience and adaptation to change allows an ongoing (and infinite) flexibility of space.

The square becomes grazing, where cows settle in the early morning waiting for food, it is a collective ritual in which people organize to bring food every day. The same space becomes square, free ground for daily activities of urban market and temporary exchange.

During the day, intensity and density of the forms of activities build the space of Manek Chowk, marking the mixture of people, parking, shops and street vendors. Instead, from evening till late night, the square is transformed into a large open-air restaurant, where temporary spaces mutate and become more urban: a very different condition from that we are used to seeing in the system of open spaces in Europe.

Movement, time and space are intertwined in the attempt to build different scenarios of use and urban facilities. "Traditional Indian architecture is the story of movement and pauses where the kinesthetics of a space is fundamental to its experience and perception" (Pandya, 2013).

In the Indian context, I perceived with a strong clarity how much the time condition determines, in every moment, a new spatial condition: the public space that we find through India, in Delhi, as well as in Mumbai or Ahmedabad, is the superposition of layers, levels and strata; it is a sequence of different thresholds that gain or lose thickness during the day.

In opposition to what we are often accustomed to grasp, urban and public life is intensified at nightfall, when the weather becomes milder, showing how the sharing of space is the backbone of the definition of what is really public.

4.3 *The street: a system of public spaces*

From the square to the road, the research moves into the definition of one of the most public places in the Indian context: life usually takes place in the streets, its edges and borders.

Indeed, the street is conceived as a real public space where people inhabit its borders, cars, pedestrians and animals live together and the action of cross is a way to find the clearest path into a winding wave of elements that are piled together.

The road is also the favorite place for a quick meal. In Ahmedabad, the street that takes to the university is full of street vendors, small shops on four wheels, who, moving, determine the urban and public identity of a space that is not only a place of connection, but becomes a place of staying.

Edges, borders and limits of the Indian public space are transformed into vital lymph and determine the new vision of a public space that characterizes the context.

If, in Europe, we look at the square, its center and at urban void that defines the action of staying and sharing; in India and in Ahmedabad you live on the edge of the street, of the square or of the market. The high density of the space and the number of its inhabitants that are intertwined during the day make the 'border'



Figure 3. Pushkar: street market. The road becomes the space for the public market.

a living space and its thickness a place of sharing. To imagine a street as a public space appears curious as in the European context roads divide, because they are elements of fast connection, mainly dedicated to cars.

In India, instead they represent an extension of people's own home and the edge becomes a place for the coexistence of different activities. Ahmedabad, as well as most of the Indian cities, lives a different time, syncopated and discontinuous; it has been characterized by a different use of its edges: on its street corners it captures the teem of a commercial life, a great and continuous shop window that interfaces with the rest of the city. Therefore, the Indian street has a different identity, compared to the European context, because it is a relational space where temporary conditions follow by allowing the determination of spaces of transition between public and private.

4.4 *Sarkhej Roza: the mosque as a shared space*

Sarkhej Roza represents a fusion between architecture, monumental spatiality and different use, integrated and harmonious, of the space. It is a royal complex built from 1446 by the King Sultan Muhammad Shah, Ahmed Shah's son, the founder of Ahmedabad. The complex was built for subsequent additions of parts, starting from the mosque system to which, later, were added a large water basin, the tomb complex and the king and queen's pavilion used as a summer retreat.

Currently, the Sarkhej Roza complex represents a gathering place frequented not only by Muslims, indeed, as well as being a place of worship, it is also one of the most used public spaces. It is a symbol of integration, sharing and exchange, adjectives that well describe the expression of public space.

I remember when I first visited it on a sunny Sunday in August. I was in India for less than a month, disoriented. I arrived at the entrance and I took off my shoes,



Figure 4. Ahmedabad, Sarkhej Roza. Religious places become public and shared spaces.

a mandatory action necessary to enter the complex. Then I crossed the threshold and I felt absorbed in an unmatched and unprecedented space. Sitting around the pavilions were families, children, elderly people intent to enjoy the Sunday rest: some played, some ate, some chatted some prayed. All together.

The sequence of architectural and urban spaces defines ideal conditions for the use and enjoyment of Sarkhej, conceived as a summer retreat. Over time, it has been transformed in an open public place able to establish a platform for social interaction and sharing.

"The mood, identity, as well as the sanctity of each world are, thus, maintained. Each world exists, in its entirety, on its own and yet at a different scale, each world remains a part of the larger whole" (Pandya, 2013, p. 122).

Sarkhej Roza represents a sequence of parts that communicate with each other, this communication being sometimes visual, perceptual or conceptual and establishing continuous references between different architectural conditions.

Sarkhej shows how the relationships between visitor and space are the expression of a communicative process that here occurs in a spontaneous, intuitive and personal way.

The lack of alignment between the different parts of the complex invites the discovery of the space, not through a straight path but through a succession of different areas linked between them. The public space is 'lived' by each visitor in a different way, so it is intimate and personal experience.

A spatial tension between full and empty spaces, between masses and open spaces, articulated by architectural elements that mark rhythm and measure of the space; columns, pavilions, walls, and porches that gather defining visual and focal nodes: all these elements accompany the journey into the complex.

4.5 *Stepwell: the charm of forgotten spaces*

Finally, there is a fourth possible category in the classification here narrated, which does not pretend to be exhaustive, but to describe a sequence of places that can be considered as public spaces. It is the stepwell, a real architectural typology very common in the western, and warmer, part of India.

Once again, the mingling of functions and identity defines the public nature of these places; the stepwell was born as a device to collect and contain water, a highly valuable good in these areas.

In Ahmedabad we can consider the stepwell located at Adalaj, not far from the city, as a symbol of this category. Therefore, the stepwell arises as a technological device that, over the time, has been established as a religious and social place; whose charm resides in the richness of its decorated spaces and in the sequence of levels leading to the heart of the well.

For women who went to fetch water, the stepwell turned into a public social place, a time to rest from the toils of the day. Beyond its original purpose, now considered obsolete, the stepwell represents an urban architecture that has been able to travel through time, renewing itself.

Movement and perception make the place charming and evocative; to enter a stepwell is a journey, a process of crossing spaces that becomes event. At Adalaj, the stepwell has been turned into public space, it is a place for musical and theater performances that use diaphragms and differences of levels such as backgrounds or scenarios for the different representations.

Ultimately, the stepwell is an architectural structure organized around a central axis that invites to the descent through a sequence of steps and platforms. The entrance to the structure is arranged around the rotation of the axis that leads to the beginning of the promenade. A sequence of continuous changes of visuals and perspectives organize the space.

5 CHANGING SCENARIOS

We have seen how in India the public space assumes different configurations, indeed time conditions and the cyclic nature of the activities which follow during a day show how public space can be flexible and able to adapt and change in a short period of time.

It radically changes the consideration of the concept of public space that we find in the Indian context, where the idea of sharing becomes an element able to inhabit marginal places, often residual.

The survey to be conducted on these sites should be related to the observation of times, uses, density of activities and categories of people who inhabit and define these spaces. Therefore, it must determine other categories of investigation compared to what has been studied in Europe in the recent decades.

How is it possible to intervene or to change the construction and the use of public space in India? What



Figure 5. Jaisalmer, Rajastan. The street is the most relevant public spaces, in which everyone is trying to find its own space.

has been described shows the need to equip public and shared spaces with temporary and flexible architectural elements, able to quickly change the layout of an urban area.

In India we can and we must imagine that the architectural design will be able to communicate with the habits and the established traditions, promoting not only a revival of Western models, but fitting and supporting local activities that animate the shared spaces.

Here, it is necessary to provide temporary structures with different materials, able to ensure the equipment for markets or bazaars, and toilets that enable the large number of people, who usually frequent these places, to have access to basic facilities.

Moreover, it is necessary to integrate public space with facilities and equipment able to provide a better and safer use for visitors.

If you think about the examples in Ahmedabad, a place like Manek Chowk requires a timely job of cleaning and 'modeling' of its edges and borders to favor the permanence of the multiplicity of the still existing activities. Other contexts, such as Sarkhej Roza and Adalaj, live a different condition, because these public spaces were born around a cultural heritage that has been preserved thanks to the modification of its use and the opening to the city.

In this sense, the public use, although intensive, should look at the protection of quality and architectural heritage, maintaining the active coexistence of different cultures and people. Moreover, in Sarkehj and Adalaj it is possible to find a certain measure between the elements of the two complexes that let the space breath and make the perception less chaotic.

This is a completely different condition if compared to the Indian road, where the experience of public space is related to the intricate use of its margins and in the overlapping of different elements. It is on the road that we could intervene more, in its integrated design of layers and levels so that they allow a better organization of the space allocated to cars and pedestrians, but at the same time, it is necessary to provide places intended for street vendors who constitute the fundamental essence of Indian public space.

What role can the architecture design assume in unstable or changing conditions such as those described in India? What design and social tools can be used to facilitate the integration of practices and activities?

6 CONCLUSIONS

There is no unique answer about the issues arisen from this research, but different ways of inhabiting the public place that work through scales and conditions in which the architectural project remains in the background. The research, in fact, described daily uses, shared habits and practices, rituals of living a place that are often independent from the architectural forms or the design of those places. The study of Indian public spaces tells us to consider the informality of uses as a value and the architecture as a tool able to make the urban space flexible.

In conclusion, a space that daily changes imposes the assumption of different paradigms of investigation, based on urban times, spatial articulations and relational dynamics that define those areas: they are necessary not to lose the richness and the density of Indian contexts.

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The squares in Portugal inventory and the creation of contemporary spaces

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ABSTRACT: Informed by the research work that makes up the inventory of public squares in Portugal, developed in the Faculty of Architecture of the University of Lisbon, part of the research team has developed two projects for very different public spaces: one for a church square in Bobadela, a small village near Coimbra, in the centre of Portugal, and the other one for a new square in the Azorean island of Santa Maria. The first square has been an important public space since the early Roman occupation of the site; the second is a completely new public space that was previously occupied by an urban block. The paper underlines the influences and relations between the architectural research developed in the Academy and the practice developed in the architectural Office in these two projects, i.e. how the research influenced the creation of reference spaces for the contemporary and future society.

1 THE SQUARES IN PORTUGAL INVENTORY

The term praça (square) is Latin in origin – *platea* – and it is used to identify a public space of an exceptional character that is morphologically distinct from the channel-like spaces that streets make. However, very different spaces correspond to this apparently clear morphology, covered by varied nomenclature and which in some way are not a cultural constant.

Although squares may not exist in certain cultures, in the West they are, by nature, an urban quality prerequisite. This importance dates back to the myth of the Greek *agora* and Roman *forum* as spatial supports for civic institutions of which we believe ourselves to be the heirs.

The fact that, in the late Middle-Ages and the Modern Age, the square has served multiple functions – commercial, political, social and religious – bordered by the public and private buildings of greatest importance in the city, has consolidated its collective character and has given it extra importance in comparison with the other urban public spaces. Its hierarchical superiority is evident in any type of fabric, not only due to the functions it supports, but also due to the finite nature of its space, its relative size or quality of its architecture, regardless of the origins behind its shape.

Nowadays, in spite of everything, the traditional square has retained much of its urban role. Although with new outlines, its production as an urban feature after the Modern Movement has seen it linked to what many were already calling "a nostalgic symbol for a lost urban quality".

By taking on the job of fact-finding, graphic restitution and illustrating the main examples of squares in Portugal, our intention is for our work to be a representative body of the diverse typology, the state of development, dimensions and usages of this so particular a type of public space. Our approach was one of taking exceptional public spaces that are generically labelled squares, even if the varied terminology in Portuguese differentiates between them, such as: "o largo", "o terreiro", "o campo", "o rossio", which in English equate to "the square" or " the public square". We excluded spaces that typologically act as a channel, like a street. If spaces, originally or at one time or another, had a clearly identifiable sub-type or affectation, as they developed the clarity of these distinctions often became foggy.

As urban features, the selected spaces are an integral part of the urban fabric, possessing a formal, functional hierarchical relationship with the other features that they comprise. In this way, analysis cannot ignore the context, and the spaces chosen were always approached as being part of a whole.

Our benchmark reference work was the *Encyclopédie de l'Urbanisme*, coordinated by Robert Auzelle and Ivan Jankovic, whose preface describes the work as "an irreplaceable instrument of work and culture". We believed that this study could meet these same objectives.

In this way, our aim was twofold in the way we approached the topic, that is, studying one of the components of the urban layout through classical representation methods of the structures, as well as using auxiliary illustrations and characterisations, carrying out analysis with all the due rigour of our field, yet remaining legible to the general public. On the other hand, it can serve as an instrument for practising urbanism, as well as teaching it, insofar as it studies the selected spaces in a methodical and comparable way

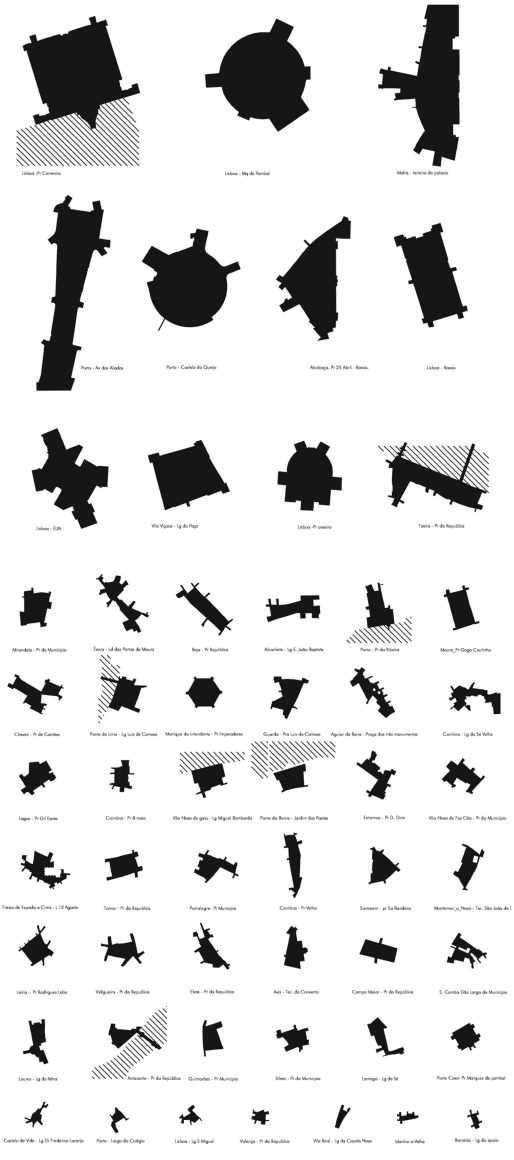


Figure 1. The Squares in Portugal – A Public Space Inventory. Squares layout comparative table.

as being examples. Its operational nature rests on the ability to be a reference for designing contemporary urban structures.

2 CONTEMPORARY DESIGN OF SQUARES

2.1 *From research to practice*

Informed by the research work that makes up the inventory of public squares in Portugal, published in 2007 and developed in the Faculty of Architecture of the University of Lisbon, part of the research team has developed at the same time two projects for very different public spaces: one for a church square in Bobadela, a small village near Coimbra, in the centre of Portugal, and the other one for a new square in the Azorean island of Santa Maria.

The first square has been an important public space since the early Roman occupation of the site; the second is a completely new public space that was previously occupied by an urban block.

Although the context and objectives of each project were different, the morphological recognition of each place was the common initial step of the design approach, with a similar methodology to the public squares inventory. Therefore, each space was represented with classically drawn features, such as plans and cross sections, as well as photographs of the environment, considering perspectives deemed to show the characteristics of the space, outstanding features and notes on details or the space's way of life, and a synthetic characterization text dealing with the urban nucleus, looking at historical development and morphological characterization, mapping the morphology of the space, its origins and its main uses.

This primordial physical and social interpretation of the place was the key for the design and transformation of each of the public spaces.

2.2 *Adro da Igreja, Bobadela, Oliveira do Hospital*

2.2.1 *Background*

Nowadays Bobadela is a small village in the Beira. What is so particular about it is that it marries the organisational and formal characteristics that can be seen in similar places with the architectural structures of a Roman city. This reality enables us to understand its origins, which date back to the establishment of a city of the Roman Empire. We do not know the name of this city today, nor do we know a great deal about how it developed with time, the points that stand out being when it was the municipal seat with a charter awarded by King D. Afonso III and, after the administrative reforms of the 19th century, when it was integrated into the Oliveira do Hospital Municipality.

The urban layout reveals the tension between the orthogonal nature of the Roman city, which can be seen in the alignment of the central area's buildings and the two backbone axes, one North–South which enabled the urban development of Senhora da Luz, and another East–West squashed in between the arch and the cemetery road, and the buildings and walls shaped by a snaking road, opened at the end of the 19th century, which encompasses the more central nucleus adjoining the Mother church.

The imbalance in the overlapping churchyard and forum can only be perceived through the different paving, as features that were of major importance in defining the Roman space cannot be seen today, such as the large temple located under the foundations of the 17th century mansion house. The continuing existence of a urban place in Bobadela that has brought urban centrality for almost two millennia is exceptional in urban development. Despite each cultural

period's changing roles, when loss of meaning justified removal of many of their buildings, one common space bolstering this evolution remains visible. The churchyard is still the small urban nucleus' most important space, marrying religious, administrative and social functions. It stands out as a symbolic, emblematic space for its inhabitants.

2.2.2 *Framing*

The remaining structures of the old Forum of the Roman city have a clear presence in the central area of the village, composing part of the whole built ensemble along with the church, manor houses and vernacular buildings. Although it has lost its significance and suffered a process of dismantling for about fifteen hundred years, it is still possible to understand the importance of the Roman city by the amount of existing traces, namely the east entrance of the Forum, the Roman Arch of Bobadela, classified as a national monument.

The space is demarcated to the south by the Mother church, an edifice that was rebuilt in the 18th century, and a massive old cedar tree, to the west by a sober 17th century mansion, to the north by a building constructed over the forum's north-eastern wedge, which is presumed to have been the Curia of the Roman city, whose walls include, together with reworked Roman features, constructions from differing periods, two highlights of which are a Manueline door and a protruding porch.

The eastern limit is not very well defined or consolidated, with various building and walls hugging the road's north–south axis. The Roman arch giving access to the forum plays the leading role as the composition's central feature. It stands out from the other major significant features, such as the pillory, the cross and even the small columned stretch.

2.2.3 *Design*

With the intervention undertaken in Adro da Igreja of Bobadela in 2006 it was intended to create a specific and identifiable space, able to merge in the same place two very different urban objects – the churchyard of the village and the Forum of the Roman city – allowing both its formal and functional coexistence, synthesized on an intervention that seeks an outstanding qualified architecture.

The planned rehabilitation will aim to give a new role to this area that plays, in the urban context of the village, collective functions of great importance. Thus, we intended to enhance the historical and aesthetic value of the set, aligning it with the daily life of its inhabitants, current depositary of these values.

The project stems from the strengthening of the Roman Forum elements and its compatibility with the existing urban context of Bobadela, valuing the buildings better architectural quality and mitigating the impact of dissonant buildings.

As the principles of the intervention are based on an enhanced reading of the Roman pre-existences, it proved essential in methodological terms, confirming the idea formulated for the reconstitution. In this sense,

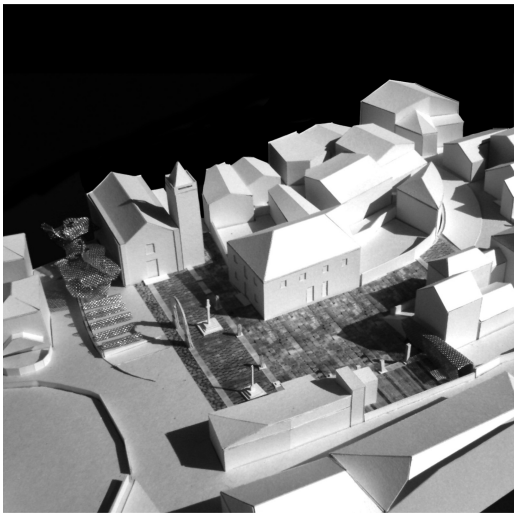


Figure 2. Adro da Igreja, Bobadela, Oliveira do Hospital, Coimbra. Project model.

places of archaeological survey were indicated strategically upon, focusing especially on the churchyard area and the likely limits of the Forum. The result of this operation and the traces found justified occasional adjustments in the development of the project.

The information obtained from the archaeological surveys has reinforced in the design of the square some hypotheses initially placed, particularly with regard to the constitution of the eastern gallery and the south limit of the ancient Forum, as well as rectify some intentions from the preliminary study of the project such as the drawing of the eastern extension of the *cardus*.

The solution is based, firstly, on the laying and recovery of pavements in the precise limits of the Forum, identifying the outer causeway, the outer wall, the gallery, the alignment of the colonnade, the courtyard and the basilica. These pavements are visually distinguished by the stereotomy of the granite pieces, in shape and size, noting clearly the alignments and accusing greater regularity in the gallery carpet than in the courtyard. The basilica, translating an interior space, is paved in recycled wood, with a level gap in relation to the ancient Forum courtyard pavement. The remaining spaces that did not belong to the Forum building are, as a rule, paved on the continuity of existing pavements.

Secondly, the solution proposed the strengthening of alignments using vertical elements, of which should be highlighted the rise and consolidation of the Forum northern wall, the elevation of the eastern wall of the Forum between the parish house and the road and also the placement of columns in the eastern alignment of the ancient colonnade and the north wall of the roman basilica.

Thirdly, we intended to create articulation elements between the Roman and contemporary structures, such as the ramp on the alignment of the arc, an operation

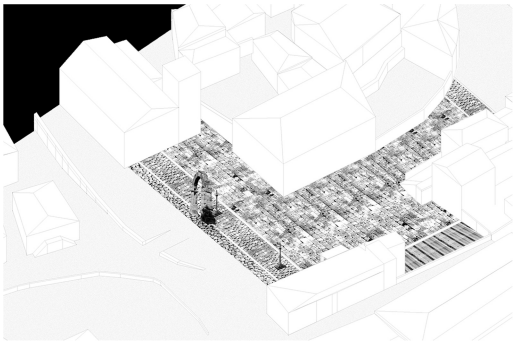


Figure 3. Adro da Igreja, Bobadela, Oliveira do Hospital, Coimbra. Pavements render.

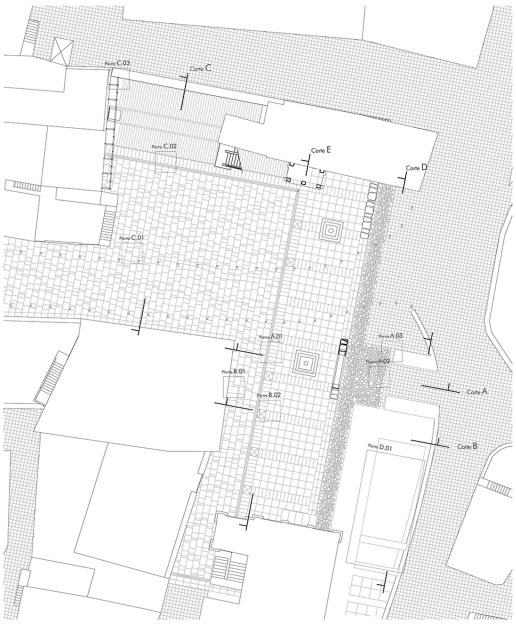


Figure 4. Adro da Igreja, Bobadela, Oliveira do Hospital, Coimbra. Plan of the project.

that required the relocation of the local pillory from where he was placed in the remodelling carried out at the beginning of twentieth century, in the alignment of the cruise cross. In this context, the design considered the extension of the boxwood garden by the east wall, the resulting composition designs with rigour small living spaces on a sand bed box.

2.3 *Praça Gonçalo Velho, Vila do Porto, Santa Maria, Azores*

2.3.1 *Background*

The urban nucleus of Vila do Porto is the foundational settlement of the human occupation of the Azorean Islands and dates back to the 15th century.

The main street that departs from the fort on its southern edge and runs along the ridgeline of the "hump" where the village sits structures both the urban layout its image. One of the features of this structuring urban axis is to be dotted by exceptional public spaces, squares that invariably are aggregated in pairs, one on each side of the main street.

Located on the southern and more ancient part of the urban nucleus, the urban block that gave origin to the new square had undergone a slow and progressive process of ruin, keeping standing only a small number of warehouses on its south edge. The space was open, without any kind of treatment and led to an informal occupation of car parking.

The creation of a public space in Frei Gonçalo Velho Street, part of the main axis of the village, constituted a commitment that the City Council of Vila do Porto took when purchasing a set of buildings in ruin. These void plots, since demolished, constitute assets of the municipality acquired under special conditions for the creation of a public space. The southern plots of the block, three of which were built, were acquired afterwards, thus allowing the full transformation of the urban block from private to public space.

2.3.2 *Framing*

The space, which was object of the intervention whose project started in 2002, is consolidated in its outer limits, as it corresponds to the simple amputation of an urban block. However, the characteristics of the

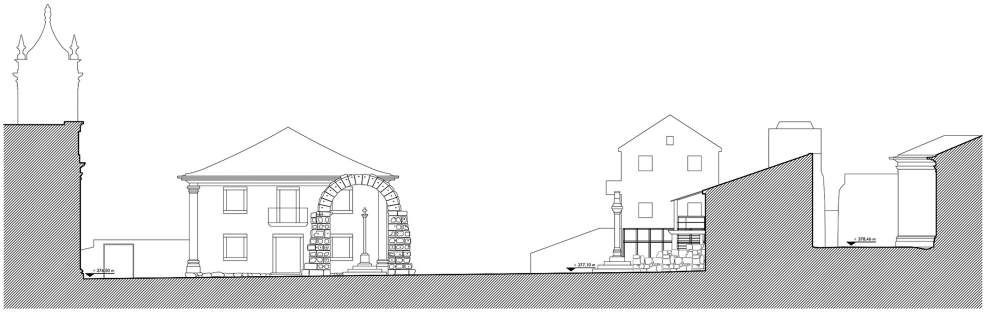


Figure 5. Adro da Igreja, Bobadela, Oliveira do Hospital, Coimbra. Cross section of the project.

built elements that define it are very distinct, existing both well-maintained buildings and in ruin, erudite and vernacular structures alike, good and dissonant architectural quality, and also contrasting dimensions.

The new urban space that was created was combined with Largo Luís de Figueiredo, a small preexistent square, in order to form a composite set of two exceptional spaces, articulated by the street Rua Frei Gonçalo Velho, with dimensions and characteristics comparable to the exceptional spaces that already dotted the structuring axis of Vila do Porto.

Although at the time of the project the space did not serve to support any special urban function, it is bordered by one of the urban blocks classified of interest of the "Ancient Area", with buildings of public ownership in ruin, which were supposed to be transformed into one of the new public facilities from those contained in the municipal development programs.

Nevertheless, this new composite exceptional space would always be an urban element of articulation, the nodal point between Rua Frei Gonçalo Velho and the beginning of Rua da Misericórdia, and also conforming an inflection of the structuring axis of the village.

2.3.3 *Design*

The project thus stems of the principle of the creation of an independent and identifiable space, referenced to an implied general evocation of the memory of the settlement itself that might be translated into an artistic element or embedded in the design of the space. It also sought to enhance the buildings of better architectural quality as opposed to mitigate the impact of the dissonant ones in a space that is to be of collective use, allowing mixed appropriations and contemplating some car parking spaces.

As acknowledged on the inventory of Squares in Portugal, the waves are used as a common composition motive of ornamentation of the pavement. Initially these waves appeared in the Lisbon Rossio and were later exported to other geographical overseas contexts, such as Brazil and Macau, or reinterpreted in more recent urban contexts, such as in the Expo'98 Rossio dos Olivais, but always as a two-dimensional design. The use of waves as a three-dimensional composition motive stemmed from the topographical nature of the space and the wish of evocating the overseas genesis of the foundation of the settlement.

The solution was based on the continuity of the pavement from the main street, Rua Frei Gonçalo Velho; the progressive waving of the topography of the surface gradually increases to the intersection with the supporting wall, an element that absorbs the gap to the lower level of Rua da Misericórdia. This ripple is more evident in northern top while it diminishes to the southern part of the square in order to allow uses and appropriations that require a more straightened surface. The dynamic effect of the waved surface is reinforced by a chromatic nuance achieved from the introduction on the black pavement of a progressive white marking on the edge of each wave.

In order to accentuate the pavement, predominantly black, it contrasts with the retaining, enclosing wall, white in vertical planes.

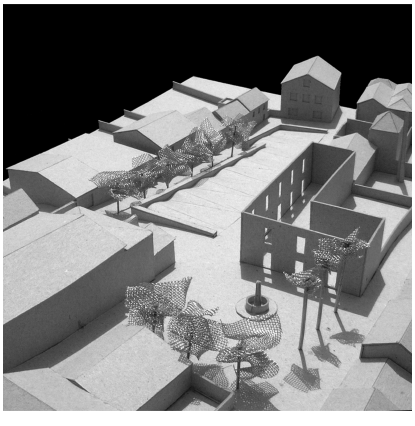


Figure 6. Praça Gonçalo Velho, Vila do Porto, Santa Maria, Azores. Project model.

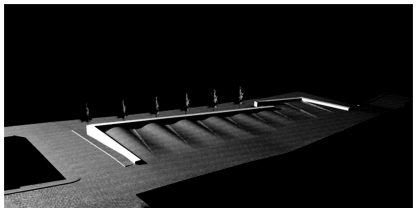


Figure 7. Praça Gonçalo Velho, Vila do Porto, Santa Maria, Azores. Pavements render.



Figure 8. Praça Gonçalo Velho, Vila do Porto, Santa Maria, Azores. Plan of the project.

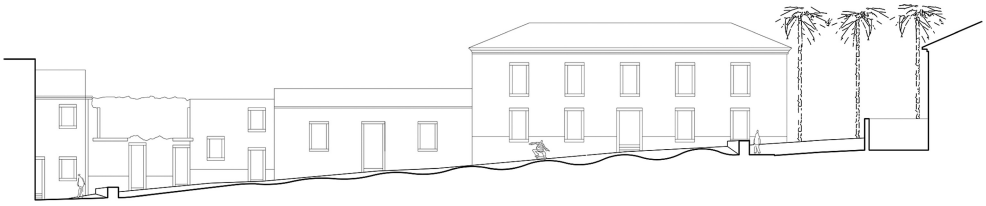


Figure 9. Praça Gonçalo Velho, Vila do Porto, Santa Maria, Azores. Cross section of the project.

This wall hides the parking spaces and regulates the placement of alignment trees. More than shading the parking spaces, the trees filter out the impact of dissonant buildings in the square. The rhythm of the waves and the trees is further enhanced by the water gargoyles, ripped in the supporting wall and connected to each of the trees in order to take advantage of the runoff water when it rains.

Here we introduced a dark red color note on the treatment of metals – grills, gutters, etc. – and the trees themselves – Paulownia tomentosa – flowering in red.

The materials chosen seek to ensure a great continuity with the flooring of "Ancient Area" of Vila do Porto, using cobbled black basalt and white limestone, recovering the vertical walls with plaster and whitewash of the village walls and using one of the species of trees previewed to be planted on the adjacent Largo D. Luís de Figueiredo. The introduction of a discreet contemporary note is given by the use of the rusted metal.

Lighting contemplates the continued existence of the street lighting framing the space, although introducing a new logic for the space itself. This accentuates the arboreal elements by illuminating their tops, and accentuates the design and shape of the floor through a skimmed light on the white face of the pavement of the waved surface, allowing an enhanced reading of the space during the nighttime.

3 MEMORY AND DESIGN

At the beginning of the 21st century, urbanism practice, the philosophy of intervention in cities and the idea of the city itself were showing less utopian signs than in bygone eras, due to several factors. These include the Modern Movement crisis and its models, and getting back to cities as points of reference, as well as the perspective of, if not disjunction in cities, then at least their illegibility in terms of traditional urban morphologic concepts.

In the more speculative predictions of the future of the city, the urban space as a support for human relationships, material and spiritual exchanges and even traffic has been superseded in favour of immaterial media, without either establishing the fate of the city's structures or introducing new morphologic models as a response to a different society. The 21st century city will naturally be different to the city of the previous century, I as this was from the industrial one, and this one from the city of Modern, Medieval or Ancient History. However, the inevitable end of the city that some predict is not a certainty, and what is more probable is that there will be developments towards new meanings which will contain the tensions between the city's structural legacy and its constant renovation. This object – the city – has always shown signs of obsolescence, due to its own nature and dynamics.

The policies of recuperating historical centres, so commonplace from the mid-20th century on, in a process increasingly apart from the phenomena of growth that has, in most cases, shaped urban peripheries, has support not only in theoretical musings, but also in public opinion, shaped as it is by a great deal of nostalgia and opting for the safe choice of preserving this value. We should not manacle urbanity to the historic centre, nor to the inevitability that urban renaissance has to make use of past shapes. However, the structural examples we inherited, which are part of our city life, will always be a driving force in new spatial conceptions.

The cases presented on this paper configure two examples on how an interpretation methodology of the urban space developed in the Academy and consisting in the recognition of the values of the spirit of the place, read in the morphology of the urban artifact itself, may contribute for the contemporary architectural and urban design of spaces with the evidence of their own memory.

Note on images: all plans are north oriented.

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Evaluating sense of community in the public spaces of residential neighborhoods in Tehran, Iran

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ABSTRACT: Sense of community is one of the significant theories in sociological and psychological research that investigates the relationship between physical environments, individuals' feelings, and interactions in a community. Previous studies in social science and environmental psychology indicate that the overall arrangement of a community and its architectural style, as well as many other physical environmental features, play a vital function in fostering and creating sense of community. McMillan and Chavis defined sense of community as "a feeling of belonging, a feeling that others matter to one another and to the group, and a shared faith that personal needs will be met through a commitment to being together." The advantages of sense of community are various and potentially embrace increased participation in community affairs and social activities, better physical, mental health, and well-being, finally improve people quality of life. This research evaluates several hypothesis from sociology and psychology to architectural studies that create and reinforce sense of community in distinct residential neighborhoods in Tehran, Iran. Data was obtained from individual interviews, indirect observation, and surveys. The analysis indicates the greater role of socio-demographic features instead of architectural factors on affecting sense of community. The presence of public spaces, green areas, and building layouts are not solely guaranteed to enhance sense of community. However, influential social variables like length of residency, socio-economic status, age, and gender, also affect residents' feelings, behaviors, and interactions that contribute to sense of community. The balance between social and architectural elements together will create a robust and resilient sense of community. Identifying the conditions that reinforce sense of community within residential neighborhoods is an essential task for researchers and designers to promote individuals' feeling of safety, security, civic responsibility and improve their physical and mental health. The findings of this study rely on residential areas in Iran, but can likely apply to residential neighborhoods globally.

1 INTRODUCTION

1.1 *Community*

Society is made up of three main components of communities, individuals, and physical environments. A large proportion of human experience and social interaction occurs in communities and physical environments in which we live. The community is where individuals learn to communicate, interact, behave, and share interests and problems; it is where cultural and social norms form and connect to a larger society. Community psychologists and sociologists, define two main sets of characteristics for community: structural and functional. (i) The structural factor consists of the people and the physical environment where people live and interact. (ii) The functional factor results from the structural patterning that includes the people's interaction in a particular physical environment, community participation and social networks (Giuliani & Wiesenfeld 1999). A "sense of community" is the result of the correlation between these two factors.

There are numerous definitions for sense of community in other disciplines. This research focused on MacMillan and Chavis (1986) articulation of a theory that suggested four elements form sense of community: membership in a group, a shared emotional connection, mutual influence on one another, and sharing of values among community members. These four suggested components dynamically work together to create and maintain sense of community among individuals in a community. At the neighborhood level, a strong sense of community makes residents have a greater feeling "*of safety and security, participate more in community affairs*", and help one another voluntarily in tough situations (Schweitzer 1996). Moreover, at the individual level, it improves a person's sense of self-efficacy, well-being, level of life satisfaction, and can help the individual to deal with stressors in their community in proactive ways (Davidson & Cotter 1991).

2 RESEARCH JUSTIFICATION

2.1 *Justification of objectives*

The author recognized the fragility of Iran's architectural identity which is threatened doubly by designers who dismiss the value of historic regional contexts and

the desire of wealthy clients to imitate European and American designs. By considering it as a threat to people's culture and identity, this research focuses on the relationship between built environments on sense of community.

The purpose of this paper is to evaluate sense of community by employing an ethnographic approach through qualitative research methods, in order to investigate the ways in which various aspects of physical environments (public spaces and building layouts). It also investigates socio-demographic features (class, gender, age, length of residency, expected length of residency, the presence of children, and quality of interaction) contributes to residents' sense of community. The study used three residential neighborhoods in Tehran, Iran. The author incorporated social science research methods to evaluate residents' sense of community to explain the results of observational research. The ideas presented in this article will apply equally to structural factors (neighborhoods) and functional factors (spiritual, behavioral, emotional).

The objectives of this study are to (i) analyze possible physical and social variables that strengthen or weaken sense of community, (ii) evaluate three different architectural styles and scales and how each contributes to sense of community (iii) assess the role of public spaces in people's quality of interaction and sense of community.

2.2 *Research questions*

The following research questions address the objectives of this study:

(i) What social and architectural variables strengthen or weaken sense of community?
(ii) How do public spaces in a community affect the residents' interaction and communication?
(iii) How do the four indicators of sense of community apply in the three case studies?

3 SENSE OF COMMUNITY

3.1 *Definition*

This research builds upon the earlier findings of Glynn (1981), McMillan and Chavis (1986), Chavis and Wandersman (1990), Nasar and Julian (1995), Talen (1999) and Obst, P., L. Zinkiewicz and S. Smith. (2002) in defining and developing sense of community. There has been no generally accepted definition of sense of community because of its multidimensionality. However, David W. McMillan and David M. Chavis (1986) introduced the most accepted theory and definition by using four leading indicators that maintain or create sense of community: membership, influence, integration and fulfillment of needs, and shared emotional connection. Based on these four components, they defined a sense of community as "*a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together"* (McMillan & Chavis 1986).

3.2 *Components*

"Membership" is a feeling of belonging and having rights for being part of a group. People's adverse action, depression, and loneliness are some of the consequences of lacking this feeling in a community. Five attributes of membership include boundaries, emotional safety and identification, personal investment, and common symbols that work together to strengthen the sense of membership and a sense of who is part of the community and who is not (McMillan & Chavis 1986).

"Influence" is a mutual feeling. Both community and individuals have interrelationships with each other. The group can affect the actions, behavior, opinions of an individual. However, an individual can have an influence on the group or community (McMillan & Chavis 1986).

The third component "integration and fulfillment of needs" constitutes a substantial proportion of sense of community and plays a crucial role in community success. It is a motivator of behavior and maintains the positive sense of togetherness among members (McMillan & Chavis 1986). Shared value is a crucial concept in needs fulfillment. Members should be able to satisfy their needs to the extent that each member can share their needs, goals, priorities, and beliefs with each other (Cohen 1976, Doolittle & MacDonald 1978).

The last element "shared emotional connection" is where the people's feelings, perceptions, and spiritual bonds come into play. The more individuals interact and share history the more likely they have become closer and develop meaningful and fulfilling relationships within the group (McMillan & Chavis 1986). Cook (1970) in his research studied the importance of the quality of interaction; *"The more positive the experience and the relationships, the greater the bond. Success facilitates cohesion."*

3.3 *Advantages and disadvantages of sense of community*

Previous research in social psychology indicates that loss of "sense of community" in modern societies are due to industrialization, lack of local autonomy, the culture of mobility and large-scale bureaucracies. They believe that the overall layout of a community and architectural style, as well as many other physical features, play a vital function in achieving it (Nasar & Julian 1995)

Having a sense of community at the neighborhood level, can increase people's feeling of safety and security; encourage them to participate in community affairs and social activities, and having better physical vitality, mental health, and well-being—in terms of improved happiness and decreased anxiety (Davidson

& Cotter 1991). Consequently, it can improve the individual satisfaction, sense of self-efficacy and help individuals to deal with stressors in their community in proactive ways (Schweitzer 1996).

On the other hand, a strong sense of community can be neutral or negative. Based on Brodsky's (1996) research on resilient single mothers living in dangerous housing projects, having a sense of community can be harmful to families, in particular for children. The mother in her study preferred to keep her children away from youth groups or gangs in a community. She believed it was children's advantage to have a weak sense of community. From the perspective of mothers, children engaging with a community is equal to losing their values and therefore threaten the family's safety.

Strong communities are those that offer their members positive ways to interact, establish important events to share, resolve disputes positively, provide opportunities to honor members, resources and time to invest in the community, and opportunities to experience a meaningful connection between members.

4 SENSE OF COMMUNITY AND BUILT ENVIRONMENTS

The use of sense of community presented in this paper applies equally to its relationship with built environments and socio-demographic features of a community. Prior studies in New Urbanism asserted that the existence of public spaces, innovative architecture and site design, appropriate density and scale, and mixed land use can enhance the opportunity for interaction and create sense of community (Talen 1999).

Various studies with focusing on residential neighborhoods and sense of community showed the substantial impact of public spaces and green areas on the individuals' quality interaction and mental health. The work of Nasar and Julian (1995) on 54 residents in three suburbs of Columbus, Ohio revealed that the easy access to shared outdoor green areas and interior courtyards can improve the possibility of creating a stronger sense of community among residents. Their findings have some correlations with this research. The author's indirect observation and interviews with residents reached the assumption of the complex without public spaces, and green areas will not have the same strong sense of community as it has now.

Other studies focused on the relationship between residents' sense of community and the easy access to pedestrian paths, having front porches, variety of nearby commercials, recreational, and educational services in strengthening and reinforcing sense of community (Plas & Lewis 1996, Glynn 1981, Wilson & Baldassare 1996, Nasar & Julian 1995).

On the other hand, the relationship between sense of community and physical environment is not always successful. Kingston, Mitchell, Florin, and Stevenson (1999) by analyzing an existed database of 2,409 residents of a Northeastern American city, found out sense of community is more correlated with individual variables such as; income and level of education than the physical environment. However, the author caution that the study has not employed a set of complex environmental ratings to adequately investigate the link between the built environment and sense of community.

Besides socio-demographic factors, the presence of public spaces, green areas, pedestrian paths, and public amenities are not sufficient to create and foster residents' interaction and sense of community. Paying attention to creating active public spaces (not symbolic) with high quality is one of the crucial tasks of architects and designers to improve people's quality of interaction, communication, and positive feeling within a community.

5 SENSE OF COMMUNITY AND SOCIO-DEMOGRAPHIC FACTORS

Literature reviews in community psychology, and social sciences regarding sense of community and its relationship with social sciences demonstrate several contradictions in some socio-demographic factors, such as the length of residency, the level of education, and residents' age. This research with focusing more on these factors and testing them, besides other aspects, evaluates sense of community in three distinct residential neighborhoods.

Based on Glynn research (1981) factors such as length of residency, resident's expectancy to live, and the number of neighbors identifiable by their names, show the strengthen of sense of community. On the other hand, Davidson and Cotter (1991) developed a 17-item scale to evaluate the relationship between sense of community and subjective well-being in three distinct case studies in South Carolina and Alabama, did not find a correlation between residence length of residency and sense of community.

Other studies investigated residents' age and showed that older adults have a stronger sense of community (Wilson & Baldassare 1996, Davidson & Cotter 1986). However, Korte (1988) argued the concept of "community helping," which is one of the key factors in having a stronger sense of community, is more correlated with young people and with a higher level of education, as well as married people. Buckner's research (1988) showed that people with lower level of education can have a stronger sense of community.

Other socio-demographic features related to sense of community consist of the study of Wilson and Baldassare (1996). They investigated sense of community in a suburban neighborhood in Orange County, California. Surprisingly the results showed that 68% of residents believe that there is a strong sense of community among neighbors in the community. The authors found that the satisfaction with a level of privacy and localism were two important factors in having an overall sense of community. By privacy, the authors

mean a controlled interaction within a community, not withdrawing from people and social life. The residents believed that the desired level of privacy decrease unwanted interaction help individuals to have a lower level of personal stress, more positive relations with neighbors, and a stronger sense of community.

Beside all these findings, other studies showed the important role of women and children in fostering sense of community. Having children at home is associated with people interacting more in public spaces and participate in community activities (Obst et al. 2002, Nasar & Julian 1995). In most societies women traditionally have wider neighborhood networks, more intense relationships with their neighbors, and greater social interaction than men. Thus, we can conclude that matters of gender and gender roles require greater consideration in creating and reinforcing sense of community (Campbell & Lee 1992, Willmott 1987 & Fischer 1982).

Overall data analysis revealed that the significant socio-demographic factors that make the residents' sense of community strong are: residents' similar socio-economic level, long length of residency, expectancy to live longer in the community, safety and security, having children in families, community helping, and participation in community activities.

6 METHODOLOGY

6.1 *Case studies*

This part of the paper will explain the methods chosen to evaluate the relationship between sense of community and built environment. The research methods selected in this study were developed to measure sense of community within three different residential areas and to identify the various physical and sociological characteristics within residential neighborhoods that might affect sense of community measurements. The significance of this study and the methods used is their usefulness and transferability in evaluating sense of community in other residential or non-residential environments.

The primary focus of the research is to assess the interrelationship between sense of community and built environment in three different residential areas in Tehran, Iran: Sheikh Hadi residential neighborhood, Ekbatan residential complex, and Vanak Garden residential building. Each case study selected depend on; a) the architectural style (contemporary, modern, and traditional), and b) community scale with presuming that the assessment of sense of community is not similar among residents in each case study.

Chavis, Hogge, McMillan and Wandersman (1986), examined the McMillan and Chavis (1986) theory and definition of sense of community based on Brunswick's test. Research findings developed and empirically tested Sense of Community Index (SCI), which is widely used to measure sense of community among adults in a community. This paper also employs this questionnaire for measuring the residents' sense of community in the three case studies.

Research data collection built upon the qualitative research methods, such as individual interviews, indirect observation, and questionnaires (SCI). Each section focused on different aspects of sense of community. Individual interviews were focused on residents' length of residency, expected years of living in the neighborhood, their need's fulfillment, places of interaction, and their feeling as a member of the community. Indirect observation looked at the residents' quality of interaction and public spaces, community activity, resident's socio-economic level, and community boundaries.

Finally, the questionnaire (SCI) used was based on four components of sense of community, measuring the overall sense of community among residents. All research instruments were translated into Farsi (native Iranian language) in order to accurately evaluate sense of community.

6.2 *Sheikh Hadi Neighborhood*

Sheikh Hadi Residential Neighborhood is located in one of the most crowded, polluted and oldest areas of Tehran with approximately 33,000 population in 2007. The history of the neighborhood dates back to the reign of Reza Shah (King of Iran) in the 19th century. The area still keeps the arrangement and urban texture of the historic neighborhood and exemplifies a traditional sense of place. However, the visual image of the neighborhood at street level does not represent the qualities and patterns of historic Iranian architecture due to the demolition of vernacular designs and the construction of more modern buildings (Figure 1).

Easy access to all kind of urban amenities such as taxis, buses, metro, hospitals, schools, public libraries, museums, shops, and markets put the neighborhood in the heart of the city. Low-income families tend to live in the neighborhood due to the reasonable cost of living for poorer families to buy or rent affordable apartments.



Figure 1. Buildings in Sheikh Hadi Neighborhood, traditional vs. contemporary.



Figure 2. Public Park in Sheikh Hadi Neighborhood.

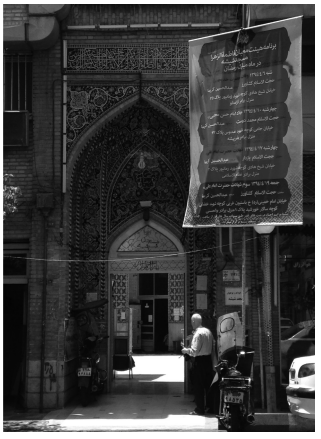


Figure 3. Mosque in Sheikh Hadi Neighborhood.

Sheikh Hadi neighborhood suffers from a lack of public space and especially green areas. The public park and mosque in the neighborhood are two significant places that bond residents together. The author collected research data from people in these two public places (Figure 2–Figure 3).

Questionnaire analysis in Sheikh Hadi showed that the percentage of each sense of community components (*membership, influence, integration and fulfillment of needs, and shared emotional connection*) is higher in women than men. Also, the overall percentage of sense of community among Sheikh Hadi neighborhood residents is greater than an average, which is 59%.

Coding the individual interviews indicated that the people can fulfill their needs within a community. Therefore they prefer to stay in a neighborhood. However, the lack of safety and security of the area makes the situation difficult for women to interact at night. Also, it should be noted that because of the residents' social and educational level, many of the residents are unemployed, with women and seniors forming the majority of residents with the time to support community. Therefore, women and seniors have more opportunity to communicate and interact in public places. This interrelationship between public spaces and residents give meaning and boundary to the park and mosque.

The authors' observation mapping and coding showed that the people interact at certain times of the day (the prayer times in the mosque, and before prayer times in the park). Also, besides the high quality of places, religion and faith keep people together and affect their quality of interaction and feeling like a part of the community.

Data analysis in Sheikh Hadi Residential Neighborhood indicates that the park and mosque in the neighborhood play a vital function in achieving and creating sense of community among residents. People's quality of interactions and communications in these two places are more than in other places such as shops, malls, museums, and libraries. In addition, socio-demographic features such as people's socio-economic level, age, length of residency, their expectancy to live in the neighborhood, community helping, having children, and need's fulfillment are contributing to fostering sense of community.



Figure 4. Ekbatan residential complex (Source: Google).

6.3 *Ekbatan residential complex*

Tehran (capital city of Iran) is deeply polarized. North of the city is where the rich and upper class live, and south is for the poor and the marginal. The Ekbatan complex is located in a neutral urban area, physically and socially accessible to many people. It is a planned town built as a project of modern apartment buildings in the western part of the city in the mid-1970s. The goal of the project was to create the most modern housing project in Iran, based on the European and American urban planning elements to control Tehran's population patterns (Dash 2015). It is the largest residential complex in the Middle East with 15,500 units for 70,000 inhabitants in three phases with all kind of amenities such as schools, a hospital, parks, libraries, mosque, shops, and malls (Figure 4).

Phase One of the complex was completed before the revolution in 1979. Consequently, many of the public spaces were changed. As an example, outdoor pools were filled, and residents were prohibited from using the rooftops. This research focuses on the



Figure 5. Public areas and green spaces.



Figure 6. Parkour and graffiti (source: Google).

residents in Phase One to evaluate sense of community and its correlation with built environment and socio-demographic features.

Questionnaire analysis showed that Ekbatan has the highest overall sense of community among all the other case studies which is %69. All sense of community components (membership, influence, integration and need's fulfillment, and shared emotional connection) are higher in women and young people than men.

Individual interviews and indirect observation revealed the reasons behind the strong sense of community among residents in Ekbatan. Architectural factors such as high quality of public spaces and green areas, building layouts, pedestrian areas, parks and public facilities (shop, mall, school, library, Metro, mosque, and sports center) play a significant role in improving people's quality of interactions, communications and positive feelings within a community (Figure 5). Accessibility to all kinds of services and needs keep people in the community and make them behave and feel like a large family.

Ekbatan is not only a residential complex but may also be considered also a lifestyle and an instigator of popular culture. It is the place where the street arts of parkour and urban graffiti started in Iran. The sense of community is stronger among young people, especially boys. They see Ekbatan as a part of their territory, which makes strong boundaries for community members and the complex (Figure 6).

Residents' similar socio-economic level, long length of residency, expectancy to live longer in the community, safety and security, having children in



Figure 7. Vanak garden residential building.

families, community helping, participation in community activities, educated and married people are most significant factors that make the residents sense of community strong in Ekbatan Residential Complex.

6.4 *Vanak Garden Residential Building*

Vanak Garden Residential Building was built in 2009–2010 and located in the Dehvanak region, which is one of the areas that upper-class families live in the central part of Tehran. The area was once full of large gardens; developers and property owners used green space to construct high rise residential buildings which have significantly changed the character of the area. Vanak Garden is the third case study to evaluate the residents' sense of community in contemporary design with a different building scale (Figure 7). The investigations link architectural factors and socio-demographic features in an attempt to assess sense of community among residents.

Interviews with the architect of the building demonstrate that the core idea of the Vanak Garden design was to improve residents sense of community and revitalize the old sense of place in a metaphoric way. This link was accomplished by keeping some of the original trees (as wooden sculptures, forming symbolic groves throughout the complex) and arrange the apartments around the central courtyard with a small fountain. In addition, features such as traditional materials used in the building, greenery, small sitting areas on each floor, and suspended gardens foster and create a positive visual experience intended to support interaction and improve the quality of spaces (Figure 8).

However, questionnaire analysis showed that despite the high quality of public spaces and shared areas, Vanak Garden Residential Building has the lowest sense of community among other case studies which is 37%. Men in the community are more involved in reinforcement of sense of community than women. Feeling of membership and shared emotional connection are the two lowest factors among residents that make the overall sense of community fragile.



Figure 8. Courtyard and green areas.

In contrast to research of Brown and Cropper (2001) and Jack Nasar (2003) regarding the New Urbanism design features in creating and supporting residents' sense of community, Vanak Garden, with having high quality of public spaces (courtyard and green areas) and preserving the original sense of place (with the aid of sculptural reminders of the original trees and materials used in the building) did not support their claim. Public spaces and green areas are more symbolic than active in a sense of creating and fostering the residents' quality of interaction and communication. Also, the building design and spatial arrangement are organized to preserve residents' sense of privacy, safety and security; this strategy for privacy between residential units directly challenges sense of community.

Interviews and indirect observations showed that the parking, entrance, and elevators are the places that residents interact and communicate most with one another, which does not have high architectural quality or value in contrast with the high quality of public and green spaces. Based on the author's experience in the Vanak Garden residential building, people were less sociable and declined to participate in this study. Most of the community members are employed and spend their time out of the complex.

The courtyard and public places are empty generally, and only families with children use public spaces and other facilities. Interviewing residences showed that children playing in the courtyard disrupt the residents' peace (because of their noise) and the residents' frown upon children playing in public spaces. Therefore, families take their children out of the complex for entertainment. In this case study, architectural features do not support the residents' sense of community and interaction.

In addition to architectural factors, the residents' socio-demographic features affect sense of community among community members. High socio-economic level and financially stable situations make people more independent and autonomous. Therefore, they tend to interact and communicate less with each other because they do not need each other's help. On the other hand, since the complex is relatively new, the limited duration of residency and expected the length of time to live in the community are doubly threatening the residents' interaction and the opportunity to create sense of community.

7 DISCUSSION AND FUTURE RESEARCH

This paper investigates three distinct residential neighborhoods in Tehran, Iran to evaluate residents' sense of community and assess the role of physical and social features each independently in affecting residents' sense of community, interaction, and communication.

By studying sense of community, built environment and socio-demographic features in residential neighborhoods, the author noticed the mutual relationship of sense of community with socio-demographic features, as well as built environment with sense of community. A strong sense of community can support, and over time, improve the quality of physical environments independent of people's socio-economic level. Also, based on a strong and healthy sense of community, people help other community members collectively to improve their quality of life, social status, well-being, and economic level.

Data analysis surprisingly indicates varying results derived from and between each case study. However, this variability reflects clear dissimilarities between the case studies and are at the heart of the insights and conclusions made in this study. Factors in creating or fostering sense of community are causal, variable, and independent. The role of architectural factors such as public spaces and green areas can play a significant role in creating or fostering residents' sense of community. Public spaces are like a heart and center of each residential neighborhood which can provide the opportunity for people to exchange ideas, culture and thoughts and collectively build the soul for their community *which is* sense of community. However, architectural factors such as public spaces do not solely promote or create sense of community among residents. Prominent variables such as the length of residency, age, gender, socio-economic level, and having children in a family can also strengthen or weaken residents' sense of community. The balance between socio-demographic and design features can create a robust and resilient sense of community among members.

Today, architects do not always know the people for whom they design buildings and do not know their actual needs. Many times their designs are generalizable and abstracted from the demographic information or building codes. This approach leaves out the social conditions embedded in a particular place and culture. However, there are problems with purely physical conditions, and in this study, Vanak Garden Residential Building is a prime example of an autonomous design (despite being derived from the history of the place) whose public spaces operate more like an artwork meant more to be looked at rather than used. For architects who want to understand the complex needs

of the people for whom they build, social research is bound to become a vital tool for understanding social conditions and issues (Zeisel, 1975).

This research shows the contribution of socio-demographic aspects in reinforcing sense of community. This is one of the elements for designers to consider when addressing social conditions in their designs. Architects should collaborate more with social researchers; approaching design from a sociological perspective will enhance and improve the quality of buildings and community design.

In addition, future research on the topic of sense of community should evaluate the role physical environments play in reinforcing social bonds in other places, such as students at universities or schools, patients in hospitals, and employees in their workplaces.

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The new roof spaces. The legacy of Le Corbusier in the contemporary city

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ABSTRACT: One of the contemporary urban phenomena is the recovery of the vertical dimension of the city and the use of common spaces at the high level of the buildings. The shifting of activities to the roof – especially those traditionally at the lower or at the ground levels – is creating changes in the relationship among urban spaces, in particular in regards to the public sphere. The forerunner of the roof space use in modern architecture is Le Corbusier. This paper looks at the beginnings of the roof space concept, focusing on the specific role that Le Corbusier had in foreseeing the contemporary approach, developing issues and theoretical reflections in relation to the view from above, intertwining architecture, nature, and landscape, and leading to their integration within a broader territorial approach.

1 INTRODUCTION

One of the contemporary urban phenomena is the recovery of the vertical dimension of the city and the use of common spaces at the high level of the buildings. The observation of the city from above creates a new image of the urban reality and a new concept for architecture. In many cities roof spaces are now used for different goals: from urban vegetable gardens to outdoor cinemas, restaurants and cafés, and sports areas. The shifting of activities to the roof – especially those traditionally at the lower or at the ground levels – is creating changes in the relationship among urban spaces, in particular in regards to the public sphere. The view from above provokes reflections at a deeper level on the city design project in relation to the new possibilities and new ways of living the urban spaces, also investing the city nature itself.

The forerunner of the roof space use in modern architecture is Le Corbusier. This paper looks at the beginnings of the roof space concept, focusing on the specific role that Le Corbusier had in foreseeing the contemporary approach, developing issues and theoretical reflections in relation to the view from above, intertwining architecture, nature, and landscape, and leading to their integration within a broader territorial approach.

Le Corbusier roof-garden has often been diminished as a mere technical issue or as a simplistic reproducible solution. Even as one of the 5 Points for a New Architecture its meaning has been reduced through the slogan formula, often forgetting the thought hidden in it. Within Le Corbusier research, the roof-garden is not just one of the famous five points, but a totally new and fundamental spatial topic that explores the relationship between architecture and nature within the urban environment. It is along these lines that this paper unfolds, focusing on the thematic issues related to the shifting of the vision from that city above the city.

It is only in recent times that the landscape dimension within Le Corbusier work has been investigated. In 2013, the MoMA in New York hosted the important exhibition entitled *Le Corbusier: An Atlas of Modern Landscapes*, which highlighted the interest by Le Corbusier in the relationship between the design project, the city and the landscape, reading his design work through the landscape approach. Before that, little has been said in regards, with the exception of a seminal article by Caroline Constant and few other writings[1].

2 THE BIRD'S-EYE VIEW

The roof space is primarily for Le Corbusier the place of the conquest of the sight, it is the place from which to look far away. Le Corbusier roof spaces, whether in the city or in suburban areas, are all designed for the view from above. This is not just a new potentiality and pragmatic opportunity for the building; rather it opens up a new approach for the design project. The view from above affected Le Corbusier vision and consequently his ideas on architecture; for the architect, so highly connected to the way of seeing, architecture is in fact a process which starts from knowing how to see, as it is clarified by the famous sentence – *the key is looking … looking, observing, seeing, imagining, creating* – (1965).

[1] Constant, C. 1988. "From the Virgilian Dream to Chandigarh: Le Corbusier and the Modern Landscape". In Wrede, S. & Adams, W.H. (eds.) *Denatured Visions. Landscape and Culture in the Twentieth Century*, New York: The Museum of Modern Art.



Figure 1. Photo of the airplane in the landscape.

The view from above, and more specifically the bird's-eye view, is for Le Corbusier a fundamental topic since his youth and his development years. The importance of the view from above is experimented within nature and among the mountains: <All the years of my childhood were spent with my friends amongst nature […] We were always on the mountain peaks; the vast horizon was an everyday view. When the sea of fog below extended to infinity, it looked like the real sea which I had never seen>[2]. The aspiration to conquer the view from the summit in order to look over the ample horizon recalls one of the most famous image of contemplation of panorama, that of the wanderer above the sea of fog by Caspar David Friedrich. Similarly to the romantic sensitivity, Le Corbusier aspires to a meditative and enchanted relationship with the landscape, a condition in which the man and the architecture are projected in the boundless nature.

It is from the aircrafts, for which Le Corbusier was deeply fascinated, that it is possible to conquer the advantage standpoint and the view from above is strongly experienced. Even before having directly tried out the aircraft flight, Le Corbusier had already realized the importance that the view from the airplane would have had in architecture and in the interpretation of reality. He had in fact planned to include in his text *Urbanisme*[3] a chapter on the aerial view. A sheet[4] with images in sequence of top views of cities shows the note: <Making a paragraph on the view from the plane new state of things of the urban aesthetics as architectural sensation. Show then some plane views (topographical service) of Paris>[5]. The view from the

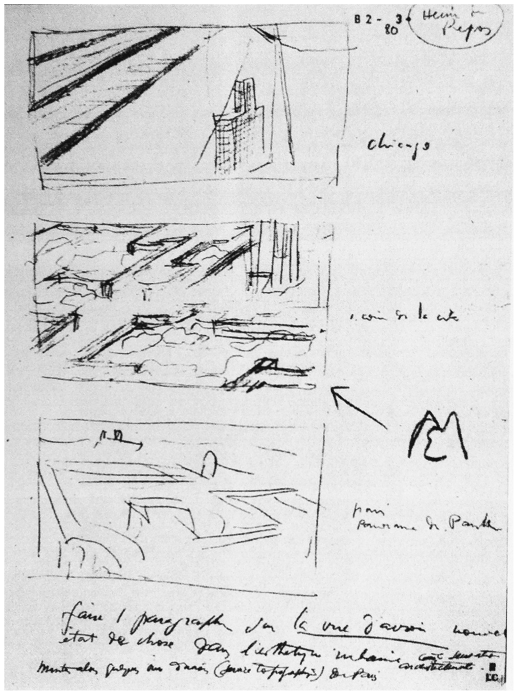


Figure 2. Le Corbusier sketch.

airplane is thus understood as carrier of a new aesthetic and programmatically used to communicate its power[6].

The fascination with the new means of transportation and in particular the challenge of the flight that had involved Le Corbusier since his childhood, will drive the architect to experience in person the airplane flight, offering the powerful vision of nature: <from the plane I saw sights that one may call cosmic>[7], wrote in *Precisions*, the text which followed the South American and Algerian experiences, that is when the architect systematically observed the territory from the airplane height. It is in this text that Le Corbusier clarifies and systematizes the concept of the aerial view. This is for the architect an extremely accurate picture of reality; the distance eliminates superfluous details and brings out the forms, the signs of the territory. The speed of the aircraft is such as to return a slow vision, unlike what takes place by car or by train, and even by bicycle, in which movement is sensed and the images are distorted. Le Corbusier is in fact not interested in the dynamic aspect, nor the representation of movement, like other photographers and avant-garde artists.

[2] Le Corbusier. 1925. L'Art décoratif d'aujourd'hui. Paris: G. Crès & Cie. Translation by authors.

[3] Le Corbusier. 1925. Urbanisme. Paris: G. Crès & Cie. (Le Corbusier. 1929. The City of Tomorrow and its Planning. London: John Rodker).

[4] Mazza, B. 2002. Le Corbusier e la fotografia. Firenze: Firenze University Press. Fig. 325.

[5] FLC, B2-3-80.

[6] Talenti, S. 2015. Visions "humaines" ou "infernailes": les moyens de transport et la perception de la ville chez Le Corbusier. In *Le Corbusier. 50 Years Later*, *Proc. intern. conf., Valencia, 18–20 November 2015*. Valencia: Editorial Universitat Politècnica de València.

[7] Le Corbusier. 1979. Precisazioni sullo stato attuale dell'architettura e dell'urbanistica. Tentori, F. (ed.). Roma-Bari: Laterza. p. 14.



Figure 3. View of Rio de Janeiro.

Rather it's the broad and precise geographic image, like a drawing, and the relationship between man, the means realized by him and the greatness of the infinite space to be of interest to the architect. <At 500 to 1000 meters altitude, and at 180 to 200 kilometres an hour, the view from a plane is not rushed but slow, unbroken, the most precise one can wish: one can recognize the red or black spots on a cow skin. Everything takes on the precision of a tracing; the spectacle is not rushed but very slow, unbroken; along with the plane, it is only the steamer on sea or the feet of the pedestrian on a road that can give what may be called sight at human scale: one sees, the eye transmits calmly. Whereas what I call inhuman and hellish are the sights offered from trains and automobiles, even bicycles. I exist in life only if I can see>[8].

The observation at a great distance relocates the architecture and the cities within the cosmic dimension of nature and within the natural and climatic cycles. <From the plane we also understand a lot of things: the Earth looks like a poached egg, it is a liquid spherical mass surrounded by a constant feature of evaporation and condensation. You can see, from the plane, the formation on the plains of Uruguay of the clouds which will grieve the houses ... or you can witness a clash of clouds from which the lightning and the thunder will come>[9].

The territory is described accurately, observing the signs, the ruts on the ground, the ripples, the texture of the earth's surface. *Precision* allows us to discover and understand the places, revealing what would not be visible from below, like the houses with gardens hidden behind the streets walls in the M'zab region in Algeria: <Seen from above, the city opens its multitude of arcades on its multitude of gardens>[10] and one understands <with a quick glance at the bird's-eye view all the secrets that the city hides>[11].

The accuracy of the view also shows the city and territory's diseases; the plane is an accusation, says Le Corbusier, and it incites urgent action to be undertaken by the urban planner and the architect: <the bird's-eye view gave us the spectacle of our cities and the countryside that surrounds them, and this spectacle is ignoble. ... The airplane indicts! It indicts the city! It indicts those who govern the city! Today, with the plane, we have evidence, recorded on a photographic plate, we have reason to want to change something in architecture and urbanism>[12].

The images from the aircraft prepare for a new and modern consciousness: <Thanks to the aircraft, everything has become clear, when you have assimilated this topography – these bodies so lively and complex, when the difficulties are overcome, and you were full of enthusiasm, you felt the rising of ideas, you have entered into the body and the heart of the city, then you understood part of its destiny>[13].

The airplane view changes the way of interpreting reality and therefore architecture itself: <The airplane gave us the bird's-eye view. When the eye sees clearly, the spirit decides vividly>[14].

3 LE CORBUSIER ROOF SPACE AND THE UNTAMED NATURE

The roof-space is a definite and clear topic for Le Corbusier. It is not only commented as one of the 5 points for a new architecture, but it also constitutes an autonomous report within the *Complete Works*, using his home studio roof space in 24 rue Nungesser et Coli in Paris as a case-study[15]. Here the roof space, after a technical explanation, is essentially commented as the place for the observation of the surrounding territory and the relationship with nature.

The roof garden is a direct result of the use of reinforced concrete in constructions, with the constant moisture on the roof – guaranteed by the greenery and the earth – it reduces contractions and expansions of the material. From technical expedient – as <model protector of the roof>[16] – this space transforms itself: <The roofs of the city could also become places of poetry>[17], writes Le Corbusier. The roof space is a place of contemplation of the landscape and the city. Through architectural stratagems, views are design-controlled and open up to the horizon of the city. Elements like the vaults covering the spaces below, limit the view of the immediate surroundings, leading the eye towards the horizon. In a letter to his mother, Le Corbusier writes: <Really, it's magnificent. There's a view over the countryside with so sense of being perched up on the 7th or 8th floor, thanks to architectural stratagems. No giddiness that way. The garden a poem. Lawn, lilac, roses, and more, and what a horizon!>[18].

[8] Le Corbusier. 1979. Precisazioni ... p. 18.

[9] Ibidem: p. 15.

[10] Le Corbusier. 1935. Aircraft. London: The Studio. Pedretti, B. 1987. Il volo dell'etica. *Casabella*. n. 531–532.

[11] Le Corbusier. 1979. Precisazioni ... p. 259.

[12] Le Corbusier: Aircraft ...

[13] Le Corbusier. 1979. Precisazioni ... p. 260.

[14] Le Corbusier: Aircraft ...

[15] Le Corbusier. 1977. Report on a Roof-Garden. In Boesiger, W. (ed). *Le Corbusier: Oeuvre complète 1938–46*. Volume 4. Zurich: Girsberger. 7th ed. p. 140.

[16] Ibidem.

[17] Ibidem.

[18] Le Corbusier. 29 April 1934. Letter by Le Corbusier to his mother. In Cohen, J. 2014. *Le Corbusier Le Grand*. New York: Phaidon Press Limited. p. 286.



Figure 4. Roof-garden at 24 rue Nungesser-et-Coli, Paris.



Figure 5. Roof-garden at Le Lac (a) and at La Tourette (b).

The roof garden at 24 rue Nungesser et Coli is a place of observation of the city and it is also a place of observation and contemplation of nature. Here the vegetation is not designed but it is left to grow according to its natural and biological rhythm. It is the nature itself which builds the garden. <Instead of digging my garden, I let it grow,>[19] wrote Le Corbusier. In the roof garden space nature <regains its rights>[20]: <The sun rules, the wind (above there) rules>[21]. Vegetation grows luxuriant on the sides and on vaults. Le Corbusier observes the development process, describing the sensory aspect of the garden – the power of the sun and the wind, the beauty of nature. <A sycamore seed arrived on a stormy day: I am watching this latest arrival which threatens to become a giant. A bird brought a laburnum seed, and in the spring the dense yellow flowers jostle the near-by lilacs. Ten years ago I planted a sprig of lily-of-the-valley, now a hundreds of lilies-of-the-valley open each first of May>[22].

The solution of untamed nature, which Le Corbusier experiences in his roof garden recurs also in other projects. Through the description of the convent of La Tourette in the *Complete Works*, Le Corbusier defines a group of projects in which the topic of the roof garden is developed through untamed nature, highlighting the continuity of his research. <The roof of the convent itself, like that of the church, will be covered with a thin layer of earth left to the vicissitudes of the wind, birds and other carriers of seeds, assuring both water-tightness and isothermic protection. (The roofs of the small house on Lake Léman, constructed thirty years ago, the apartment house at 24 Rue Nungesser et Coli and various buildings in India are similarly constructed)>[23].

The untamed and wild nature, experimented by Le Corbusier starting from the design project of his studio/apartment, highlights the perceptual and sensory character of the roof garden space. Conceived not only as the extension of the internal space, the roof garden is a phenomenological place for contemplation, observation and contact with the outside. Here man finds a new dimension through the direct experience of the relationship with the elements of nature and the observation of the natural and urban landscape.

4 CONTEMPORARY UNTAMED NATURE

Le Corbusier experimentations on the untamed nature in the city anticipate the current debate on the landscape and in particular the approach of the landscape designer and theorist Gilles Clément. His ideas were put in practice in many parks and garden projects but – as Le Corbusier – it is in the garden of his own house that the primary experiments on the principles of *the garden in motion* are developed. <A valley east-west oriented, with a stream at the bottom, a dry place on the slope where to live, a cool side dedicated to plants for shade, some already old oaks, limited still relaxing horizons, sheltered from all the winds>[24]. And it is in this piece of land in the west of France that Clément builds his gardener's house[25] – the home of *La Vallée* – not far from the places of his childhood. Here Clément becomes the observer of nature and let nature <make the landscape>[26]. <The environment has already started to operate the selection. You do not need to add to the natural pressure of the physical and chemical conditions of the place, an ideological pressure to which nature would suddenly bend over>[27]. Over the years Clément monitors the changes, the evolution of the biological life of animals and plants living in the garden, and he records its natural motion. His job is to read the existing field at the initial moment of the

[19] Le Corbusier. 1977. Report on a Roof-Garden ...

[20] Ibidem.

[21] Ibidem.

[22] Ibidem.

[23] Le Corbusier. 1985. The Convent of La Tourette. In Boesiger, W. (ed.). *Le Corbusier: Oeuvre complète 1952–1957*. Volume 6. Zurich: Girsberger. 7th ed. p. 42.

[24] Clément, G. 2011. Il giardino in movimento. Macerata: Quodlibet. p. 41. Translation by authors.

[25] Clément, G. 2014. Ho costruito una casa da giardiniere. Macerata: Quodlibet.

[26] Clément, G. 2011. Il giardino in movimento ... p. 114.

[27] Ibidem. p. 136.

garden life, and to orient it based on its natural talent, then to follow its motion through small actions that do not prevent its natural growth. The goal is to <follow the natural flow of the plants, within the biological current that drives the place and direct it>[28]. The result is a garden that changes its form constantly. <Everything is in the hands of the gardener – writes Clément – It is him to conceive the garden. The motion is his tool, the herb his subject, life his knowledge>[29].

As Le Corbusier had noticed in his garden in Paris, here too, with the passing of time, new species and plants, not previously planted, are brought by the wind. Plants travel with the men and their wanderings together with the contamination lead – according to Clément – to the birth of new landscapes. This process is <a powerful sign of the potentiality within abandoned places>[30]. In the motion of species within the world can be found the sense of contemporary landscape design. <It is precisely in the seeds – writes Clément – that the essence of the biological message resides, that is the one that generates a dynamic order, generator of unknown gardens>[31].

The concept of untamed nature experimented in his small space becomes – as it happens for Le Corbusier – the key of reading for looking at the entire urban environment. After this initial experience, Clément will look at the city and at its complex abandoned spaces. The <wandering plant phenomenon>[32] is also present in the cities, especially in the waste lands. Those are the abandoned spaces, the spaces left over by the urban planning process, now days seen as a disease of our cities. These architectural voids are in fact not empty from the biological point of view; they constitute the so-called *third landscape*, a refuge for the species. They guarantee the presence of a biological life within the cities, that is today at risk because of the intensification of the urbanization. With the increase of the built surface, the waste lands tend to increase in number though to decrease in their dimension. The result is the creation of a fragmented whole of waste lands within the city that are not able, autonomously, to keep up the biological diversity. The communication among the waste lands ensure the biological continuity and the possibility of inventions arising from the meeting between species.

Le Corbusier fascination for the nature left in its natural state is Gilles Clément foundation of a new philosophy of landscape which sees in the waste lands – the abandoned spaces of the city – places full of life. Clément recognizes in these areas city fragments that can be sewed for the construction of a balanced urban landscape where man, nature and animal species coexist in the respect for diversity.

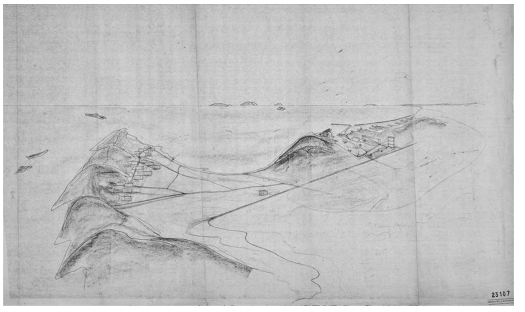


Figure 6. Le Corbusier sketch of the Unité in Marselle location.

5 ROOF SPACE ARCHITECTURE

The roof-garden space is for Le Corbusier a spatial theme criss-crossing through a variety of projects, a 'fil rouge' which becomes a narrative and interpretative thread throughout Le Corbusier work. From his own roof-garden in 24 rue Nungesser et Coli an investigation begins on the meaning of nature in the 'natural state' and also involves other projects, such as the Villa Le Lac. The relationship with nature and the process of selecting a composition of views through the control of the horizon are the two main topics within Le Corbusier roof-garden projects, variously developed in each project. Opposite to the Villa Le Lac condition, where the sight is initially enclosed and framed and then it conquers the possibility to space out on the roof, within the Beistegui Attic the view is gradually compressed along the ascending path leading to the solarium, which becomes a room without ceiling. Then, when designing Marseille Unité roof-garden, the process of creating a composite of horizon determined views becomes defined, and in turn shapes the architecture and the open spaces. From the urban dimension of the Marseille solution, the roof-garden topic finds a territorial measure in Chandigarh. Here, where all is roof, the relationship with nature acquires a new cosmic dimension: the sun, the stars, the earth, the rain, the wind, are now primary forces shaping the architecture volumes, they pass through them and fill them, giving meaning to their forms.

Relatively small scale projects, like the house on the Lake Leman, through the long distant view seem to enlarge their scale and become able to compare themselves with the large dimension, such as in this case the lake and the mountains. Urban scale projects like the Unités d'Habitation acquire even a larger scope: the urban dimension becomes a territorial dimension. In all the projects the relationship with the urban space goes beyond the area surrounding the building itself; rather than dealing with morphological, typological or urban issues, the design project involves topografic and geographical considerations. Context acquires a new meaning.

As a consequence, Le Corbusier does not find his references within the city realm, but outside of it. The

[28] Ibidem. p. 15.

[29] Ibidem.

[30] Ibidem. p. 136.

[31] Ibidem. p. 19.

[32] Ibidem. p. 53.

ocean linear, the view from the deck of the ship are more than once mentioned by Le Corbusier and a new set of signs from this world enter within the architect imaginary, and used for shaping the architecture. These signs create a space that is other from the urban space, it is a new space dedicated to the view from above, in order to peer into the vast territory and over the horizon, as the wanderer above the sea of fog by Friedrich.

6 TERRITORIAL VISIONS

Le Corbusier's view of the city from the height of his roof-terraces seems to find continuity in the contemporary scenario. Le Corbusier approach is the recognition of a new dimension of the city which he acquired through observation of the potentiality of the roof garden space. The view from above reveals the relationship with the city and the landscape, producing a radical change in architecture. The roof garden space becomes a fragment of the city project. As an element of a new concept of urbanism, the roof garden is designed in relation to the territory.

If the architecture is founded on the view, the roof space is the architecture *par excellence* being based on the observation potentialities and functioning as device controlling the views. All Le Corbusier projects – his home in Paris, his parents house on the lake, the Bestegui attic, and so on – are designed through the control of views. The roof space architecture is essentially developed through the technique of controlling the views, hiding where necessary, opening and highlighting the view toward the horizon and the geographical emergencies.

Le Corbusier moves to the roof space the dialogue with nature. Under the buildings – through the spaces between the *pilotis* – the city flows. The actual relationship with nature is instead moved to the space on the roof; and in fact it is through the character of space of nature that Le Corbusier explains and introduces the topic of the roof garden within the *Complete Works*.

Instead of being just a technical solution, Le Corbusier raised areas carry multiple meanings. Architecture is confronted with the cosmic dimension, that is with the existential condition of the man on earth, in his relation with the sun. The relationship with nature, within the simplicity of the untamed greenery, reinforces this vision. Nature is not just aesthetically contemplated; Le Corbusier follows the variation of the vegetation as an observer and not as a designer, seizing the vital and biological cycles. In this sense Le Corbusier seems to be the precursor of an ecological vision in which nature becomes a set of ecosystems. Architecture fits into the habitat. In many of his projects – especially those in India – Le Corbusier studies solutions of roofs and brises-soleil, which control and direct the dominant winds, making use of shadow and light.

Architecture becomes a means of orientation within the vast system of the territory. The top view from the roofs, more strongly than for other areas, establishes the role of architecture in the vast system. The design project must be able to read and rewrite the territory. Architecture becomes a project of topography and integration into landscape. Geography becomes the essential character, giving reason to the architecture, determining its meaning and identity.

The view from the roof spaces is conquest of a new dimension that is physical but also an advancement of meaning: the architecture is confronted with the territorial dimension. This will dissolve the dichotomy between city and country, which meet in the enlarged space. From Le Corbusier work it seems possible to extract the words in use in the contemporary realm: urban, landscape, ecology. Le Corbusier anticipates contemporary visions such as those which refer to the *Landscape Urbanism*, conceived as a way of looking at the natural territory and the man-made, joining the principles of landscape and urbanism. In his manifesto of Landscape Urbanism, Charles Waldheim explains the need for a convergence of the two disciplines, traditionally separated, in favour of <a new subject, a new language>[33], which invokes the landscape <as a means by which the contemporary city can be understood and addressed>[34].

7 CONCLUSIONS

Le Corbusier roof garden lesson lies in the close relationship that is achieved between the view from above and the design project. The roof garden is a medium, an intermediate element that holds together the scale of the building, the city and the landscape. The roof garden space is at the same time a fragment of the city and of the landscape and as such is designed within an enlarged vision, through a design control that could be called "geographical". Le Corbusier roof garden concept is therefore visionary and precursor of a sensitivity that only more recently affected the world of architecture and which attempted to overcome the dichotomy between the city and the landscape project. Within this enlarged vision and the need to establish continuity of relationships between city and landscape, Le Corbusier is close to the contemporary approach of the so-called *Landscape Urbanism* which aims at <a more promising, more radical, and more creative form of practice than that defined by rigid disciplinary categorizations [...], a spatio-material practice able to bridge scale and scope with critical insight and imaginative depth>. Le Corbusier intuitions are now at the basis of a shared knowledge which urges to think at the city through the medium of the landscape (Waldheim), where architecture is primarily under the sky before being within the urban environment (Corner).

[33] Waldheim, C. 2006. A Reference Manifesto. In Waldheim, C. (ed) *The Landscape Urbanism Reader*. New York: Princeton Architectural Press. p. 19.

[34] Ibidem. p. 16.

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Figure 1. Le Corbusier. 1935 Aircraft. London: The Studio. fig. 113.

Figure 2. Fondation Le Corbusier. Paris. FLC B2-3-80.

Figure 3. Le Corbusier. 1935 Aircraft. London: The Studio. fig. 111.

Figure 4. by Lucien Hervé: http://lucienherve.com/Le_Courbusier_Neuilly.html

Figure 5. (a) Fondation Le Corbusier. Paris. FLC L3(17)138: 9. (b) by Lucien Hervé: http://lucienherve.com/Y_C_30.html



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NmeeTon: Self-sustainable habitat for new social challenges

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ABSTRACT: This paper addresses how food preparation practices can help create a design model embracing social changes. The study involved pattern-language method, cross-fertilization, and sustainability. It intends to identify how it is possible to develop a self-sustainable habitat for food preparation as something that takes place in the city in a modern way and not isolated. On the one hand, by exploring an alliance between industry and design aimed at reinventing the local industry. On the other hand, by creating a catalyst system, interpreting the impact of liquid reality. The authors present a pilot project developed by master's design students and companies. The outcome of this study may be used as reference for local industry and design practice development. The paper highlights the value of the combination between industry and design as a mutual learning method. Both parties exchange knowledge, enhancing professional competences, proposing different meanings and creating new market opportunities in order to achieve changes in reality.

1 INTRODUCTION

In 2015, the Italian metropolis of Milan featured the Expo 2015, under the theme "Feeding the Planet, Energy for Life", highlighting the importance of conscious and responsible food choices, while Europe was facing new social phenomenon and foreseen challenges. On the one hand, there were citizens of Western Europe unsatisfied and eager for new experiences. On the other hand, there was the social challenge of refugee crisis. This new social complexity forced Western Europe States and institutions to rethink building and primitive human relations, and the acts of eating and inhabiting in order to fulfill a hybrid, changeable and illusory society. In fact, by the end of the 60's, Gilles Debord emphasized that the end of the millennium was characterized by illusory relations: "The reality of this blackmail accounts for the general acceptance of the illusion at the heart of the consumption of modern commodities: use in its most impoverished form (food and lodging) today exists only to the extent that it is imprisoned in the illusory wealth of increased survival. The real consumer becomes a consumer of illusions. The commodity is this factually real illusion, and the spectacle is its general manifestation." (Debord, 1967). Today, the complexities and contradictions of the spectacle society underline the existence of a consumer distorting perceptions, for instance, on migration flows. Unable to interpret the meaning of living in the sense that "We do not dwell because we have built, but we build and have built because we dwell, that is, because we are dwellers." (Heidegger, 1957). This means that to design something allows raising not only the semiotic question of meaning but also the normative (Latour, 2008), and subsequently the current issue of the flow of refugees may be interpreted through a problem pattern. The path towards understanding a complex system, such as a city facing new social challenges, relies on the architect' ability to provide design alternatives for parts of a whole. Interpreting the whole, we risk misunderstanding everything.

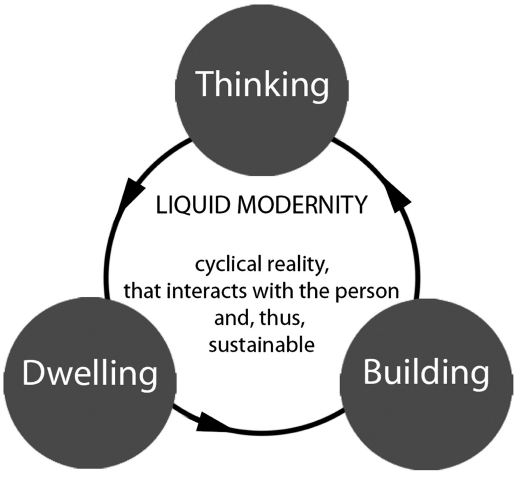


Figure 1. Dwelling/Thinking/Building System. Image by the authors.

On the one hand, consumers are increasingly inclined to spend money on "brands for causes" than direct charity. The expense associated with the gift causes more happiness than spending on him/her, which is a great opportunity (market) in time of crisis. Not take the cause of refugees is to lose a large audience. On the other hand, this situation allows architects, designers, artisans and the community to work together and not individually, and also, to implement a pilot solution in the city. This self-sustainable habitat for food preparation lends itself to installation in a marginalized area of the city, as a reference to a refugee camp, as a contribution to changing realities and mentalities. In this study, the authors chose to exchange knowledge in order to foster innovation and sustainability, recognizing this as a contribution towards the transformation of reality rather than a result from reality change. This also constitutes a unique opportunity to build a part of the whole while inhabiting a self-sustainable habitat to prepare one of the uses in its most impoverished form: food preparation. The field of design is ever changing, according to the complexity, fluidity and transformation that characterize the 'liquid modernity' (Bauman 2005). If transformation itself is a benchmark of reality, contemporary reality leads us in different directions and associations, with increasingly faster changes. The liquid modernity characteristics drive this study towards the application of a pattern-language oriented methodology (Alexander, 1977), focused in solving specific reality problems.

2 RESEARCH PROCESS

2.1 *Purpose*

This research departs from the notion of pattern-language as intuition intersecting fragments of complexity that define the whole, creating a pattern system that fluctuates according to current dynamics. "Pattern is born when one reproduces the intuitively perceived essence. When the intuition weakens, pattern becomes no more than a formal design. Design as such is no more than an intellectual composition." (Yanagi, 1990: 114). The current global crisis encourages alternative solutions. In fact, while twentieth century architecture focused on function and form, the architectural debate today focuses on relationships, limits, energies and culture.

2.2 *Related work*

One of the cases validating this research is Kenzo Kuma's interpretation of Japanese vernacular architecture as a model to think current reality. (Vitorino cit in Liotta & Belfiore, 2012: 119). As stated by Catarina Vitorino, an attempt to identify "local typologies and their responsiveness to micro-local conditions." (Vitorino cit in Liotta & Belfiore, 2012: 119). We expect to understand how patterns changed in space, verifying their ability to adapt to local and external factors interacting in the process. A pattern solves a problem in a way that "you can use this solution a million times over without ever doing it the same way twice." (Alexander, 1977). Christopher Alexander advocates that buildings should be adapted to places and individual needs, offering flexible design to meet the real needs. Another case emphasizing the role of culture in the design process is the framework developed by Barry Shore & Venky Venkatachalam (1995). This framework identifies stages in the design process that are influenced by culture, and the pattern they are likely to form. Therefore, it is possible to argue that "a design pattern systematically names, motivates and explains a general design that addresses a recurring design problem in object-oriented systems" (Gamma, Helm, Johnson & Vlissides, 1994). The solution may be implemented through problem-solving in a particular context, the problem of construction, housing and feeding in the current. On the one hand, there is the dilemma of static solutions for modern citizens that ask for experiences of pleasure and knowing. On the other hand, there is the problem of refugee situation that characterized present reality.

3 PARTICIPANTS AND METHOD

To reflect about teaching architects and designers for the twenty-first century is to think the foundations of a new rationality, reinforcing "designerly ways of thinking and designerly ways of Knowing." (Cross, 2006).

This approach aims to contribute to characterize an innovative design as one that cannot solve only one problem or target only one solution with no dialogue with the question, but rather a "semantic agent, interpreter of a purpose, producer of meanings through the shapes it produces, creating new circumstances and contexts that contribute to human freedom" (Soares, 2012). The methodological processes applied to innovative design cannot be understood as

Table 1. System of Patterns. Image by the authors.

Pattern	Pattern topic	Number of students
Pattern Energy	– Energy Uptake – Storage – Environmental impact	4
Pattern Vertical Surfaces	– Epidermis – Protection – Interaction	4
Pattern Horizontal Surfaces	– Layers – Connections – Courses	4
Pattern Equipment	– Efficient – Systemic – Connective	4
Pattern Structure	– Flexible – Light – Modular	4

linear or sequential. Their path has advances and drawbacks, questioning, criticism and several constraints. The model for Design practice is therefore a dynamic rationale, from the initial question (situation, problem) until the final solution. The project developed was entitled NmeeTon. As Tadhg MacCrossan (1995) states NmeeTon was, in a sacred space, a clearing in the midst of wooded grove or glade of ancient religions, such as Celtic religion or Ancient Greek. But it can also be a space artificially constructed. It means a place that cares. The NmeeTon Project was developed by 4 teachers and 20 students from the 1st year of the Integrated Masters in Design course from the Polytechnic Institute of Viana do Castelo, in the north of Portugal. The project consists on a 'wireless' space for food preparation, involving the undergraduate courses of Food Engineering, Civil Engineering, Environmental Engineering, and Renewable Energies, from the same university. NmeeTon was based on a partnership with the Portuguese construction company Costa & Sá, who financed the project, in collaboration with the stove company Gamadaric, and the cork products company Corticeira Amorim. As we intend to demonstrate, applied research at an academic experimentation level is able to become a key instrument to bridge the gulf between business and academia.

3.1 *First stage*

The project was developed in different stages. In the first stage, projectual thinking was defined as an ordering principle for the spatial structure, creating a 5 pattern system and related topics pattern, in teams of 4 students. During this 10-week stage, each group of students performed data collection, processing and analysis, allowing the development of a hypothesis with the following characteristics:

- The module should contain all the necessary equipment for food preparation;
- The module should have a minimum size of 12 m^2 and a maximum height of 3.00 meters;
- The module features and configuration should allow mobility;
- The module identity should relate to sustainability;
- The module should ensure open/closed configurations in a simple and practical way.

Upon defining the working groups and conclusion of data analysis and evaluation, there was a first meeting between the company team from Costa & Sá and the 20 students and teachers, in order to discuss the brief.

3.2 *Second stage*

In the following stage, during 5 weeks, each group of students developed patterns, able to be integrated in a single spatial configuration. Each team previously composed a set of sub patterns related to the chosen pattern. This pattern was structured in order to assure its execution through easily achievable solutions. Each pattern should be compatible with the patterns suggested by the other groups. This limitation required constant communication between the teams.

Also, each group developed a pattern by connecting to the teams from the other courses, such as Food Engineering, who created a book on hygiene and food safety guidance in Portuguese and English language, not only as a limit for the construction of the enclosure, but also as a guide for an ordinary user.

3.3 *Third stage*

This stage lasted 4 months, and articulated different moments with distinct natures. One of the moments was a workshop by the Chef Margarida Rego, godmother of the Nmeeton project, whose work is characterized by poorer use of food preparation to create aesthetic and playful solutions. This action was essential to adapt the functions of the act of cooking to the act of inhabiting. During the process it was also necessary to meet more often with the entrepreneurs. On the

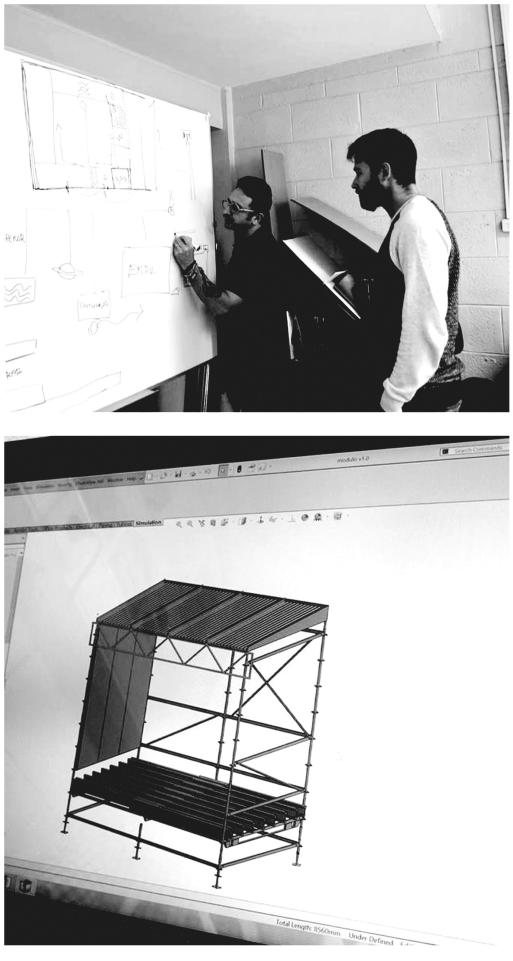


Figure 2. From top to bottom: Rush straw assembly from the Vertical Surface Pattern. Detail of black cork from the Structure Pattern. Image by student Alzira Dias.

one hand, some patterns required other technologies and other companies, calling for new partners, such as the stove company Gamadaric or Corticeira Amorim from central Portugal. Gamadaric allowed the development of a wood burning stove. The Corticeira Amorim allowed the development of isolating coatings, namely for a deep freeze appliance in cork, retrieving the early icebox concept. Project phasing required changes in projectual decisions, considering the pilot-project would be a self-contained functional prototype and not a volume model. In this sense, the project was built and tested at the university, and was open to criticism from students, teachers, entrepreneurs, and the community. When all patterns were connected and the whole resulted in dwelling construction, the components were dismantled for subsequent assembly before the community of Viana do Castelo. The space, about 28 cubic meters, has a separable structure, using materials such as metal, fiberglass and Corian, but also natural materials such as cork, wood and rush. An easily, detachable and transportable self-sustainable habitat for food preparation, when not in use. The NmeeTon space is self-sustainable and off-the-grid, since it does not rely on municipal water supply, sewer, natural gas, or electrical power grid. Instead it showcases innovative solutions such as the modern icebox to preserve food, a micro greenhouse for herbs, or a wood burning cooking plate & oven package. A biomass system that allows wood pellets as a biofuel; fuel clean, efficient and high calorific value. This option is focus on the emergent and changeable situations that, more often, characterized our time. It means, a self-sustainable space and off-the-gridd is stronger and prepared to reach social fluctuations phenomenon.

4 FINDINGS

4.1 *Advantages of the process*

- Involving native materials such as rush, black cork, and standardized materials such as metal tube allowed qualifying the product within the local culture while thinking globally.
- Design research also focused on technology, materials and marketing, linked to research based on a partnership between business and academia. A research model that may become a key tool to foster new relations between business and academia.
- The potential for crossing technologies, materials and companies should be investigated to create cross-fertilization (Cappellieri, 2005) and new business opportunities. The fact that the space doesn't need connections to any electrical or water services illustrates the self-sustainable feature of the unit, enabling its use in virtually any setting.

4.2 *Disadvantages of the process*

- Some of the project procedures were delayed due to the geographical distance between some companies.



Figure 3. From top to bottom: Rush treatment. Rush straw assembly for the Vertical Surface Pattern. Detail of black cork in the Structure Pattern. Image by student Alzira Dias.

- Rush picking takes place during Spring, which can limit the construction of the chosen sort of roof.

5 PROPOSITIONS FOR DESIGN

The propositions for this study were social, cultural, academic and entrepreneurial. At a social and cultural level, in 2015 Milan staged the Expo under the theme "Feeding the Planet, Energy for Life" drawing attention to the importance of conscious and responsible food choices, the NmeeTon project intends to stimulate new sustainable models merging tradition and innovation. The European migrant and refugee crisis also began in 2015, with a rising number of refugees



Figure 4. From top to bottom: Assembly of the Pattern Structure in the city. View of the façade. Image by student Alzira Dias.

and migrants seeking abroad for better living conditions. Thus, European consumers are more and more disposed to spend money on "brands for causes". The expense associated with the gift causes more happiness than spending on him/her, which is a big occasion for today's reality.

At the academic and entrepreneurial level, this project allowed students to connect with local production enterprises. In academic terms, a process-oriented design action is useful, since "today, Design research is a quest about specific reading instruments such as those from innovation methods studies promoted by companies in collaboration with designers and the creative world." (Verganti, 2001). This process connected companies from different sectors, which had never worked together. On one side, Costa & Sá a construction company that had never designed ephemeral self-sustaining structures, and on the other side, the cork company Corticeira Amorim, which had never produced this sort of solutions, opening a new horizon of collaborative production, and new interaction concepts with people, architecture and the city. Finally, Gamadaric was a stove company that although engaged in modern stoves seized the possibility to create a wood burning stove for underdeveloped countries. This project is currently being developed at a Master level and it is remarkable that it fostered three Master Theses in companies for students participating in the project. At a company level, it is expected to identify new business and market opportunities, both for the companies involved in the project and for local companies stimulated by this cross-fertilization.

6 CASE STUDY

6.1 *The sustainable intelligent process*

The development of the pilot project NmeeTon was based on an industry-design alliance, engaging different actors. The process can be defined as an interactive approach, with 20 Masters Students, teachers, artisans and industrialists. An open process combining idea development, discussion, prototyping and presentation; The project was presented in July 31, 2015, by the fishing docks of the coastal city of Viana do Castelo. Specifically besides the Social, Cultural and Artistic Intervention Association (AISCA), founded in 2009 by people from different backgrounds, including two former students from the School of Fine Arts of the University of Porto. AISCA headquarters are a modernized abandoned warehouse by the town pier, playing an important role in the transformation of the city. AISCA acts as an intercultural platform and space, offering workshops, seminars, concerts, exhibitions and projects. This association thus became one of the most active promoters of stimulant initiatives and incentives in Viana do Castelo, as for example the project "Sea Villages" (Aldeias do Mar), intended to requalify the abandoned seashore or forgotten cityscapes. The NmeeTon project was premiered by Chef Margarida Rego, who cooked several dishes for approximately 100 people who attended the inauguration. This action led to a widespread understanding of all actors intervening in the project.

On the one hand, the industries were challenged to leave their comfort zone and scope of production, accepting to participate in a project creating new opportunities for transformation. On the other hand, architects and designers had the opportunity to interpret specific technologies and materials. With this methodology, design students were able to develop new concepts and to intersect new experiences and different areas of knowledge. According to Francesco Morace: "(…) will always try to reach another meeting point between the aesthetic and ethical variables. What is worth today for enlightened businesses and entrepreneurs will be the universal key to identify new parameters of quality. The progressive meeting between goods and services will happen under



Figure 5. From top to bottom: Oven Detail. Chef Margarida Rego cooking inside the NmeeTon unit. Detail of freezer in black cork. Image by student João Pontes.

the jurisdiction of the alliance between ethics and aesthetics." (Morace, 2011).

6.2 *Product development*

The developed product is characterized by the intersection between artisan and industrial production. The new product emphasizes the characteristics of the materials, in their semantic value, including visual and tactile qualities. On the one hand, the new product highlights the practical role of materials, projecting materials such as the upper vertical pattern in rush, demanding the material to be picked up by the river, dried and combed mesh by mesh. The need to restore the typical rush culture in the Minho region (northern Portugal), finding in equipment design and architecture the setting to allow the profitability of an existing wealth of knowledge and to assure its survival. When design builds a correct connection between the productive qualities and the material culture history, it can also create a sustainable innovative product. Through artisan production and together with industrial production, we created a hybrid product with added value from both sectors. On the other hand, the NmeeTon highlights the aesthetic potential of materials, as the black cork relating to a metallic tubular structure, providing hot and cold sensations conveyed by the relationship between materials. Nowadays, the 'cautious designer' (Latour, 2008) who chooses a meaningful reflection about design education for the twenty-first century, projects manifestations of design education, developing connections with other professionals, academies, businesses, and people. If currently design teaching is based on a constant interrogation process, it is also the result of today's reality. And design teaching is hardly a project: it may be planned as a meta-project, related to the genius loci, to local productive entities, and with an entrepreneurial insight to promote sustainability and competitiveness. A rationality that enhances applied research projects to the development of products focusing on the valorization of the territory. This supports the notion that the development of Design discipline depends on the connection between enterprises, education and research, in a field of action that is always active, and not just sometimes. In this sense, it is vital for the productive sector to be increasingly versatile, due to a constant and growing customer demand, provided by the global world it is set upon. The proximity between industry and handicrafts may become strategic for the survival of the two sectors, creating geographically involved values, in other words, local, cultural, symbolic, qualitative values (Maldonado, 1999), which through sound design strategies are able to improve products' quality.

7 CONCLUSIONS

This research aims to understand how design and architecture research can contribute towards the future of the cities in the 21st century, considering the social fluctuations phenomenon, the contradictions and oscillations that characterize present reality, namely the migration phenomena and the dissatisfaction and the desire for surprise and new experiences that characterized the western citizens. In order to prove this thesis the authors use NmeeTon's case study developed between academia and the business sector. In terms of application, the NmeeTon project may expand the concept of agri-food sustainability, including products as well as production systems. The interest in defining sustainability is based on the emergent appreciation from all stakeholders that the future productivity and economic state of the agri-food system is dependent on the wellbeing of natural and ecological and sustainable funds. NmeeTon project





Figure 6. From top to bottom: Detail of the working bench and greenhouse in the NmeeTon cabin. Night view with lighting. Image by student João Pontes.

also allows experiences that will make users remember past memories or even a new experience by using the stove. Concerning the emotional value of everyday objects, Donald Norman (2004) advocates that memories reflect our life experiences; they remind us of family, friends and also experiences. This project may be an opportunity for all actors to transform amidst a reality in constant change. The architect and designer assessing the cultural value have the predisposition to reach an innovative and sustainable response. Innovative solution because through interpretation, the designer accepts time fragmentation and defines answers including the cultural factor, becoming an ever-renovated solution. A sustainable answer, because the process benefits from factors crisscrossing the context, such as time, communication or complexity, enabling interpretation while design process as a cyclic method; recyclable and therefore sustainable. A cognitive and dialectical process because being a path open to contrary and contradictory ideas, it becomes an innovative process leading to other ideas; a wide process whose final product quality will depend on the strength of the relationship between the parts constituting the product system. The alternative to assess and evaluate all appearances of the nature of new social challenges will allow the architect the right to choose when relating the individual to the world. In this sense, it is a productive action in which design works alongside other disciplines, interfering in reality, complex and difficult to define, instead of design operating on a dream-like reality. As a culture vehicle, architecture contributes towards preserving the cities' identity and also to uphold emotions in people's lives. It engages the thought of the uniqueness of the cities as an inspiring model for interpretation that stems from a base concept, assessing and reassessing prior to forwarding responses. The design of the cities is therefore hermeneutical and dialectical. Between the designer and the user then arises a new level of relationship, an experience of meaning exchange instead of a mere opportunity to communicate a message.

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Real estate, residency, design and sustainability: Reconsidering innovation and efficacy in development

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ABSTRACT: Real estate planning, design, development and building prove deeply complex. For nearly five decades developers have been doubling down, contractors have been cutting corners, architects and engineers have been copying and pasting, planners have been creating more rules, and bankers, lawyers, realtors and insurers have all profited excessively from a fundamentally broken system (Miller 2009). All the while, home owners have unknowingly and knowingly spent trillions of dollars on accommodation that lacks in either quality, cost, location, fit or all of the above. However, as long as the economy continues on an upward trajectory, the climate doesn't change too much and home buyers don't ask for anything more, the system will endure. Should we be changing anything?

Homes shape our communities, guide our relationships, characterize our identity, create intimacy and increasingly prove vehicles for funding retirement. Since 2008, average home prices have risen by 50% pushing family net worth up 44.5% (Marr 2015). The real estate, rental and leasing economy is equivalent in size to the educational services and healthcare industries combined and nearly 20 times larger than the arts, entertainment and recreation industries (Statistics Canada 2015). The housing sector is a life line to the economy and, if thrown off balance, has proven to be crippling. We remain dependent on a fragile system which, in many ways, doesn't function as well as we think or as well as we desire.

Today, 20% of Canadians face an affordable housing crisis, spending over half their income on their home (McMahon 2015). This problem is magnified globally, where an estimated 1.6 billion will be affected by an affordable housing crisis by 2025 (Woetzel 2014). Rising prices and lack of productivity within the construction industry contribute to unaffordability (LePatner & Jacobson 2007). This is intensified by a lack of innovation; only one construction and engineering company made it to Forbes 100 most innovative companies in 2014. Since the turn of the 19th century, the movement of architects and engineers from a craft practice model to a professional services model shifted liability onto developers and withdrew the creativity involved in place-making by creating a highly fragmented and arguably dysfunctional industry. As such, less than 5% of homes have an architect involved in the design (Brown & North 2011). The housing industry is also a great environmental concern. Buildings contribute to one third of global greenhouse gas emissions (Huovila 2009) and the urban sprawl of the last few decades has resulted in numerous negative externalities (Thompson 2013).

We cannot continue to rely on this broken system. Although new urban and minimalistic movements are becoming more prominent, a systemic change is needed (Zevon 2011). Purchasers should no longer forgo quality, cost, location or fit. By unveiling the venality of the current industry, and finding the cruxes for change, we can create a more innovative and integrative industry.

The present research critically considers the status quo, exploring aspects of the design and development industries that desperately need overhaul, integration, coordination and stream-lining. Holistic conceptual frameworks can be shaped and applied to tackle the daunting complexity of such systems (Sinclair 2009). To such ends the authors present a model for systemic reform that aims to shift priorities from profit and bottom-line thinking to place-making and quality of life, understanding that creativity, balance and reform are urgently required in order to see real progress in an endemically fragmented & problematic ethos.

Keywords: Real Estate, Residency, Design, Sustainability, Systems Thinking, Innovation

1 INTRODUCTION

The residential design and development industry grows increasingly complex in Canada and around the globe. This complexity is due to the involvement of numerous stakeholders with a diverse array of desired interests, experience, personalities and influences (Miller 2009). It isn't out of the ordinary

therefore that communication barriers exist between the different parties involved within the industry. Ultimately, this leads to inefficiencies, excessive profitability, negligence and lack of true consideration for the end user (NRCC 2002). Ironically, the system that should be designed and built for the resident might appear to be built more for the profitability of other stakeholders. This misalignment in power has created challenges within the industry from an economic, environmental, social and political perspective. Furthermore, the misalignment results in a design and development industry that is structured in a way that proves to be not very resilient. This is particularly concerning as the built environment challenges around the world are becoming increasingly acute (LePatner, 2007). However, in this challenge, there lies a great opportunity for the next generation of leaders to take initiative and reshape the industry. There must be a charge to create an industry that is more sustainable from an economic, social, environmental and political perspective. Sustainable not just in the ability to use without completely using up or destroying (Merriam-Webster's collegiate dictionary n.d.) but in the focus of this paper, sustainability refers to building and propagating longevity, resilience, equity and empowerment. It is with these considerations that we can generate truly holistic sustainability. The authors present methods and a model for improvement. Through greater awareness and the assistance of frameworks, stakeholders can reform their perspectives and alter their relative positioning within the industry. And through the assistance of intermediaries including entrepreneurs, actionable leaders and technology, change can be generated rapidly. The time to act is now, both diligently and swiftly, before it is too late.

2 WHAT IS BROKEN? WHAT IS THE RESULT OF THIS?

"People everywhere – independent of their particular background or education level – almost instinctively understand the importance of place ... few other forces, in my view have such transformational potential." – Aga Khan.

The incredibly complex and colossal design and development industry is broken in many ways. Economically, Canada and many other parts of the world are both fragile and reliant on the housing sector (Ladurantaye & Mckenna 2012). Environmentally, the negative impact of residential design and development is in many measures second to none (Huovila 2009). Socially, societies today struggle with both an identity and affordable housing crisis (Woetzel 2014). Politically and industrially, misalignments in power result in a system which is not resilient to the rapidly changing and compounding problems of the built environment that the world faces today. A deeper concern is that these problems are dealt with by stakeholders in silos as perceived interests tend not to be aligned. Therefore, they are dealt with disjointedly if at all. It is important that these challenges are acknowledged and considered comprehensively and collectively when attempting to understand their deep complexity.

2.1 *Economy*

The system is in fact broken in many ways. Financially, private investors are dependent on the gradual increase of housing prices. Since 2008, average home prices in Canada have risen by 50% pushing family net worth up 44.5% (Marr 2015). However, it is not only the home owners who carefully follow the housing market. Governments and economists use housing prices and housing starts to determine the health of the economy (Statistics Canada 2015). All of this seems logical given the real estate, rental and leasing economy is equivalent in size to the educational services and healthcare industries. And combined it is nearly 20 times larger than the arts, entertainment and recreation industries in Canada. Ironically, the industry seems to know its priorities – economics. (Statistics Canada 2015). However, as we have seen recently in the financial collapse of 2008, the housing industry if thrown off balance can be crippling. Ignorantly approving mortgages which residents can barely afford and the assumption that real estate always increases in value, renders our economy very vulnerable. It is clear that the valuation and approval techniques for homes must be reconsidered (Gjerstad 2014). Additionally, our focal point on housing starts as a metric for economic growth may also be flawed. Canadians build two new houses for every person added to the working age population (Rabidoux, 2015). This fuels the concern of depending on quantitative factors rather than truly meeting needs. These are only a few examples of inappropriateness and impracticalities of the economies of the housing sector. Undoubtedly, the reliance on housing as a mechanism for economic growth is both speculative and unsustainable.

2.2 *Environment*

Reliance on the housing industry to carry the economy has resulted in the development of a system which can output houses at a rapid rate with little consideration for environmental impact (Brown & North 2010). Unfortunately, without a profit motive this rate of growth coupled with a lack of consideration for environmental sustainability will endure (Kriese & Scholz 2010). The current housing industry is a significant environmental concern. Buildings contribute to one third of global greenhouse gas emissions (Huovila 2009) and the urban sprawl of the last few decades has created numerous negative externalities (Thompson 2013). The replacement of 'native' landscapes with development and the advent of concrete jungles has removed nature from our daily lives. This has caused many negative health and psychological

effects (Gobbo & O'Mara 2004). And the preconception that bigger is better has resulted in a desire for more space, opulence and the so called supersizing of our homes (Brown 2011). All of this, of course, comes at an expense to the environment and our precious resources. Unfortunately, this growth doesn't result in our happiness but a continual dissatisfaction and hunger for more (Kuo 2004). In recent years, the consideration for smaller and minimalistic living has grown (Zevon 2011). As well, there has been a rising popularity of rating systems, energy efficient appliances and LED bulbs to name a few (Friedman 2008). Unfortunately, the notion of environmental sustainability has been mocked with green washing and arguably only a few wealthy residential projects truly consider environmental attributes (Solomon 2005, Bray & McCurry 2006). For example, in Canada, only 1.54% of residential projects are LEED certified (CAGBC 2014). Despite a growing consumer sentiment towards environmental building, rating systems such as LEED and Built Green are far from truly holistic sustainable design (Bray 2006). Particularly, they fail to address the more spiritual and qualitative aspects of homes and lifestyle (Ben-Shahar & Golan 2014).

2.3 *Social (Identity)*

The most negative impact of an ever-growing residential industry is the emptiness it brings to our societies (Brown & North 2010). Homes are meant to shape our communities, guide our relationships, characterize our identity and create intimacy. Yet, they routinely fail to do this. There has been a true loss of consideration for identity and community in the process of residential design and development. A small degree of homes in Canada have an architect involved in their design (Brown & North 2010). Design decisions are barely grounded in any methodological understanding of the resident. They adopt a lowest common denominator approach to understanding resident needs and focus on the status quo. Design decisions are more driven by creating value for the bottom line than they are creating value for the resident (Adams & Watkins, 2002). As well, there is a strategic information gap between buyers and suppliers and the result is design decision makers that factor in a few characteristics such as number of bedrooms, square footage, location and quality of finishes. Consumers needs regarding living spaces are much richer and fine tuned (Gibler, Tyvimaa & Kananen 2014). However, suppliers choose typically not to value all of these various needs. Price and volume of sales are driven by only a few decision factors available to residents and the desire for developers to innovate beyond these factors is an unnecessary risk. After all, the stakes are high and risks for the many small developers can be substantive. A strategic and powerful veil ensures the fragmented residential development industry continues per status quo. (Gyourko & Rybczynski 2000).

2.4 *Social (Affordability)*

With the staggering rate of development and the speed by which homes are created, it would seem contradictory that 20% of Canadians face an affordable housing crisis, spending over half their income on their home (McMahon, 2015). This problem is magnified globally, where an estimated 1.6 billion will be affected by an affordable housing crisis by 2025 (Woetzel 2015). A heightened level of development and construction (housing starts) does not mean that needs are being accurately met. In order to meet needs, both accuracy and resources are required in unfathomable quantities. Including land and construction nearly 16 trillion dollars will be required to replace substandard housing and build additional units by 2025 (Woetzel 2014). Furthermore, with location, price and quality continually being sacrificed by home buyers and renters of many demographics, there is an apparent gap in the market (Marmolejo-Duarte & Ruiz-Lineros 2013). Partially, this is due to the lack of awareness of what is specifically required in market. Therefore, the need to bring the right product to the right market is crucial. (LePatner & Jacobson 2007). However, lack of capital, innovation, access to land, construction costs, waste and exuberance are abundant and further worsen the situation (Woetzel 2014). The benefits of creating affordable housing are intangible for societies and communities. Providing appropriate housing for lower income populations and improving the overall quality of housing will likely enable labor mobility, increase knowledge sharing, build resiliency in communities and increase quality of life (OECD 2014). Cracking the code on delivering affordable, sustainable and scalable housing will effectively create political, economic, social and environmental benefits across the board. In order to attempt bridging the affordability gap, innovation and reorganization are urgently required (Miller 2009). We need to dramatically challenge business-as-usual posturing and, in response, chart new and bold ways of seeing, thinking and acting.

2.5 *Politically + Industry*

Innovation within the residential design and development industry is hampered for numerous reasons. Two powerful stakeholders – the developer and financer are driven by bottom line profits (LePatner 2007). Therefore, the development or redevelopment plan of any land parcel is based on the highest and best value for that particular plot. Environmental and social innovations which are narrowly defined and determined are investigated only if they can be correlated to an increase in volume or price of sales (Eves & Kippes 2010). In both bearish and bullish markets, cost cutting measures or value engineering are often synonymous for innovation. Furthermore, horizontal and vertical fragmentation are prevalent within the industry. Developers, architects, designers, planners, builders and bankers tend to have their own measures of success. These interests are often not aligned.

Furthermore, the residential design and development industry is divided into numerous small firms who encounter variability in profits and therefore are limited to invest in research and development (NRCC 2002). Lastly, governments tend to lessen innovation in many cases by bringing about planning systems which are both bureaucratic and difficult to navigate (Adams & Watkins 2002). Design decision makers are often encumbered with constraints based on community, municipality and provincial code requirements and bylaws. Often coping with these obstacles alone leaves little time and capital resources to invest in innovation. Overall, the industry is far behind others when it comes to producing increasingly competitive products. Only one construction and engineering firm made it to Forbes 100 most innovative companies in 2014. Dismal innovation in the face of a broken and increasingly concerning industry is a wicked problem to say the least.

2.6 *Implications*

Concerns within the industry are growing increasingly worse. Since the turn of the 19th century, the movement of architects and engineers from a craft practice model to a professional services model shifted liability onto developers and withdrew the creativity and cohesion involved in place-making by creating a highly fragmented industry (LePatner 2007, Miller 2009). This fragmentation resulted in an asymmetry of information amongst key stakeholders. And inevitably, the information gaps have resulted in further vulnerability of our economy, harm to the environment, removal of identity from our homes, an affordable housing crisis, bureaucratic planning policies and lack of innovation throughout the industry. We cannot continue to rely on this fundamentally broken and troubling system. The present researchers stress that a dramatic systemic change is desperately needed to bridge these information gaps and connect stakeholder silos. Residents should no longer forgo quality, cost, location or fit. By unveiling the venality of the current industry, and finding the cruxes for change, we can create a more innovative and integrative industry.

3 HOW CAN IT BE FIXED?

"Everything should be made as simple as possible, but not simpler." – Albert Einstein.

It is evident that both a lack of mutual understanding amongst key stakeholders and increasingly complex problems hinder the progress and accessibility of an incredibly important human need. The authors present methods for demonstrable improvement. Strengthening the bonds within this industry will not be the responsibility of one key stakeholder alone, or a technological panacea, but rather numerous leaders empowered with technology innovations must arise to bridge these bonds. Collectively the industry must

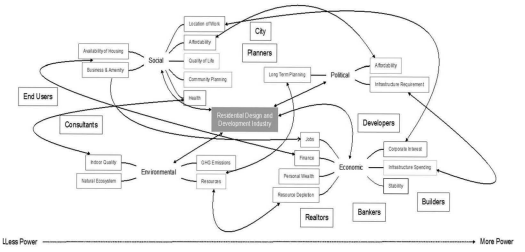


Figure 1. Model showing complexity and power struggles.

be educated to understand the broad implications of each stakeholder's actions. This can be supported and accomplished through the awareness and integration of holistic frameworks.

3.1 *Awareness + frameworks*

The residential design and development industries prove deeply complex. Stakeholders are in desperate need of better understanding each other's desires, jargons, principles and perspectives. Focal points and metrics of success are not only diverse amongst key players but also intensely dynamic.

Industry stakeholders must bring to light the divergent knowledge and burgeoning considerations of appropriately designing and developing in the world today. Using balanced frameworks can help different stakeholders realize what key assumptions they are making and how the implications of their decisions impact other stakeholders. Frameworks are both versatile and organic. Therefore, holistic conceptual frameworks can be shaped and applied to tackle the daunting complexity of different and demanding systems (Sinclair, 2009).

Figure 1 above shows the residential design and development industry mapping the key domains (economic, political, social and environmental) and a few key parameters of success for each domain. It also overlays key stakeholders and a few of their interrelationships. From this model, we see that power is associated with politics and economics more than social and environmental considerations as many of the more powerful stakeholders are motivated by political and economical considerations. Although the integral purpose of the industry is to serve the end user (LePatner & Jacobson 2007), the alignment of the industry's interests does not adequately do this. Clearly, a reconfiguration is required and a transfer of power towards other stakeholders. This may seem trivial, however, the model also helps us to understand interdependencies and the potential negative implications of the system continuing as per the status quo. Business as usual is unacceptable. Many of the social and environmental considerations have long term political and economic impacts. The domains cannot exist in their own silos.

Models can be powerful tools if they successfully build awareness and are administered across the industry amongst key players. They can serve as potent

catalysts for change. Awareness and knowledge can be shared and built in academia and through integrative workshops. However, to truly bring about widespread outreach, knowledge acquisition must be fostered through appropriate intermediaries and innovative channels of communication. This way it can reach the far corners of the industry and create more revolutionary shifts in mindset.

3.2 *Intermediaries and technology*

In a fragmented industry, the need for intermediaries to bridge the information gaps is vital. With the assistance of liaisons, we can create knowledge transfers that distribute value more evenly across the system. At each critical disconnect in the system, a clever design intervention can allow different stakeholders to see one another's perspectives. By building awareness for what should be considered, we can guide stakeholders into making more informed and therefore better decisions. Currently, the use of information technology, software and social media in the design and development industry is dismal (Littlefield, Bao & Cook 2000). There is a critical importance to engage various stakeholders by bringing them online applications and tools that foster both communication and education. In an era where information is readily available, we should be connected, integrated and sharing integral knowledge at rapid rates. In many ways knowledge is power. Positive attributes of using online tools and applications to invoke change include rapid prototyping, experimentation and engagement. However, it is important to recognize that these applications will not create change without actionable leaders backing the initiative. Leaders may include architects, engineers, developers, lenders, planners, builders, entrepreneurs or others who advocate change within the industry. These leaders must be driven, interdisciplinary and creative in order to innovate the right products, strategies and carry out effective implementation. A proposal for a four-phased design intervention using information technology that attempts to redistribute value and reform the industry is described below.

3.3 *Proposed solution*

Imagine an organization of stakeholders integrated through a social and informational network – sharing ideas and best practises at a rapid rate within an ever-growing, organized and interactive online application. The central goal would be to empower residents to take control in shaping their built environments and to drive innovation through transparency. Products, concepts, characteristics and stakeholders can be catalogued using an assortment of metrics and ratings, to an extent. The ratings and metrics can be established democratically and be designed to be organic so they can continue to reflect the needs of dynamic situations. They can also be directly compared, tailored, customized and optimized for particular projects, sites and people. The widespread use of this network would

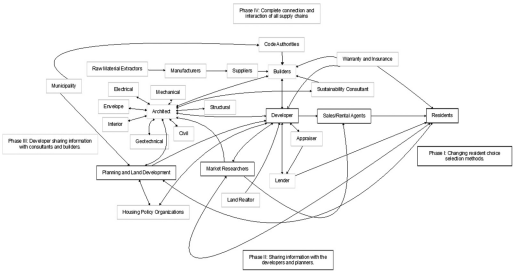


Figure 2. Model showing the current design and development industry.

result in greater accountability, scalability and shared research and development. It would be capable of bringing economics, efficiencies, more innovation, greater efficacy and appropriateness to residential design and development solutions. It is important to note that not all attributes can be associated to metrics and quantities. The application would provide guidance or an affirmation of a particular trajectory. It is still up to people to use their senses and intuition in making decisions. Qualitative aspects of the formula are vital yet commonly downplayed. Soft and hard facets of the system must be equally valued. An organic application with various functionalities may eventually find ways to capture the qualitative and convey emotions as we have seen with many examples in industry (Airbnb, Houzz, etc.). The authors present a four phase plan for implementing an ambitious and forward-thinking conceptual model. One goal of the present research is to develop and operationalize this approach moving forward. The phases of the model and current industry orientations are highlighted in Figure 2.

3.3.1 *Phase I*

The first phase will involve integrating and recalibrating the resident. It is important to first drive change through the customer as the remainder of the system will follow. This is because the system thrives based on the demands and purchase decisions of consumers (Stroebel & Kurlat). The erosion and diminishment of power within the system discussed earlier is partially due to the apathy and often negligence of the resident (Damery & Fisette 2001). Thus, residents can be given power with greater information to make more appropriate choices when it comes to their residences. They must be able to elect their desired characteristics based on unique personal needs. With optimal information, choices that are more reflective of lifestyle, community and sustainability will likely be made (the authors attempt to prove this). This phase will be tested by designing and piloting a comprehensive online application that improves the experience of decision-making and aims to modify choices by providing relevant information for the homebuyer. A process of market research will be followed by the design of a framework. This framework will be populated with

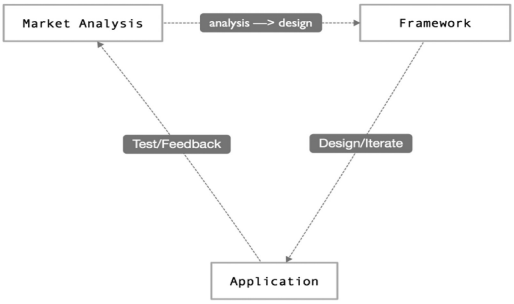


Figure 3. Process for designing and iterating application.

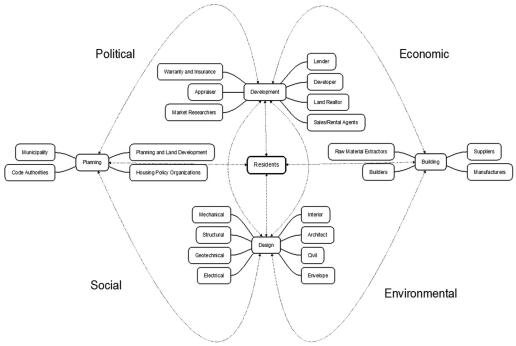


Figure 4. Reconfigured model for sustainable residential.

market data and be converted into an application. The application will be tested with a sample population then refined and redesigned until it is ready to launch publicly. An iterative process of designing and testing will ensure greater success upon launch. The process is summarized in Figure 3.

3.3.2 *Phase II*

With enough resident demographic information and desired characteristics populated into the network, information sharing with developers, market researchers, realtors and planners can begin. These stakeholders now understanding and having evidence for the desired characteristics of residents will begin to create feasible products that reflect these characteristics. Transparent qualities and ratings of homes can be compared and scrutinized. This will force stakeholders to ensure the products they are offering are appropriate and competitive. They may be required to reconsider and carefully evaluate the design and development of their products. Toward this end, a deeper consideration for place-making, quality of life and various other characteristics that are important to the end-users will take place. In many cases, the market may ask for unrealistic requirements. Developers, planners, market researchers and realtors cannot meet these needs alone. A more holistic strategy is key to progressing.

3.3.3 *Phase III*

Stakeholders from the second phase will begin informing designers, builders and lenders of the new requirement of residents that are known. These parties will then begin to create products that reflect those needs. In many cases, innovative products and services will be required to meet changing and more stringent and specific demand. New partnerships will begin to arise between various stakeholders who are like-minded or who see synergies through the application. Accountability for various teams will become paramount as the quality of residential developments can be compared and viewed globally.

3.3.4 *Phase IV*

The final phase will integrate the various supply chains of the builder, developer and lender. Ultimately, the authors aim at providing a fully integrated and responsive system online. Continuous feedback from new studies or innovative design interventions taking place in unique contexts will transfer rapidly through the network. For-profit and not-for-profit entities will be scrutinized the same way and competitive advantage without continual rapid innovation will be short lived. Products, concepts, characteristics and stakeholders will travel quickly and globally, finding the appropriate niches for their most suitable application. A revised model of the industry, placing residents front and centre, is outlined in Figure 4.

4 CONCLUSION

“The problem is that the scale, the speed, and the scarcity of means with which we have to respond to this process of urbanization, has no precedence in human history … so the role of the architect will be creating the right frame[work] so that the forces involved are channeled in the right direction.”
–Alejandro Aravena.

The residential design and development industry is, in the minds of the researchers, fundamentally broken. Over recent decades, economical and political factors have triumphed over social and environmental considerations. This has resulted in a highly vulnerable and short-term-focused system which is swiftly eroding our environment and draining the quality of life from residents, residences and communities. The current system (i.e. the status quo) must not endure. Responding to this dilemma, the authors presented a model for systemic reform and dramatic improvement. By creating awareness through the use of appropriate models and frameworks, and engaging technology as an intermediary in strategic ways, systemic reform can be created. The authors contend that our industry must transform in significant ways – it must arise anew in ways which value the end-user, has greater accountability for its actions and continually innovates in order to provide solutions that are more environmentally, culturally and socially conscious. Given the

undeniable role of housing in our lives, the unquestionable impacts of development in our economies, and the potential for design to make a positive difference, it is urgent for the players to creatively reshape our concepts, revise our constructs and restate our *raison d'etre*.

5 CONCLUDING COMMENTS

For certain, the cities of our future are designed to a large extent by city planning departments. These organizations design and plan decades in advance and consider the implication of urban plans for decades to come. These organizations are theoretically serving the interest of the people and citizens for which they are designing. However, often knowing the exact needs and understanding the future requirements of citizens is difficult. Values, interests, family compositions and lifestyles are continuously evolving. With such rapid change, cities must address these dynamic shifts. By giving a voice to residents and involving them in the discussions of the future of their cities can be of great value. In part, the city planning departments can both create this engagement and influence perspectives. However, developers, marketers, architects and builders may also play a critical role. By engaging in discussions with future customers for the products which they will be providing, they may create more reflective products while shaping the perspectives of their future customers. These entities are powerful in their ability to direct, control and empower resident opinions about their residences and communities. The media also has a significant influence on the perceptions of residents. All together, there are various ways of empowering and educating citizens on the subject of their residences.

Addressing dynamic shifts in values, interests, family compositions and lifestyle choices are not problems that cannot be solved through the acquisition of greater information and engagement of citizens alone. Development of architecture that is responsive to this change is necessary. We can for example create buildings and spaces which are agile. Where the effortless movement or flexibility in design allows diverse needs to be addressed. By better understanding the demographics and target markets, environments of multi-purpose or mixed-uses can be created with the right balance of spaces available for various family compositions and lifestyles. As property values and density continue to grow in the most desirable urban centres, space will become a more critical commodity. Therefore, it will be paramount that this space is utilized in the most efficient way possible as it is negotiated and renegotiated over multiple uses with various stakeholders.

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Shell performativity as a tool for urban action

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ABSTRACT: Within the financial glacier that has been settling into crisis stricken Greek urban centers the aging building stock of devalued and abandoned sectors has evolved into an experimental testing ground for architectural research. In this context the paper investigates small-scale and short-term interventions that challenge and upgrade current urban renewal strategies. The research hypothesis assumes that architectural operations which engage the building shell can acquire urban effects.

1 INTRODUCTION

As Western cities change character seeking new organizational systems for their deteriorated or redundant structures, small-scale and short-term urban interventions become more pertinent than large-scale and long-term urban development programs. Derelict urban areas and informal spaces become the terrain of alternative, citizenship empowering, urban actions. In de-industrialized and crisis stricken Greek urban centers an increasingly large amount of the building stock is unoccupied and manifests abandonment and dereliction. This emergent spatial surplus can be considered as a testing ground for the development of proposals that upgrade the currently fatigued notions of renewal and restoration.

To this end interventions that concern reconfigurations of the existing inactive buildings are investigated with an outlook to their urban effects. The focus lies on the building shell which in my research hypothesis is conceptualized as an urban artefact. Modifications of the shell are explored towards the orchestration of physical environmental conditions that constrain and support urban actions. Scenarios of expected use are often encoded into the design of objects in a normative manner. Instead, the notion of performativity provides the theoretical framework for a new signification and programming of the building shell revealing a field of opportunities for re-inhabitation.

Reconfigurations of the existing building mass empower the redefinition of the architect's professional expertise. Implementing the theoretical endeavor this paper discusses some speculative projects that are embedded into the contemporary Greek urban context as urban paradigms. In terms of design methodology the projects revisit design tools that have been habitually employed to configure urban space – the *urban poché* and the *streetscape* through the perspective of digital modeling.

2 THEORETICAL FRAMEWORK

2.1 *Aspects of performativity in architectural discourse*

The notion of *performativity* represents the current turn in architectural discourse to move away from describing architecture as purely a physical object but rather as a process (Smitheram 2011). Embedded in the digitally driven architectural design and fabrication methods (Kolarevic 2006) the concept of *performativity* refers to generative design processes as well as to responsive architectural elements such as dynamic facades and adaptive surfaces. The concept appears equally pertinent to the human centric architectural discourse providing a common ground between the two apparently conflicting schools of thought.

In the field of design research *performativity* is deeply associated with the notions of *function* and *use*. In the performative approach to the study of human-artefact engagement embedded in recent theories of computation use is viewed as a kind of making while users are considered as active performers of open-ended, unfolding and improvisational tasks rather than passive recipients of the designers' directives or automatic enactors of scripts and use plans (Vardouli 2015).

User centric representations of the experience of space relate performativity to the practices of the everyday referring to the reciprocity of daily performance with the assertion of identity in place. The idea of the performative body as an active creator has been exemplified in the spatial practices of urban subcultures with skateboarders as paradigm (Borden 2003). Spatial appropriation of informal and interstitial urban spaces by 'marginal' urban groups is considered as a creative engagement with the physical setting which demonstrates the latent possibilities that exist within such contradictory territories (Shaw & Hudson 2009).

The concepts, theories and general problematics of emergent spatial practices are crucial in the definition of a research by design agenda for redundant urban structures. Taking into account their state of abandonment standard functional analysis may be irrelevant. Instead, theories of improper uses – of people's appropriation and objects' affordances are better connected to the matter at hand. The notion of *affordance* (Gibson 1977) was introduced in ecological studies to describe the opportunities and risks, as possibilities for action that the environment provides to the animal. In cognitive science *affordance* refers to an object's ability to provide clues of its operation (Norman 1988 in Vardouli 2015) or a scenario of use encoded in an artefact to be decoded by the users (Vardouli 2015). Designing for performative human-artefact engagements entails a consideration of the artefact as interlocutor (Ackerman 2006). The artefacts' evocative or holding power depends on the right balance of freedom and structure. Its design ought to allow for personal reconstruction.

Behavioral models of emergent spatial practices that are constructed on the basis of empirical observation of insurgent urban groups that make use of available urban resources (Vyzoviti 2006) make explicit a probabilistic interrelation between the morphology of an appropriated location and the activity it accommodates. Human activity is constrained by the spatial envelope, though this should be considered as a necessary but not sufficient condition. This non deterministic stance to physical environmental constraints could be best described through Walter Benjamin's words as *indefinite and improvisational interpenetration of building and action* (Benjamin & Lacis 1925). In *Naples,* urban space is envisioned as a porous stone, the liveliness of its courtyards, arcades and stairways provide a condition of *porosity* that avoids the assertion of the definitive and preserves the scope to become a theater of new unforeseen constellations (Benjamin & Lacis 1925).

A performative stance to designing within available building resources ought to pursue reconfigurations of the existing that open up a field of opportunities for multiple potential appropriations. The orchestration of multiple artefact affordances may require design tools that intersect the computational and the human centric approaches. To this end a competent research agenda ought to combine the technological agility of digital design techniques with recent theories of use as a form of making. Intentionally avoiding a deterministic stance to the design of urban spaces and objects my investigation pursues the orchestration of physical environmental conditions as affordances that may support (or inhibit) emergent urban phenomena.

2.2 *A new signification of the building shell*

Emptied out of activity the building stock-redundant or deserted- becomes a contemporary ruin. The primary function of the building shell is reversed. Rather than an envelope that encloses a private interior it becomes the tectonic layer that surrounds public life. Such a conceptualization does not necessarily conflict the current intensity in the design of innovative new building shells; screens, smart, environmentally sensitive envelopes, dynamic facades, shafts, and inclined transitions. The focus on the shell empowers the redefinition of the architect's professional expertise towards an architecture of the surface, consisting on lightweight materiality that combines environmental sensitivity with digital craftsmanship.

I am particularly interested in the notion of surface as a minimum act of architecture. Departing from Semper's argument that the full force of architecture is to be found in the outer surface, the decorative layer through which the atmosphere seemingly percolates, Mark Wigley suggests that this may be just enough to construct architecture: *simply to pop up a surface that produces an atmosphere* (Wigley 1998). In this respect, superficial modifications of the existing building shell that are small-scale, lightweight and temporary bare the potential to acquire high architectural impact.

In the theoretical origins of digital architecture *surface* is conceptualized as a topological and pliable entity which provides a strategy *for the intensive integration of difference within a heterogeneous yet continuous system* (Lynn 1993). Working within the contradictory and sometimes incongruously diverse morphology of Greek city centers manipulations of the surface can accentuate the establishment of continuity between fragmented and residual spaces towards a perceptual and eventually inhabitable new whole.

2.2.1 *Learning from traceurs and skateboarders*

Conceptualized as an urban artefact, the building shell becomes embedded in narratives of multiple possible appropriations; its affordances are augmented by non-standard or improper usage. Observations of groups of *traceurs* (free runners) and free-style skateboarders in action provide empirical evidence that supports this argument.

The trajectory of a free runner in a session of parkour takes place on the roofs and terraces of two adjoining buildings. The path indicates-articulated in sequence-the locations where the constituent acts the activity system of when parkour take place (Fig. 1). In this case: crawling through the window onto the terrace, accelerating, jumping up, balancing on the pitch roof, climbing up the wall and the stairs, vaulting over the ledge, dropping from terrace to terrace, and repeating the last sequence in loops before accessing a stairwell to descend with a new combination of tricks. The free runner's trajectory connects areas of different altitudes between which transitions may seem impossible, absurd, or reckless considering their standard use. A virtual continuum –out of which a single surface model could be derived- is established by the runner's body that invents paradoxical continuities between dispersed building fragments (Vyzoviti 2013).

The documentation of free-style skate sessions at a generously designed public entrance of a culture

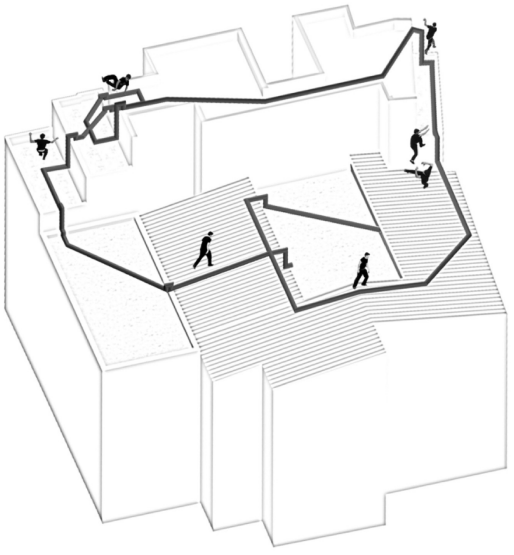


Figure 1. Documentation a free runner's trajectory of on the basis of participant observation (Vyzoviti 2013).

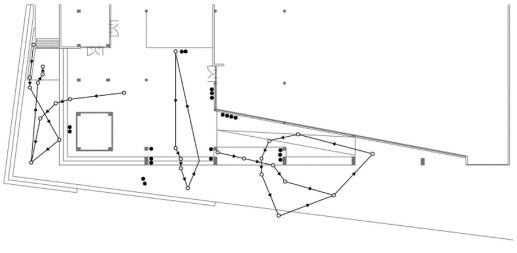


Figure 2. Digraphs of concurrent freestyle skate sessions on the basis of participant observation (Vyzoviti 2005).

complex (Fig. 2) includes digraphs of skate trick trajectories – grinds, ollies, and flips – deduced from observations. (Vyzoviti 2005) Architectural elements such as steps, ledges, ramps and columns facilitate distinct activities within the sequences of actions composing each trick. Skaters 'grind' the steps and the handrail, 'ollie up' the ledge and 'ollie down' the steps, 'flip' on the ramp and so on. The improper use of dispersed architectural elements through their articulation within skate tricks augments their affordance as urban artefacts. In addition a distributed, highly interconnected micro-location network is created in the establishment of continuity between distinct and dispersed architectural elements through their seamless incorporation within continuous skate tricks.

2.2.2 *From building shell to urban poché*

The practices of free runners and skateboarders make evident a reconfiguration of the available urban resources by making use. As diverse architectural elements are edited into coherent sequences within performative acts, the establishment of an operational continuity between them occurs. Consequently a new signification of the building shell arises: from distinct architectural elements to an operational field of solids.

Yet, the conception that urban space is configured through a spatial field of solids constituted by architectural elements is not novel. In the figure-ground theory of urban design the term *urban poché* connotes the configuration of urban voids through the walls, columns and other solids of buildings. This configuration of the public realm as a *poché* space outlined and delimited by the private building mass is habitually exemplified in the Giambatista Nolli's Map of Rome (1748). According to Roger Trancik the *urban poché* engages the buildings to their adjacent voids. Pursuing its continuous imprint on the plan can integrate the design of the public realm with the design of the private object (Trancik 1986). Taking advantage of the current digital design tools I propose an augmented understanding of the *urban poché* as a three-dimensional continuous surface enclosing the public domain.

3 CASES OF DE-INDUSTRIALIZED, CRISIS STRICKEN HISTORIC URBAN CENTERS

The investigation adopts the methodology of research by design. In accordance to the theoretical framework speculative projects for de-industrialized and crisis stricken historic urban centers are developed. Conducted within intensive design studios at the advanced architectural design post graduate program *INSTEAD_parapoesis* of the Department of Architecture, University of Thessaly in the academic years 2013–14 and 2014–15 two situated case studies in the country's major urban centers are discussed.

The first case focuses on the Quarter of the Francs (Frangomachalas) located in the western part of Thessaloniki's downtown. A thriving, cosmopolitan bankers' and goldsmiths' quarter in the first part of the 20th century, the area has transformed since the annihilation of the city's Jewish community -which constituted its major population group- during the WWII, into a high density, mixed use quarter of layers' and notaries' offices, textile industries, small scale manufacturing, warehouses, and gross handling and retail stores. During the past two decades it has gradually emptied out of manufacturing uses, and acquired the character of an urban zone in transition whose latent possibilities are revealed in the recent, fragile establishment of city's creative industries (Tarani 2011) nightlife and urban bohemia within its extents.

The second case focuses on Euripides Street located in the historic commercial center of Athens. The street manifests the transition from the neoclassical city – best exemplified by the Neoclassical Trilogy Complex at Panepistimiou Street that houses the Academy, the Library and the University of Athens, to the vibrant and problematic area of Koumoundourou Square that now hosts the Chinatown and the immigrants' enterprises and gathering places. Lying within the food market sector of the downtown the street is a characteristic sample of the urban fabric displaying high density

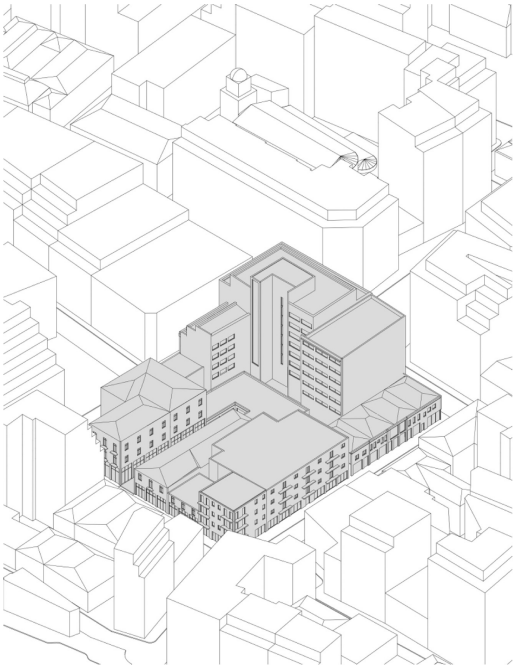


Figure 3. The mix of typologies and architectural styles in an urban building block at the Quarter of the Francs.

and mixed use in a typically Greek cross section: gross handling and retail stores on the ground floor, offices, small scale manufacturing and warehouses on the upper levels.

Having gradually emptied out of manufacturing uses during the past decades both areas of study demonstrate the character of a semi-abandoned urban zone in transition. Both possess a distinct ambiance, manifesting deterioration while at the same time making evident the traces of a thriving commercial past. Both present a mix of various building typologies and architectural styles within urban blocks. In this high density urban fabric, the generic high rise office and manufacturing buildings coexist with once glorious samples of early 20th century Eclecticism -in the Quarter of the Francs (Fig. 3), and Neoclassicism, in Evripides street. The redundant building stock, entrapped within the financial glacier of the recent Greek crisis withstands renewal allowing for bottom up incremental developments and provides certain affordances for experimental urban actions.

In this urban context the design agenda pursues the articulation of the theoretical framework into generative concepts and tools. The new signification of the building shell as a receptor of urban actions is considered as an architectural lever for the activation of the redundant building stock.

3.1 *Quarter of the Francs – Thessaloniki*

A typical cross section through the Quarter of the Francs reveals a high contrast in occupancy. The urban ground floor is porous, abundant in activity within arcades, narrow streets and secret courtyards. The high rise lays mostly unoccupied, still: a post-industrial ruin. As such the abandoned upper levels possess the nostalgic sensuality of decay, withholding opportunities for multiple temporary appropriations. The intention of the design agenda for interventions within the area was to unveil the potentiality of a porous condition above the ground floor through the discovery of available spaces in the upper building levels. Drawing from insurgent urban practices such as parkour, UrbEx, and graffiti, as well as the situationist practice of the *dérive* an urban walk was outlined. Three-dimensional trajectories were articulated within the existing networks of paths. These sequences of micro-locations were composed providing public access to discovered or invented or new common grounds to become available for a variety of urban groups.

The existing vertical circulation systems constrain the potentiality of the porous condition in the apparently impermeable upper levels. The definition of a three dimensional urban trajectory was employed as a design tool that enables the selective editing of fragments within a continuous path. Modifications of the building shell would accentuate the establishment of continuity by providing access. To this end, alterations in the vertical relief of existing building envelopes were combined and integrated with paving. The introduction of new circuits, entry points and destinations within existing urban blocks would promote an exploration of locality and a keen awareness of the ambience in the area. The attribution of public content to the abandoned facades, roof tops and shafts was expected to correspond to a material treatment of the building shell that could render its affordances perceivable.

In the '*Scaffolding*' project (Fig. 4) the incongruous but historically defined adjacency of generic high rise office and manufacturing buildings with the remains of the freemasons club *'losis veritas'* build in the late 1920's is considered as an opportunity to create a new public ground. A publicly accessible open air *piano nobile* is created on the roof of this contemporary ruin. The design proposal confronts the scarcity of urban open spaces in the quarter providing for urban action groups and local associations currently in need of gathering spaces. Employing a perceptually unifying grid the blind party walls of the two high-rise buildings are treated in a continuum with the roof of the ruin. The lightweight net structure can articulate and receive elements of urban furniture, projection screens, vegetation, steps and movable platforms. Access to the rooftop of the former *'losis veritas'* is orchestrated as a complicit use of the abandoned ground floor.

3.2 *Euripides street – Athens*

In the series of projects developed for Euripides street the notion of surface enables the departure from the two dimensional representation of the figure-ground plan to a three dimensional calibration of the street profile. The manipulation of the *urban poché* by section

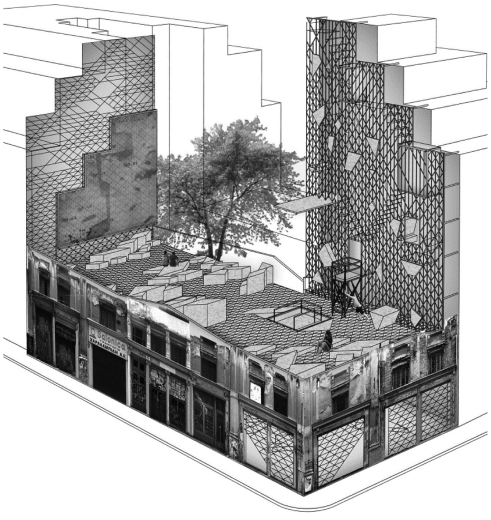


Figure 4. The '*Scaffolding*' project at the remains of the freemason's club '*losis veritas*' in the Quarter of the Francs.

was employed as design tool in order to document the complexities and reveal the potentialities inherent in the street profile.

Instead of an exterior boundary to a private interior, the building shell is considered as a porous tectonic skin integrated within a three dimensional surface that contains the street life. The current appropriation of the streetscape by groups of ethnic immigrants in the South end of Euripides Street is an extreme paradigm of an augmented condition of the urban poché. Architectural elements and urban objects– columns, doorsteps, ledges, lampposts, cars, bollards, carts and boxes – acquire a second life as an open air urban living room (Vyzoviti 2005). The integrative function of the concept of surface enables the inclusion – in addition to the building shell – of objects that may refurbish the street as they become inscribed in the practices of its inhabitants.

The '*Gardens of Evripides*' project (Fig. 5) pursues a systematic integration of vegetal elements into building shells along the street. Instigated by the discovery of a local delicacies shop green façade, it investigates processes of naturalization of the vertical relief that recall the currently lost manufacturing character of the area. Consecutive sections through the urban poché identified a number of south-facing high rise facades located opposite to low rise ones, which become the sites of implementation. The scenario for reconstructing local manufacturing businesses entails the installation of a digital fabrication laboratory (*FabLab)* in the premises of the abandoned warehouses.

The attribution of novel functions into a publicly accessible interior physically enlarges the street profile. It can also affect the processes of its transformation. In this case a robotic arm partakes in a number of tectonic transformations (drilling – printing – depositing seeds) altering the eligible for re-naturalization building shells along the street.

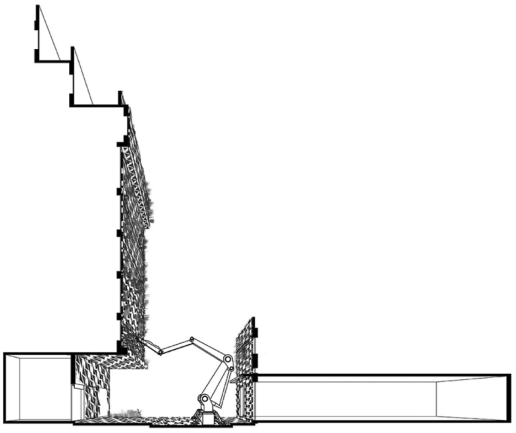


Figure 5. The '*Gardens of Evripides*' project.

In this project the orchestration of an incremental and hi-tech shell renovation process embodies a physical manifestation of performance.

In the *'Urban Canyon'* project (Fig. 6) the Evripides street profile is considered as a vertical terrain of activity. The redundant building shells are treated as a craggy and steep urban topography upon which a probabilistically augmented urbanity may be evoked. Standard rock climbing accessories such as steel hooks and rings are meticulously installed on selected facades inviting urban climbers and base jumpers to appropriate the abandoned buildings. Deployable hanging tent systems -known as *portaledges*- can be attached on the building shell. These temporary adobes hovering over the street may reveal some romantic framed views of the Acropolis. At the same time they contradict the spectacular subtly addressing the necessities of the new Athenian crisis enforced homeless.

4 CONCLUSIONS

In this paper I examined a new signification of the building shell as a receptor of urban actions. I analyzed the conceptual dimensions of performativity in architecture focusing on use-centric design discourses and particularly on the spatial practices of emergent urban groups.

I investigated small-scale and short-term architectural interventions that may activate the redundant building stock of de-industrialized and crisis stricken areas of historic urban centers in Greece. To this end I discussed a series of speculative projects situated in Thessaloniki and Athens which have been developed under my supervision in the academic studio. The urban poché and the urban trajectory have been employed as design tools. Their cross fertilization with narratives of performative acts and computational methods produced some counter intuitive and innovative proposals.

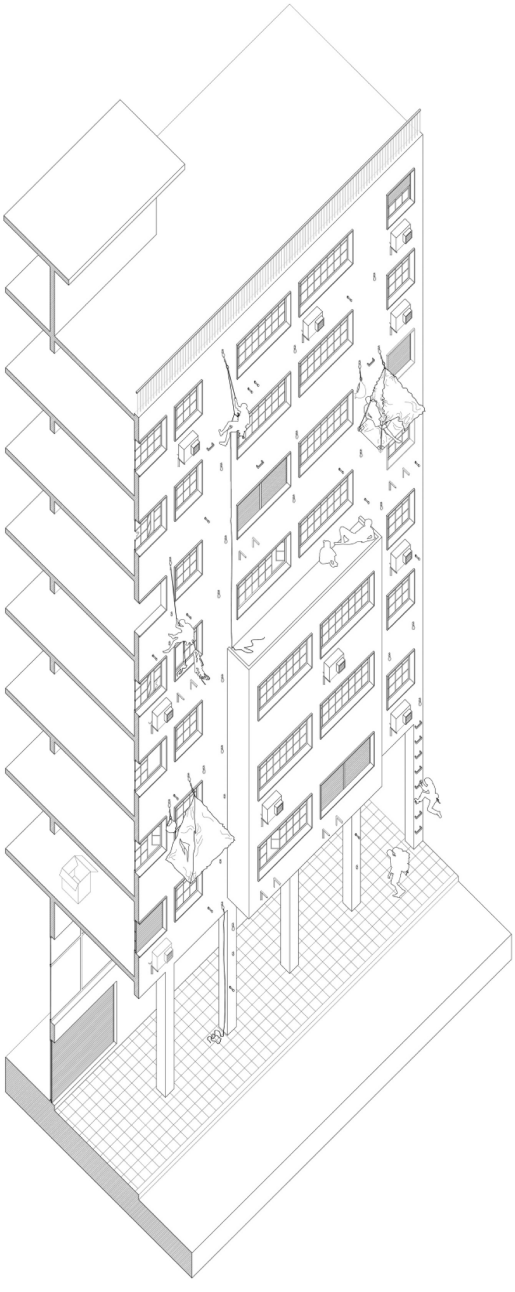


Figure 6. The '*Urban Canyon*' project.

Architecture traditionally displays elongated response time to cultural change. Socially urgent spatial necessities are often satisfied through reconfigurations of the existing available resources. In this respect the paper proposed a research agenda for the design of urban artefacts that are open to appropriation by providing conditions for usage that has not yet been acknowledged.

ACKNOWLEDGEMENT

Figures 3–6 comprise visual material from the projects developed under the supervision of Sophia Vyzoviti during the intensive design studios *Shell* and *Urban Poché Reloaded* at the advanced architectural design post graduate program *INSTEAD_parapoesis* of the Department of Architecture, University of Thessaly in the academic years 2013–14 and 2014–15. Figure 3 was produced by A. Ioannou and D. Dimitrakopoulou. The '*Scaffolding*' project presented in Figure 4 was developed by T. Papanikolaou and S. Psomiadi. The '*Gardens of Evripides*' project presented in Figure 5 was developed by E. Kalargali, K. Kallou and A. Kyroudi. *The 'Urban Canyon'* project was developed by I. Karras.

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Machinic approaches_new methodologies for responsive environments

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ABSTRACT: Recent examples of responsive environments denote a reciprocal relationship between the human and the machine, where the environment and the participant are considered as responding to each other and to the relations defined between them. This reciprocal condition is attained through machinic approaches, which alter the definition of the machine as mechanism, and consider the human and the machine as actively participating in the interaction process. In order to take full potential of this approach, and continue this reciprocal relationship, the designer of the process weakens the control over the process and embrace unpredictability. The paper considers the potentials of this approach, which offer the production of new conditions and relations while initiating significant methodological transformations in architectural design practice.

1 INTRODUCTION

Developments in sensing technologies, material science, engineering and information technologies enable the definition of flexible, sensuous, and responsive spaces that respond to the changing conditions, relations and behaviors of spaces and participants. Introduction of the concept of responsiveness to architecture alters the definition and experience of space in a radical way and questions the relations between environment, participant, architect and machine. These relations are triggered to become reciprocal and respond to the inputs provided by each other, which engenders new spatial experiences.

Shared by many parties (human, non-human), the responsive environment is defined in relation to the interactions between the participants and the environment. The information produced through their interaction enables the communication between them, hence defines the responsive qualities of the environment. In this advanced communication, both the environment and the participants affect and redefine each other. Through sharing and exchanging the information gathered and produced, the reciprocal relationship is attained, which can be considered as the significant feature of responsive environments. Ability to affect and be affected from the interaction process enables to sustain the productivity (not in terms of physical efficiency or operational accuracy, but rather as the continuity of the interaction) of the environment, since the participant and the environment constantly adapt and redefine the relations. In this constant redefinition, the responsive agent is not only the environment but also the participants, who actively take part in the interaction process rather than passively experiencing it.

2 DEFINITION OF RESPONSIVENESS THROUGH MACHINES

The concept of responsiveness and the definition of the responsive environments have undergone significant changes in the last two decades, where the environment is defined not only as being affected by the participants but also as an active agent that affects them. The reciprocal condition of the interaction process is defined and produced through machines, where the responsive environment holds the responses and experiences of the participants. In responsive environments, machines provide the engagement of participants and environment and enable their interaction with the information to define a continuous and simultaneous interaction. They do not only transfer and translate the responses of the participants, but also stimulates and provokes their behaviors, experiences and reactions. Therefore, the machines are also considered as participants of this interaction process that demand the contribution of all human and non-human parties. This shift in the conception of responsive environments alters the definition of the environment and enables new readings of the relations between the environment, human and the machine. This intricate relationship, defined through different parties, necessitates the reconsideration of the concept of machine in the definition of responsiveness. The active participation of the human and the machine in the interaction process alters the consideration of the machine as a passive computer mechanism responding to the inputs form the participants and the environment according to the already defined set of decisions, and introduces its active participation in the interaction process, which revises its focus on performance.

Although the machine concept is associated mainly with production and efficiency that relates it with mechanisms, it is also possible to reconsider this concept in reference to Deleuze and Guattari's definition of the machine. They suggest the consideration of the machine as being in continuous transformation that make new connections in order to transform and maximize themselves, while connecting and reconnecting to different machine(s), which are also in evolution and mutation processes (Colebrook 2002). They define mechanism as a closed machine that has a specific function and never transforms itself or produces new connections, where the machine does not have a closed identity like a mechanism. (Deleuze & Guattari 1983). It does not produce something determined by someone, but rather produces for the sake of production itself. (Colebrook 2002). This concept of the Deleuzian machine is related it with heterogeneity and dynamism and opposes the static conception of the machine as a mechanism. Therefore, consideration of the machine as a Deluzian machine, rather than a mechanism, re-problematizes the definition and design of interaction processes in the responsive environments.

In this sense, the paper considers three examples from different periods, which offer different approaches for the definition of responsiveness and the conception of the machine. They all have different approaches for defining the responsive experience, where the machine is conceptualized as being more than an agent of production and efficiency. Related with this discussion of machinic approach, the paper questions the methodological shifts defined in the architectural design practice. Along with that, the altered the position of the architect will be discussed in reference to the definition of the responsiveness through machines in these three examples.

2.1 *Unpredictability as a generative impulse*

The altered condition of the architect is also related with the definition of the interaction process, which enables continuous data exchange between the participants and the environment. When the responsive environment defined through machines is constantly transformed to provide new experiences and conditions, it continues to define new relations and inputs to the system. However, when the responsive environment responds to the similar inputs from the participants with similar outputs during the interaction process, it acts as a passive element instead of a provoking one. In such a case, the continuous interaction between the environment and the participants may blur and lead to predictable and similar experiences, which do not inherit variation of experience and relations. Therefore, it is possible to claim that predictability and similarity of the interaction between the environment and the participants may disrupt the continuity of the interaction process.

The concept of unpredictability can be conceived as a motivating aspect and a generative impulse for the variability of experiences defined by the responsive environment. Embracing unpredictability as a design strategy necessitates the reconsideration of position of the architect in the definition of the responsive environment and the interaction process. In order to take the advantage of this concept, the architect needs to weaken his/her control over the process and welcome inputs from the participants (human, non-human) even if they are not included in the pre-defined set of relations. This approach decentralizes the position of the architect in the design process and also enables to go beyond the conception of machines as mechanisms. It rather considers them as being in continuous transformation together with the other participants, which are also in transformation.

2.2 *Recasting the interaction process*

The paper considers three experimental projects, in which the machine concept is triggered to go beyond its mere definition as a mechanism; Yona Friedman's *Flatwriter* (1967); Cedric Price's *Generator* (1976–79); and R&Sie(n)'s *An architecture 'des humeurs'* (2010) projects. These projects introduce an interactive relationship between the machine and the participant through a responsive environment, where the space is defined through the inputs provided by the participants. The discussion on these projects is based on the architect's control on the interaction process and the productivity of the process, where provocative, unpredictable and indeterminate condition of human-machine relationship is compared with determinism of human-mechanism relationship.

Being influential in 60's with his flexible city concept, Yona Friedman proposed a system in *Flatwriter*, where the future inhabitants plan their apartments through an interface that responds to the decisions of the inhabitants (Lebesque & Vilissingen 1999). Although the project that was conceived for the World Fair at Osaka was not built, it was an influential project for the concept of responsiveness and the initial definitions of responsive systems. It allows the inhabitant to locate the future dwelling defined according to his/her preferences and decisions in a predefined infrastructure (Friedman 1971). In the proposed system, the user interacts with a keyboard of 53 keys having figures upon, through which the user implements his/her choice by inserting solid blocks within the infrastructure (Friedman 1971). The user is guided by the mechanism during the interaction process about his/her decisions about the possible consequences of his/her decisions. It provides warnings concerning the previously defined configurations and locations of the apartments introduced by other users (Friedman 1975).

The warnings provided by the responsive system can be considered as an intention to ensure maximum efficiency from the process and achieve the right combinations for the definition of the apartment. Although the project aims to define an active user that defines the output through the interaction process, the responses of the system are still limited with the design decisions of the architect. The user is not free in his/her

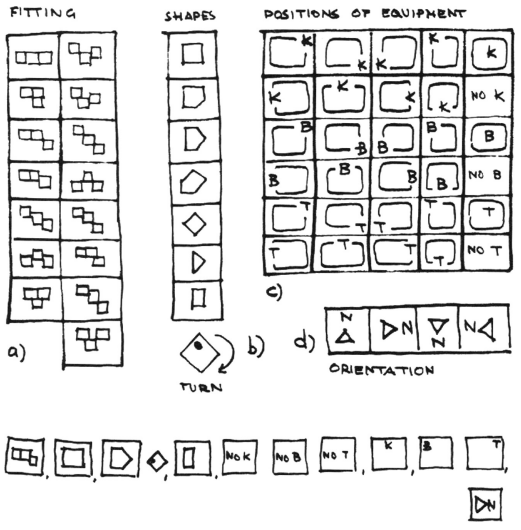


Figure 1. The repertoire of choices in flatwriter.



Figure 2. Electronic model and sketch of generator project.

decisions entirely and can fill the voids of the predefined infrastructure, without conflicting with the decisions of other users and the architect. In this process, the responsive system acts like a mechanism rather than a machine, since it only executes the commands of the architect according to the predefined repertoire and is passively involved in the process. Therefore, the architect is still the dominating figure in the definition of the built environment, interaction process and responses of the system. This is a common point in numerous recent projects of responsive environments, where the responsiveness of the system and the environment are controlled for the efficiency and performance of the system.

Another unbuilt example that holds the discussion of the altered position of the architect in the definition of a responsive environment through machines is the *Generator* project designed by Cedric Price in collaboration with John and Julia Frazer between 1976 and 1979. Designed as a visitor center, the project accommodates facilities like dance, theater, and exhibition, where the visitors actively participate in the definition of the event and the form of the building through interacting with the system. It consists of modules that enable the reconfiguration of the environment to respond to the visitors' experiences, choices and co-operations with he environment (Frazer 1998).

Price's definition of the responsive environment offers a reciprocal relationship between the machine and the participant, where they interact with and affect each other continuously. This relationship suggests the use of machines as participants of the system that creates new interactions and relations, rather than being simple mechanisms that technically enable the continuous transformation. The interaction between the machine and the visitor starts where the visitors are set in dialogue with a computer interface at the entrance of the center to state their preferences (Mathews 2007). The modules are adjusted according to the preferences of the visitor and different scenarios will be scripted to transform the environment (Furtado 2008). Endless variations will be attained according to the inputs provided by successive visitors and the environment will evolve into a collaborative one that is defined according to the interaction scenarios. One significant aspect about the project was related with the boredom condition, which suggests that the system will introduce random inputs to the environment to trigger the monotonous interaction conditions and to facilitate diverse spatial experiences (Price 2003). The system is designed to improve its own strategies for organization and make proposals about rearrangements of itself, which are unpredictable for the visitor and also for the architect (Furtado 2008). Therefore, in *Generator*, the proposed system not only responds and adapts to the preferences of the visitors, but also actively participates in the interaction process and introduces inputs to the environment and visitor.

Embracing unpredictable conditions and leaving the control to the participants (human, non-human) enables to assimilate the responses and preferences of the user in the definition of the environment, despite conflicting situations between different users. However, the conception of unpredictability in *Generator* is not associated with ultimate unpredictability of all process, but else with unpredictability of variation in form. In *Generator*, as compared to *Flatwriter*, the designer intends to attain the variability of conditions and productivity of the interaction process rather than controlling the form and output of the interaction, and hence allows certain conflicts and unpredictable conditions. However, it is still possible to trace a desire to control the process for sustaining the continuity of transformation through the unpredicted input of the system to the environment and the visitor. When the variation in form is not at the desired level, the architect is indirectly involved in the interaction process and interferes the responses of the machine. However, the centralized position of the architect as directing all the design and interaction process is getting blurred in this example to define a responsive environment through a participatory and reciprocal interaction process.

A recent example of responsive environment is proposed by R&Sie(n) titled as *An architecture 'des humeurs'* that alters the position of the architect through machinic approaches and introduction of unpredictability to the interaction process. It is a research project exhibited at Le Laboratoire (Paris,

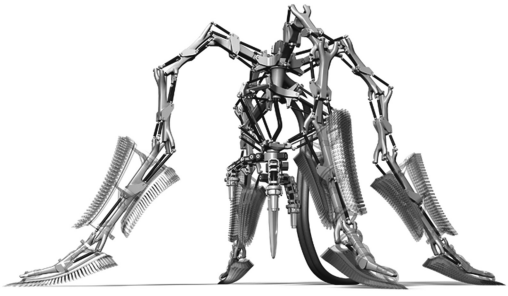


Figure 3. The machine used in the robotic process.

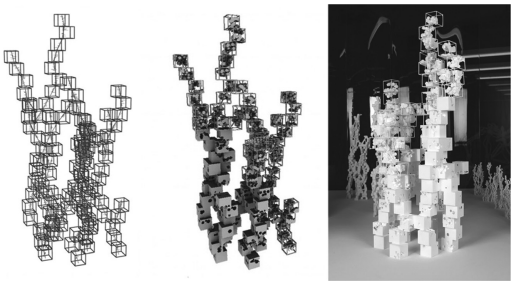


Figure 4. *An architecture 'des* humeurs' by R&Sie(n).

2010) that questions the relationship between the body, machine and environment. It offers a habitat according to the data obtained from the visitor and provides the spatial correspondence of his/her contingencies, conflicts, and desires. The visitor is confronted with a machine upon entering the exhibition area, which traces biological and physiological data for the production process ongoing simultaneously at another room (Zwingenberger 2010). During this interaction, a vapor is released that the visitor breathes in, through which the emotions of the visitor are detected. Through the vapor, four different moods are traced at molecular level, which directly affect the morphology of the future dwelling: Dopamine (the pleasure molecule), Adrenalin (the molecule of the ability to react to a need for energy), Serotonin (the molecule of melancholy or —depression‖), Cortisol (the molecule of anxiety or stress) (Zwingenberger 2010). Therefore, emotions, desires and needs of the visitor are traced through chemical secretions and also his/her responses to the questionnaire (neurobiological response). The conflicting situations -defined as misunderstandings- between the responses expressed verbally and traced chemically are intentionally constructed in the project to bring out a tension and an area of contradiction. The contradictions are processed through a script that is designed to acknowledge the definition of habitable morphologies according to the contradictions and contingencies of the visitor scanned through the interaction process (Roche 2011). Through this script, possible habitable morphologies of the future dwelling are prototyped by a robotic machine in parallel with the interaction process, which the visitor confronts after crossing to another room (Roche 2011).

The morphology is an end result of unpredictable expressions of the relations between the environment and the participant, where the machine is defined as producing new relations and embracing conflicts. R&Sie(n) explains their intentions about the proposed morphology and states that: '*The purpose is to emancipate ourselves from a conceptual logic that starts from a preconceived structure, and instead give rise to a physical matrix that reacts to the heterogeneities of human organization and adapts to the multiplicity of morphologies and the ambiguous desires of 'future purchasers'. This open source approach can replace the determinist and predictable typology usually employed for collective residences* (Roche & Naphegyi 2010). In *An architecture 'des humeurs'*, the unpredictability of the output and the deterministic conditions of the interaction process are triggered with a machinic approach, where the machine initiates blurriness and unpredictability for the visitor. François Roche defines these machines as schizoid machines, where they produce flows of information and pretend to the something while doing something else; they do not only act as a receptor that the visitor interacts with, but also maps the emotional states to be processes through the script in order to create the habitat for his/her desires, emotions and conflicts (Roche 2010). Since the principles of these decoding and recoding processes are not visible to the visitor, the process introduces unpredictability for her/him. The situation also creates unpredictability for the architect, since the inputs, conflicts and contingencies provided by the visitors and the outputs produced through the script are unknown for him. In this approach, the architect lessens his control over the process and form intentionally and leaves the control of the output to the participants: both human and non-human (machine). Therefore, it is possible to claim that the position of the architect as controlling the interaction process in the definition of responsiveness and responsive environments is altered in this example.

The considered projects are experimental projects that make use of computational design tools and strategies and alter the relationship between the architect, machine and the human participant to introduce responsive environments. Responding to various inputs provided by the participants and adapting to different conditions defined through the interaction process, they alter the definition of the machine, the relationship between the machine and the participant and also the authority of the architect. Common in all three examples is the concern for mapping the desires of the inhabitants and to respond to his/her desires, needs and emotions as much as possible through responsive environments. In each of these architectural projects, the relationship between the machine/mechanism, participant and the environment is defined through different interactions, where the position of the architect is also challenged. Not only each project offers a different technical operation, but

also conceptually offer different stands for the definition of the responsiveness, acknowledgement of conflicts and unpredictability.

In order to attain the desired level of responsiveness, they re-conceptualize the machine concept and alter their definition as mechanisms to participate in the interaction process and to attain a reciprocal relationship. These aspects are challenged more on Generator and *An architecture 'des humeurs'* projects as compared to *Flatwriter*. However, despite the deterministic approach and the strict control of the interaction process, *Flatwriter*, which is an initial example of responsive environments, can still be considered as an avant-garde project that questions the relationship between machine and participant and intends to alter the built environment. They all define the participant as the major party in the decision-making process and define the output according to the inputs provided by the participant. However, in *Flatwriter*, the participant's inputs are recognized within the limits defined by the designer, where the designer keeps the control of the process and the output. The interaction process in *Flatwriter* is more deterministic as compared to the other two projects, which leads to a repetitive interaction process of which outputs are predictable and controllable. Considering the proposed interaction scenario, it can be claimed that, the responsiveness of the process is limited intentionally by the designer to control the output.

On the contrary, in Generator and *An architecture 'des humeurs',* the participant is stimulated deliberately to go beyond the predefined inputs to emancipate the controlled outputs of the interaction process. Yet, in *Generator,* the architect interferes the process to ensure the continuity of interaction and the variation in the outputs. Despite the clear intention to leave the control of the process to the participants (human, non-human), which shifts the centralized position of the architect, it is still possible to trace the suppressed intention to control the process and the output. Through this approach, the designer welcomes the unpredictability of the outputs for him, and also the unpredictability of the interaction process for the participant. It is used as a strategy to increase the interaction between the machine and the participant and maintain the variation of the outputs. It is possible to trace a similar approach in *An architecture 'des humeurs'* about the consideration of unpredictability as a strategy to stimulate new relations and experiences. Compared to *Flatwriter*, in R&Sie(n)'s approach, the architect's existence in the process and the output is blurred, which even leads to his/her non-existence. Although the process and the interaction scenarios are still defined by the designer, his/her absence is intentionally sought to be able to define and experience the full potential of interactive processes.

Within this altered design process, in *An architecture 'des humeurs',* conflicting situations are embraced and even desired that introduces unpredictable outputs. The process is designed in order to hold and initiate these conflicting situations, of which outputs cannot be foreseen by the architect and the participant and hence cannot be manipulated. This allows substituting the predetermined typologies of conventional approaches, where the formal repertoire is limited, and introduces new relations, interaction patterns and morphologies to be discovered. Through this way, the spatial dialogues and their formal reflections are defined as a consequence of the ever-changing relationships between the machine and the participant. The structure that holds the habitat for the future residence is also designed to respond to the spatial conditions defined according to the desires, emotions and contingencies of the user. Opposing with the structure that is predefined as a grid in *Flatwriter*, in *An architecture 'des humeurs'*, it is conceived as a postproduction element, that is produced after the morphology of the habitat is defined (Roche & Naphegyi 2010). This emancipates the design ideas from the predefined rules and forms and introduces the simultaneous definition of the output according to the provided inputs, rather than selecting them from a large repertoire of possible outputs. In *Flatwriter*, despite the repertoire of various plans for possible apartments, the designer and the user are limited with this repertoire. Since the designer limits the outputs of the process before the participant interacts with the machine, the potentials of the interaction process are restricted with predetermined typologies and spatial negotiations.

3 CONCLUSION

Analyzing and comparing three examples from different periods, it can be claimed that through different approaches for the definition of responsive environment, the position of the architect and the already established relations between the architect, machine and the human participant are altered radically. Despite some discrepancies between these three approaches, it is apparent that there is an attempt to alter these relations in order to define spatial conditions responding to the inputs from the participant. Although not directly associated with, advances in technology, developments in computational strategies and increased computational capacities of the mechanisms also enable to embrace new strategies that reconsider and alter the already established relations between different parties of interaction. These advances stimulate the search for new experiences both for the architect and the participant, which also challenges the already attributed roles and positions.

In reference to these three examples, it is discussed that the position of the architect is altered in responsive environments, which are defined through machinic approaches. Since machines are considered as participants that produce new relations and connections during interaction processes defined through machinic approaches, they propose a direct relation between the machine and the participant. This direct relation excludes the architect and enables the definition of the

environment according to the inputs provided from the participants. Through this approach, it is intended to release the interaction process from the predetermined decisions of the architect and initiate new relations to be discovered. This intentional search to redefine the interaction process questions the presence of the architect and also alters his/her position. This can be considered as a significant shift introduced with the advances in technology and design.

Analyzed projects in the paper can be considered as distinctive examples, where the presence of the architect is questioned and redefined through different methods. Defining machines as participants of the process, where there exists a reciprocal relationship between the participant and the machine alters the definition of interaction and hence opens up new possibilities. Considering different approaches for the definition of the position and the presence of the architect, it can be argued that, the control of the process and the definition of the output is assigned more to the participants (human, non-human) in order to take full potential of the interaction process. As a consequence, the position of the architect is decentralized and the relationship between the machine, architect and the participant is re-conceptualized to produce new environmental conditions and new experiences. Considering the analyzed projects that decentralize the position of the architect, it can be argued that in order to take full potential of the responsive environments and the available technological advances, the architect weakens the control over the process and embraces unpredictability. This can be considered as a significant methodological shift, which initiates a change in the design and experience of built environments.

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T.E.S.S. – An interactive sustainability lab

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ABSTRACT: Given the opportunity to express and symbolize "sustainability" through the transformation of a recreational vehicle into mobile sustainability lab, a design team of nine architecture students from Philadelphia University and the SAVE Alliance/Green Allies Foundation struggled to find a core design approach and inspirations for form. The term "sustainability" has been assigned so many meanings it is difficult for designers to find its formal "image." Originating from an "environmental" foundation, innumerous aspects of our society are now considered through lenses of "sustainability." It is common to speak of financial, cultural, and political health relative to their ability to "endure." The "triple bottom line," "quadruple bottom line," or the recent rise of the term "resiliency" all become means to categorize and organize sustainable action strategies with the goal of steering toward a better future. For the uninitiated, it is easy to become overwhelmed by the ever expanding layers of the sustainability dialog. This paper expands on the team's search for a design form definition of sustainability which could inspire, the nature of interactive exhibits, and the RV design currently in fabrication.

1 SUSTAINABILITY

1.1 *The "sustainable" foundation*

We are such spendthrifts with our lives, the trick of living is to slip on and off the planet with the least fuss you can muster. Paul Newman

The SAVE Alliance/Green Allies Foundation is dedicated to the development of community environmental solutions through youth leadership. This development occurs through educational programs. Using the acronym for, "Students Against Violence to the Environment," the foundation advocates for sustainable action and environmental preservation with a mission of *"forging connections between students and communities that promote environmental sustainability both locally and globally."* (website). The foundation has delivered their message primarily through presentations to schools and on-going stewardship of the Althouse Arboretum – a living environmental classroom north west of Philadelphia. They are presently developing an active learning agenda where the presentations to schools shall incorporate interactive displays and demonstrations.

The foundation acquired a Dodge Sprinter recreational van with the goal of creating a mobile interactive sustainability lab later named T.E.S.S. It will be used to introduce, exhibit and educate students of various ages, backgrounds and economic status about the nature of sustainability. The educational programming is be interactive and include didactic dynamic digital displays, demonstrations, hands-on experiments and live/recorded presentations on the principals of sustainability. The goal for the foundation collaborating with Philadelphia University architecture students was to transform the RV into an "expressive" and "symbolic" "vehicle" to educate and communicate the value of sustainability.



Figure 1. Logo of The SAVE Alliance/Green Allies Foundation.

During the initial collaborative workshop, the project team quickly uncovered the layered dilemma that would affect the project from programming to fabrication – what is "sustainability" and how will the foundation deliver, and express, its content and message? What does, and/or should, sustainability look like? Does it have a common, identifiable "image?"

1.2 *A definition of sustainability?*

Vision: A world where students lead the way to a sustainable future.

The Save Alliance/Green Allies Foundation.



Figure 2. Daytime rendering of T.E.S.S. exhibit structure.

The etymological root of the term sustainability per Webster's Dictionary is the Latin *sustinere* – literally *up-hold* and *hold-up* and generally means *maintain, support or endure.* The current version of sustainability grew from the statement in the 1987 Brundtland Report from the UN World Commission on Environment and Development where "sustainable development" is *"that (which) meets the needs of the present without compromising the ability of future generations to meet their own needs."* Live now not at the expense of our future generations. While this definition provides fertile proposition, it is more akin to an ethical and moral compass heading. A search for clarity uncovered many "frameworks" which provide goals and guidelines. The "triple bottom line" appropriated from the economic thinking of John Elkington (1994) threaded sustainability through three "P's" – "profit, people & planet" and are often referred to as the "three pillars" of sustainability. There is also an "E" version – "economy, equity & environment." The subsequent "quadruple bottom line" begins to include design opportunities with the adding of "place" to the P's and a corresponding "experience" to the E's. To add more complexity, the 2005 the Official Agenda for Sustainable Development for the UN General Assembly Summit proposed 17 "Sustainable Development Goals" and 169 progress targets including: poverty, food, health, education, women, water, energy, economy, infrastructure, inequality, habitation, consumption, climate, marine-ecosystems, ecosystems, institutions, and even "sustainability" itself. 304 proposed indicators were developed to show compliance. Holling (1973) introduced the term "resiliency" to the arena which is a metric measuring to the ability of a system to recover from a shock or disruption. A clear definition of sustainability is elusive is ever expanding.

From an architectural viewpoint, discussions of technology offer some links to sustainable design thinking. For Peter McCleary (1983), technology is *"the discourse between societies and their natural environments in the production of the built environment,"* and includes *"the framework of thinking generated by this dialectical relationship between man and nature."* If we layer this definition of technology over the P's and E's, sustainable action might be focused on creating a more respectful discourse, or better yet *relationship*, between our society and natural environment through *how* we build – a result of what, where, why, for whom and how often we build. With this lens, building a shelter to protect from the weather, or even raising an umbrella, could be considered a technological act. Offering a bridge to the design professions, William McDonough's Hanover Principles (1992) aimed *"to provide a platform upon which designers can consider how to adapt their work toward sustainable ends."* This line of thinking led to the LEED Green Building Rating Systems, Building Living Challenge, and the Well Building Standards – to name but only a few of the frameworks that are used verify, guide and assess sustainable building.

As inspiration for expressive and symbolic design, sustainability suffers understandably from a generalist dialog. The discussion focuses primarily on the general topics and tenets which are difficult to argue with. We *do* need to develop and support a more respective relationship with our natural environment. We *do* need to better address waste, energy, water, pollution and the rest of the UN Summit Sustainable Development Goals. The vagueness of the term unfortunately allows any person, entity or municipality to self-define sustainability to align with their own agenda and enter the game. With so many differing definitions, agendas and pronouncements with few actual means to accomplish large scale change, it is difficult not to become numb to the entire subject. What is evident is convincing an audience on the importance of sustainability is finally unnecessary – the general public has caught up with the need to be sustainable regardless of whether they know exactly what that may, or may not, mean. As an added twist, the SAVE Alliance/ Green Allies foundation was unable to clearly state their own definition of sustainability and the specific methodologies they would utilize in their educational sessions. While the guideline frameworks provide vital road maps for navigating under the umbrella of sustainability they offer little imaginative grounds for symbolic design and form. The question of whether sustainability has an "image" remains.

A central tenet within sustainable building design methodologies is the need for a consensus on "guiding principles" by all stakeholders which will facilitate the decision making process. Utilizing the integrative design process, workshops eventually revealed at midterm that for SAVE Alliance/Green Allies "energy" was the central guiding principal and the symbolic core. Energy generation and use underlies all conditions of sustainability and was to be the underlying construct for the lab, the interactive exhibits and the "image" for the project. A more respective relation with our environment, and future, hinges on our appropriate use and, and need, of energy.

2 THE INTERACTIVE EXHIBIT

2.1 *The nature of exhibition and the artifact*

Exhibitions range from being either object oriented at one extreme, to concept oriented at the other. That is, objects or messages predominate.
David Dernie, (2006) Exhibition Design

In exploration of exhibit prototypes, the project team initially began work developing interactive displays on the themes of the four elements – air, water, earth & fire/sun. Each element was presented and then somehow effected in keeping with systemic approaches to sustainability. An air chamber was solar heated and the air rose through an indicator demonstrating the stack ventilation effect. Muddy water was poured into a geological container of differing materials that cleansed it. A wind turbine spun in the wind and operated a grinding wheel and electrical generator. The RV was heated with a passive solar system. The subconscious drive amongst the design team seemed to be to create an array of demonstration experiments rather than interactive devices. The question became will the RV promote interactive learning or simply be a rolling collection of demonstrations? The collective realization was that the basis of any exhibit or demonstration is an "artifact" whether actual or implied, which can act as a basis for engaged learning. A wind machine might demonstrate some principle but it is still an artifact. At a basic level an object or system of some value is offered for viewing ("showing/demonstrating") whether it is a three-dimensional object, a two-dimensional image, a digital projection, virtual construction or an installation that can be experienced. Such artifacts embody meaning inherently through their "realness" and actuality. For David Dean (1996), museums are primarily *"places to encounter actual objects – the real things"* which by nature embody social and cultural values framed through the lens of history. These objects have the power to transport us to other times and activate our imaginations about alternative realities and events. The ability of an artifact to impart viewers with meaning is directly related to the spectator's translation of the content – the process of developing a personal understanding of the artifact and its ephemeral context. The delivery of content and meaning is controlled by the exhibitor – the one doing the showing. With sustainability, though, there are many story tellers and much of their content is general and biased. Few systemic artifacts exist that make connections to one's life and experiential use of energy – the majority of the educational content has to do with attitude, interactions with our environment and how we live – our standards of living and most especially our lifestyles. The need to change our lifestyles to be more respective of our environment became a central guiding principle for the design team. Could the Lab be able to incite changes in our student's lifestyles? Unfortunately, most incentives for such a shifting of style focus on the bad repercussions of a negligent lifestyle such as pollution, death, and waste. While we might be numb to sustainability there is no question that nagging or threatening will do little to change lifestyles.

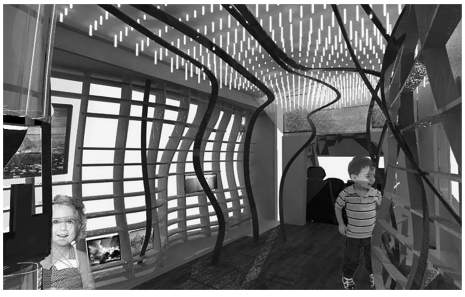


Figure 3. Interior view of T.E.S.S. looking toward cab.

2.2 *Precedent for interactive exhibit: mathematica*

An interesting precedent where systemic artifacts promote interactive learning that might make personal connections is the ground breaking exhibit Mathematica: A World of Numbers … And Beyond, designed by Charles and Ray Eames in 1961. It marked a distinct shift in exhibition design by making the visitor an active participant in the unfolding of information. Moving beyond the static, didactic "one way" presentation, the installations were organized around the notion that the visitor affected the content – transforming the exhibit into a personal experience. This ability to translate information into an "interactive" learning condition created a dynamic and engaging platform from which to consider the nature of exhibitions and the presentation of didactic information.

Commissioned by IBM and initially located at the California Museum of Science and Industry, the project embodied the notion of the educational exhibit. The content was "rigorously researched by staff members and outside experts (who) were consulted regularly. Despite the fact that the exhibitions were packed with information, artifacts, and images, a great deal of care was taken to make them accessible – learning is interesting and 'fun.'" (Kirkham, 1995) The centerpiece of the work is a collection of mechanical kinetic interactive demonstrations of mathematical concepts such as Probability, the Mobius Strip, and Celestial Mechanics. Engagement by students in the subject matter is directly related to quality of their learning and the kinetics *"have proven to play an essential role in the encouragement of longer and deeper interactions with exhibits in Mathematica … exhibits that displayed motion were more socially engaging than static or interactive only exhibits."* (Constantine, Frankfeldt, Low & Schoenfeld 2004). The visitor initiated the machines and engaged with the mathematical concepts through physical presentation of content. In completion of the exhibit, the Eames combined the roles of curator, educator and exhibit designer in creating a clear and singular exhibit that remains vital, and in use, to this day. But a question emerges as to whether these types of interactive exhibits are truly conducive to interactive learning or just better in holding a visitor's attention.

2.3 *Interactive learning?*

In the case of Mathematica the interactive quality of the exhibits was limited to activating the machines.

While their kinetic qualities did result in greater viewer engagement, the exhibits conveyed their content in a single direction – exhibit to viewer. The observer had no ability to alter the information or direct the exploration. Akin to a "download", the content was delivered via a one-way curatorial conversation. It was certainly more "fun," as was the goal of the Eames's, but still inherently singular in effecting the thinking responses of its viewers. For Moreno and Mayer (2007) educational interactivity is a *"characteristic of learning environments that enable multidirectional communication a two-way action (between learner and teacher) in order to foster learning."* They add the qualifier of multimodal learning which incorporates both verbal and non-verbal content knowledge to the environment such that, *"an interactive multimodal learning environment is one in which what happens depends on the actions of the learner (where) the defining feature … is responsiveness to the learner's action during the learning."* In other words, the learning is directed by the student rather than teacher.

For the foundation RV, it became clear that the exhibits must be interactive in allowing the students to initiate, further and direct the learning. The events in the RV could not be just experiments that are watched, the viewer must be able to alter the outcomes becoming vital instruments in the success or failures of the outcomes. The students are placed in the positions of collaborative control – the same attitude that is needed by all members of our society if we are to better our relationship with our natural environment through changes in our lifestyles. The difficulty the design team had with this conclusion was the lack of actual exhibits on hand, an integrated design for T.E.S.S. would be difficult. It was decided that the project would become a "framing" device for the eventual interactive exhibits.

2.4 *Knowledge and learning*

With the goal of sorting out "interactive learning," "active learning," "collaborative learning," and "cooperative learning," terms which have become so prevalent in current pedagogical discourse, Ted Panitz (1997) proposes initiating definitions for the two terms he believes form the starting point for discussion. Collaboration is *"a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect for abilities and contributions of their peers."* Cooperation is simply *"a structure of interaction designed to facilitate the accomplishment of a specific end product or goal through people working together in groups."* Panitz proposes the underlying premise for collaborative and cooperative learning is founded in "constructivist epistemology" and follows with an interactive teaching paradigm forwarded by Johnson, Johnson & Holubec (1991) where *"knowledge is constructed, discovered and transformed by students. Faculty create the conditions within which students can construct meaning from the material studied by processing it through existing cognitive structures and then retaining it in long-term memory where it remains open to future processing and possible reconstruction."* Panitz continues by quoting Ken Brufee (1995) who believes there are two types of knowledge to consider in the "constructive conversation" of education. Foundational knowledge "is agreed upon socially justified beliefs" – quantifiable knowledge such as correct grammar, mathematics procedures and history facts. Non-foundational knowledge, on the other hand – and of interest to this discussion- is "that which is derived through reasoning and questioning versus rote memory." "It is more likely to address questions with dubious or ambiguous answers, answers that require well-developed judgment to arrive at, judgment that learning to answer such a question tends, in turn, to develop." This idea of which type of knowledge the visitors of an exhibit can contemplate and interpret echoes David Dean's proposition (1996) that sophisticated exhibits should challenge both sides of the viewer's brain. The left brain for cognitive, quantifiable meanings/functions and the right brain appeal for imaginings, associations and intuition.

It became clear through early research presentations by the project team that in order to accomplish the goal of creating an interactive exhibit which promotes the visitor to develop personal judgments using simple didactic panels or digital displays would not be nearly enough. A means to develop an emotional response that engaged both quantitative and qualitative aspects of the topic was needed. If the audience was numb to such an important topic, it was paramount their attention be had. The team redirected its focus in a search for a means to reach a numb audience – wake them, shake them, impress them – and get their attention. Empathy became the central tool in placing one's self in the place of others as a means of understanding how our current processes of living fit must be reconsidered.

2.5 *Empathy*

Stephen Greenblatt, in his essay "Resonance and Wonder" (1991) proposed the two terms as distinct models for the exhibition of works of art. Resonance is *"the power of the displayed object to reach out beyond its formal boundaries to a larger world, to evoke in the viewer the complex, dynamic cultural forces from which it has emerged and for which it may be taken by a viewer to stand."* Wonder is *"the power of the displayed object to stop the viewer in his or her tracks, to convey an arresting sense of uniqueness, to evoke an exalted attention."* In order to grab someone's attention, empathy on the present and future of our environment was a requirement.

Empathy is a very common tool for designers and researchers to employ in projects and situations. Defined by Webster's as "the psychological identification with experiencing the feelings, thoughts or attitudes of another," the ability of designers to empathize the needs, desires and requirements of others is extremely important. Purposely avoiding the

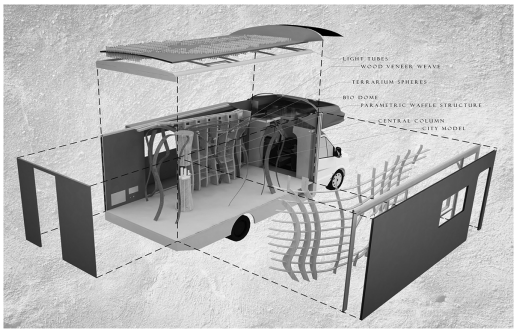


Figure 4. T.E.S.S. Axon component schematic.

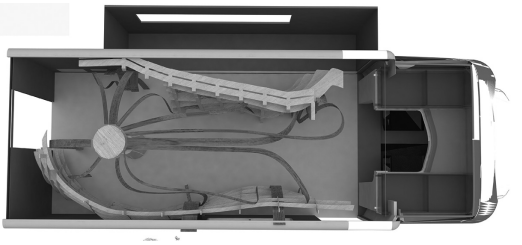


Figure 5. Plan View of T.E.S.S.

discussions on empathy in aesthetic and architectural perception theory here, the interesting component of empathy for the T.E.S.S. was the ability to establish emotional engagement in the viewer which could lead to interactive learning and the forming of individual viewpoints.

For Margaret Sutherland (2009), empathy in education has been used in three senses; learning by reproducing physical responses in watching others (often referred to as "motor mimicry"), learning by knowing what emotions others are experiencing, and learning by actually feeling the emotions others are experiencing. We certainly learn by watching others and mimicking what they do which can result in literal transference when we wince in reaction to other's physical pain. Knowing what emotions others are experiencing is of value but they are purely speculative – the greatest connection is certainly to experience some of the emotions others are feeling. This emotional connection catalogues information in our brains differently and enables easier recall and long term retention. Architecturally, John-Alan Johnson summarized in stating *"It is the emotional and esthetic power of empathy that makes the transference of human feeling and sensation at once so necessary and yet so difficult for understanding architecture."* For this project, making viewers understand the directness of sustainability and the importance it has on our lifestyles requires placing one's self in contextual situations different than their own. For the project team this entailed first and foremost creating an environment distinctly different that the students.

3 THE DESIGN

3.1 *T.E.S.S.*

T.E.S.S. an acronym for Transportable Environmental Sustainability Showcase. The students formulated the following design statement; *"T.E.S.S. is an inspirational sustainability incubator, educating the next generation on the importance and application of various sustainability concepts. T.E.S.S.'s modern interior greets visitors with an immersive, earthy environment that introduces sustainability in an energetic, interactive, and innovative way. The interior design and its integrated exhibits foster a memorable and inspiring experience for all its visitors."*

As a basic schema, T.E.S.S. will transport the interactive exhibits and demonstration materials to a target school which are then deployed outside of the RV. Students in groups of eight to ten enter into the RV where they participate in introduction sessions on the specific topics they will experience. The systems are explored through a series of interactive digital screen presentations which are to be "unfolded" by the students. Curricular content is presented as a series of questions the answers to which the students responds. Their answers activate a sequential series of additional questions continuing the cycle. Right and wrong answers are expressed through audio visual responses. The SAVE Alliance/Green Allies Foundation is currently exploring design systems for this digital curriculum delivery system. Upon completion of the introduction and the session's subject matter, students exit the RV by another door leading to the demonstration exhibits. The next group of students then enter and begin their round of introductions. Upon completion of the experiments, students re-enter the RV to review the guiding principles involved.

Within this schema, TESS is a gateway to frame the sustainability discourse. In order to satisfy the goal of grabbing the attention of numb students, it became critical to the project team that the internal environment be unique and a shift in context. The design incorporates a parametric plywood internal matrix skin which dynamically contrasts the rigid exterior RV. The poche space between the matrix skin and RV walls accommodates the tectonic systems and interstitial components of the exhibits and pedagogical content. The matrix skin itself has a depth pragmatically allowing for storage and display while parked and during transport. It became critical for the project team that the internal environment be also experientially different and empathetically diverse. Echoing the core criteria of energy as the organizational construct, the design focuses on daylight, the primal condition of the sun, and solar power generation and storage. Acrylic rods pierce the roof, weave through the parametric skin and layer under a thin acrylic plate floor connecting to lighting sources within the parametric wall poche. During the day, the sun lights the rods from above and changes in daylighting are acutely experienced inside the RV.

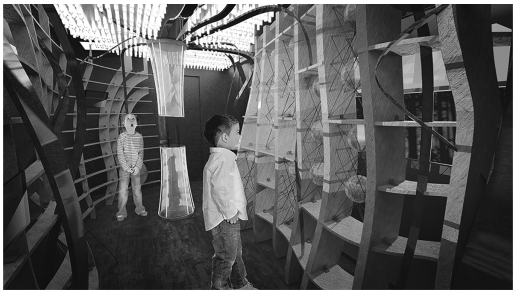


Figure 6. Daytime rendering of T.E.S.S. with solar lighting.

Solar panels charge batteries during the day which are connected to the lower end of the acrylic rods. As day turns to night, the lighting of the rods shifts from the sun above to batteries below that have been charged by solar panels creating a shift in lighting set to the timing of the sun in the sky. The primacy of the daylighting and powering through batteries of the rods at night from batteries exemplifies a powerful sustainable cycle which the team felt would generate awe and be a direct bridge between general principals and a specific system.

While the parametric skin creates an envelope which filters, supports and frames the foundation's discussion on sustainability almost as a background and storage device, the project team felt a counterpoint was needed inside the RV that could frame a special topic or unique focus. The idea was to connect the roof (sky) and the floor (ground) with a sinuous column of light. For Aldo Van Eyke, architecture is "the celebration of the realm where the ground meets the sky." The introduction of a vertical column mythically makes this connection. At the top of the column is a skylight through the roof. At the bottom of the column is a hole through the floor exposing the ground beneath. In the center is an area for special artifacts. With this device, the occupation of the realm where the ground becomes a literal link expressing the interconnected nature of our environment.

4 CONCLUSION

4.1 *A change in lifestyle*

The Save Alliance/Green Allies Foundation's primary goal is to alter world view of students in an attempt to foster a sustainable future – to encourage students to see the world in a different, and more respectful way. T.E.S.S. is intended to be an apparatus the same way the camera obscura altered the view and understanding of the world of its time. *To see differently*.

As a society, we have unfortunately become somewhat numb to the dialog of sustainability due to oversaturation. The green agenda is carried and furthered by any organization able to find a niche within its generalist frameworks. This "superficialization" will no doubt prove deadly to our species. Awareness of sustainability must be nurtured on an emotional level

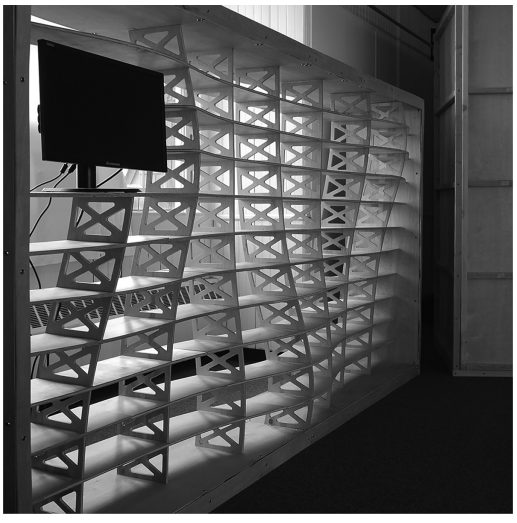


Figure 7. Fabricated section of T.E.S.S. parametric skin.

with available systems for improving the relationship with our natural environment actualized in a realistic, economic and widespread manner. T.E.S.S. offers a means to grab the attention of our youth and the interactive exhibits it frames can educate and change our ways of thinking. As Robert Vale aptly stated in his 1975 book from the previous energy crisis, developing a sustainable change in our environment requires not just changes in attitude but core changes in our lifestyle and standards of living. To accomplish this, the SAVE Alliance/Green Allies Foundation focuses on empowering students to incite change in our society.

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Life-cycle assessment of historical building reuse: Is the existing building the greenest building?

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ABSTRACT: Until now, little has been known about the climate change reductions that might be offered by reusing and retrofitting existing buildings rather than demolishing and replacing them with new constructions. This life-cycle analysis of Bent's house was carried out as an exploratory study to find out whether preserving historical buildings will have a quantifiable environmental impact beyond the cultural benefits that are known by the public. This research paper provides a comprehensive analysis of the potential environmental impact reductions associated with building reuse using Bent's opera house as a case study. Utilizing a life-cycle analysis (LCA) methodology, the study compares the relative environmental impacts and primary energy consumption of a historical building, building renovation, and new construction over the course of a 75-year life span.

1 BACKGROUND

1.1 *LCA introduction*

Life-cycle analysis (LCA) is an internationally recognized approach to evaluate the potential impact on the environment and on human health associated with products and services throughout their respective life cycles. "LCA requires life-cycle inventory (LCI) data for all materials and processes, a life cycle impact assessment (LCIA) method, and a software tool to do the work. LCI data is the inventory of all flows to and from nature due to a product or process – it's a long list of substances and quantities, which involves complex considerations in boundary, allocation methods and so forth. The LCIA method translates those flows into environmental impact potential." (Athena Sustainable Material Institute (2014). For North American construction projects, the LCI data should be North American in origin, and the LCIA method should be TRACI3; Athena software is based on TRACI.

1.2 *Approach and methodology*

According to ISO 14040 standards, a LCA is conducted in four phases. "The first phase, goal and scope definition, establishes the boundary conditions of the systems, defines a functional unit for the system, and enables equivalent comparisons with other products or processes. During the second phase, life cycle inventory (LICI), data is aggregated to determine aggregate inputs and outputs. In the case of a building materials study, this is often the quantity of materials used as well as the emissions associated with the production of those materials. In phase three, Life cycle impact assessment (LCIA), the LCI is translated using characterization factors, into impact categories, such as global warming potential. The fourth and final phase is interpretation, where data and results are analyzed to determine areas of relatively high environmental impacts and recommendations are made for improvements to the system. The four phases often occur in an iterative nature." (Thiel et al. 2013). Quite a few LCA tools and software exist that can be used to assess buildings: for example, BEES, ATHENA, Gabi, and Simpro.



Figure 1. Building materials and assemblies included in LCA.

2 STUDY OBJECTIVES

Located in the heart of Medina, New York, Bent's Opera House stands prominently at the corner of Main Street and Center Street. Completed in 1865, the opera

house was built from the now-famous Medina sandstone, which can also be found in places such Havana, Cuba, and was also used for London's Buckingham Palace. Named after the property's original owner Don Carlos Bent, the opera house has a rich and varied history. It was home to many plays, shows, commencements, elections, and other public functions. Over time the building fell into disuse but it is still considered a significant architectural landmark for Medina. In 1995 it was included in the National Register of historic places as a part of Medina's Main Street historic district. Bent's house has four floors with a total square footage of 23000 (Wikipedia, 2012).

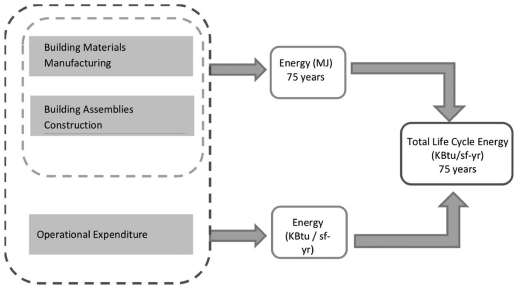


Figure 2. Impact assessment method.

2.1 *LCA boundary definition and LCI input*

The focus of this study is LCA of building material side energy consumption and environmental impact. The boundaries for the study include material extraction, product processing, delivery, demolition, and transportation. Benefits, and loads beyond the system boundary such as steel recycling, were excluded. This LCA includes the environmental impacts of Bent's house's building materials and operational expense. Three models have been examined: The first is based on the original material of the historical building (no additional thermal insulation added); the second is based on keeping the original historical building external walls and roof materials with additional thermal insulation; and the third is based on rebuilding the entire building with the same square footage and functions, to meet current international green construction (IgCC) code. Building mechanical, electrical, and plumbing systems are excluded from the material calculations because they did not exist in the original building.

Transportation of the building materials to the construction site, construction waste, and materials used for construction itself (i.e., temporary materials) are included in the calculations. The functional unit of this study is defined as the entire Bent's Opera House. Operational expenditure includes energy spent on heating, cooling, ventilation, water heating, lighting, and others. The major components of the material analysis, ranging from structural elements to interior flooring, are included. "Not included in the study were landscaping elements; interior finishes such as carpet tiling and paints were also not included in this study as they represent a small quantity of the building's total mass. Paint and interior finish represented only 2%–4% of energy and global warming impacts in previous building LCA studies." (Thiel et al. 2013).

Material inventory data were obtained through plans and project information provided by Bero Architecture and a site survey, including plans, elevations, sections, code analysis, and Revit models. A list of materials was extracted from the material schedule in Revit models then converted to an Excel database. The operational expenditure was obtained through a benchmarking method based on the Commercial Building Energy Consumption Survey (CBECS) building 2003 database (Energy Information Administration 2003). The operational expenditure's unit is kBTU/sf/year.

2.2 *Impact assessment method*

The LCIA phase was conducted using the combination of two impact assessment methods. The material-side life cycle primary energy consumption is analyzed using Athena IE4B. The Athena sustainable material institute is the pioneer of whole-building LCA in North America. IE4B is explained in detail in section 3.2, tools and data. The operational side of primary energy consumption is assessed using a benchmarking method. The benchmark database is the CBECS 2003 survey; the data-sets used in the study include offices and public assemblies.

The impact assessment categories reported from Athena included global warming, acidification potential, HH particulate, ozone depletion potential, smog potential, eutrophication potential, energy consumption, air emissions, water emissions, resource use, and land emissions. In this study, I have focused on global warming, HH particulate, ozone depletion potential, and smog potential.

3 RESEARCH GOAL AND MODELS

There have been multiple alterations to the building's interior, none of which are well documented. The basis of this study is the survey drawings done by Bero Architecture and the Revit model constructed from the survey drawings and filed measurements conducted by the researcher. Most building interior assemblies are based on field assessment.

3.1 *Goals*

The main goals of this LCA study are the establishment of a materials inventory and environmental impact references for the Bent's house. Exemplary applications of these references are in the assessment of future reconstruction or renovation of historical buildings similar to Bent's house. Furthermore, comparing the environmental impact of preserving a historical building with upgraded exterior wall insulation with that of reconstructing a new building according to

Table 1. Building assemblies included in LCA.

Assemblies Makeup	Historical Building	Renovation	New Construction
External Wall	Natural solid sandstone	Natural solid sandstone with additional fiberglass batt insulation R30	Brick cladding concrete backing with air barrier and fibreglass batt
Windows	Unclad wood window frame double pane glaze no coating air	PVC window frame double glazed no coating air	Fiberglass window frame double glazed soft coated argon
Doors	Solid wood door	Solid wood door	Fiberglass exterior door 50% glazing
Floor	Plywood decking @15 mm with 3.6 kPa	Plywood decking @15mm with 3.6 kPa	Concrete hollow core floor with love load 2.4 kPa
Columns	Softwood lumber with live lad 2.4 kPa	Softwood lumber with live lad 2.4 kPa	Precast concrete with live lad 2.4 kPa
Beams	Glulam	Glulam	Precast concrete
Roof	Plywood decking @ 15 mm without insulation	Plywood decking @ 15 mm with R40 insulation and waterproofing	Precast concrete decking with R40 insulation, EPDM cellulose and drainage
Foundation	Concrete @ 200 mm with average flyash %	Concrete @ 200 mm with average flyash %	Concrete @ 200 mm with average flyash %

IgCC can be seen as essential to help inform the decision-making process of policy makers in establishing quantified sustainable development guidelines for future historical buildings renovation, reconstruction, and demolition projects.

3.2 *Tools and data*

Two main software tools were utilized to complete this LCA study: a Revit model to take off the materials and the Athena sustainable materials institute's Impact Estimator for Building (IE4B) to assess the life-cycle environmental impact. Using the physical model, the schedule within Revit extracts the three-dimensional data and then a materials takeoff schedule is exported as an Excel file. The schedule had to be simplified by editing out the non-useful information, to make a clear spreadsheet. The useful data include: external walls, interior walls, columns, floors, roofs, foundations. These data are then manually inputted into Athena IE4B.

The IE4B software is designed to aid the building community in making more environmentally conscious material and design choices. The tool achieves this by applying a set of algorithms to the inputted takeoff data in order to complete the takeoff process and generate a bill of materials (BoM). This BoM then utilizes the Athena Life Cycle Inventory (LCI) Database, version 5.0.0125, to generate a cradle-to-grave LCI profile for the building. In this study, the IE4B model includes resource extraction, manufacturing, on-site construction, occupancy/maintenance, demolition, and recycling/reuse.

3.3 *Building analysis and assessment models*

In order to compare preservation, renovation, and new construction, three models were created.

The first step in creating a reasonable building model is to carry out a takeoff of the materials used. The takeoff for Bent's house was based on the Revit model we created based on survey drawings provided by Bero Architecture. Unfortunately, because of the age of the building, many of the actual building assemblies are hard to detect, so I made multiple assumptions. The takeoffs for Bent's house were done using the scheduling tool in Revit. The area condition is used to compute the surface area and basic geometry of the building. The count condition is used to compute the number of times the same instance occurs. A few major assumptions were made to complete this project: the foundations are raft foundation made of cast-in-place concrete; all floors are the same in terms of assembly and load; all columns on all floors are the same. The building systems included in the model are building envelope and major structural components; HVAC, lighting, and plumbing systems were excluded because they were not present in the historical building.

3.4 *Alternatives*

After the base-building historical building data had been manually put into Athena, two alternative sets were created based on the baseline building: a renovated building and a newly constructed building based on 2012 IgCC standards.

In the renovated building, external walls were added with additional R30 insulation; windows were replaced with fiberglass window frames with double-pane glass; additional R40 insulation was added to the roof; while floors, columns, and foundations were kept the same as those in the baseline building.

In the new construction, external wall were added with additional R30 insulation; windows were replaced with fiberglass window frames with double-pane glass; additional R40 insulation was added to the roof; wood columns were replaced with precast concrete columns; while floors and foundations were kept the same as in the baseline building.

4 RESULTS AND FINDINGS

4.1 *Building operational energy expenditure*

A benchmarking method has been used to determine the total site energy intensity. The data set came from the U.S. National CBECS 2003 version; the location was set to have ≤2000 CDD(cooling degree day), 5500–7000 HDD (heating degree day); the size was 0–25000 sqft; operation hours 0–90 hours/week; and the building was built before 1920. In order to capture as many buildings comparable to Bent's house as possible during benchmarking, the building type was set to administrative/professional office, bank/other financial, culture, mixed-use office, and other public assembly, recreation, social/meeting. In total, 19 buildings were found in the CBECS database with median energy usage intensity (EUI) 66.7 kBTU/sf/year. This number was used to calculate the total site energy consumption for the historical building's life span of 75 years. The same benchmarking process was repeated to determine the EUI for renovation and new construction, assuming that they are the same.

4.2 *Life-cycle energy consumption: material side*

Results from the three models were compared with the goal of providing information related to building reuse and renovation benefit. IE4B produced results for the following mid-point impact measures: total primary energy consumption, non-renewable energy consumption, and fossil-fuel consumption. In this study, I focused only on primary energy primary energy consumption, measured in MJ. The primary energy includes all energy "used to transform or transport raw materials into products and buildings, including inherent energy contained in raw of feedstock materials that are also used as common energy sources." (Carmody, 2003) In addition, the impact estimator includes indirect energy such as processing, transporting, converting and delivering fuel, and operating energy.

In general, the external walls of the Bent's house represent the highest total primary energy consumption, accounting for nearly 85% of energy consumed in life-cycle stages A through C. Next highest is floor assembly, which accounts for 6%. In the renovated building, external walls account for 78% of the total primary energy consumption and roof assembly is second, consuming 12% of the total energy. In the new construction, the external wall assembly still ranks highest; however, it accounts for only 54% of the total primary energy consumption and all other categories have a substantial increase in percentage: assembly of beams and columns ranks second, representing 32% consumption; and roof assembly, accounting for 8%, is the third-highest energy consumption category.

Within material primary energy consumption, operational energy is consistently much higher than embodied energy. In IE4B, operational energy refers to B6 stage and includes energy primary extraction, production, delivery, and use, usages that are only related to the building materials and assemblies. We need to make it very clear that "material operational energy" is different from "building operational energy expenditure," which we described in section 4.1. "Building operational energy expenditure" includes the energy used to provide space heating, cooling, ventilation, water heating, etc, for the occupancy. Through the comparison, I have three major findings:

1) The operational energy use is the most important stage through the entire building material life span in terms of total primary energy consumption.

Table 2. IE4B_v5_life-cycle stage.

Information Module	Supports?	Processes Included
A1 Raw material supply	Y	Primary resource harvesting and mining
A2 Transport	Y	All transportation of materials up to manufacturing plant gate
A3 Manufacturing	Y	Manufacture of raw materials into products
A4 Transport	Y	Transportation of materials from manufacturing plant to site, and construction equipment to site
A5 Construction-installation process	Y	Construction equipment energy use, and A1-A4, C1, C2, C4 IM effects of construction waste
B1 Installed product in use	N	n/a
B2 Maintenance	Partial	Painted surfaces are maintained (i.e. repainted), but no annual maintenance aspects are included
B3 Repair	N	n/a
B4 Replacement	Y	A1-A5 IM effects of replacement materials, and C1, C2, C4 IM effects of replaced materials
B5 Refurbishment	N	n/a
B6 Operational energy use	Y	Energy primary extraction, production, delivery, and use
B7 Operational water use	N	n/a
C1 De-construction demolition	Y	Demolition equipment energy use
C2 Transport	Y	Transportation of materials from site to landfill
C3 Waste Processing	N	n/a
C4 Disposal	Y	Disposal facility equipment energy use and landfill site effects
D Benefits and loads beyond the system boundary	Y	Carbon sequestration and steel recycling

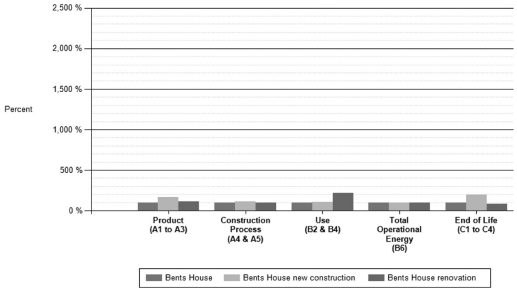


Figure 3. Comparison of total primary energy by life-cycle stage in material side.

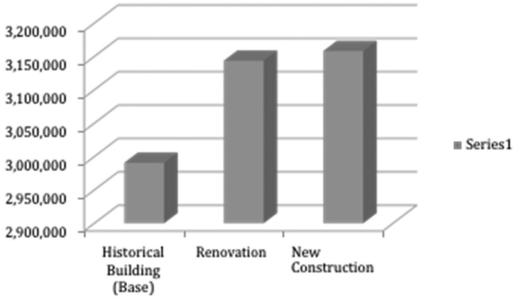


Figure 4. Overall energy consumption per year, life span of 75 years.

Table 3. Overall energy consumption per year, life span of 75 years.

	Material Energy Use (kBTU)	Year	Material Energy (kBTU/yr)	EUI Use (kBTU/sf/yr)	Area (sq)	Building Operational Energy Use	Total (kBTU/yr)
Historical Building (Base)	109,236,000	75	1,456,480	66.7	23,000	1,534,100	2,990,580
Renovation	109,840,000	75	1,464,533	73.0	23,000	1,679,000	3,143,533
New Construction	110,931,000	75	1,479,080	73.0	23,000	1,679,000	3,158,080

2) Apart from stages A1–A3 and C1–C4, the historical building has lower primary energy consumption. Overall, throughout the entire material life cycle, the historical building consumes 87% of the energy of the new construction and 97% of that of the renovated building.

4.3 *Overall energy consumption (material primary energy consumption + building energy expenditure)*

Owing to the insufficient thermal properties of the historical building exterior envelope and the long heating period in Medina, NY, the historical building consumes more building operational energy. However, because of the higher embodied energy embedded in the new construction materials, the overall energy usage of historical building is still less than that of the renovated building and the new construction. Overall, the historical building consumes 2,990,580 kBTU/yr, the renovated building consumes 3,143,533 kBTU/yr, and the new construction consumes 3,158,080 kBTU/yr.

4.4 *Life-cycle environment impact*

In this study, I have focused on the following mid-point impact measures: global warming potential, human health particulate, ozone depletion, and smog potential. The new construction has about 1.3 times the global warming potential of the historical building and 1.21 times that of the renovated building through life-cycle stages A–C. The new construction has about 1.45 times the smog potential of the historical building and 1.44 times that of the renovated building through life-cycle stages A–C. Trought the same life-cycle stages, the new construction has about 3.0 times the HH particulate potential compared with the historical building and 1.78 times compared with the renovated building, and about 1.1 times the ozone depletion potential compared with the historical building and 1.19 times that of the renovated building.

5 CONCLUSION

LCA is necessary when evaluating building reuse to understand how the embodied energy of materials is allocated during the phases of a building's use and whether building a new high-performance building could have even bigger and more negative environmental impact and higher overall energy consumption.

On the energy side, this study looked at both the embodied energy of major building materials and assemblies and building operational energy consumption in a building's life span of 75 years in upper state New York. The study compared three different models: historical, renovated, and new construction. It is important to note that the result is consistent: the new construction has higher primary energy consumption even though its advanced HVAC system might offset some building energy consumption in the operational phase. The assumption is that the longer the building life span, the closer the three model estimates will become; however, the payback period of using modern advanced materials in order to reduce operational cost will most likely exceed the building's functional life span, typically 60 years. As more and more buildings are targeted to become more energy efficient, we should not disregard the fact that the primary energy of the materials and building assemblies is important when we decide whether to retrofit or reuse an existing historical building or to demolish the old building and build a new one. Many studies in the past have largely focused on building operational energy expenditure. We now need to reconsider the important interplay between building materials and use phase performance.

On the environmental impact side, clearly new construction has a more negative impact in all aspects studied in this research: global warming potential, smog potential, ozone depletion potential, and HH particulate potential. There is an urgent need to develop a standard and guideline to regulate and monitor the impact of new and innovative building materials and systems based on a thorough understanding of their energy and environmental implications.

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Culture, context + environmental design: Reconsidering vernacular in modern Islamic urbanism

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ABSTRACT: The 21st century sees the Islamic regions as becoming some of the fastest urbanized areas on the planet. Local urban fabrics and existing buildings are often demolished in the name of progress, to make room for new, and often ostentatious, mega-projects, creating a scenario that is problematic in terms of conserving past history as well as providing inspiration for future generations. As extensive urbanization and globalization take hold, the character and quality of established cities in the Islamic world are under assault, with dramatic conflicts between traditional tenets, foreign influences and diverse interpretations of 'being modern' having serious and often little understood consequences. The current research examines how the demands of modern urbanism impact traditional centers of the Islamic world by considering emerging trends in Islamic urbanism through a critical examination of the vernacular. Using the city of Doha, Qatar as a case study, the authors explore the shifts of architecture as a coherent expression of local culture and context and question the interpretation of modern development in this ethos, and posit how environmental design might better resolve conflicts between traditional Islamic cultures (and way of life) and Western 'progressive' design. The paper concludes by recommending a more appropriate path for innovatively designing next generation buildings, communities and spaces that deploy aesthetic and applied basis of vernacular traditions, fostering greater meaning, inspiration and dialogue between and among architects, planners, governments and end-users. A model is proposed for proceeding in such creative, constructive and compelling directions.

Keywords: Design, Planning, Islam, Modernism, Vernacular, Systems Thinking, Holism

1 INTRODUCTION

> *The Middle East is becoming one of the most urbanized regions of the world. And as the place where cities may have first emerged, cities and urbanites remain most fertile objectives of study. Yet we are only just beginning to understand the social histories of these cities and the dynamic changes (or resistance to change) of these contemporary urban societies. (Bonine 2005)*

The influence and impact that globalization is having on the cities of the Islamic world proves far-reaching and consequential. The conflict between the integration of socio-cultural elements in the vernacular and modern urban developments is leading towards a clear division between those who see this as a loss of their cultural identity and those who view it as a step forward on the global stage. Polarization is evident and often problematic. The discourse on architectural form in the Muslim world is the topic of much debate. Forming a strong interaction with its natural surroundings, historically, Islamic structures were never the result of a formal master plan. They were instead the result of a diverse interpretation of the people who resided in these Muslim cities, giving them characteristics borne of reverence for the archetypal. The local knowledge, ecological and otherwise, was deep and meaningful. The prevalent view amongst many architects and urban planners is that "modern" or Western-influenced structures and planning are not always beneficial to the Islamic world, particularly in the Middle East (Bonine 2005). There are perceptions of solutions being out-of-place or foreign in character and context. The call for an "Islamic renaissance" or the demand for a return to the traditional structures and principles (Bonine 2005) runs in tandem with the growing urbanization crisis faced by a plethora of cities in the Islamic world.

2 ISLAMIC URBANISM

> *Let's start, let's move together, let's revive our cultures so that modernity is not only seen in the terminology of the West, but modernity is seen in the intelligent use of our past. (His Highness Prince Karim Aga Khan 2008)*



Figure 1. Old Doha Souq (Catnaps Design).



Figure 2. Katara Cultural Village, Doha (b.r. sinclair © 2016).

The faith of Islam unites its followers, who come from a rich diversity of societal circumstances and cultural expressions, across many facets of life. The idea of a hegemonic culture forced upon their identity through globalization, is anathema to the very ways of Islamic life. That being said, there is no dichotomy between *din* (faith) and *duniya* (material world) in the Islamic faith. The present researchers see the unification of this approach as most pertinent to the quest for a contemporary Islamic design expression. Muslims are required to carry out their worldly obligations within the ethics of Islam and are not allowed to make that division. As a result, human behaviour is measured by a set of practices developed and maintained within Islam – that covers all aspects of one's daily life, giving meaning and consistency in *all* human activities (Bianca 2000). In stark contrast, "… secular beliefs of modern Western civilization which, for the sake of "individualism", tend to ignore spiritual hierarchies and thus reject the idea of normative types of human conduct – without always recognizing that, by excluding service to higher realities, the human mind may become subservient to much more limited man-made ideologies and their constraints" (Bianca 2000). In other words and considered within an environmental design frame, the built environment within the Islamic faith has always been guided by the creation of models that express spiritual interpretation and meaning rather than transient ones that convey progress or development in the Western sense. The unquestioning belief in the divine order and its reflection in the traditional formal structures of Islam, such as the *souq* (market) or the *hamam* (baths), is a far cry from the mechanical representations of the very same structures that intend to capture and convey the modern interpretation of development.

This "clash of civilizations" (Huntington 1996) between the Islamic way of life and Western interpretation of progress in its urban form has been a topic of contention since the early–20th century. The combination of technological progress and economic growth resulted in transposing Western models of urbanization at global levels. The resulting architectural development of many Arab cities can be viewed as an accurate replication of Western cities with an inability to give deeper substance, purpose and, meaning to these creations. The authors contend that a sense of place must be a vital dimension of planning, architecture and urban design, and especially in an era where globalization can equate with homogenization of output and 'dilution' of character. Far more disastrous (if one can use the term), is the change in the socio-economic dynamics of many global cities. The introduction of a new value system foreign to the traditional ways of life, such as social segregation according to accumulated wealth, loss of cultural identity and downplay of history, and unfamiliar ways of inhabitation, is a far cry from the egalitarian principles of Islam. Such approaches have had a demonstrable and arguably deleterious impact on both the sustainability of the traditional settlement and the viability of the modern.

This paper is by no means trying to disparage Western forms of architectural and urban forms, thoughts or processes – rather, the authors ponder how contemporary principles and posturing be used in a selective manner in tandem with local traditions and values to better address current needs. By evaluating the former's achievements and failures, the possibility of an interdependence or symbiosis between the two (i.e., Islamic culture and Western modernism) can provide meaning, inspiration and dialogue and allow for the dissolution of the alien value system. The authors argue that such bridging is missing, overdue and essential. Rapid urbanization has had extensive and transformative changes in the Middle East. Citizen responses to globalization and foreign influences have been varied. Ranging from reverential regard to nonchalance to disbelief, to sadness that a certain way of life is disappearing, the reactions to urbanization are not always foreseeable. For example, studies by Sharon Nagy, an anthropologist, have shown how local socio-political factors have shaped urban plans introduced by foreign consulting firms in Qatar by altering the urban fabric through the influx of oil wealth (Bonine 2005). Changing politics, demographics, economic and ethical parameters all contribute towards satisfying business ambitions by borrowing tales from the *Arabian Nights* to reflect 'authentic' or local designs blended with modern structural concepts. These approaches need critical assessment, and critical

reimagination, in light of opportunities and obstacles confronting cities of the Islamic ethos.

3 URBAN RESPONSIBILITY

> *The architect is a member of a society and therefore reflects the values and behaviour of that society in his or her own behaviour. Yet, architects are both the keepers of a post heritage and the creators of the new. They mediate between the past and the future. Architects have a unique responsibility to create both the urban space that people relate to as well as the language of form and ornament that they identify with. Architects have, therefore, a special responsibility to address the need to symbolize a state of being and to reflect the aesthetic sensibility of themselves and their clients. (Serageldin 1996)*

It can be argued that the concept of urban conservation is more of a "trend" than a platform that can be used to reconcile the vernacular with the modern, especially in an Islamic context. Newer mega-projects are replacing older and locally crafted buildings, leaving behind very little of the heritage and thus distinctiveness for the younger generations. Such directions also translate into a loss of the indigenous social fabric so essential to place identity. This is particularly visible in the states of the Gulf region, often leading to a lamenting of loss (characterized in many ways, including both physical and cultural) from the citizens. Respect for past traditions and future conditions demands an understanding that is integral to the preservation of any architectural agenda. This is not *always* the case for the Gulf region that has undergone a metamorphosis from humble fishing and pearl-diving villages to cosmopolitan cities (Elsheshtawy 2008). The resulting fragile social fabric exists in an economically capitalist environment where consumerism is the dominant feature. There are other ways of doing business, especially in light of the common adoption of the 'Western is Modern; Western is Progressive' mantra.

Such types of development can be seen as creating an economic pressure affecting the socio-cultural sustainability, where the older generation are reluctant recipients of these associated forms of urbanity. These socio-economic changes are definitely reshaping the urban structure and form of these cities, in a divergent and arguably less-than-beneficial manner.

4 DOHA, QATAR

> *We have simply got to modernise ourselves. We're living in a modern age … You cannot isolate yourself in today's world. (Sheikh Hamad bin Khalifa al-Thani, 2000)*

The present paper explores Islamic urbanism, using Doha as a case study to explore the shift of architecture from the vernacular towards a global metropolis. Possessing over half of the world's total oil reserves, the Gulf region has attracted more than its fair share of global attention over the last decade. Recent urbanization and construction efforts along with the 'Dubaization' (Elsheshtawy 2004) of major cities across the area, has seen an arguably chaotic approach to the development of its architecture and urban design, resulting in grandiose, almost dreamlike structures that do not reference their cultural, physical or natural environments (Fraser & Golzari 2013).



Figure 3. Doha West Bay (b.r. sinclair © 2016).

Comprising of a total area of 11,586 square kilometres and only 15 metres above sea level, the peninsula of Qatar is bordered by the Gulf to the east, and Saudi Arabia to the west. With a population of 2.2 million (2014) and ruled by the al-Thani family since the mid-1800s, Qatar has the highest per capital income in the world at approximately US $105,000 (World Bank 2014). Formerly a British Protectorate until its independence on September 3, 1971, Qatar's urban development can be divided into 3 stages – first, the decline of the pearl industry in the 1930s, second, the export of oil in the 1950s (Figure 4) and last, the beginning of the construction boom in the 1980s (Elsheshtawy 2008). According to Salama & Wiedmann (2013), there has been little analytical discourse on the factors that influenced the urbanization process in Doha. The present authors contend that there are many holes in understanding Doha's rise, its embrace of Western expressionism in design, and its ability to effectively move forward with the appropriate urban guidelines to meaningfully develop and strengthen its urban fabric.

Khaled Adham's chapter on Doha's urban development in Elsheshtawy's book (*The Evolving Arab City: Tradition, Modernity & Urban Development, 2008*), addresses one gap by placing the process in a historical context but also within the framework of urban governance, describing in great detail the initial planning of the city around the old part of Doha, gradually leading to the development of the Corniche. What is

interesting to note is that no mention is made about the initial planning of Doha being carried out relative to the layout of an Islamic city. Jamel Akbar's study on the elements of an Islamic city emphasizes the creation of an Islamic built environment based on the relationship between the Muslims and their environment. Dictated by the values derived from it, Islam's influence on the form and function of its cities emphasizes the importance of achieving a strong coherence and compatibility with the community in both spiritual and worldly aspects. This is again, in the eyes of the present researchers, the *din* and *duniya* operating in concert. Akbar's study is interesting in that the four elements of the Muslim built environment reflect the early layout of the Islamic city from the 7th century onwards, where it was common for the soldiers of the newly-founded faith to cordon off an area in town where they set up a mosque and their residences and commercial space around it. The four elements of a Muslim built environment that he proposes and that are governed by Islamic principles are: (a) *fina*' (street space bordering property used by its owners) to maximize land use and provide shade; (b) dead-end streets to protect privacy; (c) *hima* (land that cannot be developed by individuals); and (d) public spaces (Bonine 2005). This clear integration of the socio-economic, spatial, cultural and administrative aspects, distinguishes an Islamic city from others, whether it is a street, a home, a mosque or a *souq* (Elaraby 1996). Taking a more integrative approach resonates with the aspirations and conduct of the present authors and their research in the region.

During the first half of the 20th century, Doha's settlements around its bay were divided into 8 districts or *ferejan*, based on the four elements of a Muslim built environment. A tribe or a large family occupied each district. Located parallel to the shoreline of the Persian Gulf, most of the alleys between these districts led to the harbor where most of the day-to-day activities were conducted (public spaces). The market place, the shops, as well as meeting places were all located in this area. It is interesting to note that apart from the *barasti* (dwellings with thatched roofs) and Bedouin tents that dotted Doha, homes ranged from one to two-storey dwellings, some featuring wind towers or *barajeel*. The architectural style of these structures including the non-residential ones was simple with very little to no ornamentation and were designed and constructed by a master mason and other workers (Elsheshtawy 2008).

With the decline of the pearl industry and the beginning of oil exports in the 1950s, new urban patterns began to emerge. Although the benefits of oil wealth were not applied immediately due to the conservative nature of the ruling family, as well as a lack of formal governance at the time, it was not long before this changed. British architects arriving to the Gulf Region during the 1950s found themselves facing a built environment unlike any they had encountered or studied before. Excess heat and over 300 days of sunshine were major factors considered in their initial design responses. More importantly, however, was the consideration of local traditions and culture when engaged in master planning and development activities. Although the call by some to ignore the historic aspects was present, the idea of building and integrating functionality into the design was even more challenging (Fraser et al. 2013).

The ruling elite centered attention to conservation of their cultural identity with the intense desire for modern technology. The influx of oil wealth only served to increase this aspiration to have the best, brightest and the most 'modern' as symbols of progress. Unfortunately, this may have led to a misinterpretation by the West, deeming this posturing as also having a desire for Western culture and politics. The concept of modernity, and its associated connotations, was seen to carry a certain prestige or stature, resulting in a desire to not only catch up with the developed world but to also be seen as the future of this modernization process (Fraser et al. 2013). It is important to note here that the design of many of these structures such as the Burj Qatar may have been intended to serve as a reminder that the new could exist alongside the old with no type of conflict whatsoever – shopping centres could exists alongside *souqs*, spas alongside *hamams* and Starbucks alongside the *gahwa shabya*.

The transformation from a coastal settlement to an urban metropolis within the span of a few decades took place in an environment where urban governance in the physical planning of Doha was still dominated by the ruling family. This was reflected in the new type of housing style – apartment buildings – that began to dominate Doha's skyline during the 1970s. The burgeoning new typology coincided with the arrival of expatriates, who came to take part in the design and construction activities. To accommodate commercial and residential growth, old neighbourhoods in the central areas of Doha were demolished and replaced with the high-rise buildings and modern structures such as shopping malls. It is obvious that the economic wealth brought in by oil and gas resources was instrumental in the rapid pace of urbanization in Doha. The rapid urbanization was also driven by the desire to be a leader and an exemplar (i.e., in a dramatically globalizing world) that gave rise to the grand mega-projects currently dominating Doha's remarkable skyline (Figure 3).

So what of the Islamic city?

5 PROPOSED MODEL – HYBRIDISM

> *Hybridity is a very complex notion. At its most basic level, it has meant the interbreeding or mixing of different peoples, cultures and societies. Hybridity thus does not emerge from the synthesis of different components, but from a space where elements encounter and transform each other. (AlSayyad 2001)*

Cultural forms of a society do not always arise from homogeneity but rather from an adoption and adaptation of concepts to their own building traditions to create a distinct urban form (AlSayyad 2001).

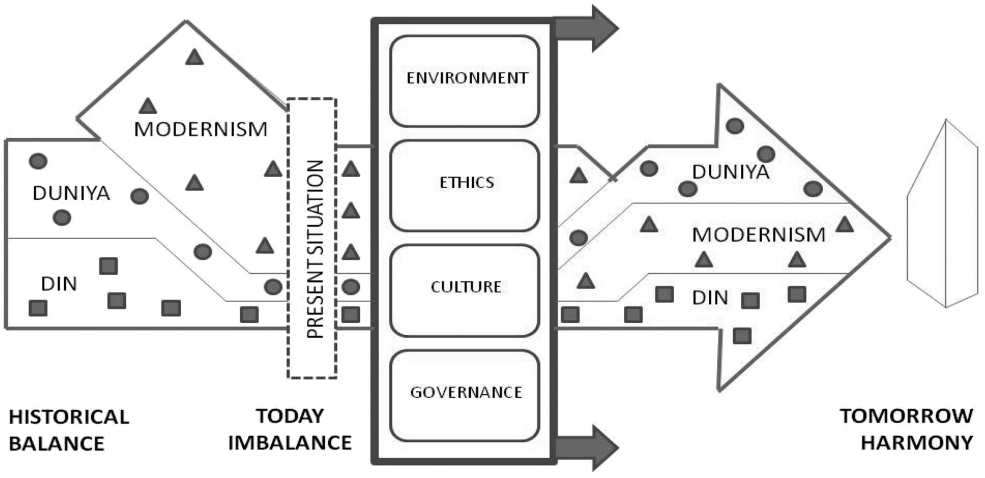


Figure 4. bin Zayyad + Sinclair Framework for Culturally-Appropriate Design in the Islamic World.

As previously mentioned, although similarities of built form exist in cities across the Islamic world, there are certain elements that are distinct or are distinguishable from each other. However, the intrinsic structure of Islamic architecture is always the same, due to the permanence of the basic and fundamental tenets that are adapted in accordance with vernacular forms (Rahman et al. 2014).

This begs the question – how can vernacular architecture, or perhaps more cogently and appropriately, 'architecture that is of its place rather than just in it' be reflected and realized in the urbanization process in the cities of the Islamic world?

Rather than creating a model within the paradigms of cultural autonomy or a neo-Islamist model based on Islam's Golden Age during the 8th century, or Westernization, what is required is a re-conceptualization of these three paradigms – a re-evaluation where the vernacular is not fixed in time but engages with the challenges that come with time, to produce a hybrid framework that is at once moral, organic and sustainable. Architecture is the perfect medium to bridge gaps between old and new and between the Islamic world and the West. The present authors suggest that deficiencies and shortcomings can be mediated in a convergent manner whereby the two perspectives (Islam and Modernism) are a continuum on the same spectrum. The following framework reflects how Westernization, or modernity is embraced when placed between *din* (faith) and *duniya* (material world). Inextricably linked to each other and strongly guided within the Islamic *tariqah* (path), this lack of separation also provides an accommodating environment (uncommon to other monotheistic faiths) to embrace foreign concepts that allow for spiritual interpretation as well as meaning and progress of not just Muslims but all of humanity in an arguably more ethical manner.

In our 'Framework for Culturally Appropriate Design' (Figure 4) we highlight that the arrival of Modernism to the Middle East proved overwhelming. Many traditions, architectural and otherwise, lost their balance of din and duniya. An obsession with the modern translated into a dilution of Islamic values, including those fundamental to city building. In considering a path forward, we call for a more holistic vantage point, which accommodates environment, ethics, culture and governance. The interplay of these aspects is intended to catalyze important consideration and discussion within the unique context of Islamic cities. A key objective is to wrap, or embrace, the Western or Modernist ways with qualities that are fundamental to Islam. By bringing Modernism into the *din* and *duniya* relationship there are greater opportunities for planning, architecture and urban design to find connection to local circumstances, conditions and culture.

In Islam, the quality of the interactions that take place within the aesthetics of the built environment, are reflected on the spiritual lives of the Muslims. In other words, the built environment is not only a physical representation of Islamic values but also a reflection of the beliefs, the cultures as well as *the needs and contexts of the world* inhabited today. That being said, it is also important to understand that each case merits its own individual solution, taking into consideration the context of not only the physical environment, but the economy, the existing institutional apparatuses as well as the available resources (Bianca 2000). Given the historical architectural achievements within the Islamic world, and the role that architecture has played in the aesthetics and spiritual expressions of the cultures Islam came into contact with, there is a gap between these past accomplishments and current practices. There seems to be a disparity when it comes to contextualizing the needs of the population in response to the infrastructure. This has resulted in creating a consumer environment in the Gulf region, where only top of the line creations are valued.

A few years ago, a survey on the education of the faculties of architectural schools in the Islamic world was conducted by the Aga Khan Award for Architecture. It was found that the vast majority had been educated in the West (Ivy 2001). This resulted in the

imposition of Western-style buildings as being the acceptable form of the architectural profession, and that such types of buildings were better in terms of quality and lifestyle. This did not give a sense of value to traditional cultures or forms of expression. Using modern materials to achieve the desired results is not enough. How then can the *din* and *duniya* be incorporated in the future planning of the Gulf region? What are the sources of inspiration, the sources of knowledge? The authors believe that it begins with education. It has to be part of the overall process and not the end result. Great attention needs to be given to structure and process in the creation of this intellectual space. It is important to study these historical achievements in order to be able to look forward and turn these heritage assets into an intellectual trampoline to generate ideas for building in a constructive and productive manner, beneficial to all mankind.

The second way in which the *din* and *duniya* can be incorporated in the future planning of the Gulf region is to recognize that design and technical issues of the built environment cannot be regarded in isolation from the cultural and religious values of the society. How can this be fostered? The creation of policies on the master planning of communities, urban design efforts, and public engagement is a requirement and should be a result of public-private partnerships. In the case of the Gulf region, collaboration between the government and civic institutions should form the platform upon which dissemination of information can be made accessible and transparent to all. Projects such as Katara Cultural Village (Figure 2) and Souq Waqif (Figure 5) in Doha, travel a long distance in their celebration of traditional values while being both of the present and aspiring to a brighter tomorrow. Future research aims to develop and delineate specific guidelines that can inform stakeholders and inspire environmental designers. While the adoption of such guidelines is no easy feat, the researchers believe that actions must be taken to raise awareness, at all levels, if more respectful, appropriate and harmonious districts and buildings are to be realized as the Gulf Region continues to expand and blossom.



Figure 5. Souq Waqif, Doha (b.r. sinclair © 2016).

6 CONCLUSION

> *Appropriate solutions to some of our most daunting problems will arise through the concerted efforts, open dialogue, and collective wisdom of the wide array of stakeholders, professionals, politicians, decision-makers, and citizens (both engaged and disenfranchised) who have the will and wherewithal to make a difference and to make the world safer, healthier, and better. It seems vital for us to critically examine, and question, our belief systems and their connections to the ways we define, refine, and realize progress. Architecture and Environmental Design, in both a philosophical and a practical sense, reflect as well as form greater aspirations, directions, and events of our times. (Brian R. Sinclair, 2015)*

The rapid expansion and urbanization of Islamic cities has been accompanied by a general embrace of Western ways of approaching and expressing design. To be Western is to be Modern, and to be Modern is to be Progressive. The present authors suggest that many important qualities have been eroded or lost by Islamic cities in the quest for their place on the global stage. The researchers developed an integrated framework that marries the traditional counterparts of *din* and *duniya* with the ever-present forces of Modernism. The framework posits a path whereby long-standing and time-tested values and beliefs can be in synchronization with contemporary metrics of success.

The end goal is to introduce more meaningful, potent and appropriate ways of planning and designing buildings, neighborhoods and cities of and in the Islamic world.

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Beyond the passage: Analytical probe into the emancipatory potential of space

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ABSTRACT: "Around 1910", writes Henri Lefebvre, "a certain space was shattered", pointing to the series of shifts in the Western culture, crucial for the evolution of modern thinking. This was also the time when the first glass-roof covered passage was designed and constructed (1910–12) in Belgrade's main shopping street. The country's capital, in the field of influence of powerful empires, was eager to catch up with the modern world. Some thirty years later (1941), the radically new transposition of the same theme was conceived through the unrealized project for the Hall of *Matica srpska* in Novi Sad. These conceptions, created in different but correlative geographical and historical conditions, are taken up in this paper as the subject for an analysis that examines the hidden emancipatory potential of this hybrid typology and the peculiar expressions of its protean capacity that gives us hints about the contemporary comprehension of public space articulation.

1 THE CITY PASSAGE AS AN EXPRESSION OF THE SHIFTING PARADIGMS OF A CHANGING SOCIETY

1.1 *The cunning meanings of a passage / an arcade*

A peculiar hybrid form of house and street – an arched or covered passageway, usually with shops on each side – first appeared in France, at the end of the 18th century with a name of Latin origin /passûs/: *passage*. To denote the same phenomenon, the similar term is now used in German, Russian, as well as Serbian, and some other languages, in countries that willingly imported and appropriated this French invention (*Passagen / nacca$$ / pasaž*). In English, however, another term was generally accepted, also of French, Occitan, Italian and ultimately Latin origin /arcus/: *arcade*. If used in other languages, the meaning of the words *Arkade / arcade / arkada* is closer to its original roots and its later Occidental and Oriental interpretations, and generally indicates a series of arches supported on piers or columns, or a covered thoroughfare formed by a row of such arches. In the first half of the 19th century, during 1820s and 1830s, around 150 such galleries were built in Paris alone, with any number of replicas promptly disseminated throughout the major European and North American metropolises.

When Walter Benjamin, in his unfinished *magnum opus Das Passagen-Werk* (*The Arcades Project*), 1927–1940, placed this architectural and cultural phenomenon as the central image of his speculative research, most of the 19th century Parisian passages were already destroyed, soon to be replaced by department stores and shopping malls. At the moment when the new glittering passage was opening in one of the most prominent Paris avenues, *Arcade Champs Elysees* (1926), Benjamin recalls the recent destruction of the famous *Passage de l'Opera* (1822–1925), to point out the meaning of lost traces of 19th century modernity. In "dazzling light and shadowy corners" (Benjamin [1927], 2002, 871) of the old passages, Benjamin sees the oblique traces of unconsciousness of the dreaming collective (Buck-Morss, 1989; Caygill, 1998).

Following Benjamin's intentions to retrace the previous century relics of modernity, this work zeroes in on two cases that explore the same architectural typology, only in radically different circumstances. They were singled out as insightful examples of the condensed public space that produces the set of dream-like images of exceptional intensity. Through this selection, analysis and juxtaposition, we evoke Benjamin's claim for liberation from "the realm of the dream, in order to experience present as waking world" (Benjamin [1928–29], 2002, 883–84).

2 THE GRAND PASSAGE IN BELGRADE, 1912

2.1 *The city context*

The first of its kind, the Grand Passage of the wealthy Serbian merchant and benefactor Nikola Spasić, designed by Nikola Nestorović, one of the most prominent Serbian architects at the time, was one of the highlights of Belgrade's early modernization at the beginning of the 20th century. At the same time, it can be considered an expression of cultural and social history, a reflection of its topographic conditions as well as its inherent symbolic meanings.

The most important task of the construction trade, understood in the most general way, in the 19th century, imposed by the political elite of Serbia, was to make

visible the new character of the modern, national state. However, both the traditional and more modern approaches were represented in the various areas of the system of government and organization of social life. The construction trade was gradually introduced into the frame of the government institutions, through the creation of a legislative base for its functioning and by establishing the conditions for providing architectural-engineering education in Serbia. At the turn of the century, architects and engineers, who had graduated from the Technical Faculty in Belgrade and often given government scholarships to continue their education at European universities, had increasingly more influence on the creation of the physical environment (Nestorović [1937], 1972).

According to M. Christine Boyer, the rise of working class protests in the 19th century resulted in the formation of the democratic sphere of public space, significantly modifying the controlled nature of the ceremonial places and disturbing its "bourgeois foundations of order" (Boyer, 1994, 8). Both the formation and disruption of capitalist urban order began in Belgrade only upon the termination of the strained coexistence of the two administrative governments – the Ottoman and Serbian – after the final retreat of the Turkish army from the Kingdom of Serbia in 1867. The end of the 19th century marked the beginning of intense modernization, in which time Belgrade took its place on the already established global landscape of the Industrial Revolution, although with all the specific features of its geocultural context (Wallerstein, 1991; Ćorović, 2015).

The capitalist development of cities, in most cases, followed market pressures which resulted in the degradation of space (Lefebvre, 2014). At the beginning of the 20th century, Belgrade experienced a similar situation. But 1912 saw a new, European town-proposal for the city by Alban Chambon, a French-Belgian architect, which called for a network of baroque directions and imposing public buildings on an idealized urban topography. The concept, however, completely failed to observe the complex historical and cultural heritage of the city. The true reflection of the city transformation was the regulation plan of the municipal technical services, titled "The Plan of the City of Belgrade with new regulation drawn, new street names written and blocks numeration prepared for the requirements of the cadastral survey, Scale 1:8000", 1912 (Ćorović, 2015). The urban modernization of Belgrade implied surveying, inspection, creation of the exact data base, namely, an approach to land as a resource and basis for state tax levying. Construction of the communal infrastructure systems continued in the first decade of the 20th century, along with regulation of the street network and landscaping and organization of parks and squares. New public buildings were constructed: hotels, banks, department stores, several elementary and high schools were built, and the construction of the National Parliament building began.

At the same time, the housing fund of Belgrade comprised mostly single story private houses



Figure 1. N. Nestorović, The Grand Passage, Belgrade, 1910–12, interior (photo: Živković and Antonijević, c. 1912; the Archive of the Serbian Academy of Sciences and Arts, Belgrade, sign. 14410-I-V-1351).

(82,74%), of which the majority was constructed by developers and intended for renting (78,37%) (Đurić, 1912). The population density of 62 inhabitants per hectare, was several times smaller than that of London, Berlin and Paris, but almost the same as Munich. A comprehensive study of the hygienic conditions of Belgrade dwellings in 1906–07, an initiative of the Office for Rehabilitation of Poor Housing Conditions of the Municipality of the City of Belgrade demonstrated, in addition to providing multitude other data, that almost 50% of the inhabitants lived in one room flats with or without a kitchen, as well as that the average amount of space, in cubic meters, of the living quarters in the flats for rent was almost half of that in flats owned by the tenants themselves (Đurić, 1912).

This was the context in which the main, commercial street, Knez Mihailova, acquired the new, and at that time modern, wooden "cobble". In 1912, the Grand Passage was opened in the very same street (Fig. 1).

2.2 *Nikola Spasić, a benefactor of architecture*

The merchant Nikola Spasić (1838–1916) initiated and financed the construction of four edifices in Knez Mihailova Street, the third of which, built immediately preceding the First Balkan War, was the Grand Passage (*Spomenica*, 1931; Borić, 2002).

Nikola Spasić was the descendant of a Serbian family, which, "desperately poor", emigrated to Belgrade from the countryside during the 1804–13 First Serbian Uprising against the Ottoman Empire (*Spomenica*, 1931). Spasić trained for 15 years as an artisan and merchant before opening, with his brother, the first leather workshop and store in 1865. The shop manufactured and vended "opanci", Balkan peasant footwear similar to the moccasin; this light, leather footwear was widely accepted as part of the Serbian national costume and was worn in the 19th century both in the city and the village. By the time of the Kingdom of Serbia acquired full independence in

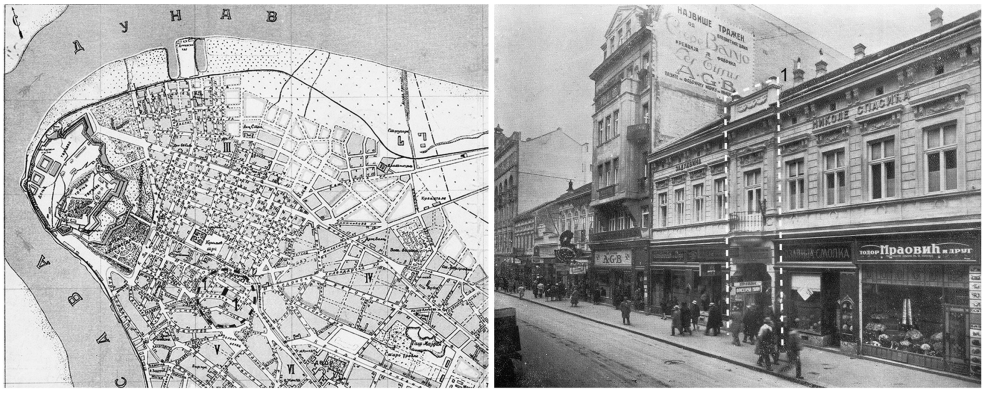


Figure 2. The location of the Grand Passage (1): a) Plan of Belgrade, 1921, 1: 15000, by lieutenant S. I. Obradović, detail (the Military Geographical Institute, Belgrade, sign. 1.5.18), b) A. Bugarski, the House at 19 Knez Mihailova Street, 1875 (from: *Spomenica Nikole Spasića*, 1931, n. p.).

1878, Nikola Spasić was sufficiently rich to completely withdraw from business. The value of the property that the Endowment of Nikola Spasić had at its disposal following his death was close to that of the Nobel Fund (Sofronijević, 1995; Borić, 2002).

Throughout his career, Nikola Spasić maintained a consistent professional attitude: he ran his business in the same way over the years and had an unwavering relation to his clients, which was reflected in his persistent, frugal, diligent self-control and modesty. This, coupled with his humanitarian work, would be how he would be remembered in the city of Belgrade (*Spomenica*, 1931). At the same time, for the architectural design of his buildings, he always selected the best architects, his buildings featured the latest technical devices, the construction material of the highest quality, with the entire building inventory procured from European centres. His will, drawn up in 1912, expressly forbade the sale of any of his buildings. Rather, it called for their exploitation in order to raise funds and thus finance all the undertakings of the Endowment of Nikola Spasić. The main goal of the endowment set by Spasić was the economic development of the nation.

For Nikola Spasić, the capable entrepreneur, the promise of architecture was a dream he pursued to the bitter end. Just a few days before his death on the island of Corfu, where he arrived as a war refugee, Spasić revealed in a letter, his hope that he would return one day to liberated Belgrade, accompanied by the renowned Viennese architect Konstantin Jovanović, who he planned to engage to design new remarkable edifices.

2.3 *The grand passage*

The single story house at 19 Knez Mihailova Street, with a large courtyard oriented towards Obilićev Venac Street, designed by architect Aleksandar Bugarski (Fig. 2b), was acquired by Nikola Spasić in 1910. Two years later, on the remaining land of the plot, a new building and the passage in-between were constructed, designed by Nikola Nestorović (*Politika*, 1912a, b; Pavlović, 2014). In late May and early June 1912, advertisements for stores and shops in the Grand Passage began appearing in the daily *Politika*. One of them advertised the opening of a cobbler shop, offering customers, in addition to expeditious work and fulfilment of all requests, a complimentary ticket to the cinema in the Grand Passage, provided they made a purchase of 20 dinars or more (*Politika*, 1912a). The knowledge of the presumed existence of a cinema in the Passage indicates a specific feature of this public urban space, the first of its kind in Belgrade (Pavlović, 2014; *Spomenica*, 1931; Borić, 2002).

A former student of the Technical University in Berlin (The Technische Universität, Berlin), architect and University professor, Nikola Nestorović, who had by 1910 already produced a significant opus of architectural design, scientific, pedagogic and publicist activity, found himself in the mature phase of his creative endeavor. He authored several books: *The Science on Styles*, n. d., *Agricultural Buildings*, *Manual for Farmers and Technicians,* 1901, *Damp Flats, Their Significance and Cause*, 1910, *Industrial Buildings,* 1926, *Building Structures*, 1927, *Buildings and Architects in Previous Century Belgrade*, 1937. He designed, either alone or in co-authorship, 68 business, public and residential buildings, some of which reflected the turning point in Belgrade architecture as examples of the first application of new structural, functional, stylistic and visual concepts. Some of these buildings in Belgrade are: Funds Administration building (1904) The Belgrade Stock Exchange building (1907), The Bristol Hotel (1912), The University Library (1925), Technical Faculty building (1931) (Pavlović, 2014, 419–32).

On Nikola Spasić's plot, towards Obilićev Venac Street, Nestorović designed a two-story, single-track building (Fig. 3). In the plot's central part, a covered inner courtyard was formed, from which one could exit both onto the commercial Knez Mihailova Street and Obilićev Venac Street, and then continue on down the hillside towards the Sava. Other than connecting the



Figure 3. N. Nestorović, the Building at 17 Obilićev Venac Street, 1910–12 (photo: Živković and Antonijević, c. 1912, the Archive of the Serbian Academy of Sciences and Arts, Belgrade, sign. 14410-I-V-1350).



Figure 4. N. Nestorović, The Grand Passage, Belgrade, 1910–12, interior (photo: Milan Savić, 1921; collection of M. Jurišić).

two streets, Spasić's Passage, at the time of its origination, was also the passage between the European and Oriental Belgrade.

The new building and the Passage included elements of Secession established in the Classicist order. The double pitch iron glazed Passage roof was located at first-story height, and the shop openings positioned on both sides of the Passage longitudinal axis, together with the windows above, made this space visually unique. The glass shop doors were as wide as the distance between the facade pilasters, positioned at regular, rhythmic intervals. Daylight got through as far as the passage interior and together with carefully composed architectural passage elements, made the passage seem open and ethereal (Pavlović, 2014). In the passage corners towards Obilićev Venac, at first-story height there were two niches: one held a bust of Nikola Spasić, and the other one, facing the first, most likely held a statue of the Greek god Hermes. The merchant and his alter ego, thus, could continue monitoring this place of multiple overlapping identities: a public space, shops, stores and cinema, protected urban passage, covered shelter, meeting and shopping place – all common experiences produced and provoked by modern urban culture. One of the images of this passage (Fig. 4) is also the image of that time: the photograph dated 1921, taken at the time of the funeral ceremony of King Peter I Karađorđević, it features funeral wreaths in the Grand Passage intended for the last farewell to the ruler, and it shows that they were maintained by the artisans and salespersons from the nearby shops.

3 THE CURIOUS CASE OF THE HALL OF MATICA SRPSKA IN NOVI SAD, 1941

3.1 *The passage and arcades of Nikola Dobrović*

The concept of covered passages, writes Marina Pavlović, never became the reality of Belgrade architecture (Pavlović, 2014). In 1939, at the location of the building forming Spasić's Passage towards Knez Mihailova Street, a four-story building was constructed, designed by architect Vladislav D. Vladisavljević. Above the other parts of the buildings which used to form the Grand Passage, new stories were constructed. It was then that the glass-cover over the inner courtyard was removed. However, the passage itself was preserved, and despite the additions, the connection between the streets was not blocked.

Nevertheless, in the period between the two World Wars, the passage as a category of architectural typology, and even more so as an expression of architectural design strategy, can be found in the series of projects of architect Nikola Dobrović (1897–1967). Being one of the most notable proponents of Modern architecture in both prewar and postwar Yugoslavia, Dobrović made an outstanding contribution to the development of architectural practice and thought, and designed and built his most significant buildings in the Dubrovnik region, in the period 1934–41 (Milinković, 2007; Ivanišin *et al*., 2015).

Arcades and passages are conceived in a series of his works, most notably in the competition project for the Terazije Terrace (1929/1930) (Fig. 6), a central place in Belgrade, where arcades appear as wide underground pedestrian passageways that connect two streets, covered and lit from above, with shopping windows on either side. In particular, this includes the project for the Kursalon in Dubrovnik (1929), and the competition project for the PRIZAD Palace in Belgrade, from 1937. The features that frequently occur in Dobrović's projects do not have the same formal and functional characteristics as the Parisian shopping passages, but Benjamin's inherent logic is consistently present in his work as an idea of space with emancipatory potential.

Still, the most pertinent case from the point of view of this analysis, is the project for the Hall of *Matica srpska* (*Dom Matice srpske*) in Novi Sad – the oldest Serbian scientific-cultural institution, funded in the Austro-Hungarian Empire – which was designed shortly before the Second World War broke out in the Kingdom of Yugoslavia. This project of Nikola Dobrović was never carried out, but the architect's

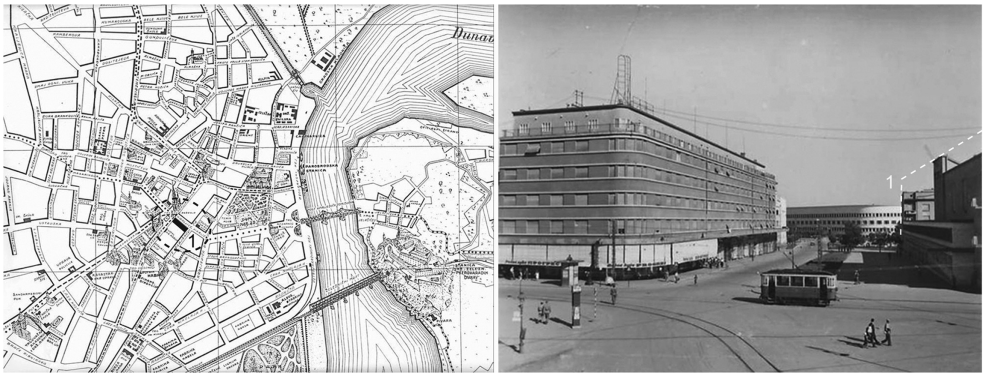


Figure 5. The location of the *Dom Matice srpske* (1): a) Plan of Novi Sad, 1929, by B. Svirèević (the Novi Sad City Museum), b) The Plaza in front of the Tanurdžić Apartments in Novi Sad, Đ. Tabakovič, built in 1934, across the site for the Hall of *Matica srpska* (a postcard, personal archive of M. Milinković).

ideas are specified in the extensive document, Technical Report in Addition to the Sketches for the New Building of *Matica srpska*, the sole remnant of the whole work. They reveal the architect's intensions to design a building for a modern cultural institution in the city, and "rising and multiplying of the new living possibilities" (Doborović, 1941, 4).

3.2 *The Hall of* Matica Srpska

During his stay in Novi Sad, in January and February 1941, Dobrović produced designs for three projects: Hall of *Matica srpska*, the Headquarters of the Bar Association and the Stadium of the Sportsmen's Club *Vojvodina*, all in Novi Sad. The designs for all three projects are missing, save for the one technical report for the Hall of *Matica srpska*. None of these projects has been published or discussed in detail in public. Considering that this was Dobrović's last attempt at getting any assignment before the war would interrupt all building activity, it may be presumed that the reason these projects remained unknown for a long time was actually the crucial moment in which they originated (Milinković, 2007).

The only preserved document is the technical report of the project for *Matica srpska*, where Dobrović explains in detail all three proposals presented in his project. It was submitted to the Main Board of the institution on March 26, the day before the Yugoslav government treaty with the Axis Powers was rejected amidst civil strife, and two weeks before the war actually began by the bombardment of Belgrade. The idea of constructing the Hall of *Matica srpska* came about just before the end of 1940. Although due to the impending war in Yugoslavia and the unstable economic conditions, it did not meet with the approval of all members of the managing board of the Institution. Still, eventually it was decided that Dobrović would be engaged to prepare the technical architectural analysis. It is obvious that desire for a new home of the institution of culture prevailed, even with smaller funds,

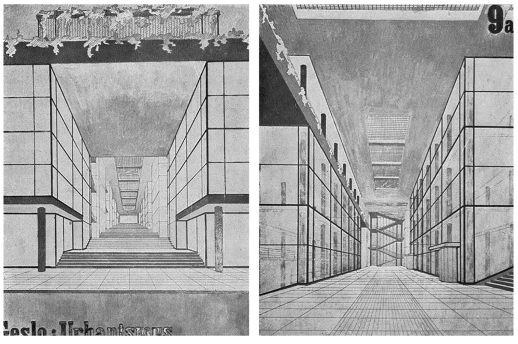


Figure 6. Nikola Dobrović, Project for the Terazije Terrace, 1929–30, Belgrade.

and, as believed, with a current opportunity of obtaining loans on favourable terms, which, at the expected dinar devaluation, would be repaid easily. On the other hand, some members voiced the difficulties of building in those same insecure economic circumstances, as well as the fact that not even the regulation line of the future building had been specified (Milinković, 2007).

The location of the plot anticipated for the construction was in the centre of Novi Sad, where the old building of this renowned institution already stood (Fig. 5). The new building, along with other existing buildings, was supposed to complete an urban block with the perimeter block construction. The plot dimensions were approximately 103 × 20 m, with a slope in the direction of one of the bordering traffic routes. According to the regulation plan, arcades were anticipated alongside this entire traffic route, and Dobrović, in his technical report informs the employers that this requirement has been met by the project. Viewed without the relevant graphic dossier, the very technical report of the architect Dobrović, includes exclusively written descriptions and calculations of the new building, indicating a clear shift from aesthetic issues to

its program strategies and considerations (Milinković, 2007).

3.3 *The technical report: Seeking new possibilities*

The structure of the building is heterogeneous, and "various rooms for various purposes" have been anticipated in it (Dobrović, 1941, 1). The library, archive, department of music and other cultural activities being the primary activities of *Matica srpska* and thus anticipated in the conceptual designs, were complemented by other, commercial functions. Dobrović's designs are missing the fourth, that is, first variant, as well as the proposals that refer to the organization of rooms on the ground floor and are in fact an attempt to provide, with obvious limitations and within given limits, certain concessions in favour of the community. The first version contained recommendations for positioning the cultural activities and proposed an arcade the length of the street front; the other two alternatives assumed the organization of commercial space that contained, as well as the street-front arcade, a longitudinal glass-covered passageway cutting through the main corpus of the building (Milinković, 2007).

Besides the office and residential part occupying the building floors, the organization of the basement was also the same for all three project variants: two auditoriums of different types were anticipated, of which the first was to be used for cinema projections and chamber music, while the second was meant as an integrated restaurant and cinema-variety show. The major difference between the first proposal and the two alternatives of this project is found in the basement organization: the first variant anticipates the coffee-room, whereas the alternative concepts call for commercial shops. Arguing in favour of the realization of the first variant and the organic relation between the coffee-room function and the cinema, Dobrović writes that the building would become the focus of urban life, absorbing both its present rhythm, and also future proportions. In the entire report, and also in the detail in question, Dobrović employs a rigorous, yet vibrant modernity. Not accepting historical inevitabilities provides Dobrović's project a utopian character and contains a latent critical reflection of the existing order, that is, it provides a relation of transgression and at the same time profound connection of an architect with the complex conditions of social reality (Milinković, 2012).

For the second project variant, namely the two alternatives with commercial shops, Dobrović's plans include the glass-covered passages, thus reinterpreting the functional essence of these spaces from the 19th century, as well as the Belgrade Grand Passage, with commercial and artisan trade shops and a cinema under the same roof. This coincidence, however, points to the intrinsic differences, namely to the change of paradigm. Fervently dedicated, in all three cases Dobrović deals equally with a whole series of social issues, considered from the point of view of functioning of an architectural object housing a cultural institution: from the possibility of establishing cooperation in financing its construction, to considering how to soften the consequences of the monopolistic placement of certain shops within the *Matica srpska* building, to securing the financial rehabilitation of other food and commercial establishments across the city and forming collective merchant companies that would ensure lower prices of products to the benefit of "the broader public". Dobrović explains his project as a constitutive part of the urban formation of Novi Sad, which, according to his opinion is still an amorphous urban community oriented more towards "organic life of its agricultural neighbourhood" (Dobrović, 1941, 4), than a product of the urban spirit. In that sense, as understood from the architect's explanation, this project is undertaken in order to be the new urbanity generator.

In its unique formal, structural and functional conceptualization, the project is characterized by simplicity, rationality and the logical application of a concrete skeleton bearing all of its own weight and any additional load (Dobrović, 1941). All the while, the facade comprises roughly cut square stones, 25 cm in width, in regular continual joints that produce a matrix. The whole project in this way, especially given its central location within the city of Novi Sad, subtly subverts the imposed requirement of a specific political representation. The simplicity of form and the visual elements of the building, the use of a specific construction system and the functional logic of the rational sequencing of rooms, along with the program strategies and plans – make this project a design for a new, socialist paradigm.

4 CONCLUSIONS AND OPENINGS

This search for the relics of these two particular 20th century passage/arcade projects, was faced with historical gaps and hidden traces. The original Grand Passage project has been lost in the meantime, the physical space transformed several times, and additional stories added over the decades. Similarly, the graphic attachments to Dobrović's project for the Hall of *Matica srpska* are still missing or at least unavailable, and the building designed has never been carried out. If we compare these two spaces, one constructed and one imagined, the main similarity is their mutual, seemingly paradoxical, characteristic: a solid flexibility at all levels of architectural discourse, manifested in relation to the public, the private, the political and the aesthetic sphere of society, manifested even to the course of history. The *spiritus movens* in the first case was a single person, a benefactor, or what Nikola Dobrović would name in his *technical report*, "a capable individual". Behind the second project there was a significant cultural institution that has initiated the ambitious venture. Since conceived in times just before the great wars commenced, in the second case literally just before, they did not become the repository for the social (un)conscious, as in the case of 19th



Figure 7. V. Maksimović, The Bezistan Passage, Belgrade, built 1953 (a postcard, personal archive of M. Milinković).

century arcades, but rather, became the dream-like images themselves.

Post-war, modern architecture in the Socialist Federal Republic of Yugoslavia, saw the establishment of new "benefactors" and new standards for open public space conception, such as the project of the Bezistan Passage in Belgrade, designed by architect Vladeta Maksimović in 1953. He designed two significant public buildings in the city center in that decade (*Investment Bank* building, 1954–57; and an office building, 1956), which shaped, among else, the new center of the modern city (Minić, 1960). In the particular case of Bezistan (the word being of Persian origin /bezistān/ meaning covered market), the passageway again became the locus of a dreaming collective unconsciousness. Innovations that were introduced through this project, like the new relationship between commercial, cultural and service sector, open roof canopy with a dome-like construction, together with a new kind of female allegorical figure (the sculpture *A woman With a Shell*, by Aleksandar Zarin, 1959), reflect the immense shift in the social structure (Fig. 7). In time, this space too fell into disrepair, just like the famed cinema "Kozara", adjacent to the passage, which did not survive the process of privatization and was then heavily damaged by fire in 2012. In the past several years, there have been attempts made to fully or partially revitalize the Bezistan Passage, yet it remains devastated and fossilized in the current social and political context.

The emancipatory potential of this special type of architecture, we would suggest, operates on two different levels. Passages are transitional places, in the way that human dwellings have become in the Modern paradigm (Caygill, 1998). As the loci inserted into urban tissue, passageways have become private, but simultaneously also public urban space or more preciously, neither private nor public – a passage is the architectural typology between the two, possessing the capacity to have different meanings inscribed onto it. This research is guided by the notion that this substantial quality of passages, if conceived as transient, ambiguous and double-edged, dependent on chance and contingencies, might contribute to prompting new forms of public life.

At the same time, the investigation of this distinct architectural typology might address the current debates on public space decline, burdened with many conflicted social, political, cultural and economic interests (Springer, 2011; Mouffe, 2005). Exploration of the historical perspective of diverse architectural tools, devices, concepts and apparatuses related to passages is enabling the search for diffused means in the analysis of the past. This allows the transformation of, as well as the release from, a previous paradigm, or, to quote Walter Benjamin, "the genuine liberation from an epoch, has the structure of awakening" (Benjamin [1928–29], 2002, 883). Thus the most significant emancipatory force, that surpasses and goes beyond the passage, can be found in separation from dreams past and in anticipation of the future (city). Architectural research that has the architectural typology of the passage as its subject can have as its goal – and achieve – awareness regarding the moment when breaking away from dominant strategies becomes inevitable.

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Sustainability and design in heritage rehabilitation

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ABSTRACT: The sustainability issue is today of crucial importance when thinking and managing architecture and the environment. Building rehabilitation is a sustainable practice, especially when it comes to the rehabilitation of heritage buildings. Design is essential through the use of life cycle thinking, maximizing resource efficiency. Wherever possible, green roofs will be used so as to avoid introducing new types of finishes, at the same time it increases the thermal insulation and reduces the problem of disposing of rainwater. It will be made a management of the existing resources from rainwater, as gutters, downspouts, gargoyles and tanks, as well as the topography of the place and vegetation that contribute to the sustainability of the historic property. The Landscape Architecture will reinforce the sustainability of the historic place. We have selected as case studies the Rehabilitation of Portalegre Cathedral and the Faculty of Law, UL.

1 INTRODUCTION

The interventions' underlying cultural attitude must combine the design process with the principles of economy and environmental impact assessment. It is necessary to question the entire building life cycle, including systems and materials since their extraction, transport, application and disassembly.

Architectural Rehabilitation, and especially heritage buildings Rehabilitation, is intrinsically a sustainable practice as the existing structures represent energy that has already been expended, materials that have been extracted or collected, components which have already been produced – incorporated energy from past generations.

Rehabilitation also means to articulate the building's ages and must have as key concepts reversibility, sustainability, versatility and simplicity, always respecting the Heritage.

Thus, there are also other aspects that should be considered: installing an efficient energy system that takes into account the performance of the entire building and maintain its historic character and ambiance; examine whether the solar technology can be used successfully and if it will benefit the building without compromising its character or the place or the surrounding historic neighbourhood. It is essential to prioritize sustainable improvements, starting with minimal-invasive treatments that are less susceptible of damaging the building.

2 PORTALEGRE CATHEDRAL

The chosen case study refers to the rehabilitation of Portalegre Cathedral, cloisters and annex spaces, 1st prize of a Competition, authored by Ana Paula Pinheiro and Rui Barreiros Duarte (Fig. 1).



Figure 1. Portalegre Cathedral. Photo: SIPA FOTO 00524019.

The annex constructions done over time, either in the building or in the courtyard where a Room for Permanent Exhibition will be built, express interventions by addition that misrepresent the building's character, being necessary to remove them.

Other interventions made afterwards must be withdrawn in order to clarify the Cathedral's authenticity, and to permit an adequate natural light and avoid infiltrations.

The Rooms of Permanent Exhibition (Figs 2–3) and Temporary Exhibitions (Fig. 4) constitute spaces contained by walls, reversible and discrete. This visual quality and maintenance creates an interactive relation between full and empty, enhanced by the shadows' expression during the day. Overnight the artificial lighting stages the spaces between the new buildings and the ancient Wall.



Figure 2. Portalegre Cathedral: Longitudinal Section of the Permanent Exhibition Room. RBD.APP, 2016.



Figure 3. Portalegre Cathedral: Terrace View to the Green Roof of the Permanent Exhibition Room in the southwest courtyard. RBD.APP. 2015.

The mentioned buildings have roofs that will be visible from various places, assuming great importance in the enjoyment of spaces and views of the landscape. It is therefore proposed that these are green roofs, as the observer can enter his own world whilst moving around the building; they transport the imagination to calm locations that belong only to the meditative mind of the visitors.

2.1 *Green roofs*

Green roofs, also known as living roofs, are coated with vegetation planted in light soil over drain materials and waterproofing membranes.

They constitute a sustainable practice that has been gaining increasing importance in order to optimize energy consumption in buildings.

These roofs help to decrease the urban temperature, fighting the heat island effect.

Their greatest potential lies in the ability to cover with vegetal permeable material surfaces that otherwise would be waterproof, restoring the ecology of the place where the building is built.

The "protection from extreme temperatures can also reduce energy costs for building owners" and "in some conditions, a green roof can act as an insulator, while in others a thermal mass effect will act to diminish the temperature gradient above and beneath the roof as the system absorbs, then slowly releases, heat". (Snodgrass, McIntyre, 2010, p. 32).

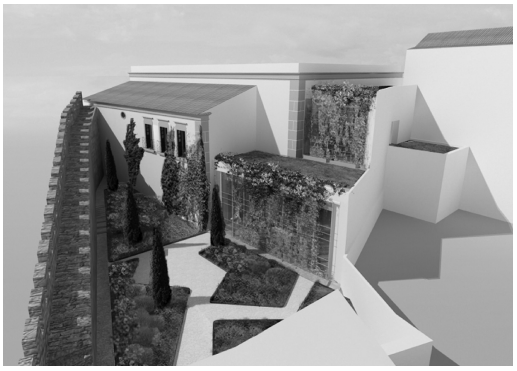


Figure 4. Portalegre Cathedral: South courtyard. Rehabilitation by RBD.APP. Landscape: ARPAS, 2016.

Thus the advantages can be described: contribution to the durability of the building; reduce the temperature range; reduce the heating and cooling costs; increased thermal insulation; micro and macro external environment temperature decrease; increased sound insulation; carbon emission reduction, mitigating air pollution; filtering of rainwater, contributing to pollution reduction, improving air quality; fixing of solvents; ecosystem recreation; attraction of songbirds and reduces the spread of fires (Braungart, McDonough, 2009).

The vegetation should be one that doesn't grow excessively, in order to maintain the character of the building, not being visible from the outside.

It is important to provide the use of a vegetal covering with little maintenance, by selecting sustainable native plants which are resistant to drought and do not require excessive watering.

Therefore, to ensure the success of plantations on the roof, a suitable substrate to ensure the needs of the plants – not only during the installation period, as during its future development – should be placed at the time of planting. This substrate will have a medium to coarse texture, and high capillarity and balanced drainage, providing a firm and durable structure for an extended vegetation cycle for any type of plants. Its specific gravity is reduced, contributing to a lasting and stable structure, ensuring good drainage.

Drip irrigation was used to restrain water consumption. It is intended to include a moisture monitoring system to protect the building from additional moisture and accidental flooding.

The chosen green roof is an extensive modular system like "Green Grid Roof System". The modules have a dimension of 1.20×0.60 m area and 0.10 m deep. The trays of the extensive modular system will come prepared, in this order from the bottom to the surface, honeycombed with drainage blanket with 0.02 m, with geotextile 250 g/m^2 and suitable land cover with 0.08 m minimum thickness. They have a weight of 75 kg/m^2 in saturated soil. The trays have a place to fix a part to move in an effective way. They will be planted with mixtures of plants of the Sedum type,



Figure 5. Portalegre Cathedral: Existing. Photo by RBD.APP, 2015.

which should have a minimum height of 0.10 m and of equal diameter. The plantation will be carried out in quincunx, so as to make a density of 44 plants per square meter. The set will have a 0.25 m thickness.

2.2 *Disadvantages of green roofs*

Although green roofs offer a wide range of advantages, there is also a series of disadvantages in what their implantation is concerned that might cause the necessity of considering other roof options:

– They weight more than traditional roofs;
– Cost of the system implantation;
– Cost of maintenance in case of making an inadequate choice;
– If not applied properly, the system can cause water infiltration into the building.

2.3 *Roofs*

It is fundamental to repair and maintain the historic roofs' materials in good conditions (Fig. 5).

The maintenance of roofing must question the materials used, their placement and operation techniques so as to avoid deterioration.

Some wood elements were detected with substantial section losses and a replacement should be expected in the ones in greater state of deterioration. It is estimated a replacement with a percentage higher than 50% on the wood elements of the roof.

It is essential to monitor the buildings so that there is a prophylactic action strategy, preventing problems detected afterwards.

2.4 *Rainwater harvesting*

The management of existing resources of rainwater, such as gutters, downspouts, gargoyles and cisterns, as well as the site topography and vegetation contribute to the sustainability of the historic property.

It is a traditional principle, which formed the basis of several civilizations, referenced in the territory with



Figure 6. & Figure 7. Portalegre Cathedral. Existing: Cistern (Left) and water canal (Right). Photo by RBD.APP, 2015.

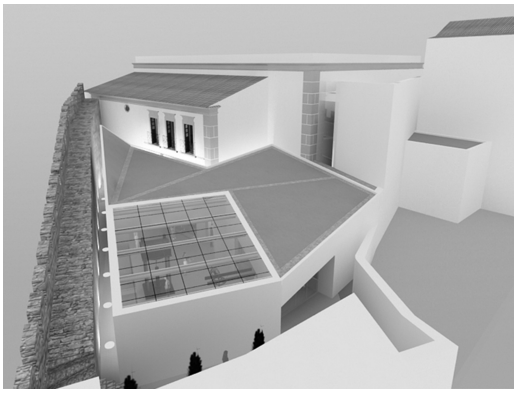


Figure 8. Portalegre Cathedral: Temporary Exhibition Room in the south courtyard. Skylight with photovoltaic cells in the glass. RBD.APP. Landscape: ARPAS, 2015.

infrastructures that can be mega-structures, such as the aqueducts example.

Cisterns correspond to a process of water collection and reuse developed by the *Order of Cister* in the convents and Cathedrals (Figs. 7–8). A process of capturing that is based on a significant cost reduction.

Green roofs filter rainwater as part of a natural system of storm water management, absorbing up to 70% of the water that falls on them. In addition, other resources will be used such as retention and filtering areas with a rainwater retention tank to improve storm water management and water reuse on site.

The Landscape Architecture, through the choice of local adapted plants and that consume little water will enhance the sustainability of the historic place.

2.5 *Renewable energies*

If it is possible to use renewable energies, these should be installed in compatible location with the site, or on a non-historic building or expansion, minimizing the impact on the historic building and site.

The initial solution predicted that the Temporary Exhibitions' building would be built in the south courtyard. The roof had a pendant that articulates with the slope of the Wall leaving a free path along the ancient Wall and next to the *Cabido* building (Fig. 8).

In this pendant there was a square area with a skylight with photovoltaic cells embedded in the glass. It allied natural light to the possibility of using renewable energies in a discrete and integrated way. Sunlight would be controlled by interior blinds. The photovoltaic cells had their presence diluted in the glasses that incorporated their energetic qualities. The research of new materials and techniques and the adaptation of technical systems to a cultural field is a path that has been steadily developing and that revolutionizes principles that so far were negative.

This solution was not approved by the *DGPC* (General Direction of Cultural Heritage), even though it was not visible from the outside of the Wall. It has however been replaced by another solution with less construction and without renewable energy. In this case, the green roofs are also used and green façades are used as natural shading, extending the existing image of the *Cabido* building with creepers on the façade (Fig. 4).

2.6 *Natural lighting*

Natural lighting is favoured in all rehabilitation. So, whenever possible, the historic windows previously blocked will be reopened adding natural light and ventilation.

2.7 *Design*

"*Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles.*

Therefore, design is the central factor of innovative humanisation of technologies and the crucial factor of cultural and economic exchange." icsid

In what museums are concerned, lighting should enhance the qualities of the exhibited pieces, cancelling the variations of the day and night, and of their transitions. When thinking about the versatility of lighting design, two questions arise: energy saving and expressing different types of acting, depending on the exhibited pieces' potential. Thus, these variables might enhance different qualities under different types of light and lighting conditions (Pinheiro, 2015, p. 128).

When exhibiting religious pieces it is necessary to create appropriate relations that manifest their sacredness and meditative atmospheres. One should reflect on the qualities of natural light, where the stained glasses – different in the north and south façade in the Portalegre Cathedral – creates, during the day, an ethereal environment sacralising the chapels.

The colour of light is of crucial importance in religious architecture, through stained glass windows and lighting design: on the articulation of spaces with exhibition displays and on the way to enjoy the exhibited pieces, explaining their physical and symbolic



Figure 9. Portalegre Cathedral: Permanent Exhibition Room in southwest courtyard. RBD.APP, 2015.

qualities. This aspect involves a natural and artificial light homogenization, especially if we are before the lighting of paintings.

The lighting enacts the spatial qualities, exploring environments and their sacredness, taking advantage of intensities, location, colour, the relations established between objects and the modelling of space.

The quality of the assembly results from different types of relations: the pieces together, along with spaces and the creation of moulded environments, having the light as material of construction.

In the case of an intervention in a building classified as a national monument, particular attention was given in the choice of solutions to propose to the facilities and on how to implement them, according to the Lighting of Historical Monuments criteria of Charter of Taxco 2009.

During the project the principles of Sustainable Design were followed. There was a concern to maximize natural light and conserve energy, specifying systems, fixtures, appliances and energy-efficient equipment. Solutions – that avoid the need to intervene in an irreversible manner and that are easy to uninstall – have been proposed, having created a dynamic solution that considers various factors, bearing in mind that the equity intervention conditions do not allow opening grooves on the walls and ceilings.

In the temporary and permanent exhibitions area and in the church, the installation of a centralized control system of general lighting, with dimmable, was proposed.

The exhibition halls will be lit with rails with projectors, using LED strips in the remaining spaces for ambient lighting. The used devices are equipped with LED light sources due to its higher yield and duration (Fig. 9).

In the Cistern access route, devices were used at low rate with lighting directed to the pavement. The Cistern vaults were lighted with projectors and complemented by others located outside to illuminate the well in the Cloister courtyard, simulating daytime natural light with a colour temperature of 5000 K.

In the Cloister, devices of ruler type in LED were placed on the arches and directed to the courtyard,



Figure 10. Faculty of Law, UL. Porfírio Pardal Monteiro, 1958. Photo by Ana Paula Pinheiro, 1994.

in its four sides. Uniform light was obtained over the entire courtyard with a colour temperature between 3000/3500 K.

The outdoor lighting of the courtyards, where the Exhibition Rooms will be built, was conducted with floor projectors.

The lighting of the main aisle of the cathedral took advantage of the existing chandeliers, where projectors of reduced dimensions were incorporated, in an adequate number to ensure the lighting of the main aisle vaults. Additionally, the installation of projectors on top of the chapiters of the columns was predicted.

The side aisles were illuminated from the pillars of the side chapels with targeted projectors to the ceiling of the vaults. In the altars the use of lighting through LED strips was predicted, placed on the side mouldings to light the ceiling, and LED rules to illuminate the arch. The carved altars were lit with steerable projectors, installed in a vertical rail and placed in the furthest corners from the vaults, allowing adjusting the required number of projectors (Gonçalves, 2015).

3 FACULTY OF LAW, UNIVERSITY OF LISBON

The Faculty of Law, University of Lisbon, corresponded to an intervention at the level of its Conservation, Restoration and Architectural Rehabilitation with Expansion by Ana Paula Pinheiro and Rui Barreiros Duarte.

1st prize of a Competition in 1994, it was inaugurated in 2001.

"The pre-existing building regained the original 'neatness' without being apparent that, for instance, a (localised) internal space reorganization took place, that the basement was changed into a serviceable floor by the lowering of the patios, or that the main entrance was renovated – with simplicity and without an unnecessary protagonist ambition.

In this intervention the proximity to Pardal Monteiro certainly helped to ponder the moments of discretion and the moments where the architect asserted his own work, thus resulting in a genuine rehabilitation of a relevant example of the 'Estado Novo' public



Figure 11. Faculty of Law, UL: rehabilitation RBD.APP, 2001. Photo by Sérgio Mah, 2001.



Figure 12. Faculty of Law, UL: main entrance. RBD.APP, 2001. Photo by Sérgio Mah, 2001.

architecture and its integration into the contemporary expansion." (Costa, 2009, pp. 18–22) (Figs 10–11).

The façades were cleaned with water jet and the dirtiest areas with silica jet; the windowsills were cleaned with fine sandpaper. Air conditioners were removed from the façades and placed on roofs. Inside, the terrazzo walls were cleaned with SIKA CLEANER.

3.1 *White roofs*

The white roofs are designed to reflect more sunlight, absorbing less heat than common roofs, decreasing the heat transferred into the building and improving occupants' comfort. They have easy maintenance, increasing the life cycle of the coverage and thus contributing to the reduction of the urban heat island effect.

The standard or dark covers can reach temperatures of 55°C or more under the summer sun. A white roof under the same conditions may be 10°C cooler.



Figure 13. Faculty of Law, UL: Circulations with natural light and view to the outdoor green area. RBD.APP, 2001. Photo by Telmo Miller, 2013.



Figure 14. Faculty of Law, UL: Secretariat with natural lighting and view to the outdoor green area. RBD.APP, 2013. Photo by Telmo Miller, 2013.

They are therefore suitable for hot climates, generating energy savings in refrigeration systems.

The covers of the existing building, as well as the expansion opened in 2001 are white roofs.

3.2 *Natural lighting*

The lighting and ventilation on Floor – 1, made possible by the courtyards pavement relegation, introduced new degrees of freedom for the functional reorganization of interior spaces that were previously occupied by warehouses and books depots of the library. This straight relation with the outside, allowing its visual enjoyment, as well as the creation of exterior accessible interaction zones, transformed the old basements in spaces occupied by new classrooms and administrative areas (Figs. 13–14).

3.3 *Design*

The purpose of design when building environments is to create the conditions for greater physical and aesthetical enjoyment of the spaces.

Tile panels were used as a graphic design example on how to communicate with the public and/or private users, bringing art to people and creating areas where we can think and dream in order to better act and create.

The tile allows an integrated thinking in terms of architectural conception, sustainability and design, answering to almost all the principles of Sustainable Design (Pinheiro, 2015).

In 2000, the design of all individual equipment was made, as a complement to the Architectural Rehabilitation – benches, flowerpots, exhibitors, dustbins – in order to create an identity and support living areas and the interaction of students, with elements that could be used both inside and outside.

The benches and flowerpots prototypes were executed in GRC, wood and stainless steel (Fig. 15).

However these were not used, and the Faculty opted, against the authors' will, to use ones offered by the Alumni that go against the design principles of the project (Fig. 13).



Figure 15. Exhibition *MEGARIM CON.VIDA*: Bench and Flowerpot designed for the Architectural Rehabilitation of the Faculty of Law, UL in 2000 by Ana Paula Pinheiro. Photo by RBD.APP, 2013.

In 2013 there was a new Rehabilitation, authored by the same architects, and Classrooms' and Workshops' furniture was designed and produced on the principles of sustainable design.

3.4 *Accessibilities*

Throughout the intervention there was a minimization of architectural barriers, making the building an inclusive space for mobility.

All areas were connected by reversible ramps, having an elevator been placed in the east ladder pump, allowing access to all the floors (Fig. 13).

4 CONCLUSIONS

Rehabilitation of Architectural Heritage, in addition to the preservation of the building, involves a thorough analysis of the roof and materials – conservation status, finishes, joints, gaps, settlement conditions – as well as the dynamic relations with water and wind.

The adaptation of interior and exterior spaces without destroying the identity of the whole, allows to introduce new services, boosting their enjoyment according to programmatic redefinition that make the buildings experienced by society. Design acts as a complement of Architecture, using life cycle thinking and maximizing resource efficiency.

One can conclude that the Rehabilitation of Architectural Heritage and Design constitutes an integrated set that must have in mind Sustainability.

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From monument to embodiment: A social case for a more expansive representational strategy for architectural heritage

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ABSTRACT: How do we tell the story of a 1600-year-old building? In architectural heritage, this question is one of representation. There is also the question, however, of choosing which story, or rather stories, to tell. St. John of Studius Monastery, later known as the Mosque of Imrahor, in present-day Istanbul, Turkey, is slated for an imminent and controversial renovation, which brings the issue of preserving myriad aspects of its tangible and intangible heritage to the forefront. A case like this exposes the urgency and significance of finding alternative modes of studying and recording buildings with complex histories through available and emerging digital tools. While effective cultural preservation projects utilize robust archiving methods, they also rely on design and representation so as to "come alive" as platforms for new scholarship and community engagement.

1 INTRODUCTION

The specific heritage site discussed in this paper is St. John of Studius Monastery Church, later known as the Mosque of Imrahor, situated in the historic peninsula of Istanbul and regarded as the oldest religious structure still standing in the region (Fig. 1). The site has not only a complex history but also a controversial restoration project in its future, which has brought the issue of preserving its tangible and intangible cultural heritage to the forefront.



Figure 1. Photo of the ruins taken from the minaret in the context of 1930s (Nicholas Artomonoff Collection 2011–2013).

Partially abandoned since the 1920s and currently dilapidated, our knowledge of the physical construction of the church and its cultural significance are based on field research supplemented by secondary resources on early Byzantine ecclesiastical architecture. While the exact date of its construction and the specific scope of the renovations the church has undergone over time are debated, scholars like Dirimtekin, Mango, and Van Millingen have illustrated detailed portrayals of the church's various distinct phases (Dirimtekin 1973; Mango, 1976; Van Millingen 1912). Literature on theoretical underpinnings of cultural heritage, specifically as it relates to new digital media, pose provocative questions on what constitutes cultural heritage, how we conserve its various aspects, and whether the objective is to deliver a single cohesive story or facilitate multiple narratives. Scholars engaged in a theoretical discussion of digital scholarship, such as Drucker and Presner, draw attention to the larger conceptual questions as to how we can leverage emerging technologies to foster new representation techniques and cultivate dialogue rather than merely answers (Drucker 2009; Presner 2014).

This paper frames an analytical discussion around a particular digital reconstruction project of the Byzantine basilica structure and uses this process and its results to draw arguments on the limitations as well as the opportunities for new strategies to represent architectural heritage in multiple contexts.

In terms of methodology, the paper first outlines the history and significance of the Studius church as a site of architectural and cultural heritage in relation to the transformation from Byzantine to Ottoman rule, and subsequently to contemporary Turkey. Upon establishing its geopolitical and historic context, the paper analyzes a specific digital modeling project in

terms of its technological and conceptual approaches and provides an overview of suggested taxonomies for organizing content. These taxonomies lead to a discussion on seminal examples of digital scholarship, which begin to suggest concrete design parameters to facilitate complex narratives for complex heritage sites.

The preservation of architectural heritage itself is a complex and interdisciplinary project, which can be resolved and, in fact, enhanced through design. More specifically, if considered as a spatial construct supported by digital scholarship tools, cultural heritage can impact communities and gain their alliance through sustained and authentic engagement.

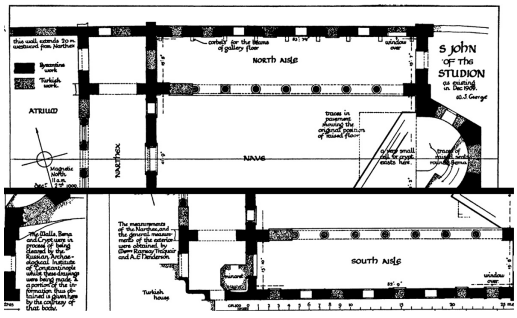


Figure 2. Plan of the basilica with notes describing some of the internal modifications over time (Van Millingen 1912).

1.1 *Background of the heritage site*

The oldest ecclesiastical Byzantine structure in present day Istanbul, the church of St. John Studius Monastery was erected around 450 A.D. by patrician Studion, possibly on the grounds of an existing parochial church, near the "Golden Gate" situated along the Theodosian city walls delineating the Byzantium of the time (Mango, 1976). Initially, the monastery housed the order of Acoemetae, otherwise known as the "sleepless monks," who characteristically held their services continuously throughout the day and night. The monastery began to gain larger prominence in the Roman Catholic community in the 8th century, when as many as 700 monks resided within its bounds (Dirimtekin 1973). The historian Van Millingen describes the monastery in the 11th century as a refuge for devoted monks, over-exposed emperors, and even dissidents—and as a focal point of clerical and intellectual culture in the Roman world (Van Millingen 1912). The Catholic Encyclopedia also tells us that the site acted as the burial grounds of holy bodies, the center of Byzantine religious poetry, and an educational community for calligraphy.

A classic example of early Christian basilica building typology, the church represented an application of this paradigm on a more squareish footprint of approximately 26 meters by 34 meters (Fig. 2). Most of the building-scale architectural elements are discernable from the remaining structure, including the three-bay nave extending in the conventional east-west direction with galleries over either aisle, an apse with a semicircular interior and three-sided exterior geometry, pillared narthex, and an underground cistern (Mango 1976).

Some of the elements that have not survived are the timber roof structure over the nave and intricate interior adornments that distinguished the Studius church from other basilica constructions "mass produced" throughout the Roman world in the Near East, North Africa, and Italy (Mango, 1976). Architectural historians, including scholars of architectural ceramics, describe the interior of the monastery as faced with marble panels, Corinthian capitals and architraves with remarkable polychrome plant ornamentation, and a marble floor constructed of *opus sectile,* an ancient inlay patterning technique featuring elaborate geometric motifs (Gerstel, Lauffenburger 2001).

While Mango's descriptions place the architecture of Studius in the early Byzantine context, Van Millingen and Müller-Wiener provide further analysis of the continuous re-building during later phases of the Empire as well as the complete neglect the monastery was in after the Latin occupation of 1204, when it became ostensibly a grazing ground for sheep. Upon the demise of the Byzantine Empire in 1453 and the settlement of Ottomans in Constantinople, all functions of the monastery ceased. Until the early 16th century, the grounds were used as a stone foundry, servicing the Ottoman Sultan's widespread construction throughout the city, including such significant structures as the Topkapi Palace (Inalcik 1969/1970). In around 1485, the Sultan's equerry, a high-ranking officer in charge of the stables, converted the monastery to a mosque, thereby inspiring the name Imrahor, which literally means the Stablemaster. Subsequently, the mosque was exclusively designated as a Sufi dervish lodge, or *tekke*, dedicated to the brotherhood of the Sunbuli, a branch of one of the most prominent Islamic sects. Interesting to note is that the interior decorative work of iconography and *opus sectile* survived until well into the 16th century, when the *tekke* not only functioned as a space for prayer for Muslims but also as a center for education of some of the most prominent calligraphy artists of the Ottoman Empire, paralleling a tradition established in the monastery by Christian monks in the 12th century.

Major physical modifications ensued from the programmatic changes related to liturgical practices, which incorporated more of the surrounding area around the basilica and almost doubled the footprint. The rehabilitation into a mosque entailed the addition of the minaret, a residence for the Imam, the leader of worship and the religious community, as well as the reconfiguration of the floor surface pattern to overlay the *mihrab,* the architectural niche oriented toward the Mecca, as is customary with all mosques around the globe (Fig. 3). Smaller scale modifications included new walls to replace the colonnade, infilled

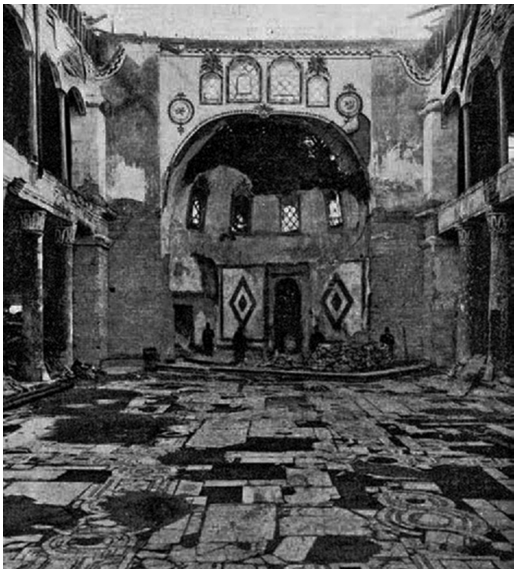


Figure 3. Interior view of the *mihrab* and *opus sectile* floor (Köse 2012).

windows and doors, and *sadirvan,* a pavilion-like fountain for ablution practices. Other major reconstruction recorded in the Ottoman state archives occurred due to environmental causes, such as the fires of 1718 and 1782, and the earthquake of 1894 (Köse 2012). Further analysis would provide detailed information on the specific chronology and materials of these alterations.

The latest phase of the series of rebuilding on the site is a renovation project undertaken by the Directorate General of Foundations administration, which has had jurisdiction over the property since the early 1920s, coinciding with the regime change in what is now the Turkish Republic (Köse 2012). Even though the building had been designated a museum by the administration in 1946, the premises was not open to the public and has fallen into decay—yet, it remains a draw for tourists on Eastern Orthodox pilgrimages as well as scholars. The planned construction agenda is to rebuild a mosque, a politically charged direction in terms of rehabilitation. The news raised controversy among various constituents, including the local and displaced Greek population who continue to regard the basilica as sacred, and others who reacted to the opacity of the process and the lack of information and details in regards to the architectural plans (Ziflioğlu 2013).

1.2 *Background of the digital reconstruction project*

The impending restoration of the Mosque, scheduled to start in late 2016, and the reaction it received foregrounded the urgency of devising inventive preservation strategies for architectural sites with multiple significant cultural identities. The revived focus on this piece of architecture coincided with the formation of the UNESCO Chair in "Management and Promotion

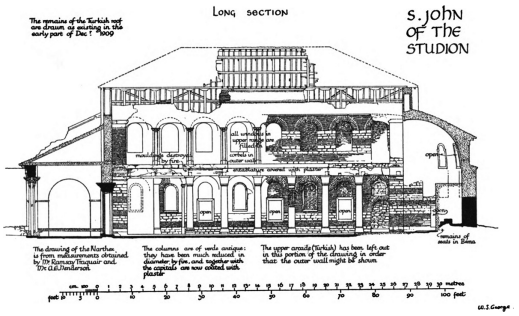


Figure 4. Longitudinal section with notes describing some of the internal modifications over time (Van Millingen 1912).

of World Heritage Sites: New Media and Community Involvement" at Kadir Has University in Istanbul. This initiative instigated collaborative efforts between other cultural institutions, industry partners, and the university. One such partnership was with Bilkom, the leading software distributor in Turkey, to work on a project involving new media with a team of students and faculty members at Kadir Has. The team agreed that the Mosque of Imrahor would be an appropriate first case study for a digital reconstruction project. Bilkom, as part of their social responsibility agenda, had undertaken a similar project for the ancient city of Pergamon in Western Anatolia, for which a tablet application to recreate specific perspectives of the historic site was launched. Similar to the Pergamon project, the goal of the Studius church reconstruction project was to produce digital models for the development of an application catered primarily toward touristic and educational visitors to the site.

The building information modeling software, ARCHICAD, is one of the programs Bilkom represents in Turkey. Therefore, one educational goal of the project was for a team of students to learn and practice the use of this specific platform. Along with digital modeling, the students also engaged in close analysis of existing documentation of the site and learned about the "layers" of history laminated on this architectural and geographic site (Fig. 4). Involvement with this project introduced the students to a community at the intersection of cultural heritage and new media—all aspects of which are outlined in the mission of the UNESCO Chair.

The students worked as the primary modelers, but they were also integral to the discussion surrounding the conceptual agenda of the project. The technological challenges stipulated a phased approach to modeling, in which the initial installment of the project would focus on a single aspect of the site's history. The team decided to transfer the Byzantine basilica in its 11th century condition, at the peak of its social prominence and architectural presence, to the digital environment of ARCHICAD. This decision entailed the task of deciphering and uncovering the later modifications carried out by the Ottomans. The relatively narrow focus was motivated by the academic calendar of the university



Figure 5. The layers of modification currently visible on the walls (photo by author).

as well as the steep learning curve the software initially demanded.

This author argues that the technical challenge of collaborating on the construction of a historic building in the digital environment created a critical limitation, reducing the physical, temporal, and inevitably, conceptual scope of the project. The major challenge with ARCHICAD was the question of how to represent or recreate the Roman masonry structure along with the series of intricate finish work within the interior, implementing a tool specifically tailored to contemporary standards and components of construction. The solution to this specific problem would be to make a model that would ultimately yield an image that was a visually accurate, idealized version of the basilica. Therefore, a "well-built and clean" model and a "finished" visualization of the basilica would essentially erase the sense of time—and represent a singular, arguably less accurate, rendition of history. The cleaner the image, the less it speaks to the character of the site and the nuances of its heritage. An image that generates a specific perspective at a particular location of the site would fall short of actually allowing "access" to its history and heritage.

2 THE NATURE OF THE CONTENT

A "noble ruin," in Cyril Mango's words, the architectural details of Studius can be visualized by comparing it to other examples in the area. Documentation available on the basilica incarnation of the building is heterogeneous and incomplete. Heterogeneity here characterizes the combination of quantitative and qualitative data, multi-scalar aspects of its construction, and the intersection of both scholarly work and personal accounts.

A stratified classification of quantifiable and qualitative data is unproductive from the perspective of the humanities disciplines that study ambiguities. It is an evasive task to distinguish between strictly informative and expressive images. As Drucker reminds scholars working within visual studies, all images embody an agenda (Drucker 2014). An investigation of what is known on this site must accommodate and, more importantly, relate to both types of data. In terms of measured data, the architectural drawings produced by Van Millingen convey an analysis of layers of construction that were discovered in the late 19th century (Van Millingen 1912). Additional documentation is available on the various construction projects the building went through after major earthquakes and fires in the city. Due to the incomplete nature of these drawings, and in order to find suggestive representations of what the spaces were like, researchers can reference the photos taken by Nicholas Artamonoff in the early 20th century and those included in the archives of the Council on Historic Heritage (Nicholas V Artamonoff Collection 2011–2013; Köse 2012). In addition to visual data, further investigations of other sensory experiences of the space, such as the sounds of the hymns during the Acoemetae chants or the call to prayer, would add yet another atmospheric layer to the story. This body of diverse representation begins to convey a sense of space as well as the life outside the walls of the basilica at different times in history.

A second type of variety occurs with scale. As a piece of architectural heritage, the building offers opportunities for critical research that ranges from the building's components to the wider urban fabric in which the building is situated. Documentation in the field captures the current condition of the wall assembly, which exhibits the typical Byzantine method of alternating bands of brick and stone coursing, along with the transmogrification the walls have gone through with discontinuous patches and fills (Fig. 5). At an even smaller scale, mosaic *opus sectile* with marble inlays prove to be of interest. Patterns and types of stone used in floor construction in the 11th century create connections with other Byzantine examples of mosaic work. On a larger architectural scale, investigation can include the basilica in its built context, and preliminary analysis shows the changing housing stock in its neighborhood, Yenikapi. The building has gone through numerous renovation projects, as well as has faced major damage and additions. At the scale of the city, the transformation of this part of the world from the 5th century Constantinople to the 21st century Istanbul calls for analytical mapping studies. The Studius monastery was situated relative to the Sea of Marmara, the city gates, and nearby stone foundries. It held a commanding position in the Byzantine era. The dissolution of the monastery complex and the rapid urban growth in the surrounding neighborhood buried the church within the denser urban fabric. In its current context, the ruin is precariously sited in immediate proximity to new construction developments and large swaths of densely populated blocks (Fig. 6). For these reasons, documentation of the building at a variety of scales from the object to the city is a challenging archival task and an even more difficult representational project. This body of information is essential to understanding the make-up of the building in its changing context.

A third type of heterogeneity in data exists between scholarly work and personal accounts. The question of what is historically relevant and individually significant has traditionally been definitively separated (Cameron, Kenderdine 2007). In order to be able to



Figure 6. Aerial view of the ruins in the contemporary urban context of Istanbul (Kudde & Ahunbay 2014, Fig. 1).

entertain open-ended questions and cultivate multiple readings with potential connections, however, a combination of scholarly and anecdotal, written, and oral histories is required. Personal connections with the building can be traced within various groups that inhabited the building in different ways. Some examples include the descendants of the Greek population of Istanbul, by now mostly displaced; the Sumbuli followers who were officially disbanded with the formation of the secular Turkish republic; the apprentices of the calligraphy program conducted in the mosque; and ultimately, the neighbors—including the daughter of the latest imam of the mosque—who are among the very few with de facto access, if only visually, to the basilica (Fig. 7). A record of these oral histories would suggest the multiple identities the building embodied for different social groups, which may be initially framed around differences but potentially yield salient commonalities.

Given the layers of seemingly disparate content on the site, speaking in terms of the building as a finished product is insufficient as far as it fails to capture the full breadth, depth, and character of its cultural heritage. A more apt framework is speaking in terms of a "landscape," as suggested by Jessop (Jessop 2008). The ongoing nature of change and complex sets of relationships suggest an ecological framework—or landscape—that, as a layered and dynamic entity, captures these qualities.

3 THE ORGANIZATIONAL STRUCTURE

An overview of the available sources of data establishes the complex nature of the content, which highlights the equally complex issue of how to manage and deliver this content. The nature of the organizational issue is two-fold, technical and conceptual, both of which comprise a design problem. As Drucker states in her article "Blind Spots," the very design of the content, the archival project, defines the intellectual engagement it will initiate, be it scholarly or personal (Drucker 2009). Therefore, this paper supports the argument that the technological task must serve the conceptual agenda.

The technical endeavor is one of building a flexible yet stable database that can manage large amounts of multi-media documentation. Software becomes an integral part of any digital scholarship project, introducing a level of precariousness to the project as technologies shift, update, and inevitably become obsolete. Much like the discussion of digitizing traditional media and archiving "born-digital" data, the preservation of the system is a secondary level issue. For the Studius project, the partnership with a commercial party specialized in software distribution promised sustained digital maintenance.

A more critical task is to establish the conceptual agenda to determine the framework in which information needs to live. Again, Drucker reminds us that no act of representation is neutral; furthermore, the mode of representation shapes our knowledge of the referent. For the digital reconstruction of Studius, Kadir Has University team resolved to recreate the basilica in its 11th century condition in a photorealistic manner. This type of a rendering exercise, given the nature of this cultural landscape, posits the question of what is real. A project focused on cultural preservation supported by new media might seek solutions to design problems of maintaining the layers, broadening the extents, and preserving the open-ended questions. If the question had not been "What does the building look like in the digital environment of BIM software?" but instead "How do we preserve the cultural heritage embodied in this piece of architecture?", the project would shift focus conceptually and technologically. The "product" would not be an image capture but rather a platform facilitating multiple narratives.

If the goal is to design a facilitator of multiple readings and not a vehicle for a singular message, what are some of the appropriate modes of representation? A familiar and established approach to storytelling in an expository sense is textual, or syntactically organized and following linguistic rules. This narrative structure follows a linear trajectory and a singular agenda, as well as eliminates overlapping stories (Refsland 2007). Cultural heritage sites seen as "landscapes" demand multiplicity, and therefore a medium that can accommodate layering and subjectivity. Any "finished" product, whatever the medium may be, commits to a single or dominant story (Paraizo 2007). A preservation project that focuses on memorializing an "intact" artifact digitally mimics and replicates the limitations of traditional, analog media. Digitally recreating an image does not fully utilize the emerging scholarship tools or take advantage of the possibility of designing an environment.

The next question is what are some of the narrative strategies available that might be unconventional but required to think about new tools. Software for Geographic Information System (GIS), Virtual Reality (VR), and data visualization are exciting and potentially robust opportunities for any future projects. However, the answer to the question above is not a response in terms of a type of software, but rather a set of design parameters. Upon consideration

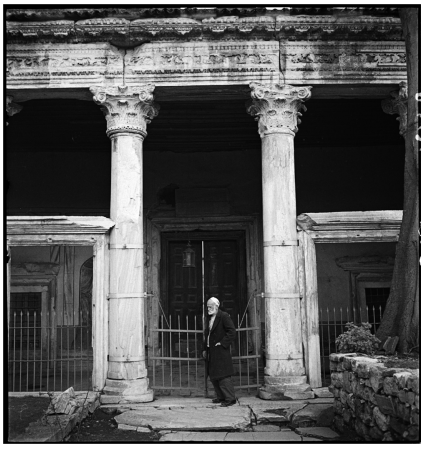


Figure 7. The narthex (Nicholas Artamonoff Collection 2011–2013).

of how to represent the history of the Monastery of Studius/Mosque of Imrahor with a conceptual agenda and technological framework in mind, several requirements emerge: layered organization, scalability, and multiplicity of access points. This paper argues that this set of attributes would ensure a solid foundation for how a robust yet flexible digital environment on cultural heritage might operate.

4 SPECIFIC EXAMPLES

The following examples implement experimental methodologies where the conventional modes of operation for any given medium are challenged. Specifically, they all exhibit layering, scalability, and multiplicity of access in ways that begin to suggest how these parameters might be incorporated in a spatial representation of architectural heritage.

The question of how medium-specific, therefore limited, renditions of the physical world might be challenged is not new. Étienne-Jules Marey and Georges Demeny, with their iconic work in the late 19th century, were exploring the still image as a medium to capture motion. In a series of studies with chronophotography, they were able to quantify the movement of the figure in space registered along a temporal sequence to produce a continuous sense of the body in action, form in flux (Fig. 8). The print medium embodies the dynamic body by visually layering each instance, such that two-dimensional work describes the three-dimensional object in time.

Another experiment in representation using a new set of layering techniques is the drawings of Bramante's Tempietto crafted by the architect Daniel Castor in late 1990s (Fig. 9). In this particular example of a strictly architectural study, Castor uses the drawing medium as a device to reveal what is physically hidden from view, superimposing the interior volume on the exterior envelope or interpolating a wireframe skeleton of the masonry structure, thereby establishing

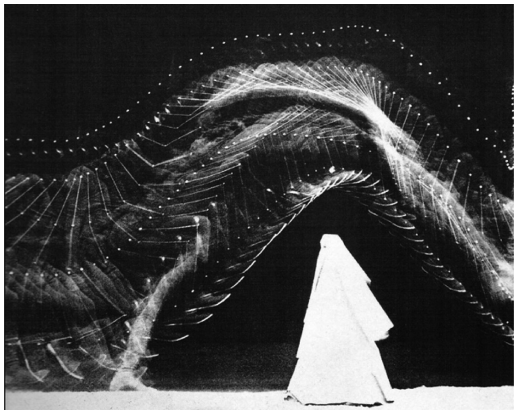


Figure 8. Title unknown (Demeny, Marey n.d.).

such a representational strategy that he s as "jellyfish" drawing. These layers of invention, interpolation, or inspection generate different readings in a way that challenges the common cognition of Tempietto specifically, or the objecthood of an architectural monument in general.

Another project that uses layering but on an urban scale through mapping is HyperCities, a collaborative initiative by UCLA, the University of Southern California in Los Angeles, City University of New York, and other community organizations (HyperCities 2016). A recent publication on this experimental platform defines HyperCities as what is and what is not: HyperCities is not a map or a finished piece of software, but a collection of laboratory projects testing the boundaries of mapping as a process of telling stories through geo-temporal structures (Presner 2014). Inhabitants of HyperCities are in a way virtual flâneurs, navigating through places and time as opposed to open and close windows or looking for a particular thing through a search field. As a collection, HyperCities projects typically implement the quantitative base layer of GIS or Google Earth but create knowledge by overlaying other types of stories across geography and through a temporal dimension, thereby effectively blending the notions of positivist and metaphorical mapping (Presner 2014). Characterized as "thick mapping," these projects allow for expansive wandering in a lateral sense, akin to the phenomena of "hyperlinking," as well as vertically in any one location, referred to as "drilling deep," harkening back to a geological act and reinforcing the depth of layers.

The HyperCities project also utilizes the notion of scalability in a spatial way, characterizing it in optical terms as "zoom." The user (or viewer or reader) "zooms in" to conduct close reading exercises and "zooms out" to see broader relationships and comparative patterns. When the ability to itinerate exists in an expansive environment, the change in scale of focus helps uncover different levels of information, to hone in, much like the way an architectural drawing will



Figure 9. "Jellyfish" drawing (Castor 1999).

convey a different level of detail on the same element at different scales.

Another project, conducted as part of an interdisciplinary course at UCLA, exhibits a similar take on using a variety of scales to narrate a variety of stories and casts the object scale along a vast temporal dimension. Andean Narratives starts with a very specific scope of study, a defined collection of ceramic pottery crafted in the South American region of Andes, ranging in date from approximately 100 to 800 C.E., and currently held in UCLA's Fowler Museum (Andean Narratives 2016). The student project zooms in to digitally and three-dimensionally scanned objects and zooms out to find complex patterns across geographical regions and historic time periods. The story of a singular vessel is available but also supported by the multiple other strands of knowledge an object may have relative to the other artifacts in the collection. In spatial terms, the design of the platform allows the researcher to have intimate proximity to the physical qualities of the vessel—its texture, color, form, and even weight. The design of the environment also allows for a critical distance that puts other kinds of information—cultural, social, and otherwise unknowable—in clear view. The analytical work conducted through data visualization encompasses geographic and historical space, allowing a researcher to filter data in multiple ways, thereby generating multiple access points. This is particularly significant when interactive platforms seek to engage scholars and community members with different agendas.

The final example is an experimental project that captures aspects of layering, scalability, and multiplicity of access by the application of virtual reality (VR) technology in a specific heritage site. David Finsterwalder of Realities demonstrates VR capabilities in the Ellwangen Excavation, where the user/visitor can inspect the entire urban-scale model, locate themselves within a specific point in the model, and experience the sensory qualities of the site (Ellwangen Excavation 2015). Where the visualization technology allows for unique opportunities for scholarship is the ability for the user to activate different kinds of information overlayed in the digital model and tagged onto specific elements.

5 CONCLUSION

Engagement with architectural heritage entails a variety of kinds of information and generates a multitude of stories. The archival work required for preservation efforts must aim to maintain a plurality of identities. In the social context, an authentic and sustainable sense of diversity can be achieved by a multi-layered culture of heritage. Therefore, the representation of heritage must facilitate access to large groups and encourage their engagement. This type of diversity will foster authentic ownership of the built environment, its history, and its community. If nuanced narratives can be preserved, or better yet "kept alive," history will resonate with individuals.

In addition to scholarly endeavors, cultural heritage will benefit from alliances on a personal level. Only if these connections are achieved, preservation will become an active undertaking, one that generates new scholarship and understanding of societies as opposed to a Sisyphean endeavor to save the past.

This paper argues that preservation of cultural heritage is not only an archival project but also a representational project. Further, the author proposes that any representation of this sort requires the design of a spatial-temporal construction, which can implement emerging tools of digital scholarship and new media. The author suggests specific parameters toward building a platform that would meet technical requirements and, more critically, a conceptual agenda of facilitating complex histories and fostering long-term stewardship of cultural heritage.

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Towards an adaptive urbanism beyond hard control: The theories of Johnson and Lefebvre

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ABSTRACT: This paper examines the socio-spatial ideology towards an adaptive urbanism beyond hard control in works by Henri Lefebvre's, *The Right to the City* and Steven Johnson's *Emergence: The Connected Lives of Ants, Cities, and Software*. Both Lefebvre and Johnson understand urbanization as basically violent and dominated by uneven expansion of urban space. This process has been the dynamic force of transformation in society. They both strive to formulate a conception for a self-organized city free of hard control. Although their respective approaches differ in fundamental ways, they share several values. They both provide concrete critical tools, methods and clarifications for conceptualizing urban planning and politics.

1 INTRODUCTION

In *Emergence: The Connected Lives of Ants, Cities, and Software* (2001), Johnson imagines the city as a manifestation of emergence and offers characteristics of a city's bottom-up evolution. Emergence, in Johnson's conception, "has always been about giving up control, letting the system govern itself as much as possible, letting it learn from the footprints" (Johnson, 2001). This refers to a community being able to self-organize into a higher level system of awareness from bottom up, instead of being directed by an external controlling factor. Johnson goes on to argue that cities grow and operate as an adaptive self-organized system based on interactions with neighbors, pattern recognition and a form of swarm logic. For Johnson, the city is as a computationally self-processed urban configuration which is produced on the micro-level of social interactions, but which appears in phenomenological terms on the macro-level of urban form.

This theoretical approach is directly confirmed and translated into urban planning and design as parametric urbanism through the use of advanced technologies and digital tools. Planners and designers are attempting to generate, simulate and control organic patterns to surprising levels of complexity that can perform as the fundamental basis for understanding this process in the urban environment. However, the integration of demographic, cultural, and human factors into these systems has so far been neglected; and the gap between a simplified condition in the parametric design process and the actual complex urban context in the real world remains large.

In Johnson's theory, social interactions are a focal point, but he dismisses highly complex factors in the urban realm. His scientific approach is almost mathematical and biological. He continues where naturalists such as Charles Darwin and entomologists such as William Wheeler left off (Johnson, 2001). The problem with his approach is most apparent in the discussion of cities. Johnson sees them as the human equivalent of ant colonies: the economic and defensive imperatives that drive people into cities yield patchworks of neighborhoods and the development of functions that transcend those original needs. Under this kind of situation, Johnson's explanation of the organic society would have presumably missed a main part of its foundation in social reality.

Compared with Johnson, Lefebvre in *The Right to the City*, published in *La Droit à la Ville* in 1968, anchors his account of socio-spatial ideology towards city planning and design much more firmly in a story about the development of urban space associated with urban life. *The Right to the City* set out to satisfy the practical questions of social rights—not just the abstract "rights of man" and the citizen, but substantial rights relating to culture, liberty, and social groups, like labor and women, amongst others. He critiques approaches to the city that simplify and neglect the complexity of social, cultural and political dimensions in the real urban space. He understands the organicist approaches to city planning and design as "travesties of science" due to the unity of partial knowledge (Lefebvre, 1996). From this standpoint, scientism in Johnson's *Emergence*, accompanies the deliberate forms of operational rationalism and also tends to fail to care for the intricacy of human society. Lefebvre introduces a vision for a city in which users manage urban space for themselves, free of both the state and capitalist control. He defines a different kind of freedom from what rationalism and functionalism offer, based on the freedom of the Greek city. He conceives the transformation of traditional forms of political citizenship into the broader concept of urban

citizenship. He focuses attention on the role of the inhabitant or user of the city. Arguably, this is the experience of everyday life that authorizes one to a right to the city, rather than a user's nation-state citizenship. He strives to articulate a critical stance towards this process by providing indispensable critical tools for conceptualizing the urban space and its political possibilities.

In this paper we will not attempt to present comprehensive overviews of their conception of cities, nor do we intend to affirm one over the other. The focus is exploring the ways in which they cast their concrete critical tools, methods, and clarifications for conceptualizing the urban planning and design. Although they both have strengths and unique conception towards urban planning and design, their approaches can be critiqued in some aspects. In this sense, Johnson oversimplifies patterns of cities based on a limited analogy of living organisms, such as ants' colonies or networks of neurons, while Lefebvre's *Right to the City* is more radical in its class struggle and political position. This article seeks to connect and bridge the gaps between these two positions and outline their unique conceptions of urbanization, in order to present a more dynamic and holistic approach for dealing with today's urban complexity. Although both Johnson's theory and Lefebvre's ideology call for deep change, their ideas are eminently practical; they have critical responses to contemporary debates on the urban theory and practice to modify the current city towards a harmonious society and an adaptive urbanism beyond hard control.

2 EMERGENCE AND/OR PLANNED URBANISM

Are cities manifestations of emergence or planned processes? How do cities grow and organize over the years? The critical question is, what is the position taken in the present and possible near-future of design and planning in today's complex and uncertain era? What are the pitfalls of the parametric shift which has occurred in the practice of architecture and urban design process due to new technologies and infinite computing? In contrast to many approaches to contemporary architecture and urbanism, Johnson and Lefebvre offer critical theories and unique conceptions to address these issues and questions.

Johnson and Lefebvre both argue that cities are an outcome of emergent systems that refer to a self-organized phenomenon. Everything that is generally subsumed within the self-organized order is usually assumed to be a bottom-up phenomenon and a process by which the urban space is produced by aggregated individuals, not a central authority or external power enforcing precepts of urban design and planning.

Self-organized systems are those undergoing upward mobility through this process. Such systems will reach a critical point and jump into a new pattern of organization. In this sense, where planning is understood as synonymous with control, emergent order eventuates in the absence of control. This position leads to a conflict between notions of fully planned cities and uncontrollable phenomena of evolutionary urbanism. Now the critical question is: what comes of the absence of planning? It seems this is an oversimplification to assume that adaptive, evolutionary urbanism lacks all planning.



Figure 1. Yazd, Iran, 2016.
Source: https://www.google.com/maps/place/Yazd,+Iran/

Presumably pre-industrial and historical cities—such as organic growing cities in Iran, Pakistan, Egypt, among others—are understood almost as emergent systems. The architectural and morphological characters of these cities – before been modernized- align with the bottom-up and self-organized process. As an example, consider Yazd in Iran: a city in the middle of deserts where individual decisions were enabled to adapt to the harsh ecological condition and fit the natural and human landscape through long process of trial and error (Keirabadi, 1991). Such cities' organic growth is a result not of a lack of overall design but rather of smaller agents. Development of these cities is based on an organic process which is associated with the role of individuals, not a central authority. In this sense, the actions of individual and local decisions create the large-scale structure of complex order. The rules of emergence are holistically applied in all components and infrastructure of such a city. In this way, "one thing leads to another, and what began as the seizure of an accidental advantage may prompt a strong element in a design … it moves from need to need, from opportunity to opportunity, in a series of adaptations that themselves become interestingly coherent and purposeful" (Mumford, 1961).

"Natural or organic growth interwoven both in space and time" (Batty, Longley 1994). Through centuries, the city's spatial pattern has revealed the influence of nature, culture, and community. In this sense, a multidimensional approach has played a more comprehensive, unique and to some extent creative milieu on producing urban space.

We can now state that cities are as a self-organized system; raised, provoked, and sustained by humanity. This order is an independent phenomenon which manifests without full planning and design and is free from central power. As Johnson makes clear, the mechanism of organic city growth, organization, and operation

through an analytical comparison with the interaction of a 'super organism' of ants with the city where the neighborhoods of individuals solve their problems through local interactions collectively, which leads to global behavior. In the same way, local interactions and decisions of individuals on an organic city contribute to the creation of the 'complex order' of the city. Each ant acts on a system of low-level rules and feedback from its neighbors, which explains how "local information can lead to global wisdom" (Johnson, 2001). The feedback loop between neighbors is critical in city vitality. "Feedback is a way of transforming a complex system into a complex adaptive system" (Johnson, 2001). As Johnson discusses, each ant is not intelligent and only can do simple actions, although an ant colony shows a complex collective behavior. The underlying mechanism of this intelligence emerges from the social interactions among neighboring ants. Therefore, interconnected behaviors support the feedback loops. "All decentralized systems rely extensively on feedback, for both growth and self-regulation" (Johnson, 2001). However, this is a simplification of the image of complexity in the human world that ignores the complicated layers of human society in terms of cultural, social and political aspects.

The use of emergent and self-organized patterns in the urban design and planning as parametric urbanism has great potential to develop the systematic analysis and following arguments to alternatives for future cities. Parametric design as a technical procedure allows one to rapidly generate different design alternatives by simply changing the values of a particular parameter to facilitate decision-making during the creation process. We can now create, simulate and analyze self-organizing patterns to surprising levels of complexity that can perform as the fundamental basis of understanding the process in the urban environment through digital tools. Parametric practices are not similar to traditional digital design implementations regarding the capability of patterns to transform from one type to another through the design process, and to support generating and examining a large number of outcomes from a simplistic replacement of a particular parameter value. The parametric paradigm grants its resultant patterns the significant adaptability to modify and develop at any step of the design process, but ensuring the keeping of compatibility and orderly character.

Regardless of the high abilities allowed by parametric urbanism approaches and means for improving the urban quality and performance, the design is just responsive to formal, programmatic, and environmental parameters. Algorithms derived from nature or organic patterns are very popular in today's parametric urbanism. As organic cities in terms of the visual and statistical order "have led to the various biological analogies" (Batty, Longley 1994). In this case, the critical threat may be the imitation of living organisms on the basis of superficial similarities. So, the main challenges that are usually subsumed within self-organized manifestation through organic-derived patterns and algorithms in urbanism are ostensibly applications of superficial similarities, which only rhetorically reflect some qualities associated with the adaptive phenomena.

For example, works by designers such as Zaha Hadid and Patrick Schumacher in London and Istanbul can be seen as parametricism in urbanism, which fails because of the susceptibility to concession of only formal, functional and environmental aspects of design, while abandoning other essential parameters for the upswing of urban life. The complicated layers of culture and human values in these proposals have been dismissed, and the gap between a simplified model in the parametric design process and the complex urban realm remains considerable. In other words, critics such as Steven Johnson and designers such as Hadid and Schumacher claim their ideas surrounding city planning and design are connected with social interactions. However, they simplify their ideas based on reliance on formal characteristics of living organisms, not real complicated layers of the society.

On the other hand, planned cities were characteristic of the twentieth century. What is considered problematic urbanism by Johnson and Lefebvre in the modern era is an outcome of processes of industrialization. When modern planning parallels mass production, cities emerge as repeatable, predictable and controllable patterns and top-down plan processes. The urban is treated as "a fixed, unchanging entity—as a universal form, settlement type or bounded spatial unit ('the' city) that is being replicated across the globe" (Brenner and Schmid, 2015). This model opposes the fundamental concepts that used to apply in unplanned and pre-industrial cities, which in Lefebvre's term, are something unique and unpredictable; accessible through a process which is associated with creativity and art. Lefebvre imagines an ideal city as *oeuvre* (works of art and monuments) rather than *produit* (product), which arises from repeatable and serialized actions that is a manufacturing process. In this manner, the *oeuvre* can be considered as having use value and the *produit* is synonymous with exchange value. So, Lefebvre's image of an ideal city is characterized by the predominance of the *oeuvre* (*city-oeuvre*), until the use value of the city was eclipsed by the exchange value (Lefebvre, 1996). This formulation places the traditional city in extreme contrast to the rational and technologically driven regimes of modernist planning.

To a large extent, Lefebvre presents a radical criticism against modern urban planning and its vision of urban society. He criticizes the ideology of modern city planners. According to him, these planners' insight of the city is based on the idealized and rational model of the ancient city. "The agora, place and symbol of a democracy limited to its citizens, and excluding women, slaves and foreigners, remains for a particular philosophy of the city the symbol of urban society in general" (Lefebvre, 1996). So, Lefebvre criticizes this notion as a typically ideological extrapolation to which they add fragmentary understanding; "this purely ideological operation consisting in a passage (a leap),

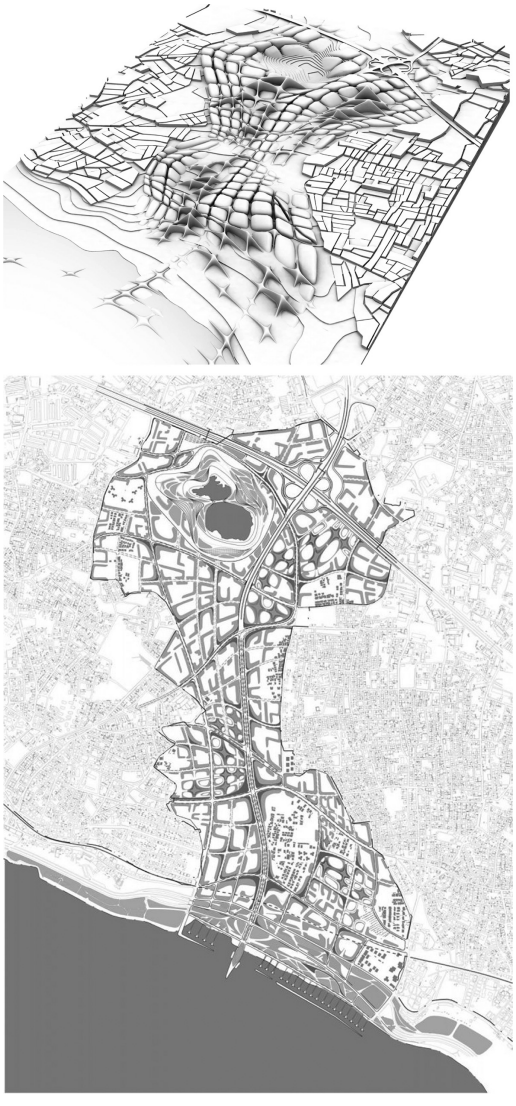


Figure 2. Parametric urbanism, Kartal Master plan proposal, Istanbul, Turkey, Zaha Hadid Architects, 2006.
Source: http://www.zaha-hadid.com/masterplans/kartal-pendik-masterplan/

from the partial to the whole, from the elementary to the total, from the relative to the absolute" (Lefebvre, 1996).

Lefebvre focuses attention on the role of the inhabitant or user of the city. Arguably, this is the experience of everyday life that authorizes one to a right to the city, rather than a user's nation-state citizenship. He offers the point that all city inhabitants should feel themselves to be a part of the emergent whole and have the freedom to make and transform their cities themselves. He believes that as this conversion heavily relies on the use of collective power, it is a common right of everyone (not an individual one) to be able to change through changing the urban space.

Lefebvre defines spatial ideology as a system of implications of the reality of space, owing to "political strategy" to execute what elite priorities – i.e. their aspiration and needs over the dominated classes. Lefebvre asserts "Urbanism as an ideology formulates all problems of society as questions of space and transposes all that comes from history and consciousness into spatial terms" (Lefebvre, 1996).

Both Johnson and Lefebvre's conceptions of city planning ideology are in close link with social interactions. In this sense, Johnson and Lefebvre evoke Jane Jacobs' ideas on urban planning in *The Death and Life of Great American Cities*. Jacobs explains "how cities work in real life, because this is the only way to learn what principles of planning and what principles in rebuilding can promote social and economic vitality in cities and what practices and principles will deaden these attributes" (Jacobs, 1992). They found a relationship between city ideology and space, which is understood as a social concept. However, their approaches are entirely different. Lefebvre's ideology in city planning is radical and in some cases problematic, such as Lefebvre's class bias in the vision of urban democracy. Johnson almost simplifies his ideology based on what Lefebvre understands as a 'travesties of science' - living organisms such as an ants' colony or networks of neurons or software.

3 REDEFING CONTROL AND URBAN NETWORKS

It is important to return to discussion of the other side of digitalized urbanism; as an inseparable part of today's urban approach that participates in the misinterpretation of control and freedom, and a certain mythology of the relationships that exist between networks, flow of information, and social equality. As Johnson pointed out, "Like any emergent system, a city is a pattern in time" (Johnson, 2001). We are living in the age of advanced information technology, network mapping, and infinite computing, which have significantly influenced our cities. In this sense, Johnson and Lefebvre argued, such massive technical systems interweave and infuse cities and daily urban life. In this way, the crossover between information communication technology and its applications in urban structure—between the surveillance and control of everyday life, rather than bottom-up order—could be considered as a focal point of a complex system that characterizes the new critical urbanism.

The techno-scientific approach mobilizes "the tools of natural science, mathematics and 'big data' analysis to analyze, and often to predict, inter- and intra-urban spatial arrangements" (Brenner and Schmid, 2015). The discourses surrounding electronic data collection systems, sensing and feedback systems, smart materials, intelligence, and interactivity and responsiveness all pertain to a "control society" in which information is "immediately fed back into the system" in real time (Shaviro, 2003). Existing extensive global networks

of sensors generates an abundance of electronic eyes and ears; furthermore, they potentially enable cities to be a stage of permanent surveillance by whoever has access to that information. In today's urbanity, citizens are always being watched and visible. This trend is inarguably pervasive, indeed almost ubiquitous. In the contemporary city almost all public or semi-public spaces such banks, offices, shopping malls, and streets are under surveillance and control.

Now, the question is: If a city is as Johnson defines is – a computationally self-processed configuration which can "generate emergent intelligence, a macro-behavior spawned by a million micro-motives, what higher level form is currently taking shape among the routers and fiber-optic lines of the internet?" (Johnson, 2001). Controlling the net is hard enough at present, but what if it starts getting ideas of its own? Will emergence or self-awareness arise unbidden in cyberspace? Johnson understands life on the internet, machine intelligence, and computer programs based on what evolves on their own and feedback loops in modern media networks that are intelligent, witty and tremendously thought-provoking. The networks idea derived from the cybernetic theories of the 1940s are as self-generating, self-organizing, and self-sustaining systems, which operate through several loops of feedback. Irrespective of the interactivity and dynamism of networks, they still create local solidity and retain internal homeostasis in situations or conditions that are not at equilibrium (Verebes, 2014).

We argue that we need to redefine our perception regarding control, to achieve more resiliency and flexibility. Networks now permeate the way we see the world; as densely distributed and intelligent. Our comprehension of network phenomena, like the self-governing nature of the rain forest, deepens our knowledge of the connectedness that exists in the broad industrial network, which libertarians insist upon as organic and natural. The networks could be seen as unbiased; they have the ability to deliver, control, publicize, connect, censor, and inform. They create new systems of collective organization. Through the advent of bottom-up organization, the stability and undeniable solidity of institutions could be equipped through the interaction among a host of agents, who have the ability to at least bring about transformation to institutions if they cannot displace them. In today's urbanity, in which everything is computerized, overly-connected, and mobile as a result of information networks, urban planning and design need to catch up to the interactivity and dynamism in networked, technologically effective, more supple and adaptable models of control.

4 CONCLUSION: THE POSSIBLE URBAN

What paradigms, if any, can be followed to generate, direct, and illustrate the present or near-term future of urbanism in today's complex and uncertain era? What position can be taken in design and planning—beyond raw imposition of control? The concept of adaptive urbanism beyond hard control proposed here addresses these questions through reading of key concepts in Johnson's theory and Lefebvre's ideology. In doing so, the proposal discussed their conceptual strengths, alignments, and divergences between their approaches, and their potential applicability in today's urban context. We try to hypothesize a hybrid approach that combines their concrete theories—albeit not in a deterministic way.

Both Lefebvre and Johnson conceptualize a self-organized city free of hard control. Although they share this theory, their respective approaches differ in fundamental ways. In this sense, Johnson more simplifies the process of urban organization. He compares human beings with living organisms and the software and computation world. He claims his ideas regarding city planning and design are connected with social interactions, yet he oversimplifies this attractively elegant theory by referring to characteristics of living organisms or information systems vis-a-vis their ability to respond to feedback and adapt to their environment, but with scant attention paid to the real, complicated layers of intersecting forces and feedback inhuman society. At the risk of overstating the obvious: cities are more advanced than ants' colonies and human behavior more advanced than ants.

Contemporary use of parametric technology in urban design and planning associated with the main challenge, which is subsumed within the organic-derived patterns and algorithms due to just partially underlying qualities such as flexibility and adaptability in generative systems. Parametric design methodology and computation has fundamental limitations and lacks cultural and social dimensions that contribute to the urban morphology. It fails because it is susceptible and adaptable more to formal, functional and environmental aspects. The key issues lie in no comprehensive approach of design, associated with urban life. It provides spatial and social solutions that have dismissed the labyrinth of human beings and human use of city. So, the gap between a simplified model in the parametric design process and the complex urban realm needs be filled through comprehensive understanding of urban life.

While Lefebvre's ideology is associated with urban life, a process underlying the role of citizen's in producing urban space beyond hard control—control of state and capitalism Cities can be mapped through the way people live them. A process of meeting the right to the city—the right to create urban space and liberty. He formulates the problem of the city as interpreting partial knowledge, and it application of this knowledge in technical or political context. Now the question is that how we can connect and bridge the gaps between these two positions, in order to present a more dynamic and holistic approach for dealing with today's urban complexity. We can call for better understanding of an emergent or self-organized process, a stepwise process of producing urban space that is adaptable and

responsive to feedback as citizens' rights are its focal point. The transformation we follow to affect moves us closer to an adaptive urbanism in uncertain and complex contexts, growing according to local rules and decisions which manifest in global order of a bottom-up system. In this, our approach tends to be scientific and biological with predominant emphasis on visual order—barring evocation of a broader and deeper perspective reflecting the daily life of the citizens. Their collective ideas can provide a more dynamic parallel to the social, political, and technological prospective in urbanism, compared to the relatively static and monolithic decision models advanced in previous eras.

Now, through the use of advanced technologies and digital tools, we can generate (rather than impose), simulate and loosely control self-organizing patterns to surprising levels of complexity that can perform as the fundamental part of understanding the process in the urban environment. With integration of demographic, cultural, and human factors into this computer-controlled model—which have so far been neglected—we can fill the gap. Parametric urbanism applied the present technologies. But the superficial similarities based on imitation of organic patterns in algorithms raises questions about parametric urbanism's abilities. Therefore, we must proceed with a certain degree of caution to avoid this issue. This theoretical approach in the contemporary urban design and practice should apply multidimensional character of emergence system in human scale.

While we argue that hard control of city planning, design, and operations cannot lead us toward solutions adaptable for the complexity and unpredictability of urban environments, realistically we cannot apply an entirely emergent process to urban design and planning. We ought not to assume that adaptive and flexible urbanism lacks all planning and relinquishes control over the city. Presumably this, too, would be an oversimplified and impractical approach.

Thus, rather than being constrained by the planned or controlled or emergence process of urban design, what needs to be theorized, tested, experimented upon, and applied is a heterodox approach of top-down and bottom-up processes that considers complexity and multi-dimensional levels in urban contexts. Therefore, we need a more dynamic *set of approaches* to deal with this complexity. We can now clearly state that use of emergence and self-organized processes in urban design and planning could close the gap between bottom-up processes, which have been applied in organic and vernacular architecture and urbanism, and the top-down design and planning structures which have been used in modern urbanism. We need to redefine our perception regarding control. Our cities require a degree of dynamism in design and planning, as well as flexible systems of control. In today's urbanity, in which everything is computerized, overly-connected, and mobile as a result of information networks, urban planning and design need to catch up to the interactivity and dynamism of networked, technologically efficient, more flexible and adaptable models of control.

Both Jonson and Lefebvre's imaginations toward tomorrow's urbanism may be seen as somewhat utopian, but we argue that this is precisely their strength. It seems what Johnson or Lefebvre is offering is not impractical; however, their ideologies call for deep change and in some cases have problems: Johnson with an overly scientific, mathematical, and biological approach, and Lefebvre with an ideologically committed vision. Both offer distinct potentials for resisting current urban issues and an opening to a conception of more harmonious social space and democratic urban politics – but not however, as an elegantly universal panacea. We argue that Lefebvre's *The Right to the City* and Jonson's *Emergence* are not the only possible solutions and not individually sufficient for defining adaptive urbanism and urban democracy alone.

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IEP sites: Combining planning tools to address planning uncertainty

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ABSTRACT: Dealing with uncertainty in planning is a much-discussed challenge. In academic research, different planning tools have been developed, to facilitate the planner's task of coping with uncertainty. Our paper reports on the use of an integrated planning method, in which we combine different planning tools to cope with the uncertainty of a self-elaborated spatial design. In particular, it concerns an explorative assignment on the design of a so-called 'Inclusive Economic Participation (IEP) site' for socially deprived citizens, located at the Colony of Wortel-Merksplas (i.e. Flanders, Belgium). In order to cope with different causes of uncertainty amongst which (I) uncontrollable social, political and/or economic changes in society, (II) contradictory statements within current spatial plans, studies and other policy documents, (III) a not well specified and unclear assignment, (IV) conflicting and ambiguous interests of stakeholders and (V) sudden and unexpected changes in opinions and attitudes of stakeholders, we have combined the planning tools of (i) knowledge gathering, (ii) partnership working, (iii) storytelling, (iv) visioning and (v) scenario-writing.

1 PROBLEM AND RESEARCH QUESTION

The planning field has been criticized over the years, because of its complexity, but also its inflexibility or ignoration of dealing with uncertainty (Rosenhead 1980; Meyers 2001). During the planning process, several decisions on the subsequent planning actions and outcome (i.e. a plan) must be made, in order to improve the future. However, it is often difficult to know the actual future in advance, let alone to predict the consequences of the proposed planning actions and outcome on an actual improvement of this unpredictable future (Meyers 2001; Klosterman 2013). As such, the planner's task of dealing with uncertainty is essential and important, but also difficult (Friend & Jessop 1969).

Discussing this difficulty has been the subject of many papers (Christensen 1985; Silva 2002; Balducci et al. 2011; Chakraborty et al. 2011; Myers 2011; Rasouli & Timmermans 2012; Abbott 2012; Klosterman 2013). Some of these papers focus on planning tools, as a strategy to control, reduce or constrain certain aspects of planning uncertainty (Chakraborty et al. 2011; Myers 2011; Abbott 2012; Klosterman 2013). However, these tools are rarely or never used in an integrated or combined manner. In this paper, we want to apply and evaluate such a combined approach, within a specific uncertain planning setting. In particular, we want to explore: How a well-considered combination of different planning tools can help planners to cope with uncertainty in a more comprehensive and flexible way (i.e. central research question)? By 'comprehensive', we mean coping with (nearly) all aspects of planning uncertainty, instead of only one or a few uncertainty aspect(s). By 'flexible', we mean responding in an adaptive and dynamic, instead of a rigid way. Planning uncertainties are present in the spatial design of a so-called 'Inclusive Economic Participation (IEP) site' for socially deprived citizens, located at the Colony of Wortel-Merksplas (i.e. Flanders, Belgium). In line with the planning literature, the following causes of planning uncertainty are present: (I) uncontrollable social, political and/or economic changes in society, (II) contradictory statements within current spatial plans, studies and other policy documents, (III) a not well specified and unclear assignment, (IV) conflicting and ambiguous interest of stakeholders and (V) sudden and unexpected changes in opinions and attitudes of stakeholders.

2 CONTEXT

2.1 *IEP site*

The concept of an 'Inclusive Economic Participation (IEP) site' is launched and elaborated by a multidisciplinary research team (Faculty of Design Science at the University of Antwerp, Belgium), consisting of researchers within the disciplines of both social sciences (i.e. (social) economy and management) and design sciences (i.e. architecture, urbanism and spatial planning). We define an 'IEP site' as a location that accommodates, and thus connects, public, (social) profit and/or private organizations that support and stimulate the economic participation of the growing amount of socially deprived citizens, both as a consumer of goods and/or services, and as a producer of labor (Termote 2006; Vranken 2010; Coene et al. 2011; Termote & Galand 2012; De Nys-Ketels, Vallet & Bylemans 2015). Such a joint or spatially concentrated

location seems to be necessary, as socially deprived citizens often lose their way in the substantial amount of already existing support initiatives. Given the more restrained mobility of socially deprived citizens (Lucas 2012), it is especially the spatial dispersion, and thus physical accessibility of these initiatives, that generates physical and mental barriers to actually benefit from these initiatives (Opdebeeck et al. 1998; Laenen 2001; Sannen 2002, 2003; Steenssens et al. 2007; De Corte & Kolijn 2012).

As the concept of an 'IEP site' is new and still 'under construction', it is not yet clear what the planning process and specific design features should look like. Presumably, these design features depend on the present and future challenges of a particular contextual setting: Who are the socially deprived citizens? Who are the partners involved? What are their inclusive economic participation ambitions? And what are the associated spatial and architectural needs and opportunities of the site?

2.2 *Colony of Wortel-Merksplas*

This paper reports on the results of a first explorative case-study research, realized within the particular contextual setting of the former vagabond Colonies of two Flemish municipalities: 'Wortel' and 'Merksplas'. Both Colonies are often seen as one colony, because of their geographical proximity.

The Colonies of 'Wortel' and 'Merksplas' are compartmental landscapes with a surface of respectively 552 and 480 ha. These colonies consist of an historical pattern of tree alleys and rectangular plots with meadows, wood- and farmlands. In addition, several original 19th century buildings (i.e. a chapel, a school, houses, industrial and farm buildings) and two newer 20th century buildings with the function of a prison, are present (De Borgher 1999).

The Colonies of 'Wortel' and 'Merksplas' were developed in 1822 and 1825, in response to the extreme poverty at that time in the Low Countries (i.e. Belgium, Luxembourg and the Netherlands). The benefits of their development were twofold. On the one hand, poor people (i.e. beggars, vagrants, orphans, disabled, etc.) were housed and provided with care, education and employment, in order to help them escape from poverty in a more structural way. On the other hand, poor people cultivated large amounts of farmland, which decreased the need of paid workers (De Borgher 1999).

After the abolition of the 'Law on Vagrancy' in 1993, both Colonies lost their initial function and a new destination had to be elaborated. Our concept of an 'Inclusive Economic Participation (IEP) site' is considered to be an interesting option, as it relates to the initial function of accommodating poor citizens. However, our 'IEP site' will have to coincide with other destinations, such as touristic activities for all types of citizens. As such, our 'IEP site' will not encompass the entire surface of these Colonies.

Because of its historical value and innovative concept of solving poverty, the Colony of Wortel-Merkspas, together with five Colonies located in the Netherlands, are trying to gain the recognition of 'UNESCO World Heritage' by 2018 (see also: http://whc.unesco.org/en/tentativelists/5841/).

2.3 *Planning and uncertainty*

Over the past 50 years, several scholars have made the link between 'planning' and 'uncertainty' (Friend & Jessop 1969; Marris 1987; Hoch 1994; Abbott 2005, 2009, 2012). Uncertainty in planning refers to a lack of knowledge about the future or a gap between what is known and what is unknown – but needs to be known – about the future, to make correct decisions, in order to change the future in a better way (Abbott 2005, 2009, 2012).

In related literature, several dimensions of uncertainty affecting planning are discussed. A distinction is made between 'environmental uncertainties' and 'process uncertainties' (Abbott 2005, 2009). While the former consists of uncertainties that relate to the planning environment or context, and can be experienced by everyone (Mack 1971), the latter consists of uncertainties that relate to the planning process, and can be experienced only by the people involved in this planning process (i.e. stakeholders and planners) (Friends & Jessop 1969). In our 'IEP site' case-study, both uncertainties are present.

When considering the specific nature of 'environmental uncertainties', it concerns the presence of (I) uncontrollable social, political and/or economic changes in society (Galbraith 1977; Bryson 1988; Marris 1996; Christensen 1999; Abbott 2005; Fitzsimmons 2006; Frame & Brown 2008; Innes & Booher 2010) and (II) contradictory statements within current spatial plans, studies and other policy documents (Fitzsimmons 2006). In line with the general Flemish 'trend', a social change in the group of socially deprived citizens can be noticed in the particular contextual setting of our 'IEP site' case-study. This group not only grows, but also becomes more diverse and thus is no longer limited to merely fringe groups in our society (Muffels et al. 1999). More often people are confronted with sudden far-reaching events, such as a resignation, bankruptcy, divorce or sudden health problems. As a result, even (highly) educated and wealthy citizens end up becoming socially vulnerable (Jans 2011; Spoor 2004). In our 'IEP site' case-study, contradictory statements within current spatial plans can be noticed in guidelines regarding the protected heritage. The conflicting opinions are present in whether or not architectural modifications can be made to its buildings. The master plan's basic standpoint is "not allowing architectural interventions unless these interventions are necessary, in order to restore the buildings in their original status". In contrast, the legal zoning plans or the so-called 'Provincial Spatial Implementation Plans' (i.e. 'PRUP's') allow architectural interventions whenever their added value and architectural quality can be proven.

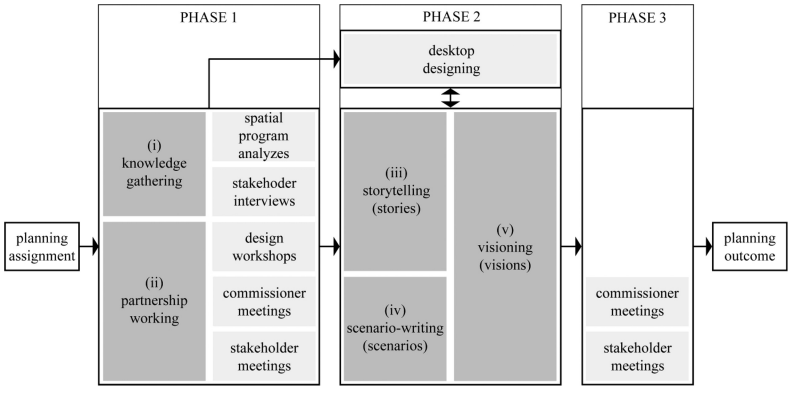


Figure 1. Planning process of our 'IEP site' case-study, showing multiple (iter)actions and planning tools, being used as a more comprehensive and flexible way to cope with the encountered uncertainties and to realize the planning outcome.

The specific nature of 'process uncertainties' can be found in three different aspects, noticed during our 'IEP site' case-study: (III) a not well specified and unclear assignment, (IV) conflicting and ambiguous interests of stakeholders and (V) sudden and unexpected changes in opinions and attitudes of stakeholders (Friends & Jessop 1969; Abbott 2005, 2009). An example of a not well specified and unclear assignment can be found in sudden and unexpected changes within the initial design instructions, given to the research team. Initially, a volume study was demanded on the position of new buildings, as a replacement of the demolished barns at the Colony of 'Merksplas'. However, when this volume study was finished and presented, it suddenly seemed no longer to be a policy priority, and it was removed from the initial design instructions. An example of conflicting and ambiguous interest of stakeholders, can be found in the impossibility to reach a consensus on certain planning and design instructions. The inclusion of (ex-)prisoners, as socially deprived citizens, is for instance heavily disputed by certain partners involved. Out of fear that (ex-)prisoners might scare off visitors and tourists, no consensus is reached during the first months of the already started design assignment. Eventually, a kind of consensus was reached as this particular target group was put 'on hold'. An example of sudden and unexpected changes in opinions and attitudes of stakeholders, is for instance the fact that certain partners involved, changed their minds about the redevelopment of the vacant attics at the Colony of 'Merksplas'. Initially, sleeping units for youth movements seemed a perfect fit. However, such accommodation seemed no longer desirable later on. Some partners involved suddenly were convinced that the capacity of these vacant attics was insufficient, to accommodate large groups of scouting and camping children.

3 PLANNING PROCESS: TOOLS

In the planning process of our 'IEP site' case-study, we used multiple (iter)actions and planning tools, as a more comprehensive and flexible way to cope with the encountered uncertainties and to realize the planning outcome (i.e. a strategic-spatial plan for an 'IEP site') (Fig. 1). A strategic-spatial plan consists of both strategic guidelines (for administrative and political policymakers of local governments, as well as managers of public, (social) profit and/or private organizations) and spatial guidelines (for architects, urbanists and spatial planners), as a way to facilitate the actual implementation of an 'IEP site'. As illustrated in Fig. 1, the (iter)actions are grouped into three main phases. The first consists of an initial set of data collection and analyzes actions, realized by means of spatial program analyses, stakeholder interviews, design workshops and both commissioner (i.e. 'Kempens Landschap'), and stakeholder meetings. In view of coping with the emergent uncertainties, we used two particular planning tools, being (i) 'knowledge gathering' and (ii) 'partnership working'. The second phase consists of a subsequent set of design actions, in which all data of the first phase is processed by means of 'desktop designing'. In view of coping with the emergent uncertainties, we used three particular planning tools, being (iii) 'storytelling', (iv) 'visioning' and (v) 'scenario-writing'. The third phase consists of feedback actions, realized by means of both commissioner and stakeholder meetings. In view of coping with the emergent uncertainties, we used the same planning tools as in the second phase. In the next paragraphs we will describe and illustrate the particular use of each previously mentioned planning tool.

3.1 *Knowledge gathering*

According to the literature, 'knowledge gathering' is a planning tool that focuses on collecting as much knowledge as possible, by the confrontation of various perspectives and types of data (Abbott 2012; Lau 2015). When used and applied in our 'IEP site' case-study, 'knowledge gathering' is realized in the first phase, when analyzing the spatial programs and interviewing the numerous stakeholders. The former reveals the societal, policy-related and spatial needs

or challenges of the Colony of Wortel-Merksplas, as well as numerous initiatives, to counter these needs or challenges. The latter reveals the motives of the numerous stakeholders interviews are held with, amongst which administrative and political policymakers of local governments, managers of public, (social) profit and/or private organizations, and professional experts on inclusive economics.

By combining the obtained information of both the spatial program analysis and the stakeholder interviews, we received a more complete set of detailed insights (i.e. knowledge) into the complex and dynamic future (i.e. uncertainties) of our 'IEP site' case-study.

3.2 *Partnership working*

According to the literature, 'partnership working' is a planning tool that focuses on letting partners with possible conflicting intentions communicate about proposed planning actions and their desired outcomes (Rosenhead 1980; Meyers 2001, 2011; Chakraborty et al. 2011; Abbott 2012). Within our 'IEP site' case-study, 'partnership working' is realized in the first phase, when organizing the design workshops and holding both commissioner and stakeholder meetings. The former consists of workshops with professional experts, within the disciplines of both social sciences (i.e. (social) economy and management) and design sciences (i.e. architecture, urbanism and spatial planning). The latter consists of two types of meetings. On the one hand, there are commissioner meetings with the organization 'Kempens Landschap'. On the other hand, there are stakeholder meetings with administrative and political policymakers of local governments, managers of public, (social) profit and/or private organizations and professional experts on inclusive economics.

By using design workshops and both types of meetings, we could clear out the complex and often ambiguous ambitions of all partners involved. As such, we could get a better or less uncertain grip on the joint 'preferred future'.

3.3 *Storytelling*

According to the literature, 'storytelling' is a persuasive planning tool that can be used by planners during the feedback phase, in order to inform the commissioner and stakeholders of the planner's way of thinking and to win them over to the planner's proposed planning actions (Throgmorton 1992; Myers & Kitsuse 1999; Meyers 2001; Klosterman 2013). Within our 'IEP site' case-study, we preferred the use of a 'visual' or 'graphical' storytelling technique, being that of 'organograms'. 'Organograms' are developed in the second phase, not only by processing the information and first ideas uncovered during the spatial program analyses respectively stakeholder interviews and design workshops, but also the continuous flow of creative and innovative ideas from the research team (i.e. planners), processed by means of 'desktop designing'. 'Organograms' represent the complex organizational structure of our 'IEP site' case-study, and each one uncovers a particular part or topic of this structure, as well as possible synergetic relationships between these different parts and topics.

To illustrate this, we give a particular 'organogram' on the topic 'tourism' (Fig. 2). During the planning process, a lot of preferred economic activity topics are taken into consideration. When evaluating the specific nature of these topics, there is clarity, agreement, and thus certainty, about only one, being that of 'tourism'. As such, the future redevelopment of our 'IEP site' case-study should be primarily focused on this type of economic activity. In contrast, there is no clarity nor agreement about other economic activity topics, such as 'care', 'education' and 'agriculture'. For some stakeholders it is not clear 'if' and 'how' these topics are compatible with 'tourism'. To overcome this uncertainty, all the possible synergetic relationships (dotted lines Fig. 2), between the different economic activity topics, are visualized in each 'organogram'. 'Children care' represents for instance an uncovered synergy between 'care' and 'tourism', and is suggested to be located in the existing children farm and/or suggested play barn. A second example concerns the suggestion of 'allotment gardens', indicating a synergy between 'agriculture' and 'tourism'. After all, the fruits and vegetables of these gardens can be used in the suggested restaurant, or sold in the suggested market hall, by means of both food packages and picnic baskets. A third and last example concerns 'educational projects', indicating synergies between 'education' and 'tourism'. This particular suggestion of the research team (i.e. planners) is a 'response' to the 'unwelcomed' target group of prisoners, as socially deprived citizens. By letting prisoners who work in the 'bicycle atelier' (i.e. at the prison of 'Wortel'), also repair bicycles from tourist, visitors and residents (i.e. at the 'IEP site'), prisoners can be involved as socially deprived citizens, without being physically present at the 'IEP site'. By letting prisoners who work in the 'furniture atelier' (i.e. at the prison of 'Merksplas'), also make furniture for this 'IEP site' (e.g. furniture for an 'exhibition space'), a similar result can be obtained.

By using 'organograms', we could not only show synergies between the different parts or economic activity topics, but also demonstrate where socially deprived citizens could be involved, either as a consumer of goods and/or services, or as a producer of labor. As such, 'organograms' are used to change and clear out the original opinions of stakeholders, who were not aware, familiar or convinced of certain planning options and outcomes (i.e. creative and innovative ideas of planners). Initial uncertainties thus become more certain.

3.4 *Visioning*

According to the literature, 'visioning' is a participatory planning tool that can be used by planners

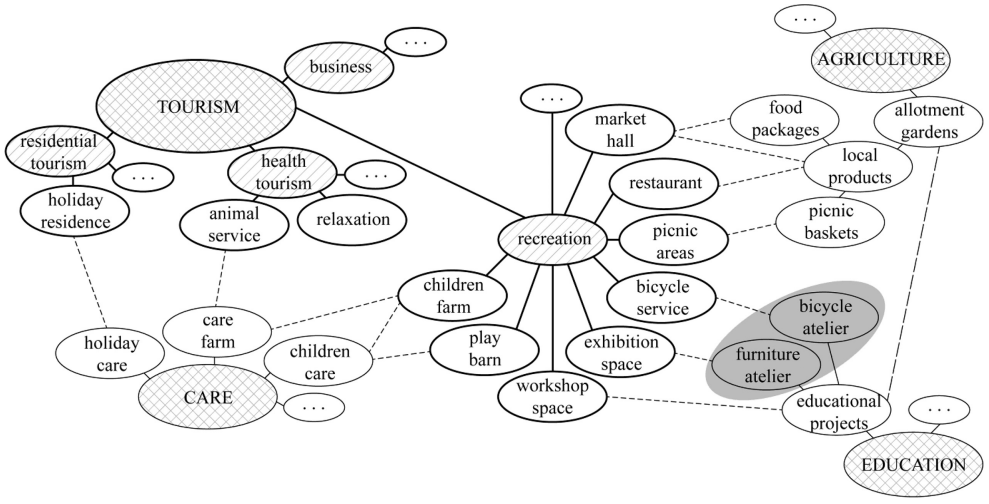


Figure 2. Organigram of 'tourism', showing possible synergetic relationships (dotted lines) with the other economic activity topics.



Figure 3. Present state of a particular location.

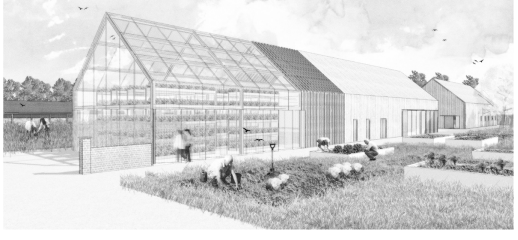


Figure 4. Desired future state or vision of the same location.

during the feedback phase, in order to let the commissioner and stakeholders develop (more) shared visions of a jointly desired future (Myers & Kitsuse 1999; Meyers 2001; Chakraborty et al. 2011; Abbott 2012; Klosterman 2013). 'Visions' are so-called 'simulations' of a jointly desired future, based on shared concerns and interests, regarding the development of a larger area or specific location in a city or town. 'Visions' are not a fantasy, but rather an image of what might be achieved within a city or town, given the available capacities and resources (Myers & Kitsuse 1999). As a technique to create 'visions', 'imaging' is used. 'Imaging' implies the capture, storage, manipulation and display of pictures or other visual representations (e.g. sketches, renders, 3D models, etc.) (Reinhard et al. 2010). Within our 'IEP site' case-study, 'visions' are developed in the second phase, based on not only shared concerns and interest uncovered during both commissioner and stakeholder meetings, but also the extra input of the research team (i.e. creative and innovative ideas of planners), processed by means of 'desktop designing'.

To illustrate this, we give two different images of one particular location at the Colony of 'Wortel', where presently some old barns are accommodated. In Fig. 3, the location is shown in its present state, while in Fig. 4, its desired future state is given, based on the identified shared concerns and interests of stakeholders. In order to find an appropriate reuse, the research team (i.e. planners) suggests to remove these barns and replace them by two new buildings (Fig. 4). The first will accommodate a greenery, grocery and workshop space, while the second a stable for therapy with horses for several groups of socially deprived citizens, amongst whom children and adults with autism. Additionally, allotment gardens can be installed in front of these buildings. The gardens can be used by everyone who is interested in gardening, but in particular by elderly people or people with a mental and/or physical disability (i.e. providing a meaningful day activity).

In short, by bringing the uncovered shared concerns and interests of the commissioner and numerous stakeholders together in a shared vision or single image, they recognize their own input, and clearly feel (more) connected with the cleared out and more 'certain' outcome of the planning process.

3.5 *Scenario-writing*

According to the literature, 'scenario-writing' is a sensitizing tool that can be used by planners during the feedback phase, in order to make the commissioner and stakeholders aware of alternative scenarios for



Figure 5. Museum-scenario for a particular building.



Figure 6. Wellness-scenario for the same building.

a possible future (Van der Heijden 1996; Myers & Kitsuse 1999; Chakraborty et al. 2011; Klosterman 2013). In contrast with 'visioning', 'scenario-writing' offers a much richer perspective, because of the exploration of all alternative options (Hopkins & Zapata 2007; Chakraborty et al. 2011; Klosterman 2013). Within our 'IEP site' case-study, 'scenarios' are developed in the second phase, based on all data collected during the first phase, and the extra input of the research team (i.e. creative and innovative ideas of planners), processed by means of 'desktop designing'. To do so, we have applied the approach of 'Research by Design' (De Somer & Van Der Veken 2012; Uyttenhove et al. 2012). This approach uses design methods from the disciplines of architecture, urbanism and spatial planning, in order to discover, depict and test different spatial possibilities. By doing so, the designing activity generates new knowledge, insights, practices and products (i.e. outcome). As such, 'Research by Design' does not primarily focus on the outcome or design result, but rather on the design process (Downton 2003; Schreurs & Martens 2005).

Within our 'IEP site' case-study, two alternative scenarios are elaborated for the reallocation of one particular building at the colony of 'Merksplas'. The scenario in Fig. 5, remains within the restrictions imposed by the commissioner, whereas the scenario in Fig. 6 is more open. The first represents a museum, for which the present building structure can be retained (Fig. 5). The second represents a wellness, for which the floor needs to be 'deepened', in order to install a new sunken water basin (Fig. 6). In addition, other architectural interventions are suggested. By lowering the windows and by removing a part of the floor together with a part of the roof, more natural light can be brought into the building. Because of the opening in the roof, right above the sunken water basin, this natural light reflects directly on the water. As a result, the effect of a Greek or Roman 'compluvium', or open space above a sunken water basin or 'impluvium', is obtained. Additional effects of these architectural interventions are the extra exposure of the beams and the provoked perception that the space seems bigger.

To summarize, alternative scenarios are used as an eye-opener for the commissioner and stakeholders, in order to make them aware of the added value that architectural interventions can generate. Uncertainties thus become once again more certain.

4 CONCLUSION

Fig. 7 indicates the possibility of coping with planning uncertainty in a more comprehensive and flexible way, when a well-considered combination of different planning tools is used (i.e. central research question). As shown in this figure, the combination of all five planning tools (right column Fig. 7) can address all five planning uncertainties encountered during our 'IEP site' case-study (left column Fig. 7). More certainty about both (I) uncontrollable social, political and/or economic changes in society, and (II) contradictory statements within current spatial plans, studies and other policy documents, is obtained by (i) 'knowledge gathering'. As a result, more information and detailed insights (i.e. knowledge) about these particular uncertainties is received. In addition, more certainty about the latter is also obtained by (v) 'scenario-writing'. All the contradictory statements are compared in alternative scenarios, in order to get more certainty about which one of these statements has the highest added value. More certainty about (III) a not well specified and unclear assignment, is obtained by (ii) 'partnership working'. By this tool, better arrangements about the assignment can be made. In addition, to avoid unexpected misunderstandings about the assignment, the products to be delivered are written out in a so-called 'assignment clause'. As a way to address the last two 'process uncertainties' of (IV) conflicting and ambiguous interests of stakeholders, and (V) sudden and unexpected changes in opinions and attitudes of stakeholders, four planning tools can be used. The first tool of (ii) 'partnership working' brings more certainty by clearing out the complex and often ambiguous ambitions of all partners involved. All the other tools of (iii) 'storytelling', (iv) 'visioning' and (v) 'scenario-writing', try to influence stakeholders during the feedback phase, and thus generate more certainty about certain planning actions (i.e. creative and innovative ideas of planners). 'Stories' are used as a way to change and clear out the original opinions of stakeholders who were not aware, familiar or convinced of certain planning options or outcomes, while 'visions' are used to let stakeholders feel (more) connected with certain planning options or outcomes. Finally, by presenting 'scenarios', stakeholders become (more) aware of all the possible planning options or outcomes, and thus get a better view on which one should be chosen.

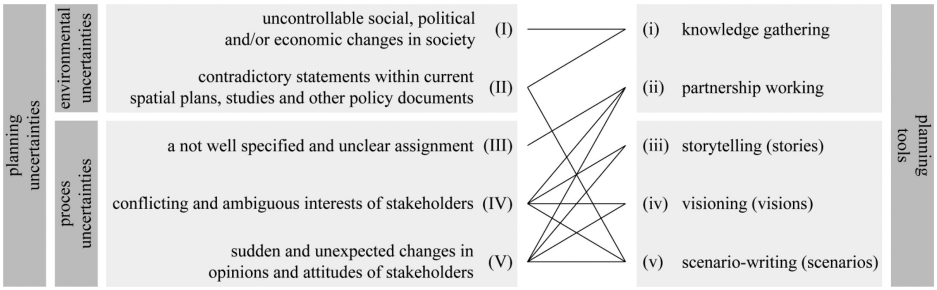


Figure 7. Well-considered combination of different planning tools, as a strategy to cope with uncovered planning uncertainties.

As such, and by combining all these different planning tools, the encountered planning uncertainty is dealt with in a more comprehensive way. A more flexible way of coping with planning uncertainty is realized by means of the creative and innovative ideas of the research team (i.e. planners), especially present in 'stories', 'visions' and 'scenarios'. These ideas are far more adaptive and dynamic, than the initial rigid ideas of most partners involved.

In view of new projects, we want to reuse the same planning tools from our first and explorative 'IEP site' case-study, as a way to address the possibly new encountered planning uncertainties. Due to a wider application of this 'toolbox', we can make more general statements about the effects of combining planning tools, but also which one is best and which one is missing in order to deal with (all aspects of) planning uncertainty. In addition, we want to examine the stakeholders involved, whether or not they experience the benefits of combining planning tools, in order to deal with planning uncertainty.

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Social challenges meet architecture – from participation to digital fabrication

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ABSTRACT: Society today faces new challenges and needs. Due to drastic climate changes, economic crises, war, or people looking for better knowledge or adventure, around the world the migration has substantially increased, either temporarily or definitive. This has a big reflection on the urban space. It is quite common to find in the same place coexistence between different cultures, as well as different age groups or social classes. How should the architect find a way to deal with these differences? How should the architect think and design urban space?

In this paper it will be explained how a team of architects respond to these questions. The action puts together multidisciplinary teams – architecture, design, digital fabrication, informatics, sociology and management – working with the experience of the final users to achieve solutions that contribute in a positive way to the daily life of an interior, exterior architecture or urban space.

Practical examples of these works will be given, focusing in three main groups: Workshops, Partnerships with local communities and Alternative Curricula in schools.

The paper aims to demonstrate the direct relationship between social challenges, users' participation and digital fabrication.

1 VITRUVIUS FABLAB – ISCTE IUL

1.1 *What we are and what we do*

In contemporary digital revolution, digital data can be transformed into material objects, namely by the further dissemination of digitally controlled production machines in FabLabs. For example 3D printers, laser cutters, CNC milling machines or robotic arms can produce objects on the basis of rapid prototyping, tooling and manufacturing (Walter-Herrmann & Büching, 2013). The Fabrication Laboratory (FAB LAB) was born at MIT's Center for Bits and Atoms (CBA) as a: (1) technical prototyping platform for innovation, providing stimulus for local entrepreneurship; and (2) platform for learning and innovation (Gershenfeld, 2007). FABLABs are open to who want to "move quickly from an idea or concept to a physical object or prototype, or (…) want to experiment with and enhance their practical knowledge of electronics, CAD/CAM, Design, 21st century DIY" (Eychenne, 2012).

In consequence, architecture is defined by computationally-based processes of form origination and attached with the fast development of machinery and computation tools. These interdependences constantly create new challenges and provide more tools that influence the creative process. Resources like Computer Aided Design (CAD), parametric design, bottom up design methodologies, Computer Aided Manufacturing (CAM) and Building Information Modeling (BIM) are evolving together with new logics of thinking, creating, producing and constructing.

It is in this context that Vitruvius FabLab – ISCTE-IUL (VFabLab) is born [Figure 1].

VFabLab is integrated in a university and it is also open to the public; it is a place where knowledge, fabrication and innovation is shared. The main goal is to explore new approaches to the architecture project, as well as to explore new ways to apply and transform materials in construction. We intend to develop automated techniques for producing architecture models, to explore modular systems for construction, and to make interventions in areas like product design, graphic computation and multimedia.

VFabLab develops projects from small scale to the real object, from draw through production and use. We are equipped with hand tools as well as CAD and CAM technology. The work connects industry, companies, individuals, schools and local communities. Companies can come to us to develop prototypes of objects or if they wish to research materials and techniques of construction and assembling. An individual person can make a rapid prototype of an object or develop an idea for a product or space.



Figure 1. VFABLAB, ISCTE-IUL. Workshops and Assembly areas. (Credits: Authors).

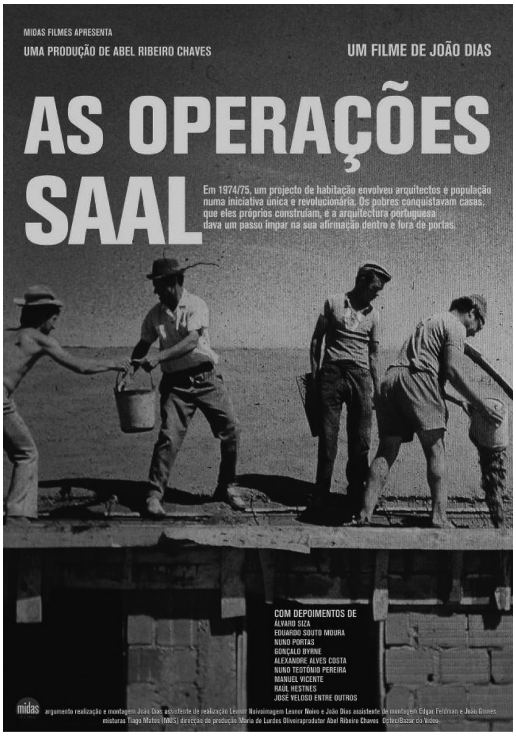


Figure 2. Documentary "As Operações SAAL". Directed by João Dias (Credits: Midas).

With the schools we connect the students with new technologies stimulating new skills either in education or cultural areas. The work with local communities goes through local association, gathering and developing ideas, creating meeting points with teams of different subjects with the aim of generating multidisciplinary projects.

Our course of action can be demonstrated in the practical examples given in this article that connects research, industry, education and society.

2 "SOCIAL CHALLENGES MEET ARCHITECTURE"

2.1 *Participatory architecture*

Participation in architecture comes from the 20th century 60's and the 70's it started by connecting new approaches in social housing (Jenkins & Leslie, 2010) (Jones, Petrescu & Till, 2005). In Portugal it had a big presence with SAAL (Serviço de Apoio Ambulatório Local/Local Ambulatory Support Service). [Figure 2]. In the 20th century 80's Giancarlo de Carlo (1980) believed, in the future, organization and form in architecture would come from the user, for him the project shouldn't have different parts as "defining a problem", "elaborating a solution" and "evaluating the results", for him a project was a "process" where participation implied the presence of users along every moments". There should be communication between architects and users, under standing the context and program of a design, achieving a proposal and the appropriation of the space should not be in different or independent parts of a project, they must connect and give information to each other, so the solution brings up something it will contribute for the user routine.

As Sanoff states (2007) "Participatory design is an attitude about a force for change in the creation and management of environments for people. (…) Citizen's working towards collective outcomes, has been described as visionary strategic planning, and deliberative democracy, all aimed at actions that shape and guide what a community is, what it does, and why it does it. Overall, studies in participation conducted during the past decade have referred to such bene?ts as citizen empowerment, increasing social capital and promoting a sense of community".

Today participatory architecture is a worldwide concept and it has no strict rules of approach, it has only guide lines that can be adapted to the context of every project (Jenkins & Forsyth, 2009) (Spinuzzi, 2005). The participatory design process can be presented in fields like: (1) redesign urban planning, bottom up methodologies; (2) implement alternative practices of city appropriation, group actions in the living context; (3) develop interactive interventions in public space, like associative proposals of urban farming; (4) increase social projects in emergency contexts; (5) apply strategies in informal architecture based on open source connections. Basically "from programmatic challenges to the life in the city, to the group proposals of urban and social encouragement, or reactivating repressed urban spaces, participation can endorse new and different ways of living the contemporary city" (Baptista, 2011).

According to Alejandro Aravena, winner of 2016 pritzker, "participatory design is not a hippie, romantic, let's-all-dream-together-about-the-future-of-the-city kind of thing. It is actually not even, with the families, trying to find the right answer. It is mainly trying to identify with precision what is the right question." In the redesign of the city of Constitución, in Chile 2010, after an 8.8° earthquake and tsunami had

devastated almost all city, Elemental studio used a participatory processes to understand the context of the situation and start asking people "what kind of city do you want? (…) express your opinions, participate!", they realized that more than preventing a next tsunami, they had to rethink the river front providing solutions for every year flooding as well as better public spaces, increasing a better connection with the river, which was the foundation of the city and get lost with private ownership of the river front (TEDGlobal, 2014).

Participation along the process of design can bring information that was not expected in the beginning, information that without it the intervention can be a failure.

3 "FROM PARTICIPATION TO DIGITAL FABRICATION"

3.1 *Participation in the digital fabrication process*

We are living in an era of globalization: drastic climate changes, economic crises, war, people migrating either temporarily or definitive; these are not only problems of a country, it has reflections in the whole world. The way we think cities and how communities react need to respond to those events and that brought us many questions on how should the architect work. Together with these challenges, architects also have to keep up with the constantly evolving technology. It is time to rethink the profession. Pedro Clarke (2014) supports that "there is a lot of work that needs to be done, it may not be the most glamorous job, but it is a work where architecture can once again show that it's relevant to society".

Parametric or CAD/CAM tools in the design process, allows the architect to change and adapt the project to the context of the intervention in real time and involving participatory design along the process. The computationally-based processes are the opportunity for the architect to be more close to the user needs.

This new communicating process gives easy access to the potential of digital tools either in drawing or in construction. It can be an approach that gives fast results in a context of fewer resources, it can complement the participatory design, by personalizing the action, adapting to specific cases it can generate an increasing flexible way to intervene (Ramalhete & Silva, 2014).

4 PRACTICAL EXAMPLES

All the projects here presented are supported by participative processes along the project and digital fabrication of a solution as a respond to local specific needs.

The interventions do not start on standards or pre-established concepts. The processes start in the experiences and uses of the public space. After we understand the routine of spaces we look for the needs of the users with them and only then we analyze how to intervene in the space. By the end of the project the intervention does not need to be presented and explained to the users, they had contribute along the process, so they know that what was built will respond to their needs and normal day routine.



Figure 3. INSITU 2013. Community table (Credits: Like Architects).

4.1 *Workshops*

4.1.1 *INSITU*

INSITU is a laboratory of intervention in architecture. It is now in 2016 happening de fifth edition, but we will focus on the second in 2013 [Figure 3] and third in 2014 [Figure 4] that happened at Bairro do 2° Torrão da Trafaria, in Almada, Portugal. This workshop is a partnership between Centro de Estudos de Arquitetura, Cidade e Território da Universidade Autónoma de Lisboa (CEACT/UAL) and Vitruvius FabLab (ISCTE-IUL), with the support of the local entities Câmara Municipal de Almada (CMA) and Junta de Freguesia da Caparica, and Madeivouga as sponsorship.

This workshop involves university architecture students (UAL + ISCTE-IUL), architects, public entities and the local communities that live in neighborhoods of informal construction. In the workshop, each intervention aims to respond to specific problems in a specific context and reality of that space. Participation of local community has a really important role, with decisions that are taken and made, from conception, through construction, promoting and maintaining the spaces (Ramalhete & Silva, 2014).

As a first part of the workshop, for a faster and more eficient aproach, in the second edition there was a previous work to understand the main problems of the neighborhood, in the third edition, architects get already involved in this part of the project. In the second part – the physical intervention – students and population get together with architects and organizing team to work on the solutions. The process encompassed three steps: (1) research, to understand the local problems and study the real secnario; (2) drawing, defining the specific intervention program; and



Figure 4. INSITU 2014. Shed (Credits: Bárbara Varela).



Figure 5. Community table from INSITU 2013 under the Shed from INSITU 2014. Intervention done by the users (Credits: Autors).

(3) fabricating, assembeling and built on site with the local community (Ramalhete & Silva, 2014).

With the people from next example (Pendão) there was a visit to Bairro do 2° Torrão da Trafaria, to show them what we do and what kind of approach we could do to their community as well, this visit also allowed us to understand what was the stage of the workhop intervention's a year after. It was surprising to see how some had almost desapired but with others, it was clear how well the interventions were received by the population and how they interacted with the proposals of both workshop editions, adapting it to their needs and maintaining it through weather and time. [Figure 5].

4.2 *Partnerships with local communities*

4.2.1 *Pendão*

The main project at Pendão, Sintra, Portugal, came from a CLDS (Contrato Local de Desenvolvimento Social/Social Development of Local Agreement) that identifies with local entities territories that need to be intervened. The CLDS team invited Aga Khan Foundation to manage the project in Pendão. This foundation works to "improve the welfare and prospects of people

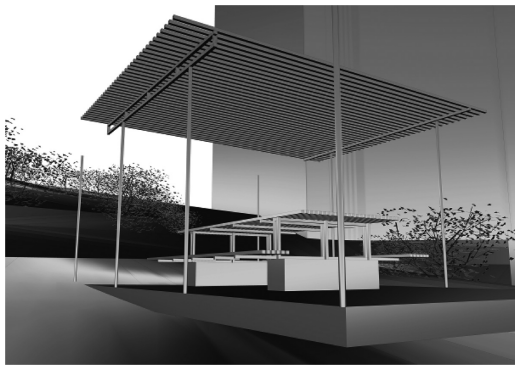


Figure 6. 3D Model of the community shed. Project "New Image" ("Nova Imagem") Pendão. (Credits: Vfablab).

in the developing world, without regard to faith, origin or gender. (…) Its projects encompass many of the determinants of the quality of life, including the natural and built environments in both urban and rural areas, food security, health, education, access to financial services and economic opportunity, as well as the cultural areas of traditional music, architecture and art" (Foundation A. K., s.d.).

Aga Khan Foundation created a urban reabilitation project, a PIC (Projectos de Inovação Comunitária/ Community Innovation Projects) called "Muda as ruas do pendão" in english "Change the streets of Pendão", with the aim of using the locals to participate and improve the social, economic, cultural and environmental state of their own neighborhood. The people from Pendão, as individuals or groups applied 17 projects for the area, partners like local entities (Câmara Municiapl de Sintra, Associação Mirante de Queluz, União de Juntas de Freguesia Queluz-Belas), Olho Vivo organization, Young HeArt project and Vfablab team are now working to complete those projects.

VFabLab role is to follow up the projects, discuss the different stages of the projects: through cultural and participatory activities, workshops and meetings with partners. To make possibly the users' ideas it was adopted a bottom-up methodology, so the population will not abandon the project, and with the available resources, create interventions that reflect the relationship between people (existed and created along the project) and the identity of the neighborhood [Figure 6 and 7].

4.2.2 *EB1 + JI Alfornelos*

This project was requested by a parent that knew what we have been doing and asked us to work with the school of his sun to make a better playground.

It is an ongoing project, located in Alfornelos Elementary School (Escola Básica 1° ciclo + Jardim de Infância), Amadora, Portugal.

We start by introducing VFabLab team and the projects that we do with the students. The team developed a workshop that explains architecture to children from 6 to 10 years old called Pequenos & Atelier



Figure 7. Stencil for the message "Este muro vai mudar!!" made in card board with CNC milling machine at VFABLAB. Project "For the sun to be able to shine in Rua do Sol" ("Para que o Sol brilhe na Rua do Sol"). (Credits: Bárbara Varela).

(ISCTE-IUL, Vitruvius FabLab, 2012). The students learned about architecture, geometry and a bit of why we were there. The next moment we start to work with all the groups of people that use the school: students, assistants, teachers and parents. In this moment we used a tool kit to understand with the users how was the school in the present and how it could be in the future (Sanders & Stappers, 2012). After analyzing which were the main concerns of the school it was possible to define the goals of the intervention: (1) painted games on the floor; (2) tables and places to seat; (3) a covered area for kids to play outside and to protect the parents when they are waiting in the beginning and end of the day for the children. In the next phase we put together the same groups and ask them to draw or make what they would like to have in the school. We understood that the common points were starting to get obvious and that is when the draw of the solution started, introducing digital fabrication in the outcome solutions by exploring short resources and fast production, always responding to the user's everyday needs [Figure 8].

4.3 *Alternative learning curricula in schools*

4.3.1 *EB2 + 3 Alcabideche*

In this project VFabLab team worked with students in a special level school program called vocational. It is still ongoing and it is an intervention in the



Figure 8. 3D Model of the project to EB1+JI Alfornelos exterior playground intervention. (Credits: Vfablab).



Figure 9. Student drawing suggestions to the table's project. EB2 + 3 Alcabideche exterior playground intervention. (Credits: Bárbara Varela).

outside playground space at Alcabideche Elementary School (Escola Básica 2 + 3 de Alcabideche), Cascais, Portugal.

This project is a partnership between the project "Young HeArt" (Guterres, 2015–2016) (promoted by Aga Khan Foundation Portugal and financed by Calouste Gulbenkian Foundation).

The project supports classes from 7th to 9th grade and aims to associate the traditional way to work with wood to the digital fabrication processes having a real project as scenario. In the first moment, with the students, VFabLab team organized a visit for mapping the exterior playground context. This showed us how they live the spaces, what they enjoyed and what should change and why. The next phase inside the classroom students used areal views and plans of the school to put words and symbols of what is was for them the "School of the present" and the "School of the future". Then we start a process of shared knowledge between the traditional and the digital ways of working wood. The students explored hand drawing, CNC milling wood techniques to understanding the limits and advantages of traditional and digital fabrication, and when to use each process or when to mix them to accomplish the best solution. The next moment we look for the design that would better suit the space: a community table with some table games under a shed that could be used either in summer or in winter. Some tests were made in VFabLab and in the school classroom with the students to improve the solutions. The project is ready to be assembled in the school [Figure 9 and 10].



Figure 10. Students giving suggestions to the shed's project. EB2 + 3 Alcabideche exterior playground intervention. (Credits: Authors).

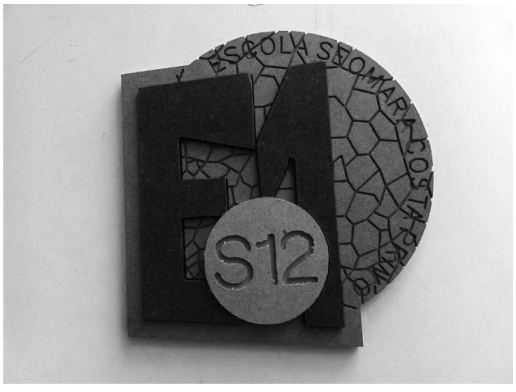


Figure 11. Classroom sign at Seomara da Costa Primo. (Credits: Susana Neves).

4.3.2 *Secundária Seomara da Costa Primo*

In this project VFabLab team was invited by the responsible entity of the vocational school program EPIS – Empresários Pela Inclusão Social (Entrepreneurs for Social Inclusion) at Seomara da Costa Primo Highschool, Amadora, Portugal (Social, 2006). This is a concluded project that happened with one class.

The students were attending CAD learning classes, knowing the basic notions of 2D drawing. The challenge was to use that knowledge and built an object to the common areas of the school building. The school had been recently rebuilt but due to lack of funding there were still many places that were empty and did not offer anything students could interact and relate with. The design process started by mapping the spaces with the students.

There were two intentions that immediately stand out: (1) classrooms had no sings identifying them; and (2) in one of the main common areas was missing a place to seat in group. The drawing process was fast and almost immediately because of the students' knowledge, we just explain what would be the limitations of digital fabrication and their creativity took control. We enhanced the proposals at the same time tests were been made and the next phase was just assembling the proposals on site [Figure 11 and 12].



Figure 12. Bench assembling at Seomara da Costa Primo. (Credits: Bárbara Varela).

5 [EXPECTED] CONCLUSIONS

From the practical experiences explored here it is possible to conclude that architects can respond to different social challenges by thinking and designing with the user along the process.

With the Workshops we have learned that architecture can have an effect in different ways. That giving this kind of opportunities to the architecture students and putting them out of their comfort zone – the classroom –, working with architects and the users, make them lose the fear of working in this kind of informal architecture and allow them to use digital fabrication as a way to respond to the users' needs fast and with less resources. These kind of Workshops also indorse new ways of practicing and teaching architecture.

Being in a project of an urban design, a partnership with local communities, made possible to achieve faster a physical objet, through the way how customized and personalized digital fabrication is, especially when using parametric design as tool along the process of design.

The work done in schools allowed us to better connect with young people and show them what we do and how we work. Thus, gives the opportunity to the students to qualify and connect them with new career

possibilities based on social and technological inclusion. For us these experiences are excellent tests of a new architecture process of thinking and making. We hope that the design process implemented at the schools can, in the future, be applied in an urban scale.

Using participation allied with digital fabrication design allows personalized design solutions, and makes possible to produce the physical intervention faster and with less resources.

In conclusion, by improving the design process through CAD/CAM tools and participation inputs on site, we can not only achieve better solutions but also create and increase "data bases" and "know how" that can be reused, adapted and updated in other projects.

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Lifelong learning in the context of socialization and sustainable development

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ABSTRACT: Social transition, fast changes and developments are causing serious challenges for individuals, social groups and organizations with socialization and sustainable development. It is possible to adapt effectively to these changes and challenges through the ability to change, by bettering and developing skills, which are typical to flexible, conformist type of behavior.

The aim of this study is to present the important role of learning/education, in particular, lifelong learning (LLL) and its features, which contributes to ensuring personal and institutional competitiveness, longevity and sustainable development.

1 INTRODUCTION

Modern societies are characterized by quick and often unpredictable changes. They cover all areas of social life: economy, politics, education, science, social relationships and so on. In particular, in the higher education system fundamental changes and reforms were carried out based on the Bologna Declaration, which was signed in 1999, and singled the beginning of Bologna Process. The reforms spread over the borders of the European Union to include 48 countries and these processes continue until today. The reforms relate to all the areas of the activities of the Higher Education Institutions (HEIs), such as management, study programs and curriculums, organizing and implementing the learning process, etc. The primary purpose of all this, as we know, is the creating of a system, which provides attractive and competitive educational services, as well as integration into the European Higher Education Area. "The decade that we have now embarked upon presents enormous challenges for Europe. The Europe 2020 strategy for smart, sustainable and inclusive growth rightly recognizes the key role education and higher education must play if our ambitions for Europe in a fast-changing global reality are to be realized" (Vassiliou 2011).

In order to adapt to these developments and changes, without suffering from important losses and disruptions, individuals, social groups and institutions are compelled to realize permanent research and tests. But their results are not always satisfactory, to urgently realize this objective, to solve it in substantial and long-lasting way. So, as one of the most important pre-requisite for ensuring the individual, institutional sustainability and competitiveness considered their inlaying resources and skills for adapting to a rapidly changing external environment, as well as their revelation and systematic management. Thus, it turns out that the challenges that arise because of change, can be resisted by having the ability to change. However, this process should come about in a smooth, non traumatic fashion: i.e., not as a revolution, but as an evolution. This will be more effective if done methodically, in a clear general direction and with certain principles. The effective implementation of this process can result in the development of flexible or conformist type of behavior. This means that "… the person accepts social values and goals, as well as the legitimate means to achieve them" (Khachatryan, A., et al. 2002). In this case, at first glance, it might seem that we are dealing with a passive behavior. Moreover, the name "conformists", sometimes considered as a not-so-positive, submissive type of behavior, without personal goals and actions. Actually, conformism is quite active, self-determined and, we believe, is a necessary quality, especially in the modern socio-economic, political, as well as educational and cultural context. This is the reason, that repeatedly use the words "to adapt", "conformists", but don't use the seemingly synonymous words "submissive", "passive". Because from the point of view of issue under discussion, they aren't synonymous, but sometimes even have contradictory meanings.

We should also pay attention to another important issue, that is the determination of the effective measures, tools for creation and development of

adaptable/conformists behavior. At first, we will talk about learning/studying, in broad sense of this word. In this case the process gets more systematic, regular, predictable and manageable, therefore, more acceptable to conformists.

Experts, who are dealing with the issues of development and longevity of organizations, mentioned that "… the degree of adaptation to the external environment and its possible changes due to ability of learning" (Kazhoyan 2004). Which is, in a way, also analogous to Darwin's theory of evolution.

In addition, the following features are noteworthy:

a) high degree of staff's cohesion and accurate perception of the organization's culture, which directly affect the process by which the employees are creating and shaping own values,
b) the respect and tolerance to the new/or opposing ideas and activities, which provides an objective assessment/self-assessment of the overall condition of organization/individuals and openness to learning.

All these features are more or less related to learning/education, in the broad sense of the word. Learning/study is more, than achievement of additional professional knowledge, but rather the acquisition of new knowledge in a different sphere of life, as well as the development of skills and capacity building, which can be applied in the given situation.

People not only learn in the classroom or auditorium, but they are learning in real-life conditions as well. Anyway, all organizations learn to adapt to the external environmental changes. Learning is an important component of the organizational culture (Kazhoyan 2004).

For society, especially during the period of social changes, there is two types of learning, which is distinguished by Chris Argyris (https://hbr.org/1977/09/double-loop-learning-in-organizations). According to him, learning involves the detection and correction of mistakes, which takes place when something wrong happens, and the results and the objectives of the action do not corresponded. He separates two types of learning: single-loop and double-loop.

a) Single-loop learning takes place, when the detection and correction of mistake does not require changes in the values of individual, group or organization.
b) Double-loop learning takes place, when error detection and correction requires changes in the values, objectives and strategies of the individual and the organization (https://hbr.org/1977/09/double-loop-learning-in-organizations).

As an example, we can mention that if we want to shape and develop typical traits for adaptive, conformist type of behavior, it is more effective, if we apply double-loop learning. That is, at the first stage of learning, we must make some changes in our perceptions and re-evaluate our values. As we have noted already, this type of behavior is sometimes associated with not-so-positive, so-called submissive qualities. Accordingly, in this case does not arise the desire to develop unacceptable and negative qualities and abilities. So, if we consider that during the first loop adaptation and conformism give possibility for competitiveness and sustainability, then it is possible on the second loop of learning to teach how to develop the relevant skills and competences.

Chris Argyris indicates that the double-loop learning is necessary, when individuals and organizations are going to make good decisions in the rapidly changing and, often, in uncertain context. By such approach, the learning (study, training) actually becomes as a tool for the formation and development of skills for knowledge and human resource management. And as a result, it promotes the revision of cultural values, norms and perceptions, as well as to the creation and adoption of new values and strategies.

During social changes, learning organizations receive important role and mission. Peter Senge considers that such organization:

a) encourages the vertical and horizontal learning inside and outside of the organization,
b) constantly encourages the exchange of information among its employees.

In this context, the concept of lifelong learning gets special role and meaning. If the changes are continuous, their adaptation and integration process becomes continues. Naturally, the learning process accompanies individuals and organizations during their entire lifetime. In this regard, HEIs should pay particular attention to the creation and development of opportunities for implementing lifelong learning, considering it a part of their social responsibility and as one of the important educational services provided to the society. Due to above mentioned reasons, it is important to use those learning methods and technologies to promote educational accessibility, democracy and quality assurance. In particular, features of open learning, as a new educational concept and philosophy, is implemented through the modern methods of e-learning and distance learning (Diagram 1). Since these methods and technologies, which are called Learning Management Systems (LMS), not serve only the purpose of providing information, but rather the creation and distribution of knowledge and new ideas, they promote individual activities by students and increase their involvement in the learning process. These systems enable the formation of participatory communication, creating a partnership between teachers and learners. And these are, as we know, one of the primary requirements of Bologna Process and the pre-requisite for improving the learning process.

Perhaps, mainly due to this fact, in Prague in 2001 lifelong learning was defined as a separate action line in Bologna Process. Thus it becomes possible to ensure the implementation of the main purpose of the Lisbon Recognition Convention. That is, to recognize the qualification given in any European country in other countries as well, excluding any

discrimination against the holder of the qualification (http://www.ond.vlaanderen.be/hogeronderwijs/bologna/documents/Lisbon_Recognition_Convention.htm). Due to this, the LLL actually has an impact on all the aspects of European higher education: academic mobility and exchange, mutual recognition of qualifications, distance learning, etc.

In 2001 the idea of European Lifelong Learning Area was formed, which aims to promote European cooperation in this sphere. In particular, the following aspects are highlighted for the LLL development:

a) recognition of prior learning outcomes,
b) development of flexible learning paths and the National Qualifications Frameworks, which will include LLL programs as well,
c) LLL and its connection to the social dimension of higher education (www.ond.vlaanderen.be/hogeronderwijs/bologna/news/EQF_EN.pdf.)

In 2007, the European Parliament adopted the "Recommendation of the European Qualifications Framework for LLL (EQF)", which includes general, vocational and adult education and training programs, as well as all of the higher educational qualifications.

In 2008, European University Association in collaboration with many beneficiary organizations from European Higher Education Area, developed the "European Universities' Charter on Lifelong Learning" as a tool for implementation and development of the special role and participation universities in the process of the creation of Europe of Knowledge. This Charter particularly says: "Universities now need … to enhance the development of a creative lifelong learning environment that is open to a more diverse population of learners, and thus respond to societal needs for the modernization of higher education. Fully integrating lifelong learning to the mission of universities is essential to enhance the creativity and innovation profiles of institutions" (www.eua.be). This will enable the universities to become: "… remarkably resilient and adaptable institutions, continually developing their role as society evolves" (www.eua.be). As a result, the universities will take over a new role, serving as a model for society, simultaneously increasing the knowledge and skills of their own employees through lifelong learning.

2 ANALYSIS: LEARNING AS THE TOOL OF ENSURING THE INDIVIDUAL/INSTITUTIONAL SOCIALIZATION

Due to the fact, that the Republic of Armenia signed the Bologna Declaration in 2005 in Bergen and joined the Bologna Process, the higher educational reforms have been systematically realized since this period. Now, all Armenian universities carry out activities to create modern educational services based on the principles and requirements of the Bologna Process. One such HEI is the Gyumri State Pedagogical Institute (GSPI) which primarily serves the educational needs and demands of population in one of the northern district of Armenia-Shirak region and Gyumri town.

GSPI was founded in 1934 and throughout its history has had both success and difficulties. In particular, during the years following the devastating earthquake in 1988, GSPI faced serious challenges, when the socio-economic and political changes were being carried out throughout Armenia. Within this period the Soviet Union had collapsed (1991), and as a result, Armenia faced partial economic blockade. As a result, the demands of the labor market completely changed the requirements of the higher education.

Sometime later, since 2005, deep reforms were initiated in higher education system, as Armenia joined the Bologna Process.

And now, when we look back, and try to assess and evaluate the journey which GSPI has accomplished, we can see that actually it was able to withstand and overcome these difficulties and tried to integrate to the modern educational environment mainly due to the fact, that, at first, it is a self-organized institution, which evaluates and mobilizes its own internal resources, trying to understand the inner logic and main directions of the changes and challenges. After that, GSPI has started a fundamental reform process, which still continues today.

This process has two main directions:

a) the first is the introduction of new, modern specialties, which was accompanied by the relevant professional and logistical development. Its main goal was to satisfy the educational needs and demands of the labor market and the society,
b) the second direction is learning/study, in a broad sense of this word, as already has been mentioned above.

The GSPI's academic/administrative staff and students have not only learnt new professions, but also have learnt the new, modern methods and technologies of teaching, studying and administration, as well as acquired skills and competencies, which they can apply in this process. Moreover, this process of learning is going on today and, we believe, it will always continue, if we want to stay a competitive and sustainable HEI.

In order to be more precise and objective, we have tried to briefly present some activities that have been done in GSPI. Alongside the introduction of new specialties and the use of new teaching methods and technologies in GSPI, we would like to note the fact that distance and open learning systems were introduced in GSPI, starting from the late nineties, in the frame of the projects "Creating a System for the Training of Social Work and Social Policy and Administration as a Specialty within Institutions of Higher Education in the Republic of Armenia" (JEP-10202-96, for 1997–99 years) and "Armenian Distance Learning Network" (JEP-21133-2000, for 2001–2003 years) of the TEMPUS program funded by the European Commission. The activities of these projects in Armenia

were coordinated by the Department of Sociology of Yerevan State University (YSU). The main objective of the projects was to develop and to implement distance and open learning systems and perform the short-time training courses in "Social Work" specialty.

We will now briefly present the situation, in which the Armenia, particularly Gyumri, and the higher education system were like during this period (from 1992 to 2000).

Armenia, as a former Soviet Union Republic, was in a process of transformation. Social, economic and political systems were trying to adapt to the new situation and to implement the reforms. The educational system, in particular, the higher educational system could not be isolated from this process. It tried to respond to the demands of the emerging market economy by the establishment of new, modern specialties. One of them was the profession of "Social Work", the need for which was particularly highlighted by the fact, that after the severe consequences of the devastating earthquake in 1988, there was a need to implement appropriate professions for social support. But in Armenia at that time such professions did not exist. To fill this gap, the YSU started to cooperate with the leading Universities of USA, UK, Germany, and in these activities were included those Armenian HEIs, which are located in an earthquake zone, particularly, Gyumri State Pedagogical Institute and Vanadzor State Pedagogical Institute. In the framework of the above mentioned Tempus Projects the professionals from these HEIs were trained at the YSU, Open University of UK, London School of Economics, Fachhochsule of Frankfurt am Main, by the profession "Social Work and Social Administration". Simultaneously, these HEIs also studied the open and distance learning systems, as well as the opportunities and options of their introduction to the Armenian HEIs.

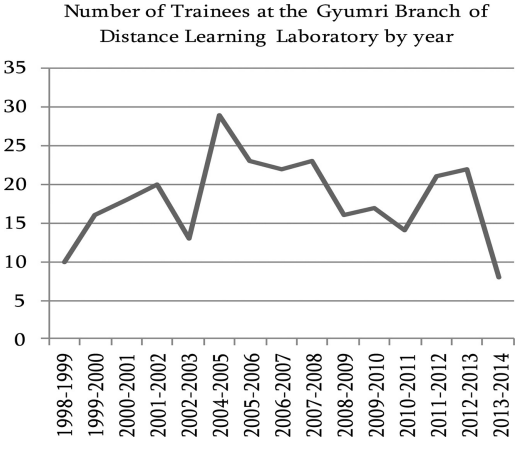
As a result, in 1997 at GSPI the profession "Social Work" was introduced and the Gyumri Branch of Distance Learning Laboratory of YSU was established. Here, through the use of distance and open learning components, short-term training courses in "Social Work" were organized, after the graduation of which, the participants were awarded with Certificates. This is an interesting option for networking in the educational system, because there were lectures and presentations conducted not only by the lecturers from GSPI, but also from partner universities, such as: YSU, London School of Economics and Political Science, Open University of United Kingdom. The students of this Educational Center are the employees of the Social Service Centers in Gyumri, Region of Shirak, beneficiaries and employees at local and international charity NGOs, as well as representatives of various socially vulnerable groups.

For this case study, as can be seen from the Table 2, the number of trainees participating in the "Social Work" courses at the Gyumri Branch of Distance Learning Laboratory of YSU, were initially relatively few (see years of 1998–1999).

Table 1. Number of Trainees at the Gyumri Branch of Distance Learning Laboratory by Gender.

Year	Male	Female	Total
1998–1999	3	7	10
1999–2000	7	9	16
2000–2001	3	15	18
2001–2002	8	12	20
2002–2003	1	12	13
2004–2005	3	26	29
2005–2006	3	20	23
2006–2007		22	22
2007–2008	1	22	23
2008–2009	4	12	16
2009–2010	2	15	17
2010–2011	1	13	14
2011–2012	1	20	21
2012–2013	1	21	22
2013–2014		8	8
Total	38	234	272

Table 2. Number of Trainees at the Gyumri Branch of Distance Learning Laboratory by Year.



Later on, during the period of 2000–2008, their number has gradually increased, as on one hand there is awareness regarding the profession, and on the other hand, there is high social and labor market demand. This is due to fact that trainees in this profession are mostly workers from both public and non-governmental organizations, or have decided to look for a job in that field. This means that our stakeholders were highly motivated, and that had a positive impact on their academic performance.

It should be mentioned that their number gradually decreased in 2009–2011 and especially in 2014. This can be explained by the fact, that the Gyumri Branch of Distance Learning Laboratory, as well as GSPI's "Social Work" Department almost completely satisfied the demands of Shirak Region's labor market during the past ten years (2005–2015 years).

As we can see in the above mentioned Table 1, most of the trainees of Gyumri Branch of Distance Learning Laboratory are women (234 from 272 trainees, 86%). We think that one of the main reasons for this is the fact that in post-soviet period, since 1992, the position and role of women have changed in the Armenian reality. In particular, if during the Soviet period (1920–1991 years), especially due to national traditions, the Armenian women were considered mainly as mothers and caretakers, then, after the Armenia's independence from the Soviet Union in 1991, the emerging civil society has reviewed some traditions and the role of women in society has significantly changed. After these changies, Armenian women started to have a greater participation in the social, political and economic processes.

The second reason was the devastating earthquake of 1988. Some women, who lost their children or relatives because of earthquake, couldn't stand the loss and isolated themselves from the society. The other part, on the contrary, became more active in social life, finding solace and comfort in it. They were trying to help, support not only the women, who had loss, but also the families which were socially disadvantaged.

After these changes, Armenian women started to have a greater participation in the social, political and economic processes.

In order to institutionalize the women's involvement, various governmental and non-governmental organizations have been created. These organizations worked in the interest of women, carried out informative trainings and courses for them.

In addition, we believe that the social care sector is more familiar to women in particular. They, on one hand, protect and support representatives from various socially vulnerable groups, and on the other hand, they try to realize their rights. By receiving relevant professional education, they could ensure the effectiveness of this process. Perhaps, due to this fact most of the trainees of Gyumri Distance Learning Center were women (Table 1). They are mainly employees or beneficiaries from governmental or non-governmental organizations that are realizing a social care.

When we analyze composition of the trainees by age (Diagram 2), we can see that the majority of the participants are middle aged (40–50 years old) and have already studied in the field of another specialty. And now, due to their current work, additional training is needed. In this case, of course, they preferred more flexible and free open and distance learning course. Taking into account this fact, new activities are currently in process in order to organize and implement new specialties, in particular in the sphere of "Public Relations" (PR), "Human Resource Management" (HR), "Social Pedagogy", "Jurisprudence" at Gyumri Branch of Distance Learning Laboratory.

In addition, GSPI performs activities in order to start a process in the Correspondence Learning Department to combine the elements of "traditional" and distance/e-learning. Because these two learning systems do not exclude each other, but rather create additional opportunities for making education more efficient and accessible: "Flexibility in higher education has also been enhanced by the ongoing development of new technologies. Distance learning, e-learning and the recent development of open universities in a number of countries, including Greece, Spain, Cyprus, the Netherlands and Norway, illustrate how the traditional higher education institutional landscape is changing. Meanwhile, established higher education institutions are also launching a range of distance and e-learning programs, providing a broader range of study opportunities for the mainly, though not exclusively, working adult population" (Eurydice 2011). Due to this: "… currently, there is a lot of research into how to effectively combine online learning and face-to-face meetings in what are called 'hybrid' courses or 'blended learning'. Hybrid courses combine the best of both worlds" (https://moodle.org/mod/data/view.php?d=55&rid=6824).

In GSPI the project "Institutional Building and Human Resource Development in the Field of E-Learning in Caucasus", was another notable initiative invested and developed in the field of distance and e-learning systems in 2012–2014. The project was funded by GIZ (Deutsche Gesellsheft fur Internationale Zusammenarbeit (GIZ) GmbH) and Federal Ministry for Economic Cooperation and Development, and coordinated by the Armenian National E-Learning Network.

The goal of this project was to develop a strategy for e-learning, create an electronic platform for partner universities, preparation of study materials, as well as training for specialists for online learning and e-learning system management. Within this project, at GSPI a working team was formed, that has developed "Guideline for use of the ECTS-Credit System" and published it on the GSPI's website.

After the completion of the project, the working team of GSPI continued to contribute to the students and lecturers with the knowledge and experience received in the frame of the program and GSPI is currently involved in the National E-Learning Network.

The team is currently working on a pilot project carried out in GSPI. It aims to create and implement an e-learning course for BA students, with 1 ECTS-Credit workload. Simultaneously it is developing the "Guide for organization and implementation of the e-learning process".

3 CONCLUSIONS

In accordance with what has been presented throughout this paper, the following conclusions can be reached.

In the past, universities were seen as organizations, producing knowledge and graduates, but have become an integral part of the environment, where they are

situated. By facing these challenges, universities will assume responsibility for education and research based on the advancement of sustainable development. And in this sense, we should take into account the perception and definition of sustainable development, by which: "… according to the concept of sustainable development of Republic of Armenia, the sustainable development emphasis the self-recovering and dynamic adaptation skills' development to the changes rather than the maintaining in perfect stable condition" (www.gov.am/files/1322.pdf).

The concept of the sustainable university should include all dimensions of sustainable development (environmental, economic, and societal ones) and political will (top management commitment) to make changes, including structural ones, to achieve the objectives. Therefore, this university could be defined as: "A higher education institution, that addresses, involves and promotes, on a regional and a global level, the minimization of negative environmental, economic, societal, and health effects in the use of their resources in order to fulfill its main functions of teaching, research, outreach, partnership, and stewardship among others as a way to help society make the transition to sustainable life styles" (http://www.uml.edu.com/CITA.lusiv.pdf).

In other words, universities generate and implement changes, and they are in turn subject to the impact of these changes. So, fast and sometimes unpredictable changes are the constant companions of social life, which brings new challenges for individuals, groups, social institutions and the whole society. One of the more efficient means for adaptation to these changes and challenges is the ability to change, by shaping and developing new skills, being flexible and having the ability to create a conformist type of behavior.

Learning/study is the most effective tool for new knowledge and capacity building, and for ensuring sustainable development. Nowadays the concept "Education for Sustainable Development" (ESD) is already used, and has a wider meaning then just "Environmental Education" (EE). Since the changes are performed during lifetime, the learning/study process goes throughout life and is lifelong.

New learning/educational technologies, e.g. e-learning, distance and open learning, blended/hybrid learning, are excellent tools and methods for implementing lifelong learning.

Universities, as educational, scientific and research centers, should pay appropriate attention in their course programs, to create strategies for the implementation of lifelong learning. As it will enhance the competitiveness and longevity of universities, ensuring their flexibility and rapid response to the labor market demands and to environmental challenges which are faced by humanity as a whole.

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Measuring urban ageing. Città Giardino Torino: A resilient archipelago for the elderly

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ABSTRACT: Disruptive demographic trends show a world that is rapidly ageing. The goal of this paper is to measure the possible fallout of the demographic phenomenon on the physical environment through multiscale analysis – from the city to the house – and identifying the diachronic processes of adaptation and manipulation. In order to reach the geographical dimension of the phenomenon, the data related to the ageing population in the city of Turin were merged with the urban fabric. The ageing mapping obtained from this analysis shows the substantial convergence of the "public city" with the one of the elderly, with the exception of the neighbourhood of *Città Giardino*. Through the case study of *Città Giardino* in Turin and his story – made of continuous transformations – the paper points out the dynamic process of adaptation and some resilient practice. In particular, the analysis highlights the physical transformation and the tendency to place attachment, reinforced by new patterns of use of the existing private and public buildings. Within an invisible crisis and in a context of little institutional awareness, *Città Giardino* offers the opportunity to rethink urban policies and to organize a governance strategy in a longer time perspective. Moreover, the research identifies a housing stock that represents a possible resource for a more inclusive habitat.

1 INTRODUCTION

The world is rapidly ageing: the number of people aged 60 and over as a proportion of the global population will double from 11% in 2006 to 22% by 2050. By then, for the first time in human history there will be more elders than young (aged 0–14 years) in the population (World Health Organization 2007).

According to the United Nations Population Fund (2007), "developing countries are ageing at a much faster rate than developed countries: within five decades, just over 80% of the world's older people will be living in developing countries compared with 60% in 2005. The older population is growing from far more rapidly–in 2007 expanding by 2.6 percent per year–than the population as a whole–at 1.1 percent."

Population ageing has been described by demographers as the result of two humanity's greatest victories: increased longevity, or victory over death and disease; and reduced birth rates, or victory over unwanted childbearing (United Nations, Population Division 2000). The shift toward more aged populations is not the result of some inevitable evolutionary development in the human organism but rather a product of a process of societal "modernization". This phenomenon has gone hand in hand with that of urbanization and industrialization.

This unprecedented global process has profound consequences and implications for all facets of human life, including the economic, the social, and the political sphere. Furthermore population ageing is enduring, pointing out a process that is unlikely to be reversed in the future. According to Simpson (2015) the sociodemographic transformation has in most recent times been largely interpreted in terms of two forms of crisis. The first is a future crisis of dependency both for economic and health reasons. The second is a crisis of programming of architectural and urban settings, which were previously dominated by the young. This interpretation adds another issue, introducing a reflection on the relationship between demographic and urban change, and architectural transformation.

In this respect, recently there has been an increased interest and research on the ageing population and the relationship between demographic change and the environment into the three strands.

It is possible to trace three lines of research. The first is related to the clinical studies (Environmental Gerontology), while the second focuses on the policies and actions to promote age-friendly urban spaces and to facilitate active aging population (Plouffe & Kalache 2010, Handler 2014). Requirements for the ideal city open to critical perspectives on this topic, studies more oriented towards a qualitative redefinition

of the question starting from the existent (Buffel, Phillipson & Scharf 2012).

Finally, the partial description of the housing phenomenon linked to ageing, that of retirement communities and the related migration (King, Warnes & Williams 2000, Simpson 2015).

These heterogeneous literature is focused on the theoretical debate and on the models, avoiding the direct observation of the spaces and their transformation (Smith 2009). By contrast, this paper aims to show the blueprint of ageing in the city, analyzing the current situation in a precise context in order to identify a possible connection between ageing and urban transformation. The final goal is to measure the fallout of the demographic and social phenomenon on the physical environment – using the topics proposed by the World Health Organization as reading keys – and identifying the diachronic processes of adaptation and "manipulation" of the physical environment (Pynoos 1992).

2 MAPPING THE AGEING CITY

2.1 *Ageing data and urban description*

Research needs to be placed in a particular place and time. The city of Turin is the background for the evaluation of urban practices, uses of space and the physical layers that have affected the territory, through the lens of ageing highlights and weighs up the traces of the transformation. In order to measure ageing on the urban scale we refer to population ageing data in order to identify the geographic distribution of older people in the city.

The data provided by the Turin Registry Office (2015) for the whole city show an uneven map of ageing, with a higher concentration of the elderly population in the south. In fact, the statistical indicators such as the ageing index, average age and the structural dependency ratio locate the areas most affected by the phenomenon in the districts of Mirafiori and Santa Rita (Circoscrizione 2). Furthermore, the graphs of the population show that this area also has the lowest percentage of foreigners in the city.

The southern area of Turin is characterized by the massive presence of factories and infrastructures related to production, these are the places that made Turin one of the economic capitals in the Italian "boom" during the second half of the twentieth century. It was a period of great transformation, where the agricultural land became the place of car industry (Gabetti 1977), above all the FIAT factory, firstly with the complex of Lingotto (Olmo 1994) and then Mirafiori (Olmo 1997). Along with the industrial fabric was developing its infrastructures, roads and services, but above all the land was consumed by urbanization (Magnaghi et al. 2005, Mazza & Olmo 1991). The landscape of farmsteads that characterized the South of the city quickly disappeared under the pressure of thousands of people arriving in the city in search of employment. The different products of "modernization" generated a new city, expanding the boundaries, changing the spaces and building a new society.

The in-depth analysis of micro-data and the mapping of demographic dimensions within the territory of the city required the selection of smaller geographical units. Census areas in Turin provide precise groupings of people based on the ageing index, the population composition ratio between the elderly (65 and over) and the young (0–14 years). This work of mapping (Fig. 1) shows a detailed picture of the contemporary situation, a non-homogeneous carpet with high concentrations of elderly people.

The evaluation threshold for the ageing index, has been placed on the higher values of 300%, this means that these areas have at least three senior citizens per child, which is twice the national average, estimated at 151.4%, while for all the municipality of Turin is 199.6% (ISTAT 2014).

By overlapping the demographic data and the cartography some particular areas it arise, in particular three zones corresponding to what is called the "public city" (Di Biagi 2008): "a urban form that created in the twentieth century in Europe from an question of housing, [. . .] the belief spread that it was the task of the community to respond to the need for housing of disadvantaged social groups". In this sense the "public city" becomes a metaphor for the different seasons of the city, characterized by specific tools and precise forms. This process began in Turin in the early twentieth century, with isolated dwellings, than increases after the war, firstly with apartments buildings in series, and later with entire blocks.

The first important consideration of this work is to outline the convergence of the "public city" of the 60's and 70's with today's city of elderly. The second step is to identify and define the area of study among those that emerge from previous mapping. The choice fell on the territory that seemed to offer the highest level of morphological complexity, an area formed by the border with the municipality of Grugliasco and two main roads: Via Guido Reni and Corso Allamano.

At first glance the area appears as an archipelago made of fragments, these islands are inhabited by a number of different buildings from the high-rise dwellings to an urban village made villas (Fig. 2). This village is named *Città Giardino*, Garden City, whose name only seems to refer to the urban model theorized by Ebenezer Howard in 1898.

The towers and the linear buildings were the result of public policies for the economic and social housing, especially the law 169 of 1962.

Within this tissue lie the services, the road infrastructure, the commercial network and, the public space system.

Observing the area is possible to underline another key aspect: the heterogeneity is not only morphological, but also relates to modalities and practices that generated it. This urban section shows the change in the contemporary landscape – aged with the



Figure 1. Map of the ageing index in the south of Turin.

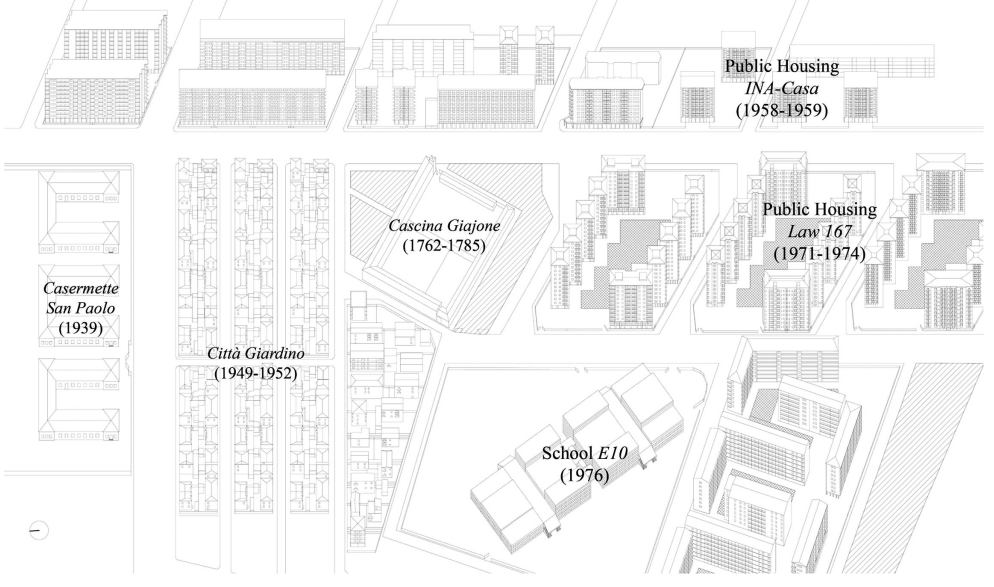


Figure 2. Front isometric of the study area.

inhabitants – and the same is true for the models and the imaginary that had been proposed for an expanding country. Those lifestyles and uses of space today appear distant and no longer coherent with the new requirements and with the recent social emergencies.

2.2 *Methodology*

At this point it is crucial to reconstruct the entire process, starting from history, from the individual stories described by the case study.

The tools to accomplish this route are proper of an analytical survey, the method and the instruments were diversified in an attempt to preserve the dynamism of observed urban practices (Blau & Rupnik 2007): maps, charts and drawings are intended to show a faceted situation, in the reading of the ageing.

In particular both archival research (drawings, documents and journals) and direct exploration of the places were necessary. The spatial experience is supported by the use of photographs, interviews, meetings with actors and inhabitants (Bonomo, 2013, De Pieri

et al. 2013). It is a way "to talk" the case study, gathering useful information and collecting the many "microstorie" (Ginzburg 1979) that lie behind inhabiting. These are precious modalities, useful to tell a different story, as complete as possible. Moreover, these items represent the possible traces that reconstruct the overall picture, directing research towards the most interesting results.

In this regard, the analysis and description advance some issues regarding the forms of living, typologies, habits, practices, and devices, related not only to architecture but to the project in general. Dynamism and tension reveal the forces at play, the modes of action and the possible conflicts. From these shared elements and strengths emerge strategies of action and the ability to foreshadow the urban future, all seen within a broader vision, in which the research questions the relationship between the inherited living spaces and the deep social and demographic change.

3 CITTA' GIARDINO AND MIDDLE-CLASS CITY

3.1 *Urban village*

The area is located in the periphery north-west of Turin, on the border with the Municipality of Grugliasco. At the time of his birth was far from the rest of the city, which in a few decades would have incorporated.

Especially after the Second World War was immersed in an agricultural landscape, characterized by farms and large estates, but not far from the factory of Mirafiori-FIAT and from that of Pininfarina.

In 1947 the Società Torinese Città Giardino (S.T.C.G.) bought land to build a new city, made up of 400 villas with their own garden and equipped with all facilities. At that time Italy was facing the housing problem for all those people who were displaced in the II World War or who had lost their homes. It was a wide real estate transaction propagated throughout Italy: ac "the most impressive group of houses that will never built [. . .] composed of six or eight rooms, each arranged so as to be divided into more accommodation of two, three or four bedrooms. Each unit will be accompanied by various services essential to modern lifestyle and standard of living. All villas have the the ornament of a garden completely fenced".

(quotation from La Stampa Sera, 12–13 novembre 1948).

A "hybrid" solution, an urban village consists of independent two floors, with cellar and all the possibility of expansion.

Furthermore, the S.T.C.G. proposed in its offer also a number of works of infrastructure and services for the community including park, pool, service building, school and church. The houses were designed for a young middle class, made up of artisans, workers and employees in the automotive industry.



Figure 3. *Città Giardino* internal roads.

Despite the inauguration of the first house in 1949 the work were slow, only to only to stay permanently with the company's bankruptcy.

The many people who had bought land, marrying the design of *Città Giardino*, they found themselves in front of building sites not yet completed, the total lack of services and infrastructure works. To cope with this situation of isolation and impasse residents founded the Consorzio Pro Città Giardino, with the objective to finish the work and obtain official recognition from the city, full recognition will come only in the 70s.

On the ground there were only excavations and the first concrete structures, in fact there were few finished homes. The cooperative sought support in the City of Turin in order to overcome the serious crisis and uncertainty, due to the bankruptcy of the company. The works slowly resumed in 1951, there were to be solved the problem with the basic services of urbanization, that was totally covered by the inhabitants of the *Città Giardino*.

Meanwhile, the surrounding town grew, filling the void with private and public building (Fig. 3). Between the 60s and 70s the residents of *Città Giardino* had saw a fence of buildings growing around them. In particular the INA-CASA projects (Di Biagi 2001) and then those of the Law 167 (Caramellino et al. 2015), trying to give shape to the growing urbanization. Together with the houses had stood new services, especially churches and schools that were trying to sew together urban and social fabric.

3.2 *Public housing*

The law 167 of 1962, "Provisions to promote the acquisition of areas suitable for the construction of economic and social housing", played an important role in the process of expansion of big Italian cities between the 60s and 70s and is often remembered as the provision behind the construction of some of the big public housing estates. The law offered the municipal authorities tools to purchase land for assignment to public bodies, cooperatives and, in some cases, private organizations, at subsidised cost, for the

construction of housing for medium or low income families (Caramellino et al. 2015). According to De Pieri (2015) one of the aims of the law consisted, from the start, in favoring a consolidation of the urban middle classes, simplifying access to housing by large segments of the public.

The law 167 was implemented in Turin with a plan for economic and social housing (Peep) in 1963. This plan did not overturn the comprehensive logic and the lines of the city's expansion. In particular it confirmed the radio-centric growth upheld by the general town planning policies (Mazza & Olmo 1991, Di Biagi 2008). The northern areas of Turin were built largely by public bodies (Iacp, Gescal, sometimes with the collaboration of FIAT), while the western and the southwestern areas the cooperatives had a greater weight. These operations focused more evidently on building fragments of a middle-class city, not always so different from the surroundings city built by the market.

The logic of adaptation to the fabric of the existing city and fragmentation was also used for the area around *Città Giardino*. The construction began in 1971 with the designed area named E10 (corso Cosenza). The site was divided into a series of operations managed by different cooperatives (related to the Democrazia Cristiana party), which built a series of buildings clustered around courtyards. In particular these ten or seven-storey building adopted two specific typologies: the tower and the linear block. Furthermore, these buildings were characterized by two garage floors below ground, a *pilotis* ground floor a great differentiation of the apartments – representative of the emerging middle class –, a garden, standardized building technologies and a great differentiation of the apartments. The size of the apartments ranged from 70 to 110 square meters, consisting of entrance, living room, kitchen, two or three bedrooms and one or two bathrooms. In addition, all the apartments had double exposure, balconies and were served by a staircase and elevator system. The buildings perfectly represented the new middle class, with its demands and its lifestyle.

The plan for the area also provided the construction of a church and a school, typical elements of the law 167, to provide services and to make cohesive the ever-expanding community. These public buildings were completed after the construction of residential buildings, in particular the church in 1972 and the school in 1976.

3.3 *Social pattern*

Città Giardino highlighted a social pattern linked to the scheme of arrivals, from early pioneers to the family chains, which brought friends and family to live in the same area. In fact, families of *Città Giardino* not came from Turin, but from the surrounding countryside or by other small rural realities, such as Asti and Cuneo.

This specific social structure can explain a precise ideological component: the specific Italian immigration. According to Foot (2004) from the analysis emerged a number of conservative values, "the desire to reproduce the life of the ordinary village with small houses, gardens, vegetable gardens, terraces and balconies." Moreover, it could emphasize an individualistic and economical desire, represented by the choice of family ownership of land and houses.

In contrast, the underlying ideology in *Città Giardino* was not only conservative. In fact, had produced a strong community that formed strong bonds of solidarity and organization for the common good. The most important example was the establishment of a consortium that would protect the people and would allow the completion of the work. The *Pro Consorzio Città Giardino* in the 50s and 60s was able to obtain permission to build and the habitability of houses. Furthermore the inhabitants had completed the construction of the basic infrastructures: electricity and water, distribution, paved roads, and drainage system, without the help of the municipality (Libert 2003).

As it regards the buildings constructed by the law 167 pursued an urban and social mix between public and private and middle-class oriented operations. In most cases there was a coincidence between the residents and the employees of FIAT. Through interviews it was possible to reconstruct many of the paths that led to the purchase of these houses. In particular, the inhabitants were attracted by the modernity of these apartments, both for the life in the new condominium and for the solutions adopted in the construction (spaces, materials and services).

The design of these buildings provides a separation from the rest of the city with some devices such as gates and green barriers. The buildings and their inhabitants were isolated, a separation both physical and social, within a system other fragments.

3.4 *Built environment and mobility*

Within the study area there were two other elements: the farmstead of *Giajone* and military station San Paolo. These initially had a minor role, except with time become the central places. In the first case, after years of abandonment, in the late 80s it was redeveloped to become a new pole with the municipal library and other services for local residents. In the second case the station were returning to take on a military role after years in which it were the refuge for many people looking for work and hunting home.

The urban fabric was innervated by commercial facilities, especially in *Città Giardino* it was a trade of proximity, characterized by small shops. These shops that did not withstand the new market pressures in the 80's and the shopping mall born near the neighborhood. At the same time there had been a fundamental change in mobility, the roads that skirt the area became increasingly busy, changing into multi-lane roads.

4 CONCLUSIONS

The rich history of the area shows a dynamic and complex process through which is possible to provide some interpretations.



Figure 4. *Città Giardino*, back of houses.



Figure 5. *Città Giardino*, interior of the house of Maria Nella.

First of all the case study area works like a Petri dish, a reading of the wider urban renewal, both in its epochs and in its instruments. Along this period the transformation also had took place in *Città Giardino*, a less visible change, made of small additions (Fig. 4). In particular, the housing added a floor or a veranda, the garden also changed with the addition of a garage or a warehouse in place of the flower. Other changes took place inside houses, new modern facilities replacing existing one, the internal organization was changing to accommodate the changing needs of the inhabitants (Fig. 5). While in the other residential buildings, those of the law 167 on social housing, there have been no changes. The inhabitants are aged in their homes without being able to adapt the buildings to the new challenges posed by ageing. In fact, the condominium regulations and building regulations do not allow a change of the functions and structures.

Through direct observation and reconstruction of the different levels is possible to highlight a city designed for a specific period and for a specific population, that of the middle class.

A population that is concentrated in certain areas of the city, the same areas now affected by ageing. It is a city within a city, made up of homes, public spaces, services and behaviors. The mutation in the uses of space and forms may be clues to the interpretation of urban aging.

Since the proposed division of the World Health Organization (2007) there are some topics in specific areas for the age-friendly city. In particular, the attention is focused on the physical environment: outdoor spaces, housing and transportation. This topic goes hand in hand with the social environment.

As part of the ageing in place *Città Giardino* highlights certain aspects of typology, in particular it comes to changed housing and needs of the inhabitants. The direct observation shows a series of devices that have gone to change the volume and the shape. Most of the houses were raised at least a plan, they added a garage for cars, closed their previous balconies with a veranda, the space around the house was paved and a number of roofs were built. The rooms of the house have increased and they have been renewed, older rooms have been merged and expanded. Some devices designed for the elderly were added, especially as regards the accessibility of the distributional spaces and in particular for stairs and the bathrooms (Fig. 6).

The changed needs and habitat does not seem to be matched by a change of ownership. Families who first arrived at *Città Giardino* still reside there, showing a resilient process. Most of the time the house was divided, hosting within the same family with parents and children. Few newcomers *Città Giardino* still appreciate the housing solution. Through interviews it was possible to detect the reasons for this success: the freedom provided by the stand-alone solution, the possibility of a green space in an urban setting and proximity to services.

In this real estate resilience framework it appears important to note two elements, the first resides in house prices, significantly higher than the neighboring buildings. Second, it should be resumed the ideological component that acts both at the community level



Figure 6. *Città Giardino*, interior device for elderly.

and on the individual household. In particular, *Città Giardino* operates as an urban village, closed not only physically but also socially, a kind of gated community consisting of different combinations that tend to close and isolate the settlement. This factor is crucial in reading the practices and the internal behaviors of *Città Giardino*.

To the dwelling resilience corresponds public services that slowly adapt to the changing needs of the elderly population, it is the case of the open spaces and schools in the area. The only exception is the *Cascina del Giajone*, converted to services, which had become a gathering place for the entire population.

Within an invisible crisis *Città Giardino* is not only a blueprint of ageing, it represents an opportunity to rethink policies and projects weighed for a morphological and functional change. In a context of institutions little conscious of the phenomenon, it is necessary to measure the needs of the "new" residents, compare and organize a strategy of governance along a longer time perspective.

This perspective could start from the existing housing stock and from public buildings underused in order to activate new resources – freed through the placing on the real estate market of a range of new properties – generated from sharing the existing buildings (Polci 2013). The new housing policy would have positive effects for the elderly owners and users – economic and social – and for the dynamics of the entire city.

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Social sustainability in urban context: Concepts, definitions, and principles

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ABSTRACT: This paper focuses on the concept of urban social sustainability to explore main themes and dimensions by a comprehensive comparative overview. The first objective of this research is to clarify the social sustainability definitions, principles and frameworks through reviewing the existing literature. Later, it attempts to recognize the major factors affecting social sustainability in urban context focusing on satisfaction of human needs. As a result, to connect between theory and practice, Maslow hierarchy of needs has been chosen on the subject of human needs in urbanism. Finally, spatial qualities made by reflecting these needs to space designing such as Comfort, Privacy, Legibility, Diversity, Public Participation, Visual Richness, Sense of Place and Identity. In addition, reviewing studies conducted in different urban scales (Micro/Medium/Macro units) revealed that previous attempts on urban social sustainability emphasized more on Macro Scale (city) and Medium Scale (Neighborhood) units especially emphasizing on urban renewal and regeneration strategies especially in developed countries.

Keywords: Sustainability, Social Sustainability, Urban Social Sustainability

1 INTRDUCTION

In recent decades, Social Sustainability has gained an increased awareness as a fundamental component of Sustainable Development and Sustainability. There are various studies conducted on social sustainability as one aspect of sustainability or sustainable development. However, concise review of related literature shows that the definitions on social sustainability are quite complex; therefore, this research will provide a clearer framework for achieving a comprehensive definition of social sustainability in urban context. This study is aimed for social sustainability of future and contemporary cities by drawing conclusions on "What are the parameters for enhancing social sustainability in contemporary urban contexts?" In order to answer this question, this article studies theoretical background related to social sustainability, definitions, frameworks, perspectives, dimensions, and finally investigating the concept of social sustainability in urban context. The aim is to present a framework, which can be, considered for wider use of sustainable design by urban designers, planners, and policy makers concerning social sustainability.

2 HISTORICAL EVOLUTION OF SUSTAINABILITY

In the 1920s, the ideas of Modernism began to surface in urban planning. By the late 1960s and early 1970s, many planners felt that Modernism's clean lines and lack of human scale sapped vitality from the community, blaming them for high crime rates and social problems (Smith, 1997). Since the late 19th century, the problems resulted from modern urban development has appeared as different urban crisis in three dimensions of environment, social and economic, which has made these communities unsustainable and instable and made experts think about other methods of urban development patterns. Some planners argue that Modern lifestyles use too much many natural resources, polluting or destroying ecosystems, increasing social inequality, creating urban heat islands, and causing climate change. In this regards, the term of sustainability was first developed by United Nations released the Brundtland Commission Report, which defines sustainable development as development which meets the needs of the present without compromising the ability of future generations to meet their own needs (Sen, 2000; Partridge, 2009). In the beginning, the

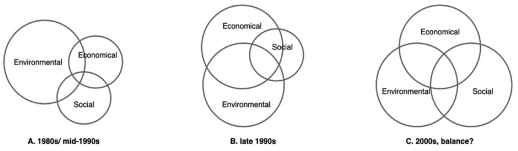


Figure 1. Different dimensions of sustainability and their relative importance through time; A. Importance of Environmental Aspect (1980s/mid-1990s), B. Importance of Economical and Environmental Aspects (Late 1990s), C. Balanced Importance of all three Aspects (2000s)
Source: (Colantino, 2010).

notion of sustainability was narrowly linked to environmental and resource diminution caused by current ingestion patterns. These very narrow considerations were widened by the UN-Conference on environment and development in the Rio de Janeiro in 1992. For the first time, the Agenda 21 explicitly mentioned the human development and social dimensions of sustainability (Harun et al., 2014). The report suggested that social sustainability is aiming to preserve the environment through economic development and poverty alleviation, but it did not recommend any practical perspective (Landorf, 2011).

3 CONCEPTUALIZING SOCIAL SUSTAINABILITY

Sustainability embraces three equally important aspects/pillars –environmental, economical and social, which need to be balanced (Dempsey et al., 2011; Davidson & Wilson, 2009; Mak & Peacock, 2011; Barron & Gauntlett, 2002). Among the three stated pillars, social aspect of sustainability is the least studied (Ghahramanpouri et al., 2015) and only has been seriously considered after the year 2000 as an integral part of sustainability that should distinctively debated (Dempsey et al., 2012; McKenzie, 2004; Lamit et al., 2013). Colantino (2010) argued that, Environmental and economic pillars dominated the sustainability debates since its beginning whilst it is only in the late 1990s that social issues were taken into account within the sustainability agenda (Figure 1). As a result, there are few practical resources that directly address the question of "how to create places that are socially sustainable?' (Woodcraft et al., 2011).

Scholars believe that regarding the social aspect of sustainability; there are still uncertainties in definition, criteria and measurement system until now (Landorf, 2011; Bramley et al., 2009; Bostrom, 2012; Mak & Peacock, 2011; Laguna, 2014). Such vagueness has given rise to many efforts by scholars to recognize the crucial role of social aspects and through the second interpretation; they attempted to discuss social sustainability to become re-socialized (Maloutas, 2003). Today, there is a little consensus over the definition of social sustainability, and many varied definitions have been proposed (Manzi et al., 2010). Such variation can be explained by following reasons extracted from previous works as follows: Concept intangibility (Littig & Griessler, 2005), Multi-disciplinary Approach (Colantino, 2010; Ahman, 2013), Multifaceted nature (Ghahramanpouri et al., 2015), Dynamic characteristics (Colantino, 2010; Dempsey et al., 2012), Context-dependent (Maloutas, 2003; Dempsey et al., 2011) and conceptual flexibility (Bostrom, 2012).

Table 1. Translation of the human residence to spatial qualities in urban design. Source: (Authors).

Theoretical Framework	Researchers	Urban Social Sustainability Definitions
Conditions Framework	(Chiu, 2002)	Social sustainability relates to social norms and conditions in that any environmental or economic decision must not exceed the community's tolerance for change.
	(Laguna, 2014)	A condition where an extended set of basic needs are met for all residents regardless of their race/ethnicity, age, religion, gender, socioeconomic status and/or level of ability and the highest possible level of social inclusion and participation in community life is promoted.
Measurement Framework	(Colantino, 2010)	Traditional hard social sustainability themes such as employment and poverty alleviation are increasingly being complemented or replaced by the emerging "soft" and less measurable concepts such as happiness, social mixing and sense of place.
	(Barron & Gauntlett, 2002)	Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life.
Future Focus Framework	(Chiu, 2003)	Social Sustainability is the maintenance and improvement of well being of current and future generations.
	(Magis & Shinn, 2009)	Social Sustainability concerns the ability of human beings of every generation to not merely survive, but to thrive.
Process Framework	(McKenzie, 2004)	Social sustainability is a life-enhancing condition within communities, and a process within communities that can achieve that condition.
	(Holden, 2012)	A process of urban development, supported by policies and institutions that ensure harmonious social relations, enhance social integration and improve living conditions for all groups.

3.1 *Defining social sustainability*

Among those who work on this concept, researchers try to theorize this multidimensional concept in relation to society, people and Built Environment (Woodcraft, 2012). King (2008) and Littig and Griessler (2005) suggest that social sustainability means the satisfaction of basic human needs and the subsequent continuation for future generations. So 'Human' is the main focus in the definition of social sustainability concept (Dempsey et al., 2011). Various definitions of this concept have been provided in different frameworks (Table 1).

4 URBAN SOCIAL SUSTAINABILITY

Due to the extensive applications of social sustainability concept in built environment disciplines, there is an increasing trend among researchers to view the concept from an urban design perspective and identify related aspects that contribute to this concept (Chan & Lee, 2008; Davidson & Wilson, 2009; Dempsey et al., 2011). Studies, in which social sustainability concept is viewed with an urban design lens, usually refers to the physical aspects while evaluating the impacts of built environment design on this concept (Secher, 2014). In the notion of urban social sustainability, The chronological analysis indicates how traditional themes, such as equity, poverty reduction and livelihood, are increasingly been complemented or replaced by more intangible and less measurable concepts such as identity, sense of place and community stability and security (Glasson & Wood, 2009). Urban social sustainability initially had been searched in urban and rural contexts of developed nations. The most prominent example is the one adapted for city of Vancouver in the year 2005 as this framework encompasses definitions and relevant detailed policies. These components are underpinned by equity, security, adaptability and social inclusion and interaction-as the four guiding principles of social sustainability (Ghahramanpouri et al., 2015). In Australia, Porta and Renne (2005) studied the social sustainability of small-scale built environment units (i.e. public spaces or streets) utilizing formal indicator concept. For their measurement, they used some urban fabric indicators including permeability, land use diversity, accessibility, public/private realm, natural surveillance, employment density and number of buildings. Chan and Lee (2008) studied social sustainability of urban renewal projects in Hong Kong and suggested a list of six important parameters including; preservation of local characteristics, townscape design, accessibility, provision of social infrastructure and availability of job opportunities. More recently, studies have been conducted on developing and less developed countries; for instance, Dave (2009) studied seven characteristics including facilities and amenities, living space, health, community spirit and social interaction, sense of safety and neighborhood as a place to live, in order to search the relationship between social sustainability and urban density in a developing country. However, Ahmed (2012) utilized eight criteria comprising layout quality, integration of public spaces, priority to pedestrians, healthy environment, safety, privacy, vitality and social interaction and participatory decision making, while researching in Emirati city. In another study, Karuppannan and Sivam (2011) studied design parameters including accessibility and permeability, open space, safety, legibility, aesthetic and social infrastructure in an Indian neighborhood. Ghahramanpouri et al. (2015) conducted a research in Kuala Lampur streets and measuring factors including quality of place, participation and accessibility, adaptability, place attachment, legibility, street amenity, food and economic services, heritage and local culture and permeability.

4.1 *Urban social sustainability indicators*

Reviewing existing definitions of social sustainability in related literature suggested that there are common characteristics: First Factor; Future Focus (or Long-term viability and promotion); it is indicated that social sustainability is primarily about valuing and protecting positive aspects of cultures (McKenzie, 2004) and promoting current conditions-encompassing individuals, communities and societies, and also ensuring the qualities for generations to come. It focuses on continuing ability of an urban setting where survivals of human beings in addition to community thriving conditions are guaranteed for generations for a long time. Second Factor; Satisfaction of needs (basic needs and access to resources); It relates to both human and society; Relevant to individuals, it follows Maslow's hierarchy of needs, and covers physiological (food, water, health and safety), social (relationships, confidence and mutual respect) and self-actualization (creativity and morality) levels (Ahman, 2013). On the other hand, it is about provided opportunities and available resources in society in community level. Third Factor; Socially cohesive and physically integrated urban unit; It is about relational aspects of society but also on individual and personal aspects. The significance of inter-relationships between social and physical worlds is highly elaborated in the current extensive social sustainability literature. In many existing definitions of social sustainability, physical setting is considered as being conductive to social cohabitation, socially integrated and promoting well being and quality of life of the diverse group. Such communities are described as well balanced and well connected that can fulfill a wide range of those living or working there (Bacon et al., 2012). In table 2 different parameters of social sustainability in relation to urban studies have been collected through academic references.

4.2 *Scale-based and approach-based urban social sustainability studies*

Urban social sustainability have been scoped from macro level; regional and city (Barron & Gauntlett, 2002), to medium level urban units such as urban districts (Yung et al., 2011) like "Central Business District (CBD)", "Historical District", neighborhood (Dempsey et al., 2011) and urban public space as Micro scale built environment. Studies on the three different urban units (macro, medium and micro Scales) were brought in Table 4 based on the existing literature, social sustainability of micro-scale urban built environment like public urban spaces of the cities has been identified as the least studies, which needs to further researches. However, another Category that includes social sustainability in urban context is Approach-Based studies. As represented in Table 4, dominant

Table 2. General aspects in reviewing social sustainability in relation to urban context. Source: (Authors).

Aspects (Reviewing "Social Sustainability" in "Urban Context ") Related References (Academic References that highlighted related aspect)
Social Equity
Includes equity of access to key services (including health, education, transport, housing and recreation) highlighted in almost every references (Landorf, 2011) (McKenzie, 2004)
Satisfaction of Human needs
Relevant to individuals, it follows Maslow's hierarchy of needs, and covers physiological (food, water, health and safety), social (relationships, confidence and mutual respect) and self-actualization (creativity and morality) levels (Ahman, 2013)(Ancell & Thompson-Fawcett, 2008) (Littig & Griessler, 2005) (Littig & Griessler, 2005) (Laguna, 2014) (Ahman, 2013) (Maslow, 1954)
Well-being, Happiness
(Barron & Gauntlett, 2002) (Castillo, Price, Moobela, & Mathur, 2007) (L.H.Chiu, 2003) (Magis & Shinn, 2009) (Bacon, Cochrane, & Woodcraft, 2012)
Quality of Life
It is the sum of factors that contribute to the social, environmental and economic well being of citizens. It covers aspects such as well-being, happiness and satisfaction. (Weingaertner & Moberg, 2011)(Polese & Stren, 2000) (McKenzie, 2004) (Colantino, 2010) (Weingaertner & Moberg, 2011)
Social Interaction, Social Mixing (Cohesion and Inclusion)
It is about right and opportunities to participate in community and interact with other members of community. It encompasses cohabitation of culturally and socially diverse groups in societies where people Involve in a wide variety of social activities and preventing social exclusion. (Colantino, 2010) (Polese & Stren, 2000) (McKenzie, 2004) (Ancell & Thompson-Fawcett, 2008) (Bramley, Dampsey, Power, Brown, & Watkins, 2009) (Dempsey, Brown, & Bramely, 2012) (Bacon, Cochrane, & Woodcraft, 2012) (Colantino, 2010)(Sedaghatnia et all, 2015) (Mehan, 2016 a)
Pride, Sense of Place and culture (Identity)
It is about people's precipitations of a certain place. It mainly relates to a positive sense of attachment, dependent and identity that people feel about the place they live (Dempsey, Bramely, Power, & Brown, 2011)(Colantonio & Dixon, 2011) (Yung, Chan, & Xu, 2011) (Dempsey, Bramely, Power, & Brown, 2011)
Sense of Community
It is about social interaction of people living in a given area, related with sense of community or place attachment (Dempsey, Bramely, Power, & Brown, 2011)(Barron & Gauntlett, 2002) (Castillo, Price, Moobela, & Mathur, 2007) (Bramley, Dampsey, Power, Brown, & Watkins, 2009) (Colantino, 2010) (Landorf, 2011) (Bacon, Cochrane, & Woodcraft, 2012)
Future Focus
Social sustainability is primarily about valuing and protecting positive aspects of cultures (McKenzie, 2004)(McKenzie, 2004) (Magis & Shinn, 2009) (Ghahramanpouri et all, 2015)

studied approaches in urban issues are; Housing and density, urban renewal projects in historical areas, urban form, urban rehabilitation, urban regeneration and restoration issues. Glasson and Wood (2009) highlight the growing array of social sustainability assessment tools within urban Regeneration Strategies in UK. In another study, Yung et al. (2011), examines the attributes and factors that contribute to social sustainability in the rehabilitation of historic districts in Shanghai, China. However, Ancell and Thompson-Fawcett (2007), tried to develop a model of the social sustainability of medium density housing in New Zealand, Australia. However, in developing and less developed countries, Pakseresht and Fazeli (2011) discuss about the need for a social sustainability-based strategy for designing regeneration plans of Tehran, Iran. In another research, Ahmadi et al. (2011), propose the restoration strategies of Naghsh-e-Jahan Square to achieve social sustainability based on users' vision.

4.3 *Major factors affecting social sustainability in urban context*

Regarding the previous discussions, Social Sustainability in urban context can be considered as "Sustainable City", in which the basic needs of its residents must be met. And, on the subject of human needs in urbanism, generally, Maslow's hierarchy of human needs is popular. On the other hand, it was mentioned that the spatial qualities are defined based on the human needs. In other word, spatial qualities can be made by reflecting these needs to space designing. Table 3 provides a translation of Maslow's hierarchy of needs to the qualities that are intermediated in urban planning and design. According to the Table 3 There are some qualitative factors for each need. It means while a designed space possesses the mentioned qualities, it can establish a long-term relationship with the users to achieve socially sustainable community.

Table 3. Translation of the human needs to spatial qualities in urban context. Source: (Authors).

Human Needs Residents	Spatial Qualities in Urban Design
Physiological Needs	Comfort/Public Services/Firmness and Balance
Safety Needs	Privacy/Legibility/Safety
Belongingness/Love Needs	Social Amenities/Social facilities/ Sense of Place and Identity
Esteem Needs	Inclusiveness/ Preservation of Local characteristics
Self-Actualization Needs	Diversity/Public Participation
Beauty Needs	Visual Richness/Visual Proportions/Visual Distinctiveness

5 CONCLUSION

As mentioned above, among the three stated pillars of sustainability (Environmental, Economical and Social

Table 4. General comparison of social sustainability studies based on different Urban Scale and Approaches. Source: (Authors).

Urban Scale/Approach	Macro scale Medium scale Micro scale					Urban Approaches					
Researchers	City	Community	Neighborhood	District	Public Space	Housing	Renewal	Rehabilitation	Regeneration	Urban Form/ Density	Restoration
(Mehan, 2016 b)					•				•		
(L.H.Chiu, 2003)			•			•					
(Pongsmas, 2004)			•							•	
(Ancell & Thompson-Fawcett, 2008)			•			•					
(Bramley & Power, 2009)						•				•	
(Dempsey, Bramely, Power, & Brown, 2011)		•								•	
(Dempsey, Brown, & Bramely, 2012)	•									•	
(Landorf, 2011)				•							•
(Colantonio & Dixon, 2009)	•								•		
(Yung, Chan, & Xu, 2011)				•				•			
(Dave, 2009)			•							•	
(Colantonio, 2008)	•						•				
(Bacon, Cochrane, & Woodcraft, 2012)		•				•					
(Yung, Chan, & Xu, 2011)				•				•			
(Sharifi & Murayama, 2013)	•									•	
(Harun, Zakariya, Mansor, & Zakaria, 2014)					•						
(Paksereshtt & Fazeli, 2011)	•								•		
(Bramley, Dampsey, Power, Brown, & Watkins, 2009)						•				•	
(Chan & Lee, 2008)	•						•				

pillars), social aspect of sustainability is the least studied and only has been seriously considered after the year 2000 as an integral part of sustainability. As social sustainability is a context dependent concept, various frameworks for defining Social Sustainability Indicators have been provided as conditions, measurements, future focus and process framework. Reviewing existing definitions of urban social sustainability in related literature suggested that there are common characteristics in scholars' definitions including; Satisfaction of Human needs, Future Focus, Social Interaction, Social Mixing (Cohesion and Inclusion) and improving Quality of Life. It was determined in previous sections that social sustainability literature is fragmented, complex, vogue and chaotic; Such variation can be explained by following reasons extracted from previous works as follows: concept intangibility, dynamic nature, multi-disciplinary approaches, Context dependent, multifaceted nature and different scale, scopes and perspectives about issue. Reviewing studies conducted in different urban scales revealed that previous attempts on urban social sustainability emphasized more on macro-scale urban places issues like cities. This research concluded that there has been little discussion on micro-scale urban public spaces like streets and public squares. Analyzing the studied urban approaches such as housing, urban renewal, urban form, urban rehabilitation, urban regeneration and restoration in social sustainability literature shows that urban form and regeneration strategies to achieve social sustainability are the most studied issue which shows the context dependent nature of

social sustainability discussions. In addition, since the spatial qualities are defined based on human needs, Maslow hierarchy of needs has been chosen for translation of human needs to spatial qualities in urban design. As a result, Comfort, Firmness, balance, Privacy, Safety, Legibility, Social Amenities, Sense of Place, Identity, Inclusiveness, Diversity, Public Participation and Visual Richness are some of recognized factors affecting urban social sustainability.

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Mind the GAPs: Are urban planners defined by generational mindsets?

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ABSTRACT: Current societal changes signal that accelerated shifts stemming from the genesis of gaming is transforming the ways we design, interact and perceive the physical world around us. In asking *Are Urban Planning Practices Generational Mindsets?* this article seeks to expand on the growing studies that explore the mindset and expertise of seventy-five and a half million Americans presently at the cusp of entering this nation's workforce. The thesis of the paper agues that millennials are surrogates of planners, a premise which can help to elucidate how gamification and data-driven processes challenge the quality and production of socio-spatial definitions as game theory forwards the urban planning processes of our time.

1 INTRODUCTION: GAMERS AND MINDSETS

A year ago, while blogging with *idgafrith, [–]csolo112* exclaimed …

> *Ok, I never played a SimCity game before 2013. I love it, man. I sunk hours into building cities, and trying to get them just the way I want them. There are bugs and issues, yes, and it's awful that they released the game like that. But I still love it to bits. I can zone out and just play for like 6 hours at a time and not even realize it. Cities of Tomorrow does add some cool stuff, but it's really differentiated from the base game. I still don't use the Cities of Tomorrow stuff in every city, because the base game is still enjoyable to me.*[1]

This post is one of the many affixes serving to depict millennials, a termed coined by Howe and Strauss, authors of Generations: The History of America's Future, 1584 to 2069 and Millennials Rising: The Next Great Generation. By their definition, millennials are individuals born within a twenty-year period starting in1980 and ending in 2000. Close to seventy-five and a half million Americans encompass this age bracket, a stunning number that rendered [–]csolo112 words all the more remarkable for inscribing in readers a caricature of what is presupposed to be the lifestyle of the incoming workforce. This type of pervasive rendition peddled by McGonigal, a game designer, disclosed that "by the time Millennials reach age 21, s/he has spent about 10,000 hours gaming," a number that is equal to the time spent in school from 5th to 12th-grade. (TED 2010) It is the amount of practicing time required to become a craftsman, per Richard Sennett's 10,000 hour-practice; or seven years of the 10 Year Rule essential to achieve extraordinary breakthroughs in any given discipline according to John Hayes, 1989.

As games increase in popularity and mature its immersion power, the sheer number of gamers coming of age emphasizes the impact their cognitive role will have in shaping the future of our world. For this reason, in 2011 when Nick Shore declared Millennials are Playing with You, his essential message to Harvard Business Magazine readers was not about their video gaming habits but rather about the ideological portrait he is painting of millennial's and their meta-game-mentality that as he states enables them to gamified all aspects of life. (Shore, 2010)[2]

2 GAMERS

The explorations and understandings of how playing expands through time lead researches to associate gaming with learning. This phenomenon is also linked to social and spatial definitions, traced to Huizinga's writings "Homo Ludens: A Study of Play-Element in Culture" published in 1944.[3] Today, with the increasing popularity of video gaming, it is common to believe that gaming is embedded in all aspects of our socio-cultural fabric. Evident by a series of recent studies, gaming is a way of exploring new uncharted territories, of willingly venturing into learning about diverse modes of socio-cultural engagement and of figuring out how to reprocess all kinds of rules. Additionally, studies that aim to distinctly separate analog from digital games are noting that all players are keen at tweaking and calibrating their techniques almost instantly, constantly improving and learning from inputs, using emerging data and personalizing their synaptic connections to strategically win.[4] For these reasons, when paleoanthropologist Ian Tattersall says that homo-sapiens hone the ability to abstract realities and pursue new improve methods that significantly alter their physical surroundings, the logic of Nick

Shore's declaration that millennials are playing with you implies imagination. It is not simply that gamers possess unique and innate powers to think strategically; but that there is a long-standing trajectory from Homo Erectus to Homo Sapiens that has incrementally improved our cognitive abilities to ensure survival.[5] In other words, from Tattersall's and Shore's accounts, it is possible, even permissible to grasp a gamer's mental condition as a reflection of mankind's pursue towards perfection, a long-standing expedition if you will towards imagining utopia.

3 UTOPISTS

Utopia is the one idea profoundly rejected by contemporary planners. In 1997, at Centre de Cultura Contemporània de Barcelona [CCB], Robert Fishman declared _*"we can no longer share the fundamental assumption that lies behind this image [Plan Voisin]: that is both possible and desirable to completely rebuild our cities and our societies according to some new and better model."* For Fishman, it was clear then as now that we are *Beyond Utopia: Urbanism After the End of the Cities (1998) and that the city is no longer the place for the dynamism of civilizations to take form.*[6] Conversely, one could also argue, through numerous generational cycles and according to gaming studies, that the city is now becoming a platform which continuously folds and unfolds in a myriad of ways through the will and whim of multiple influences. In fact, it is probable that by tweaking, calibrating, relying on inputs and outputs of data and personalized synaptic connections that strategical urban concepts and designing processes within today's cities signal a pursue toward utopian ideals where everything is seemingly perfect.

As we learn to retrofit, substitute, mutate or expand design according to expertise, it would be false to say that utopian strategies are stored away in opprobrium or that they along are the future of city planning; just as it would be a mistake to place utopia under extinction. Today, utopists are not pure ideologies or urban planners, not even film directors or cultural producers; instead, utopists are complex strategical thinkers using gaming platforms as well as real life scenarios that shape new worlds. Utopist own endless potentialities to evaluate the past, present, or future methods of urban development. Presently, they are game designers of games like SimCity and Skyline, and players actively creating and altering different gaming compositions to render seemingly new urban scopes.

Under these assumptions, ambitious utopian proposals from the 20th century are now relegated to gaming experiments, first played out as analog proposals, then built to fail and now as virtual compositions that are ultimately rendering new unrecognized milieux. In fact, Ada Louise Huxtable, who dedicated her writing career to critique architecture, in her article The Real Fake and The Fake Fake (1997) signaled the process. Writing about the spatial reproductions of places like Venice or New York New York in Las Vegas as an evolving phenomenon that redefines real architecture for the fake. Her article alluded to the experiential transitions we humans undergo as we adapt to recognizing the outrageously fake for the real place. Perhaps, this was the way Huxtable attempted to explain that an occurrence in spatial experiences was shifting, and our modes of experiencing space are now instantly reproducible, places where __ *"extraordinary things are happening."*[7] More importantly, through her writing, she recognizes that Las Vegas has transcended from a place of gaming for entertainment to a sandbox game that entertains.

4 GAMERS OR UTOPIST

Indeed, games prelude future planning practices by extrapolating ensconced utopias from their stigma of improbable perfection. In our milieu, among game designers, computer scientist, game theorist and speculators we are finding new ways to calibrate the city. Here, unlike the utopist of our near past, game designers create an array of codes that demystify perfection and enact games which have the capacity to fold and of unfold over and over again in an array of different ways. Also, through games, game designers are leveling the planning field and developing reflective tools to grasp desires for customizing bits and pieces of utopias rather than attempting to make one complete utopian states. It silently critics urbanist that stand on the sidelines, emancipated from actively participating in solving urban's pressing urgencies. It is a wake-up call, as millennials learn through gaming how to turn downtowns into technocratic cities like Google-towns, Ikea-lands, and Zappo-landias. These new kinds of urbanity serve as windows for urban planners to see the world absent of urban design processes. A warning to stop imagining grand big solutions and start collaborating in compositions that interact within existing cities; igniting new leveraging methods that can effectively affect _the cities of tomorrow. In essence, the current urban revolution denotes that a quest for smaller, manageable utopias are the renewed raw material that urban gamers, designers, and urbanists can hone as they seek to regain planning expertise.

5 DICHOTOMIES

T Urban dreams and ambitions should not bracket into age groups, or to one designer, they are collective knowledge, a process in time that gains from new inputs, judicious planning, and tactical actions. They are evolutionary goals. Current spatial enthusiasm is not gear to enrich speculators or rooted in building edifices or designing personal spaces but rather in imagining "improve" lifestyles. It is the opposite of how 20th-century city planners envision growth. Residues of that century remain and those interested

in immediate rewards and in augmenting territorial gains struggle against the evolving aspects of human imagination.

Returning to Ian Tattersall's view and the idea that human imagination is the tool for future endeavors, forwards the point that we are the *Masters of the Planet* and creativity is not a rarity but rather the fundamentals of progress __*"The capacity for abstract thinking is the key to our success. All our creativity stems from it. But abstract thinking is not only useful for making art. Early hunters, for example, reporting back on the movement of reindeer herds, would be disadvantaged if those hearing the report could not make the mental leap of faith needed to understand that these herds existed even though they had not seen them."*[8]

Under this impetus of how abstract thinking evolves lies, the means to link different creative mindsets rooted in game designing with planners. Here and specifically to their disparate utopian proposals one could argue that the 20th-century planning was like gaming a type of scenario, an extravaganza, and a spectacle; too encompassing and difficult to accept in one gulp. The consideration is also how one can explain why so may of those proposals were left incomplete, as part of world fairs or local political ambitions. The dissatisfaction with grand plans and encompassing urban designs is what makes games like SimCity, Skyline, and other planning games challenging. But if Tattersall is right, if we are all seekers of efficiencies and improve realities __Do we hold the potential to test and envision new proposals as part of a continuum towards improving experiential realities? Can we all make the mental leaps required to planning?

6 FORMULAS

From Hayes, Howe Sennett, Strauss, Tattersall and others, it is encouraging to note that through time humans improve their cognitive abilities, advancing concepts, layouts, and modes of interfacing with one another. The basic principles for how these practices evolve and are commonly understood in history, criminology, economy, biology, sociology, evolutionary studies, political schemes, and other life scenarios. It all starts with the acceptance of rules. In gaming and planning rules determine the process for how outcomes unfold. Yet, rules are just one part of a broader system that deals with understanding calibration, definition of concepts, tactics, layouts, and actions. In the case of planning, to affect urban scenarios, it remains necessary to know city charters, and the protocols instituted within these charters to engage in developing amendments that can cause an effect. Rules, therefore, are the basis to observe details and identify changes. But, rules are not just useful for the continuum of great societies, planning futures, they are also part of how altering and seizing emerging opportunities occur.

Currently, within our existing urban conditions, opportunities to intervene in planning affairs reminisce stages of 20th-century mindset. Back then, projects focus on proposing large-scale interventions, the size of cities, the kind that seemingly eradicate old detriments. For instance, Patrick Abercrombie's proposal for Greater London (1944) based on the pretext that social problems are resolved through overall planning. (Batty and Marshall 2009) There, efficiencies of transport, public open spaces, mix use buildings, and public areas focus on facilitating the flow of the car. It was a time when planning visions encompass urban, suburban, and outer country sites. By mid-century urbanist like Niemeyer, Sert, Wren, Wright and others responded to their times by shifting their focus toward inner city spectrums; with the exception of Le Corbusier, who innately possessed the ability of a game theorist dealing with modeling scenarios inside, outside and within pockets of the inner city. It is his sandbox approach to planning that inspired the thesis of this paper, which suggests that gamers are the current surrogates of planners. It leads to the reconsideration that the strength of urban planning is based on scenarios similar to those now emerging in gaming. The switch is an opportunity to propound that rules of both analog and digital games are inherently necessary to host and examine urban possibilities which can yield new spatial experiences.

7 GAME-ON

Ever since the early 20th century, be it Paris, Chandigarh, Rio de Janeiro, Algeria or any remote sandbox, Le Corbusier methodologically advance rules and codes using mathematical logics. He set methods to organized playoffs according to place. His goals like those of SimCity or Skyline gamers was to augment living standards and avoid chaos, congestion, pollution or collapse. He like current gamers instinctively focus on optimal outcomes and to ameliorate urban performances.

8 STRATEGIES

1. Modulor: an anthropometric scale/rule base on numerical proportions from the golden ratio.
2. Machine-á-habiter: a dwelling defined by modulor
3. Cité-Radieuse: one city block form by stacking hundreds of machine-á-habiter dwellings equipped with sporting, medical, shopping and child care facilities.
4. The Skyscrapers: luxurious steel and glass buildings shaped as cruciform to let natural light and fresh air into the executive +/−8000 units that would be provided luxury living and working standards for all its inhabitants.
5. Ville Contemporaine: a place complete with infrastructural grids for public buses, rail systems, cars and planes to move freely among Skyscrapers, Cité-Radieuse, Machine-á-habiter and public parks.

9 PLAYOFFS

- 1922, 10 machine-á-habiter units built on the Bassin d'Arcachonpart.
- 1926, 50 machine-á-habiter units built for workers working for Henry Frugé.
- 1925, Plan Voisin/1st Ville Contemporaine proposed for Paris – France.
- 1929, Modern Brazil, 2nd Ville Contemporaine proposed for Rio de Janeiro – Brazil.
- 1930, 1st proposal of Cité Radieuse, Brussels-Belgium's
- 1933, Plan Obus, 3rd Ville Contemporaine proposed for Algeria – Africa.
- 1947, 1st built Cité Radieuse, Unité d'habitation in Marseille – France.
- 1951, 1st proposal for a complete city with governmental buildings, cultural centers, and Ville Contemporaine in Chandigarh – India.

Indisputably, like a game theorist, in adding, subtracting, curving, and squaring the inhabitable logics of Cité-Radieuse, Skyscrapers, Machine-á-habiter – and Ville Contemporaine, Le Corbusier was always looking to optimize the characteristics of his sandbox. He adjusted and tweak scenarios to improve his inputs, using emerging data on site, synoptically connecting his building parts in organized ways that strategically repurpose ideas for specific sites.[9]

The desire to build anew in the 21st century is less rooted to one master planner. In fact, technocrats driven by data and numeric logics are already imagining new urban fabrics. In Las Vegas, Tony Hsieh – Zappos CEO has ignited his gaming plan. Starting in 2010 as he looked to relocate 1,200 employees from Henderson Nevada to Downtown Las Vegas via third-party fixers, he encountered a friendly political machine in the City of Las Vegas. Soon to the surprise of most speculators and realtors Vegas leaders ceded 60 acres of downtown to Hsieh. It is a unique experiment, a full-scale sandbox granted with the hope of economically revamping a city in decade. Exceptional incentives that surpassed Hsieh's relocation bid (Medina, 2010) is granting Zappos's CEO the ability to become a policymaker and to spearhead the playoffs of a live-scenario simulating SimCity games. Six years after its initiation, the shuttered Fremont Street is unveiling a new commercial corridor based on sweat equity investment from young entrepreneurs and start-up wannabes. It is a revolving door game where investors who take risk win or loose. One can not say it is an amusement park, but it is a series of retro hotels accommodated for micro-living around stations to eat, drink and be merry that have mostly crowed when annual events like life is beautiful concert, or miniature burning man cubes are laced between, holiday activities.

In retrospect, the outcome is not surprising, on June 25, 2011, when Paul Carr [PC] from Huffington Post, spoke to Tony Hsieh [TH] (computer scientist who graduated from Harvard with a track record for developing successful startups), about his 350-million-dollar experiment in Downtown Las Vegas, the following was said:

TH: "This will be a completely different area in the next five years," he says, "we're bringing food, live music, an entertainment scene; we've even talked about opening a charter school. Did you ever hear of the game Sim City?"
PC: "Of course."
TH: "Well, for us it's like playing Sim City in real life. One tagline we've come up with is 'from Sin City to Sim City'…"
PC: He pauses.
TH: "…you know, like adding another little hump on the 'n'".
PC: It's impossible not to love Tony.[10]

10 THE FUTURE

Neither Le Corbusier or Hsieh can stand as exemplary models to spearhead _the cities of tomorrow. Their for-profit agendas lack the means to invigorate meaningful life to any given socio-cultural place. As millennials become the first true digerati and a significantly large workforce in the planet, they will impact and possibly ignite a reshaping of urban design. Their task lies in developing improve rules and codes that safeguard urbanity and forwards intelligent socio-spatial environments. If the past century privileged the car, this century would privilege life. The observation is simple, the future of urban forms lies within inform solutions, stemming from data and gaming expertise base in analog, digital and crowdsource gaming, using intelligent software that can update rules and codes according to collected data from diverse environmental conditions. Perhaps, new economics can begin to reconsider a collage of inner – outer, urban and suburban conditions; less focus on singular mindsets, set on blank sandboxes and more attentive to the local conditions of human behavior.

11 CONCLUSION

Absent of models and inundated in a sea of retrofitted plans, Millennials are faced with one critical choice that will force urban thinkers to attend to greater solutions beyond the ones that prioritized the car, banks, and speculators. Within this century when it will be possible to ignore parking, assemble and disassemble units through improve zoning, and add algorithms based on need and environmental data, the questions left unanswered is __How? The theoretical angled from which I proponed to improve planning practices lies in the idea of scale. What once constituted distance and networks has ultimately change and it is necessary to embrace that the future of city planners will be in using gaming logics, organic interventions, and human ingenuity that may favor the development of improving environments in the absence of blank sandbox or flat screens. Perhaps the goal is not to look

back at decaying ideas but to engage in the challenges of real sites, with real buildings, and real people, gaming in ways that provide new influx into dysfunctional infrastructures.

One possible point of departure is to regain civic understanding, clean up the planning processes that once favored the automobile and learn to identify urban pockets, collaborative endeavors, and unknown opportunities. This all translates to a different mode of learning and practicing urban planning, one less center on idea development and more focus on problem solving agendas.

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Red light at night to enhance cognitive functioning for society's special needs groups

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ABSTRACT: While human life expectancy may be increasing due to advances in public health, technology and medicine, there are serious questions as to whether the quality of human life can keep up with this increase in longevity. Postindustrial society is experiencing a proliferation of light-related disorders and diseases specifically because our technologically-based society can operate 24 hours per day in illuminated indoor environments. Natural changes in daylight synchronize and help coordinate the body's circadian rhythms, which determine sleeping and eating patterns, brain wave activity and hormone production. Disturbing circadian rhythms by changing the 24-hour light/dark cycle can lead to jetlag, seasonal affective disorder (SAD), delayed sleep phase syndrome (DSPS), and other abnormalities, and is implicated in various diseases and disorders, including cancer. These effects are particularly pronounced with special needs populations whose physiological systems are already under more pronounced stresses such as children with autism spectrum disorder, older adults with dementia and homeless individuals.

1 INTRODUCTION

In June 2012 at their annual meeting in Chicago, the House of Delegates (HOD) of the American Medical Association (AMA) declared that light at night results in adverse health outcomes (Blask 2012). The Council on Science and Public Health recommended that the AMA support the need for developing and implementing light technologies at home and at work that minimize circadian disruption, while maintaining visual efficiency. Adverse light effects can be minimized by using natural daylight or daylight-matching electric light during the day and a new HOD policy recommends dim red lighting in the nighttime indoor environment.

Research has shown that individuals working in natural sunlight are more productive, more effective, and happier than those who work under traditional artificial light (Perrin 2004). Natural changes in daylight synchronize and help coordinate the body's circadian rhythms, which influence every biochemical, physiological and behavioral parameter in the human body. Disruption of circadian rhythms can lead to jetlag, seasonal affective disorder (SAD), delayed sleep phase syndrome (DSPS), and other abnormalities, and is implicated in various diseases and disorders, including cardiovascular disease, psychiatric disorders and cancer (McEachron 2012). Furthermore, the Council on Science and Public Health recognizes that exposure to excessive light at night, including extended use of various electronic media, can disrupt sleep or exacerbate sleep disorders (Blask 2012).

The dLUX light lab at Drexel University has developed an LED lighting system that auto-tunes natural daylighting in its full diurnal changing color spectrum and light intensity during the day and changes to dim red lighting during the nighttime hours. This 24/7 LED luminaire mimics the full spectrum of natural daylight in both color temperature and light intensity. Through a combination of white and RGB (red, green, blue) LEDs the lighting system is programmed to change color throughout the day to mimic the full spectrum of natural daylight from dawn to dusk; to change in color from the amber rising sun to the red setting sun and to illuminate the indoor environment with a low-intensity red light throughout the nighttime hours.

This integrated 24-hour 7-day daylight-mimicking LED lighting system was installed in the 25-men dormitory at St. Columba Safe Haven for Homeless Men and evaluated in three phases: Phase I LED downlights as usual; Phase II LED downlights in the daytime (6 am–9 pm), red downlights at night (9 pm–6 am); Phase III gradual onset/offset daylight LED downlights in the daytime, red downlights at night. Resident data was collected for all three phases using a Demographic Form and the standard research instruments PANAS (Positive And Negative Affect Schedule) Scale and WEMWBS (The Warwick-Edinburgh

Mental Well-being Scale). Additionally, staff performed a dormitory check every hour of the day to determine if the residents were awake, sleeping, or out of the dorm. The six months of staff observations of 24-hour day bed-checks of the 25 person dormitory were used to evaluate the effects of the light.

2 EVOLUTIONARY CHANGES

2.1 *Introduction*

Human beings are the result of biological evolution rather than engineering design. It is impossible to overstate the implications of this rather simple sentence on human health, well- being and productivity. This is because of the existance of two vastly different rates of change – cultural and biological evolution. As the rate of cultural evolution continues to accelerate, there is evidence of a growing disconnect between the artificial environments humans create and the environments to which our ancestors were adapted. Despite the incredible adaptability of human beings, there are limitations and these limitations may now be beginning to impact the interaction of humans with the artificial structures they create. How we deal with this impact will determine the quality of life for millions of our fellow citizens.

2.2 *Background*

The process of biological evolution is primarily dependent on the twin mechanisms of random mutation and natural selection. This has rather profound implications for the interaction of humans with their environments – natural or artificial. First, evolution proceeds by way of increasing and decreasing gene frequencies over generations, irrespective of how these changes are produced. Thus, it is possible – and often observed – that the welfare of individual organisms is sacrificed in order to promote gene propagation. As a result, evolutionarily determined physiology and behavior may or may not promote the welfare of the individual processing those traits. Second, random mutation does not necessarily create the best adaptations even when those adaptations would benefit gene propagation. The adaptations observed in individuals may or may not fit with the expectations of a design engineer. Third, organisms are always best adapted to their ancestors' environment. It is the ancestors who succeeded in propagating their genes over, not the current representatives. Although rapid evolution is possible, significant change is generally dependent upon generation time and organisms with relatively long generation times – such as humans – take longer to adapt to new conditions, at least biologically. Fourth, emotions are part of evolution and thus likely to be one method by which genes promote behaviors that result in their own propagation.

These factors generate a variety of compromises between *adaptation* – the evolution of a relatively fixed set of physiological parameters – and *adaptability* – the ability to adjust to a diverse set of environmental conditions. In predicting which strategy is likely to be favored, several factors must be considered: stability of the environment, impact of the specific environmental factor, advantage of prediction, etc. One major physiological adaptation which has evolved due to the extreme stability and impact of an environmental factor (the Earth's rotation creating day and night) is circadian rhythmicity. It is such a powerful physiological adaptation that all eukaryotic organisms on the Earth have evolved one or more circadian clocks to provide organization and scheduling of every biochemical activity, physiological and behavioral activity. It is, as the phrase goes, 'in our very DNA'.

Why is this important? It is important because humans have inherited a circadian organization from our ancestors that organizes virtually every aspect of our physiology. It is important because physiological control systems in humans – from the cardiac cycle to metabolism to brain management – all have rhythmic components whose activities are regulated by these circadian clocks. It is important because biological rhythms are so fundamental to living organisms that humans cannot eliminate those influences on health and well-being. And finally, it is important because human ingenuity has generated lighting, structures and schedules antithetical to good temporal hygiene with well-documented negative impacts on human health.

3 THE CIRCADIAN SYSTEM

3.1 *What are circadian rhythms?*

There are a multiple of biological rhythms in the human body, ranging from the millisecond rhythms in neural networks to the near second cycles of the heart, 20 minute glycolytic cycles, hourly pulsatile rhythms in hormone secretion through seasonal cycles in conceptions, births and psychiatric episodes. Playing a central role, both in terms of frequency and in terms of impact, are the so-called circadian rhythms. Circadian (Latin for 'about a day') rhythms are endogenous or self-generating oscillations that organize human physiology and behavior and, until recently, scheduled those activities into a temporal ecological niche. Although there are many tissues and cells that express circadian rhythms within the human body, the overall control of the circadian system lies in a small bilaterally symmetrical pair of cell groups (called nuclei; sing. nucleus) located in an area of the human brain called the hypothalamus. This overarching circadian clock or pacemaker is found in the suprachiasmatic nuclei or SCN for short.

Like all circadian pacemakers, the SCN express oscillations with a frequency near but not exactly 24 hours. In the absence of any environmental cycles (called *constant conditions*), this endogenous oscillator is free to express its own inherent frequency,

which, in humans, is about 24.5 hours. This frequency is called the *free-running frequency* and implies mechanisms that allow the internal period of the circadian clock to be adjusted so as to match the period of the day/night cycle. This ability to synchronize to an external environmental cycle is called entrainment and those environmental cycles capable of generating entrainment are called *Zeitgebers* (Ger. 'time-giver'). The most powerful of the known Zeitgebers is the alternating cycle of light and darkness produced by the Earth's rotation. Although there have always been other sources of light (fires, moonlight, etc.), until recently, the most powerful and consistent source of lighting input to the eye has been solar radiation.

The mechanism of entrainment to light/dark cycles is complex and need not concern us here. What is important is the observation that the lighting needed to see objects (called photopic vision) and the lighting used to entrain the SCN do not have exactly the same spectrum. The lighting which generates the highest impact on the SCN is shifted towards the blue-green end of the visual spectrum and is centered around 450 nM. Interestingly, light at the dark amber-red range of the spectrum still impacts photopic vision but is thought to have little or no effect in terms of entrainment or other effects on the SCN and thus, the overall circadian system (McEachron 2012).

3.2 *What has the circadian system evolved to expect from the external environment?*

During the solar day-night cycle, light intensity increases gradually (sunrise), then displays a powerful, sustained intensity (daylight) followed by a gradual decrease (sunset) and then a prolonged period of profound darkness (night). Combined with these intensity effects, there are also changes in wavelength, beginning and ending with red-yellow wavelengths bracketing periods of blue-white light and near blackness. Considering illuminance alone, the darkness provided by a moonless overcast night might provide only some 10^{-4} lux of lighting, while full daylight reaches 10,000–25,000 lux and direct sunlight provides 32,000–130,000 lux (http://stjarnhimlen.se/comp /radfaq.html Hoffman 2006). The actual lighting changes in both intensity and wavelength will depend on the location of the observer on the Earth's surface, the ecology (ex., forest cover vs. open grassland) and other variables, but clearly biological systems have evolved in environments which can provide gradual illuminance changes covering 6–9 orders of magnitude.

This evolutionary expectation has shaped the manner in which circadian systems entrain to the external environment. For example, circadian systems are typically more sensitive and react with greater levels of change when exposed to light during periods which would normally be dark than during similar times during daylight. In addition, for both evolutional and mathematical reasons, gradually changing light/dark cycles are far more powerful Zeigebers than square waves (simply turning lights on and off at regular intervals) (McEachron 2012).

3.3 *To what is the system actually exposed in modern urban environments?*

If circadian systems have evolved to expect and adapt to gradually changing lighting with varying wavelengths and intensity changes covering multiple orders of magnitude, what do human clocks actually encounter in modern urban environments?

If we focus on a well-studied environment – residential facilities for the elderly – the results are disturbing. In one study, it was reported that nursing home residents only experienced an average of 9 minutes of light over 1000 lux per 24-hour day (Ancoli-Israel 1997). In another study, sixty–six institutionalized elderly were observed over a three-day period. The average lighting exposure was only 54 lux with merely10.5 minutes of exposure over 1000 lux (Shochat 2000). In another review of 53 nursing homes, illumination was considered scarcely adequate or insufficient in 45% of the hallways, 17% of the activity areas and 51% of the residents' rooms (Berson 2002). Thus, it is not surprising that sleep problems and disorders are often reported for nursing home residents, even when such problems were not reported prior to admittance (Clapin-French 1986, Regestein 1987).

This is not an issue isolated to such facilities. In a study on undergraduate students, Baynard and McEachron (2011) reported that students at an urban university suffered from significant sleep loss. Many undergraduates live in dormitories ill-suited for stable entrainment and adequate sleep. Shared dormitory rooms often do not isolate light and sound effects between roommates, leading to inadvertent light exposure at night. Most such accommodations require students to walk down brightly lit hallways to get to the bathroom facilities, again leading to significant light exposure if activities are undertaken at night. Additionally, the ability to block out light from the external environment is often limited, making darkness difficult to achieve even under the best of circumstances. Studies indicate that sleep deprivation in this population is associated with poor academic performance (Lee 2015). These issues are also being noticed in hospital environments as well (Pilkington 2013), and so the questions of appropriate design for circadian stability and temporal hygiene are becoming more persuasive for architecture and architects.

3.4 *What are the consequences of circadian disruption?*

Shift work, which often results in such disruption, was reviewed in McEachron (2012). The majority of studies report negative effects associated with shift work. These effects can be broadly classified as behavioral problems, abnormal or disrupted sleep (Akerstadt 1981; Foret 1976, Knuttson 2003) , reproductive issues (Fido 2008, Su 2008), gastrointestional complaints

(Caruso 2004, Pietroiusti 2008), metabolic abnormalities (Ghiasvand 2006), increased risk for cardiovascular disorders (Suwazono 2008; Tuchsen 2008) and an enhanced susceptibility for certain cancers (Davis 2006, Hansen 2006, Schernhammer 2003). The behavioral problems range from decrements in performance (Boivin 2007, Harrington 1994) to depressed mood (Healey 1993) to increases in neuropsychological problems (Costa 1981, Koller 1981). Numerous reviews have been published linking shift work with various health problems (Boivin 2007, Harringon 1994, Haus 2006).

Human studies tend to be correlational in nature and thus cannot be used to establish causality – shift work may simply be correlated with the observed results and not causal to them. Thus, it is critical to the contention that architectural designs be modified to include temporal hygiene because of the numerous animal studies that have been done which do establish causal links between circadian disruption and gastrointestinal disorders (Larson, et al. 1994; Press, et al., 2008), cardiovascular disease (Penev 1998, Roenneberg 2005), and cancer (Filipski 2003, 2004, 2005, 2006, van der Heilingenberg 1999).

3.5 *What can be done?*

Thus, disturbed or desynchronized biological rhythms carry serious consequences. It is estimated that between fifty and seventy million people in the U.S. suffer from some kind or sleep disorder or disturbance (Report from National Academy of Science). While artificial environments are often designed with multiple windows or specific "sunrooms" for institutionalized residents, it is not always possible to bring daylight to building interiors in general, leading to inadequate daytime levels of lighting. This situation can be exacerbated due to institutional lighting levels that not only do not provide residents with the biologically required full spectrum of light throughout the day, but also do not provide total darkness at night—difficult to do when caregivers need to work throughout the night monitoring patient health and safety, as well as fulfilling administrative tasks. As a result, lighting may be too dim in the daytime and too bright at night to generate an effective timing signal for human biological rhythms, which rely on both the amplitude and waveform of the day/night differences in lighting to convey time-of-day information to the brain.

4 LIGHTING FOR A CHANGING SOCIETY

To maintain health and save energy it is important to either use or mimic *the full spectrum of natural lighting* applied with the proper amplitude, wavelength and waveform to foster circadian entrainment and temporal hygiene. This is not merely a matter of altering existing lighting but also of designing new facilities with the need for rhythm coherence in mind. Humans are not computers and do not operate in the same manner 24/7. They are the result of evolution and carry that legacy with them. In regards to time of day, buildings should adapt to the temporal requirements of their occupants to ensure the best outcomes in terms of health and quality of life.

In the meantime, what can be done with existing structures? In an attempt to find out, the study team investigated the use of nocturnal red lighting and gradually shifting solar-day mimicking LED lighting in a residential facility for homeless men.

5 RED LIGHT AT NIGHT

5.1 *Rethinking privacy for dwelling in public*

The residential program at St. Columba offers residents service coordination, personal recovery services, health care, education, and social enterprise and employment opportunities. Residents are encouraged to participate in recovery-oriented activities that lead to personal growth, well-being and self-sufficiency with a focus on moving to permanent housing. Forty homeless men live at St. Columba accommodated in a 25-bed dormitory on the first floor and fifteen single rooms on the third floor. This residential program is housed in two Philadelphia twin homes, which were joined in the 1980's to create one united residence for homeless men. The 1980's redesign was labyrinthical, with no views to the exterior from the community spaces and no landmarks to guide the resident through the network of spaces.

BAU Architecture was retained to redesign the interior. The first floor toilet and shower facilities were dangerous: there was only one way in and out of each of the two rooms and there was no privacy for the private functions intended to occur there (Fig. 1). While the design was compact, it was also very dangerous and the men were afraid to use the facilities. The bathroom was redesigned to provide for safety and security through exposure. While private functions could remain private and protected, there is now ease of visibility into the bathroom and within the room without increasing the square footage (Fig. 2). The rest of the three-story facility was redesigned to allow views into the community spaces and views from those spaces to the exterior, which opened up the interior to provide orientation and visual landmarks while moving throughout the facility. The overall goal of the redesigned interior environment was to support the residents' transitioning to become members of the broader society.

5.2 *A pilot project at a residential facility for homeless men*

At the St. Columba safe haven residence for homeless men Drexel University's dLUX light lab has partnered with Project H.O.M.E. to install its solar-day mimicking LED lighting system in their 25-bed dormitory. Research has shown that LED Solid State Lighting is more energy-efficient and longer lasting with lower

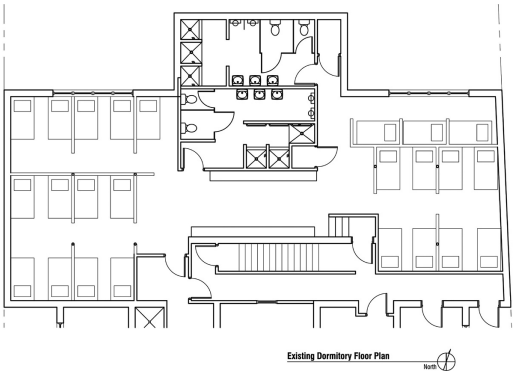


Figure 1. Existing first floor 25-Bed St. Columba dormitory. (By author).

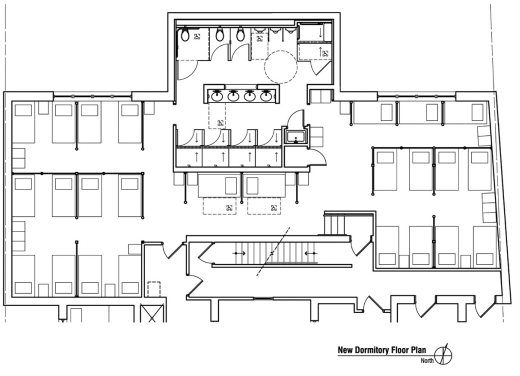


Figure 2. New first floor 25-Bed St. Columba dormitory. (By author).

lifecycle costs than other light sources and that natural daylight controls the body's circadian rhythms and affects overall wellbeing. dLUX is installing a fully programmed, automatic integrated LED lighting system in the 25-bed dormitory that simulates the optimal color and intensity of natural daylight throughout the day to regulate the men's circadian rhythms (Fig. 3). In lieu of complete darkness at night, the gradual onset and offset lighting dims to the red spectrum to provide light at night for general mobility and so staff can monitor the residents' wellbeing. Automatically controlled blackout shades were installed over the dormitory windows: the shades go down at 9 pm and up at 6 am. The goal is to prevent disrupted sleep patterns and the negative behaviors associated with sleep deprivation and to promote the residents' overall health and well-being.

The individuals in this study were otherwise homeless men living at St. Columba Safe Haven for Men in Philadelphia, PA. These individuals were able to come and go as they pleased but were encouraged to participate in various programs designed to promote self-sufficiency. The question can be then asked: if these individuals are exposed to environmental lighting outside of the residence, how efficacious will the solar-day mimicking lighting be for them?

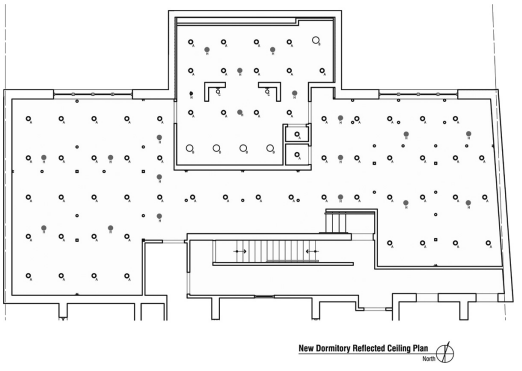


Figure 3. New lighting for 25-Bed St. Columba dormitory. (By author).

The effects of lighting on circadian clocks are not uniform across twenty-four hours and there is both experimental data and a theoretical basis for the concept that a gradual onset and offset of lighting with diminished red light at night will provide a substantially more powerful synchronizing signal for circadian rhythms than current artificial lighting in the facility (McEachron, 2012). Thus, despite the residents' mobility during the daylight hours, the dawn- and dusk-simulation, combined with dim red lights at night, should provide a powerful stimulus for temporal hygiene. This was the purpose of the study – to determine if lighting cycles of this kind can have beneficial effects on residents' wellbeing and sleep.

5.3 *Study protocol*

The original study consisted of three phases.

5.3.1 *Phase 1: Baseline*

After the Institutional Review Board (IRB) at Drexel University approved the study protocol, residents who consented to be in the study completed a demographic form and two questionnaires (PANAS: Positive and Negative Affects Scale; and WEMWBS: Warwick-Edinburgh Mental Well-being Scale) at baseline.

5.3.2 *Phase 2: Red light conditions*

For three weeks, residents were then exposed to standard lighting during the daytime mimicking current conditions with LED lighting, but lighting at night was provided using dim red lights as shown in Fig. 3. At the end of three weeks, residents who consented to be in the study completed the two questionnaires (PANAS and WEMWBS) to determine the impact of the red light conditions on residents' well-being.

5.3.3 *Phase 3: Solar day mimicking and red light conditions*

Immediately after data were collected in phase 2, for the following three weeks, residents were exposed to a time-varying lighting system with intensity and

wavelength variations mimicking the solar-day cycle. This was combined with red lighting at night at all the downlight locations shown in Fig. 3. At 6 am the lights gradually shift in color and intensity from dim red light at night to a bright 6500 K daylight at 9 am. The downlights remain at the daylight-corrected color and intensity until 6 pm at night when they gradually dim to red at 9 pm. Residents who consented to be in the study completed the demographic form and two questionnaires (PANAS and WEMWBS).

5.3.4 *Initial results*

Fourteen residents signed the consent form to participate in the study. Seventy-seven percent were African Americans and 23% were Caucasians. The mean age was 51 years (SD = 13.8). The mean number of years in formal education was 13 (SD = 3.28). The majority were single, and 15% were married. The following challenges were encountered during the implementation of the study: attrition rate was high because participants were transient residents, lack of participant's compliance to complete the questionnaires, and technical difficulties in installation of the lighting system causing a delay in starting the study, and damage to the automatic blinds. Because of the residents' lack of adherence to complete questionnaires on Phases two and three, the research team used the staffs' documentation on residents' sleep on Phase 3, when residents were exposed to a time-varying lighting system with intensity and wave length variations mimicking the solar-day cycle to assess the residents' response to the changes in lighting.

Although a complete analysis of the staff data is still in progress, based upon staff and resident comments, red night lighting seemed to have a calming effect in the environment and improved residents' sleep. Residents indicated that they appreciated having the red lights at night. The research team plans to conduct a feasibility study and replicate the research protocol in the future to assess the effectiveness of the changes in lighting on sleep and quality of life.

6 CONCLUSION

Temporal hygiene is both an old and a new problem. It is an old problem insofar as circadian rhythms and the ability to synchronize physiological and behavioral rhythms with the solar day/night cycle is one of the oldest adaptations which evolved on Earth. It is a new problem that has arisen due to the artificial structures and indoor lighting human engineering has created, which has isolated people from the temporal ecology of the external environment. It will be up to the next generation of architects and designers to determine the best designs to retain the advantages of our artificial environments while simultaneously promoting the temporal hygiene necessary to fully enjoy the advantages brought by the new technologies we develop.

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Classroom design for children on the autistic spectrum

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ABSTRACT: Social justice movements significantly changed design culture over the last twenty years. The disabilities rights movement, in particular, has had a profound impact on building design. But there has been more attention to accommodating mobility and sensory issues than cognitive issues. Built environments can pose many barriers for people on the autistic spectrum (AS) due to their unique cognitive structures. Although design for people on the AS has received attention by designers and architects, existing design guidelines often lack a scientific basis and may lead to questionable outcomes. Further, useful knowledge from scientific research is not being applied consistently in design for this group. To bridge the gap between research and practice, the authors applied knowledge translation methods to the existing scientific knowledge on the AS to produce design recommendations for classrooms. This paper describes the knowledge translation process used to identify key knowledge in this field and examples of how it can be applied in design. The implications for future research on the topic of knowledge translation in design for the Autistic Spectrum (and design in general) are provided.

1 INTRODUCTION

Built environments discriminate against people with disabilities if they include barriers that limit access to services and resources intended for all building occupants and visitors. "Barrier free design," an early paradigm for designing to eliminate discrimination, focused on addressing physical disabilities. Universal design, sometimes called "inclusive design" or "design for all," is a newer paradigm. It recognizes that all people share the experience of barriers (Steinfeld and Maisel, 2012). Improving accessibility, usability, and social participation opportunities through design is a benefit to all. Universal design emphasizes giving attention to a broader range of disabilities and also recognizing that people are limited in the use of the built environment for other reasons as well, e.g. low income, intolerance and stigma. In essence, universal design provides a conceptual framework for practicing social justice through design.

Children on the Autistic Spectrum often have profound limitations in social and communicative function, and may have restricted and stereotyped behaviors and interests (Volker et al., 2010). In addition, they usually have problems in processing sensory information.[1] The learning environment (LE) is where children started to interact with society and learn skills that may help to shape their whole life. The typical classroom is a site of dynamic social interaction and intense sensory and cognitive challenges. It presents serious barriers for many children on the AS (e.g., see Kanakri, 2012; Ben-Sasson et al., 2013). This may have a detrimental impact on these children at the very beginning of their life and thus prevent them from fulfilling their full potential.

For architects, design for children on the AS can be a complex design problem that is difficult to resolve without the appropriate knowledge. Although design ideas that seem to have worked in the past can be provided by stakeholders (e.g., parents, teachers), they may not address the complex causal factors underlying the distinctive behavior of this group of children, and result in solutions that work for only a few individuals and are less than optimal. Objective scientific knowledge, augmented by theory, is needed to better understand the complexity of cognitive processes of children on the Autistic Spectrum. An understanding of these systems and their role in person-environment interactions can help to provide high-quality design criteria (for review see Gifford, 2007).[2] This is not to deny the very real value that life experience can provide in design. Rather, a foundation of scientific knowledge can provide a lens through which experiential knowledge can be evaluated and understood.

[1]There is an evidence that children on the Autistic Spectrum may respond atypically to visual, auditory, vestibular and tactile stimulation (see Hilton et al., 2010). However, their atypical reaction to visual and auditory stimuli have the strongest empirical support. (Mottron et al., 2006).

[2]Design recommendations based on practical experience should not be discredited. However, they should be given careful scrutiny, just like intuitive suggestions from designers themselves, to evaluate whether they are supported by theory and/or scientific evidence. This "triangulation" can lead to a more informed process and identify new directions for scientific research and theory development.

Knowledge about the cognitive processes of people on the Autistic Spectrum can be divided into "non-social" and "social" cognition. Among the most understood non-social cognitive traits for people on the AS are:

- *Unusual focus on details (i.e., local bias).* This means that people on the Autistic Spectrum, who have this trait, may tend to see "trees first, not forest" to a greater degree than other individuals (Iarocci et al., 2006; for review see Mottron et al., 2006). From the neuroanatomical perspective, it is believed that focused vision can be caused by inappropriately functioning attentive mechanism ("top-down" modulation) (see Frith, 2003; Happe & Frith, 2006).
- *Executive function (EF).* EF is an umbrella term for cognitive processes involved in a goal-oriented behavior (e.g., actions planning, shifting of goals) (Kenworthy et al., 2008; also for review refer to Hill, 2004). It is suggested that problems with EF may be linked to atypically functioning attention and prefrontal brain areas (Kenworthy et al., 2008; Frith, 2003).
- *Atypical sensory processing* (i.e., either enhanced and decreased), which may occur in different sensory modalities (see Belmonte & Yurgelin-Todd, 2003, Kanakri, 2012, Kern et al., 2007, Baranek et al., 2007 Lockner et al., 2008). Empirical evidence for atypical processing of visual and auditory information is the most established (e.g., see Mottron et al., 2006 ,Bertone et al., 2005; Belmonte & Yurgelun-Todd, 2003).

Limitations in social cognition underlie the difficulties that children on the Autistic Spectrum might experience with socialization. Brain areas responsible for consciousness and emotional processing likely have a big impact on the understanding of mental states (see Frith, 2003).Social cognition of people in the Autistic Spectrum is explained by the theory of "mentalizing deficit", i.e., the inability to understand what is on others' minds (Frith, 2003). Complex mental states (e.g., irony or sarcasm) may cause more problems than basic emotional states (e.g., fear) (see Frith, 2003; Jones et al., 2011).

2 METHODOLOGY

Even though the integration of interdisciplinary knowledge in architecture is a normal practice, the systematic approach to its translation from scientific research into design is uncommon, especially when the knowledge source is scientific research with no obvious relationship to design.

Knowledge about AS was translated into design guidelines using the systematic approach described in detail below. Through the extensive literature review, Key Knowledge (KK) was identified that uncovered typical problems children on the Autistic Spectrum might encounter in their environment. Design Guidelines and Strategies were then proposed to solve these problems.

The studies included in the literature review addressed the following research questions: *What cognitive and neural "abnormalities" are most inherent to the Autistic Spectrum? How these "abnormalities" can affect the interaction between person and environment?* In most cases, studies do not provide the obvious answer to the second question.[3] However, it was critical to identify the potential role of a particular cognitive feature in a person-environment (PE) interaction since it can identify implications for design. To identify this potential role, additional research on similar topics (especially, studies generalizing their findings to real world situations) and concepts from *environmental psychology* were considered.[4]

The literature review was based on the following inclusion criteria: (1) a relationship of the work to established cognitive and neurological theories about the Autistic Spectrum (e.g., Theory of Mentalizing); (2) presence of supportive empirical findings from other studies addressing the same topic; (3) a relationship of findings to high-functioning children on the Autistic Spectrum; (4) publication of the article in a peer-reviewed journal(s). Some studies concerning the lower functioning population on the Autistic Spectrum were also reviewed if their findings could be generalized to a high-functioning population. In addition, if a study was theoretical and had a number of revisions, the most recent revision was reviewed.

The search was conducted using databases that provide knowledge from cognitive psychology and neuroscience: *PsycINFO*, *Psychology and Behavioral Sciences Collection*, *PsycARTICLES* and *PsycTESTES*. For social cognition, 1437 studies were found; 28 studies were reviewed. For non-social cognition (including executive functioning and atypical sensory processing), 986 studies were found; 100 studies were reviewed.[5]

Based on the reviewed literature, the basic knowledge addressing the research questions was identified and analyzed. Finally, the knowledge was summarized into twenty-one concepts representing the Key Knowledge (KK) statements. Twenty-six Design Problems ("Problems") were derived from the KK that cast the KK into a framework for design. Problems were derived by logical inference to a particular condition or environmental feature, which made it easier to translate them into design implications. Essentially, the Problems summarize and interpret the KK statements

[3] Essentially, the lack of direct implications for design in psychological and neurological studies increases the gap between both basic and applied research and between studies of the Autistic Spectrum and environmental design for this population. This gap is a major challenge for translational research.

[4] For review on concepts of environmental psychology see Gifford, 2007.

[5] The references of the reviewed studies were analyzed and additional search was done on any references concerning the research questions.

to provide designers with clear and concise design criteria accompanied by explicit links to underlying knowledge. Design Problems provide a *comprehensive* framework for application of design responses and concern various aspects of the environment, including but not limited to: spatial organization; informational and product contexts; and thermal, acoustical and visual (lighting and color) conditions.

To aid designers in translating the Key Knowledge (KK) to actual design interventions, design recommendations in the form of Guidelines and Strategies were provided. The Guidelines represent the most general level. They can be applied to numerous design contexts and support the creativity of designers. Strategies provide more specific information about how to fulfill the Guidelines and benefit designers that do not have additional knowledge regarding the Autistic Spectrum.

A review of literature in relevant design disciplines was also conducted to identify potential ideas for design solutions and design parameters. Existing design standards, recommendations and empirical studies in building physics were used to understand how issues of indoor acoustics, lighting and air quality could be addressed.[6] The research on impact of color on person-environment (PE) interaction was also considered (see Bosch, Cama, Edelstein & Malkin, 2012). Relevant concepts and theories from the field of environmental psychology were considered, including the concepts of privacy (e.g. see Altman, 1975; Sommer, 1969), wayfinding (e.g., Garling & Evans, 1991) and the theory of situated concepts (Barsalou, 2009). The latter provides an overview of how people process and categorize the information necessary for their actions in the context of different situations (for review see Barsalou, 2009). In addition, sources on the anthropometry of children were considered (Weber, Lehman & Schneider, 1985). This information is especially useful for addressing Design Problems concerned with product design (e.g., furniture parameters). Finally, existing design guidelines for the Autistic Spectrum were reviewed to identify and assess current guidelines and criteria on design for the Autistic Spectrum (see Humphreys, 2008; Ahrentzen & Steele, 2009; Paron-Wildes, 2013).

3 EXAMPLE OF KNOWLEDGE TRANSLATION

3.1 *Key knowledge 4*

People on the Autistic Spectrum have an increased sensitivity to early "low-level" stimulation (i.e., the first perceptual responses occurring in the primary visual cortex) (Belmonte & Yurgelun-Todd, 2003; Mottron et al., 2006; Mottron & Burack, 2001). This may lead to excessively strong reaction to bright color and light, complex textures, rich patterns, and complex contours of objects (see Hilton et al., 2010).

3.2 *Problem 4*

A high level of visual stimuli can create a sensory overload.

3.3 *Guidelines and strategies*

G 4.1: Prevent clutter (Fig. 1).

S 1: Provide storage containers and cabinets for each activity area.

– Storage containers and cabinets should be located close to spaces where the particular activity occurs so the material/toys may be immediately removed when they are no longer needed.

S 2: Provide information board(s) in specific spaces of a classroom to prevent cluttering a classroom's walls.

S 3: Consider using movable boards or table letterboards in each activity area of the LE to transfer the information from walls to areas where it is most relevant.

In addition to Problem 4, there are three more Design Problems derived from Key Knowledge 4. One of them is *Problem 8*.

Bright and intense colors may become a reason for a stress.

3.4 *Guidelines and strategies for problem 8*

*G*8: Prevent exposure of students on the Autistic Spectrum to bright and intense colors in the LE (Fig. 1).

S 1: Use colors in a neutral, minimally saturated palette for background elements of the environment (i.e., elements of environment that usually deserve least attention; e.g., walls and floor). Make sure that excessively high contrasts between objects and background are avoided.

S 2: If items with saturated color(s) are provided to attract attention (e.g., posters), the number of those items should be limited.

– Especially, minimize the use of intense *reds*.

S 3: Primary colors could be used for small objects. Extreme saturation, however, should be avoided entirely.

Figure 1 on the following page represents a mainstream elementary classroom designed to address all Guidelines and Strategies developed through the research project. The annotations highlight only the Guidelines and Strategies discussed above.

Table 1, located on the following page, summarizes all the key knowledge and related design problems identified. Due to limitations on space, details, citations to the literature, and the full set of guidelines and strategies are omitted. It is important to note that not

[6] For review of standards reviewed see IESNA, 2000, and WHO, 1990; for review on empirical studies concerning thermal comfort and indoor air quality see Bako-Biro et al., 2012; Choi et al., 2014; Huang et al., 2014; Ormandy & Erzatty, 2012.

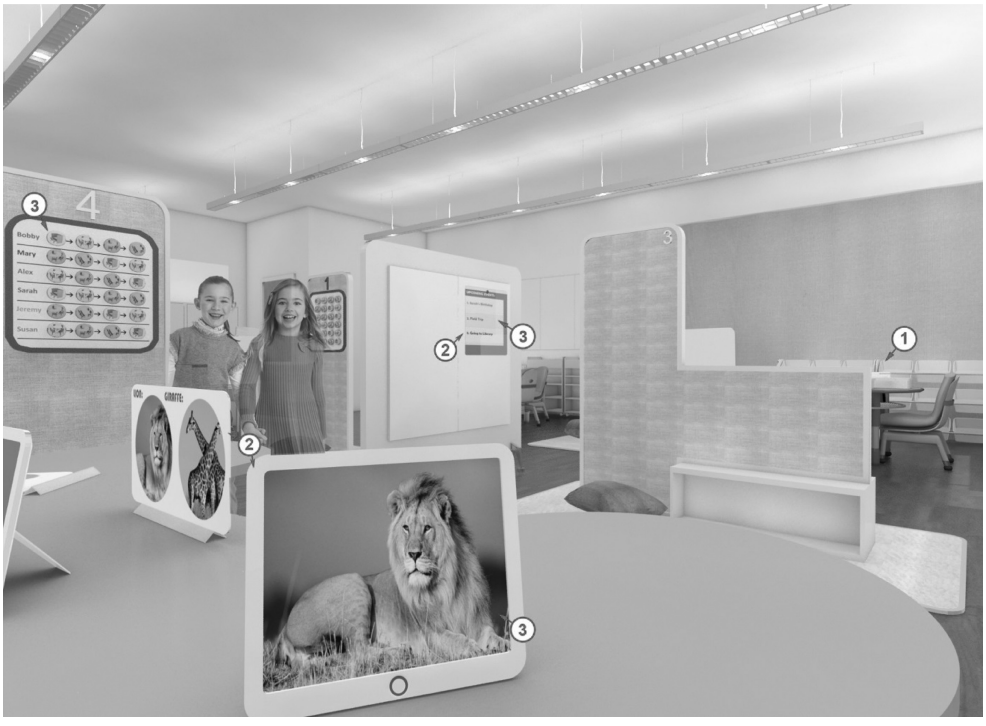


Figure 1. Interior of elementary classroom. Source: Authors.
Annotations: 1 – Storage for learning material is provided near each study zone to control cluttering; 2 – The information board in the center of a classroom and letter-boards on the school desks help to bring the hierarchy in the informational environment; 3 – The overall palette of the classroom is subdued and contrasts are diminished. This provide "soft" visual experience and may help to attenuate irrelevant stimuli and accentuate the relevant ones (e.g., learning tasks, schedules and other important information as highlighted by annotations).

Table 1. Summarized Key Knowledge and Problems.

Key Knowledge (KK)	Problems (P)
KK1: Reduced cognitive and behavioral flexibility can create problems and great stress when transitioning from one occupation/task to another.	P1: An environment that has an *abrupt* change between different activities may be confusing and distressing.
KK2: Exceptional visuospatial abilities lead to distress at small changes in the environment.	P2: Changes in the visual profile of a learning setting after classes may cause inappropriate reaction of students when they return.
KK3: The cognitive mapping process based on episodic, item-related memory rather than on abstract cognitive representations.	P3: Wayfinding will be difficult if there is a lack of visual landmarks and cues on a circulation path and if those cues are visually isolated from each other.
KK4: Excessively strong reaction to bright color and lighting, complex textures, high contrast and complex contours of objects.	P4: High levels of visual stimuli can create sensory overload. P5: Direct and indirect glare, flashing light and very bright light may be exhausting and may hinder the learning process. P6: Sharp contrasts of light and shadows, complex textures and visually expressive artwork may be distracting and disturbing. P7: Complex and unusual shapes may be highly distracting. P8: Bright and intense colors may became a reason for outbursts and stress.

(*continued*)

Table 1. Continued.

Key Knowledge (KK)	Problems (P)
KK5: Sensitivity to high spatial frequency (i.e., average number of spatial elements per unit area).	P9: Objects with many details may reduce attention and cause distraction.
KK6: Negative reaction to inharmonic sounds. Harmonic sounds (e.g., classic music), however, can have a positive and even therapeutic effect.	P10: Loud high-pitch sounds and noise can be highly distressing and may disturb the learning process. P11: A learning environment should accommodate the requirements of music therapy.
KK7: Highly reliant on visual cues in maintenance of postural stability and motoric functioning.	P12: Lack of appropriate visual stimuli can cause clumsy movements and feelings of disorientation.
KK8: Hypersensitivity to tactile stimuli, especially high-frequency vibrations, "fine" textures and hot or cold surfaces.	P13: Materials with high thermal conductivity and fine, "tickling" textures can cause an overload in tactile stimulation and highly irritating experiences.
KK9: Enhanced visuospatial and auditory perception can be a basis for a developing "savant" skills in drawing and music.	P14: The school program and learning environment should accommodate an interest in music and art.
KK10: Development of savant abilities after an encounter with a material-catalyst. KK11: Savant skills can be generalized from one learning material to another by detection of structural similarities.	P15: Failure to provide an access to a specific learning material (i.e., visually clear and well-structured) for students will prevent students from reaching full potential and can hinder the access to culture and development of abstract thinking.
KK12: High-functioning people on the AS have problems with posture and locomotion.	P16: People on the AS are in a greater risk for muskuloskeletal problems due to inactivity
KK13: People on the AS may be inaccurate while executing tasks required a long sequence of complex actions, however, they can use compensatory mechanisms to accomplish such tasks (i.e., "systemizing").	P17: Complex tasks consisting of a large number of required actions, especially multitasking, may be unusually challenging for students on the AS. A failure to accomplish task can be the reason for anxiety and reduction in motivation.
KK14: People on the AS might be unable to construct concepts that lie beyond the present reality (e.g., concept of place based on its function) but be able to construct the concepts that are visually evident (e.g., table and chairs of the same color as a concept associated with a place for study).	P18: Elements of the environment that are not linked by a common visual feature (e.g., color) limit the abilities of those on the AS to construct concepts (i.e., mental images of objects or environments). This leads to a diminished capacity of action planning and hinders goal-oriented behavior.
KK15: People on the AS can have problems in perception of complex stimuli leading to a reduced situational awareness (e.g., walking people; book falling from the shelf).	P19: Intrusions into personal space and undesirable encounters with other people are more likely since people on the AS are less aware about movements of others. P20: Unstable objects can become a serious threat to safety in the LE.
KK16: Perceptual connections are enhanced when stimuli are organized in a regular manner (i.e., objects set up on the same axis) the sense of clarity and pleasantness can occur.	P21: The visually disorganized LE may hinder comprehension and diminish clarity.
KK17: Some individuals on the AS have limited ability to perform motor tasks requiring strong coordination of actions (e.g., trying to reach the book standing on the tiptoe).	P22: The environment that does not provide an easy physical access to functionally important items may seriously limit functioning and performance of students.
KK18: Selection between two competing alternatives is believed to be limited.	P23: Choices for action that look similar may be confusing and may increase anxiety.
KK19: Weak immune defence against external infections.	P24: An environment that exposes students to inappropriately low temperatures and infections are particularly dangerous for people on the AS.
KK20: Lack of fear in response to real dangers and excessive fearfulness in response to innocuous objects or situations.	P25: Interaction with objects and activities may cause injuries (e.g., scissors) are particularly dangerous for students on the AS.
KK21: Diminished interest in collaboration, acceptance and avoidance of rejection.	P26: Avoidance of collaborative environments can negatively affect overall motivation for learning.

all people on the Autistic Spectrum have all the behavioral, cognitive and health conditions identified in the key knowledge summaries. In fact, the great variation among individuals adds to the challenge of designing learning environments for this group. Flexibility and options, therefore are critical overarching design goals to provide educators with an environment that can be easily adapted to the specific needs of the students in a class.

4 CONCLUSIONS

The current study provides a knowledge translation model as a tool for producing design recommendations for elementary classrooms accommodating the needs of high-functioning children on the Autistic Spectrum. The model supports systematic and transparent knowledge transfer from the fields of cognitive psychology and neuroscience. The proposed model provides a valuable framework for other applications of scientific knowledge in design. Moreover, the method for translation of scientific knowledge and its integration into design can be useful as a prototype for knowledge translation in other domains. The main limitation of this work is that formulated Guidelines and Strategies are not yet tested. The next step in this initiative will be the implementation of the proposed design recommendations and assessment of their efficiency through Post-Occupancy Evaluations (POE) and experimental studies (see Gifford, 2007). A second limitation is that the proposed design recommendations are mostly focused on interior design. This provides simple and cost-effective design solutions that can be applied to re-design of existing learning spaces to facilitate mainstreaming. Nonetheless, design solutions of other types and character (e.g., the spatial organization of buildings) are a worthy topic for investigation that would help broaden the application of the key knowledge identified.

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The impact of patient room design on airborne hospital-acquired infections

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ABSTRACT: Transmission of airborne diseases in healthcare facilities is an increasingly important concern. This, in part, is due to the reduction in funding from insurance companies for hospital-acquired infections (HAI) and the consequent economic impact of an influenza outbreak in a hospital. With increasing cases of HAI in the USA, it became necessary to examine the current ventilation standards for healthcare facilities. While design guidelines have focused on recommending appropriate ventilation rates, it ignored the delivery of conditioned air to occupied spaces and the impact of room layout relative to the placement of air supply and return. The paper will also estimate the probability of infection based on air change effectiveness, and the relative spatial relationship between HVAC air delivery system and room design. The resulting outcome is a guideline intended to support health facility designers.

1 INTRODUCTION

Today's regulatory air quality standards for healthcare facilities effectively maintain heating, cooling, and ventilation requirements in the acute patient room by fulfilling overall air change rates. American Society of Heating, Refrigeration, and Air-conditioning Engineers or ASHRAE require that air changes occur to keep fresh air continuously entering spaces. However, this guideline does not suggest how to remove effectively contaminated air that may be caught in dead zones affected by room design. The standard does not consider that the air being mixed in the ventilated spaces is allowing clean air to be mixed with contaminated air.

These airflow patterns created by the ventilation contribute to air-temperature, distribution, thermal comfort, air quality, and the possibility of airborne pathogen transmission within a space or spaces. Airflow patterns of existing rooms need to be studied in order to understand pre-existing relationships between location and type of supply diffusers, supply airflow rates, supply temperature, return air location and size, infiltration, furniture arrangement, heat sources and location of the patient and others in the room.

Influenza was chosen in part because of its seasonal and continued yearly effects on populations as well as its lower quantum level. The quantum level explained more fully in the risk assessment method portion, is a measure of the infectious material present and the pathogenicity of that material (Wagner et al. 2009). Other airborne threats such as Tuberculosis and SARS would yield a larger quanta production rate.

Studies have been done proving influenza as an airborne threat within hospitals at close range like that in patient rooms (Blachere et al. 2009, Brankston et al. 2007). However, there have only been a few significant studies showing how airflow patterns can be affected by supply and return vents as well as room configuration. A review article lead by Dr. Yuguo Li in 2007 found only 40 studies focusing on ventilations impact on airborne transmission in the built environment cataloged between 1960 and 2005. Of these forty studies, only ten were deemed conclusive by a team of multidisciplinary reviewers. These conclusive studies had met the teams determined the evidentiary threshold, and provide strong evidence on ventilation effects of airborne transmission of diseases including Tuberculosis, SARS, Influenza and chickenpox (Li et al. 2007).

Most recently a study using computational fluid dynamic modeling was completed by Khankari. Two mechanical placements were tested in one patient room to show resultant airflow patterns (Khankari 2015). The information gathered from this study can be significantly furthered by looking at two common patient room designs and computational fluid dynamic models to test a plethora of supply and return air locations relative to the patient, caregiver, and door.

The following study using a calibrated model verified by field measurements of air distribution patterns in patient rooms. In addition to airflow patterns, the CFD algorithm is used to determine the age of the air to measure the effectiveness of the recommended air changes in the standards delineating through graphical and numerical means the potential location for concentrated airborne contamination. It is also intended to encourage the development of design codes and standards that take into account airborne pathogen transmission in places where the patient is most vulnerable to infection from visitors or staff.

2 RESEARCH METHOD

2.1 *Room criteria and selection*

The geometries selected and tested in this paper correspond with the general trends in the healthcare design field. While shapes and sizes of rooms can differ drastically, three average room sizes were selected to correspond with small, medium and large patient room sizes.

The room sizes are as following 21.4 m^2 (230 ft2), 27.87 m^2 (300 ft^2) and 34.84 m^2 (375 ft^2) all inclusive. The sizes address the possibility of the implementation of universal or acuity adaptable rooms in all sizes and critical care patients in the larger room size (Brown & Gallant, 2006).

The patient rooms used for the simulation follow the FGI Guidelines for Hospitals and Outpatient Facilities 2014, thus having private bathrooms, and glazing that is no less than 8% of the floor area of the room served (2014 FGI Guidelines for Hospitals and Outpatient Facilities 2014).

Each room tested is rectangular in shape and propose either an inboard bathroom located at the entrance of the patient room or outboard bathroom, located along the exterior wall of the room and building. The bathrooms are placed on the headwall, or where the patient's head is located near the wall in bed with supply air being placed above the patient bed and return located near the door to the patient room. The supply diffuser is a 4-way diffuser supply air with six (6) air changes per hour calculated by room's volume from finish floor to 6 ft above.

2.2 *Computational fluid dynamic modeling*

Computational Fluid Dynamic Simulation focuses on the numerical and algorithm modeling of fluid flow and heat transfer processes. Given boundary conditions including climate, internal energy sources, and HVAC systems CFD simulates a building's likely internal or external airflow.

The numerical solution of the airflow simulation uses differential equations to find values of flow quantities at certain points of a system. These values are then converted to a system of algebraic equation that represent the interdependency of the flow at each point (Sayma 2009). The points correspond to a grid or mesh used by the modeling system.

2.3 *CFD modeling*

IES VE has been tested and fully validated under ASHRAE Standard 140. The IES VE program allows for dynamic thermal simulation, including design load calculations, and simplified computational fluid dynamic modeling. IES VE primarily focuses on integrated graphics-driven results, however, does allow for simple numerical analysis based on points located within the graphic model.

IES VE uses the k-epsilon turbulence model to find the turbulent viscosity of a 3D space. The standard

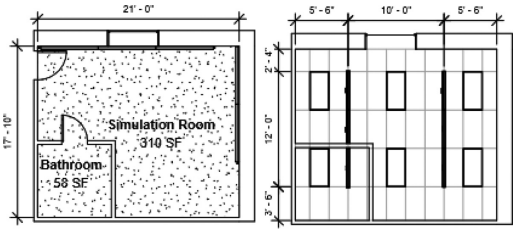


Figure 1. (Left) Simulation room layout, (Right) simulation room ceiling plan

k-epsilon model is widely accepted due to its applicability to wide-ranging flow situations primarily looking at internal flows with weak streamline curvature models. The equation solves for the kinetic energy turbulence and the dissipation of the kinetic energy (Awbi 2003).

While the standard k-epsilon turbulence model is accepted it has limitations when more complex flows are being studied, and the length scale for the determination of turbulence can only be speculated. The RNG k-ε or renormalization group model and low Reynolds number k-ε model are more accurate when considering forced convection or mixed convection turbulence models, while the Large Eddy-Simulation (LES) model is a more accurate predictor of flows with strong streamline curvatures (Awbi 2003).

IES VE's MicroFlo 3D Computational Fluid Dynamic modeling application was used to simulate different conditions. Boundary conditions such as America's northeast climate were applied to the model through the Apache application that uses weather data to provide an environment for the evaluation of a building and system design. Thermal comfort conditions were regulated by specifying HVAC system and placement based on ASHRAE 170, 2013 healthcare patient room standards including required air changes per hour (ACH) and humidity.

MicroFlo produces a visual representation of an internal space's airflow based on velocity, concentration of CO^2 and local mean age of air. Local mean age of air (LMA) is the amount of time a parcel of air has been in certain areas of the simulation space. Higher values indicated areas with poor ventilation.

2.4 *Calibration*

In order to calibrate IES VE an educational nursing simulation room was tested with field measurements to prove that results gathered from IES VE would be correct. The nursing simulation room was located in Northeast Ohio and had an overall area of 34.19 m^2 (368 ft^2). The field measurements were taken on two days November 2nd and November 23rd, 2015.

2.4.1 *Field measurements*

Field measurements were performed in the nursing simulation room, 5.43 m (17.83 ft.) (L) × 6.4 m (21.0 ft.) (W) × 3.05 m (10 ft.) (H), with the bed located on the same wall as the bathroom shown in

Table 1. Boundary Conditions for Patient Rooms.

	Flowrate	Temperature	
	CFM*	°F	°C
Small Room	252	70	21.1
Medium Room	315	70	21.1
Large Room	400	70	21.1

*CFM based on required 6 air changes/hour per ASHRAE 170

Table 2. Simulation Room CFD Simulation compared to field measurements

Height ft.-in.	Average Velocity – Simulation ft. /mins.	Average Velocity – Field Measurements ft. /mins.
0′-6″	4.74	5.625
3′-6″	8.15	10.375
6′-0″	12.11	12.5

figure 1. The air is supplied and returned through linear slot diffusers located at the ceiling. The room is illuminated by six $2' \times 4'$ fluorescent lights, one located within the bathroom. Measurements were taken at 3′ grid intervals, at 0.15 m (6 in.), 1.1 m (3.5 ft.), 1.8 m (6 ft.) above the floor. A TSI indoor air quality meters model 8386A and 8760 were used to measure temperature, humidity, carbon dioxide and air velocity at nine specific points.

The boundary conditions that would be completed by IES VE were also collected; like wall surface temperature, outside temperature, and current weather conditions.

IES VE run of simulation room. The simulation room's CFD run had boundary conditions estimated from the field measurements, including outside temperature as well as surface temperatures. The supply air was delivered through slot diffusers that were equivalent to 360 cfm, approximately 6 ACH. The simulation room also used perimeter radiators located on the exterior walls, causing higher surface temperatures on the respective walls.

2.5 *CFD runs of patient rooms*

The selected six room designs for patient rooms were tested through IES VE, similar to the simulation room specific data was collected through the micro flow runs at three specific heights .15 m (6 in.), 1.1 m (3.5 ft.), 1.8 m (6 ft.). Each room was supplied with 6 ACH, the required ACH per ASHRAE 170. This required 252 cfm for the small, 315 cfm for the medium, and 400 cfm for the large patient rooms in order to satisfy the required 6 ACH.

The results all pertain the same climatic influence, boundary conditions that coincide with February 8th. Each result is reflecting sixty minutes of time, the length of time for the required amount of air changes to take place.

2.6 *Data analysis*

2.6.1 *Risk assessment: Wells-Riley equation vs. Gammaitoni-Nucci equation*

Local mean age of air and Velocity of air vectors in the different patient rooms are analyzed to see if any significant differences were seen in various room sizes or layouts.

The risk of transmission is evaluated using the steady state Wells-Riley equation and non-steady state Gammaitoni-Nucci equation. Exposure times can vary in patient rooms from days for a patient to as little as a few minutes for a staff member. Thus, the risk of transmission is influenced by chance events (Beggs et al. 2010).

The Gammaitoni-Nucci equation is a modified version of the Wells-Riley equation that reflects the exponential increase in the number of new cases of infections in a room. The Gammaitoni-Nucci equation takes into consideration the transient behavior of transmission over shorter periods of time, and that not every newly infected person may infect another due to their short time in a particular space (NOAKES et al. 2006). The equation considers room volume, which varies per room size, ventilation rate, and the quanta production rate. The quanta production rate is best explained as the infectious dose required to infect 63.2% of the people in the affiliated enclosed space.

The mean quanta production rate for influenza that is used for the Gammaitoni-Nucci equation is 100.0 quanta/h, value for a highly contagious case (Rudnick & Milton 2003). However, there is still dispute over an official range of quanta production rate for Influenza; it can vary from 15-128 q/h depending on which steady or non-steady state Wells-Riley equation used to determine the quanta production rate.

The equation assumes ventilation as a large factor in particle removal while it is a significant source, many other sources also factor in pathogen settlement (Rudnick & Milton, 2003). For Influenza A, an important factor in pathogen removal is inactivation through settling, thus removed from the air but not the space entirely. The equations do not take into consideration that outside factors such as temperature, humidity and settling can have an impact on a person's risk of airborne infection.

3 RESULTS

Each CFD run resulted in velocity quantities and local mean age of air approximations that differed based on room size and layout, inboard vs. outboard. The LMA or local mean age of air and known volume of the rooms were then used for a risk analysis of Influenza A in those respective rooms using the Wells-Riley and Gammaitoni-Nucci equations.

3.1 *Simulation room CFD run*

The simulation room's CFD model ran closely to the documented field notes. The boundary conditions

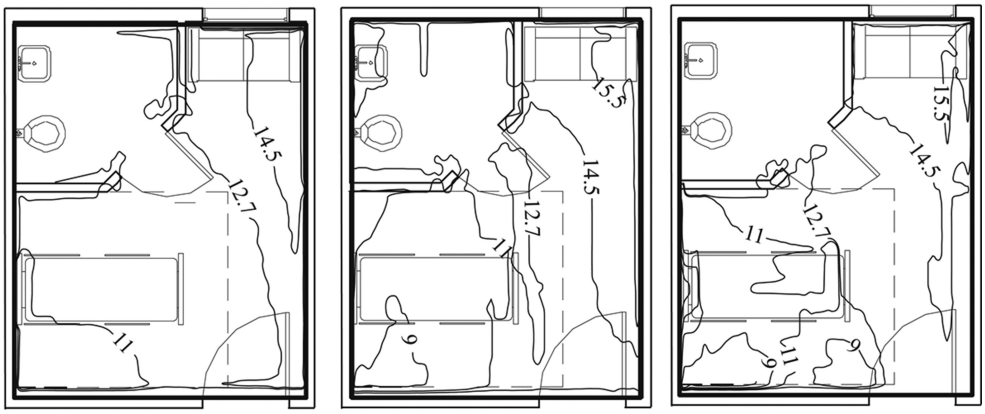


Figure 2. Small outboard room (left: 0′–6″ AFF, middle: 3′-6″AFF, right: 6′-0″ AFF) LMA in minutes.

were controlled by the data obtained from the field measurement like surface temperature and input air temperature. Table 2 shows the averages for each differing height level for the simulation room CFD model compared to that of the field measurements.

3.2 *Room comparison*

3.2.1 *Size*

The selected rooms varied in size; small, medium and large. Figure 2 shows the differences of air age in the different patient rooms. Overall, the size did not have a large impact on velocity and air age; rather design had an impact on the mean air age at different areas in the room.

3.2.2 *Layout*

3.2.2.1 Inboard patient room

The inboard CFD model showed that the air is circulated relatively consistently among all room sizes, and the local mean age of air is similar throughout the rooms, ranging from 10.9 minutes to 12.7 minutes. Local mean age of air is older or higher in the bathroom if the door remains open, resulting in air age of 14.5 minutes. This, on average would approximately result in 6 ACH per hour, each air change taking on average 10 minutes.

3.2.2.2 Outboard patient room

The outboard patient room is relatively different when it comes to local mean age of air throughout the space. The CFD model shows that the back zone in all the outboard rooms have older air parcels as shown in figure 2. This area has air that is an average of 15 minutes old, which would be the equivalent of 4 ACH while the area around the patient bed has an average air age of 10.5 minutes which would result in the required 6ACH.

This air change discrepancy is significant the risk of transmission will significantly increase in the areas of poor circulation. The following mathematical risk assessments show the increased risk associated with the poor circulation.

3.3 *Risk assessment*

The Wells-Riley steady rate and Gammaitoni-Nucci non-steady rate are mathematical models that predict the rate of airborne transmission. The Gammaitoni-Nucci model is better suited for short-term exposure models. However, both will be used and compared to understand the risk of transmission. Each room is analyzed using the average ACH. Thus the outboard will be broken into zones and analyzed according to the different LMA associated with the different zones of the room. The differing LMA would result in a different ventilation rate for that space, so instead of the required 6 ACH there may be less in poorly ventilated areas.

3.4 *Local mean age of air*

The mathematical risk models predict the transmission of airborne disease and are based on flow rate or the ACH. However, a dimensionless equation that shows how efficiently different room airflow structures remove contaminants regardless of the flow rate can also be utilized (Bartak et al. 2001). The following table 3 shows the efficiency of the airflows in the six rooms. The outboard rooms were broken into different volumes based on average local air age to understand the changing efficiency rates with relation to the local mean age of air at points within the room.

3.5 *Comparison between mathematical risk assessment models*

It is important to understand the above table shows three drastically different equations, and in turn drastically different results. The Wells-Riley results show the potential for new cases in an exponential increase or decreasing form. If the results are less than 1 ($a < 1$) the pathogen would be removed or settled before infecting any of the susceptible targets while the results that are greater than 1 ($a > 1$) would result in increasing pathogen transmission. Therefore, the zones that were identified as poorly ventilated in the

Table 3. Mathematical Risk Assessment Models and Efficiency of Airflow in Patient Rooms

Room Design and Zone	Wells-Riley *	Wells-Riley with required 6 ACH	Gammaitoni-Nucci	Gammaitoni-Nucci with required 6 ACH	Airflow Efficiency (Bartak et al., 2001)**
Small Outboard				0.1061	
43.89 m^3 @ 10.5 LMA	0.9451		0.1560		2.0170
27.47 m^3 @ 15 LMA	1.7696	0.5303	0.3544	10.61%	4.6040
Small Inboard	0.6045		0.0991		1.3588
Medium Outboard				0.0858	
69.38 m^3 @ 11.5 LMA	0.6206		0.1017		1.1147
19.82 m^3 @ 13 LMA	2.0399	0.4289	0.3376	8.58%	4.4109
Medium Inboard	0.4898		0.0801		0.8670
Large Outboard				0.0682	
91.17 m^3 @ 10.9 LMA	0.4564		0.0754		0.6332
22.1 m^3 @ 14.5 LMA	2.0411	0.3410	0.4087	6.82%	3.4752
Large Inboard	0.3708		0.0611		0.5097

*Solves for P, a dimensionless exponential increase of new cases **The lower the number, the higher the efficiency of airflow

outboard design have an increasing chance of infection, while the inboard room and better-ventilated areas in the outboard would not.

The Gammaitoni-Nucci results are based on percentages. Thus, the results that are shown as decimals could also be shown as the equivalent percentage (i.e. large inboard: $0.0611 = 6.11\%$). Again, like the Wells-Riley model the inboard rooms have well-mixed air resulting in a low percentage of people that will contract Influenza through the airborne route. Contrastingly, the particular outboard room zones that have nominal ventilation result in a probability of infection of 35–40%. It is important to note that this model predicted at the likelihood of an individual who has been in the room with the infected for an hour.

Furthermore, if 15 minutes were used as the exposure time rather than an hour the probability of a susceptible person being infected would decrease (i.e. Small outboard patient room, the poorly ventilated area decrease by 86% from a 35% probability of infection to a 5% probability). The required 6 ACH in a well-mixed and ventilated room would drastically decrease the probability of a person becoming infected. However, depending on room design parts are not getting ventilated properly, and the air age is increasing.

Lastly, the equation used by Bartak and others takes the relationship between air age in the room of certain volumes to find the efficiency of the airflow, while not considering the ventilation rate. Similar to the Gammaitoni-Nucci model, if 6 ACH were achieved everywhere in the room regardless of the design, the airflow efficiency in the rooms would be improved.

4 DISCUSSION AND CONCLUSION

4.1 *Significance*

The main regulatory source for healthcare facilities' ventilation systems is ASHRAE 170. The standard is also included as part of the FGI Guidelines for Hospitals and Outpatient Facilities 2014. According to ASHRAE, non-critical patient rooms should receive 6 ACH, with a minimum of 2 outdoor ACH. Many studies have been completed that have been the basis of ASHRAEs regulations that dictate 6 ACH. However, from this study, not all patient rooms can be considered suitable with 6 ACH. The design has to be taken into consideration when writing and considering minimum ventilation standards.

While the airflow in the inboard patient rooms was effectively shown by the local mean age of air, the outboard patient room airflow was less than effective for circulating fresh air. The rooms tested were linear in design and less suitable room designs may be found if tested.

The outboard design's least effective space is what is used for family and visitor zones. The regulations primarily have supply outlets located over the patient beds to protect the patient from airborne infection. However, this leaves visitors and staff more susceptible to airborne infection like Influenza A as well as other more transmissible diseases.

The airflow effectiveness is necessary to prevent airborne disease within the room. As seen using the mathematical risk assessment models the air age has a large impact on Influenza A infection probability.

Thus, ventilation with room design in consideration can effectively be a primary measure against airborne infections like Influenza A or another airborne disease. However, ventilation regulation needs to focus on how design impacts spaces and its result on the ventilation needs.

4.2 *Limitations and considerations*

This study primarily focused on two designs of patient rooms which leaves many geometric configuration untested. Thus, it would be suggested that room designs are tested to understand ventilation properties for better efficiency and prevention measures

The supply and return air were also only tested at one location with the supply air above the patient bed and the return near the exit. Other placement could have shown more effective ventilation strategies, and should be considered to maximize effective airflow. While other ventilation strategies should be explored, 6 ACH have been found to be adequate as long as the room is receiving the adequate airflow that allows for the required ACH. Thus, possible added supply to evenly distribute air may also be an ideal strategy.

Limitations of the CFD modeling include the software used IES VE is a simplified CFD program that is based more on visual representation. Thus, LMA numbers are based on produced contours and not actual data points. Furthermore, a more complex system could produce more data per cell better to understand small air vector characteristics like eddies instead of the general room level airflow analysis. The Standard k-epsilon turbulence model is also found to over-predicts the gas turbulence kinetic energy which results to a high turbulence viscosity, and an estimated over mixing. Thus, the result could be showing slightly better conditions than what exists in the rooms (Tian et al. 2007).

The mathematical equations assumed an hour of exposure while many times visitors or staff are in the areas for shorter periods of time. The quanta used for Influenza, $q = 100$, is suggested as a highly infectious strand. There is controversy over the actual quantum of a disease due to significant variance quanta can have. The quanta itself measures the infectious material present and the pathogenicity of that material. However, the consideration for droplet evaporation and settlement is still disputed (Wagner et al. 2009).

The equations are also based on an assumption that the room air is well mixed and has a proportional distribution of quanta or infectious material throughout (NOAKES et al. 2006). Due to this assumption, the equations were used in the different zones that have visibly different airflow efficiency as shown by the CFD models.

Lastly, other airborne diseases could have a significantly higher or lower risk of infection based on their quantum level. A study by Qian estimated that the SARS quantum level ranged from 2460–4680 contingent on filter efficiency. These quanta levels are drastically higher than the tested Influenza quanta level and would lead to a faster and more devastating transmission rate (Qian et al. 2009).

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Quality of life by design: Study of space usage for affordable housing in Harbin, China

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ABSTRACT: Chinese government provides affordable housing in the cities to help cope with the housing shortage for rural-to-urban migrants. But there is limited research on these residents' needs and preferences. This study examined the space usage in affordable housing for migrants, and provided corresponding design recommendations for improvement. A post occupancy evaluation was conducted using mixed methods including design analysis, surveys (N = 0), and semi-structured interviews (N = 9). Findings revealed three main problems, including: (a) space being too cramped (mean usable floor area = 37.20 m^2) for the household size (mean = 3); (b) storage space being insufficient; (c) space arrangement not accommodating multifunctional usage. Based on these findings, potential design strategies were proposed to improve space arrangement and quality of life in affordable housing.

1 INTRODUCTION

China is now witnessing "the largest migration in human history" (Avent 2012). The trend of rural-to-urban migration has continued for over 30 years. In the next two decades, there will be another 320 million rural migrants moving to cities in China, which is equivalent to the total U.S population (Pierson 2011). This leads to the population boom in urban areas, and as a result, the shortage and unequal distribution of resources, especially housing (Ford 2007). While moving to the cities for employment opportunities, the migrants face a huge gap between their low income and the high housing cost in cities (Sicular et al. 2007). As a result, some of the new migrants from rural areas have to live in undesirable environments, move from place to place frequently, and/or be separated from their families for a long time period.

On the other hand, Chinese government provides affordable housing for low-income urban populations, including rural-to-urban migrants, to help cope with the housing challenge. During China's 12th Five-year Plan (2011–2015), 36 million affordable housing apartments were built, accounting for 20% of China's total housing supplies (by both market and government).

Such projects are supported by the government as one of the most important initiatives directly related to residents' well-being and quality of life. They are provided for purchase or renting at prices that are much lower than the market housing price. In order to reduce the construction cost and ensure affordability, they typically feature small dwelling sizes and address minimal functional needs. The building area of each affordable apartment is strictly limited by provisions published by the government. For example, the per capita living space of affordable apartments should not exceed 60% of the local average. This means an upper limit of 60.00 m^2 per dwelling unit and 15.67 m^2 per person based on China's national average in 2005 (Jiao 2008). The government expects improvement for affordable housing in the coming years, with the per capita living space reaching 20 m^2 by the year of 2020 (Ministry of Housing and Urban-Rural Development of PRC 2004). But that is still a tight space limit. In such contexts, the efficiency of spatial arrangement becomes especially important in these affordable housing projects.

Previous studies on these affordable housing projects have examined the design of dwelling units, building arrangements, and neighborhood open spaces. There are two main trends in this line of research. One trend is to examine how different locations, climate, or policies impacted residents' attitudes. For example, Sun (2014), Zhou (2011) and Wang (2008) used surveys in Changchun, Wuhan and Beijing respectively to examine the affordable housing residents' spatial preferences and needs. The other trend is to develop new methodologies for the design and provision of affordable housing. For example, Li (2014) and Zhang (2013) studied how to apply the modular design methods into the affordable housing projects in order to enable more efficient construction. Feng et al. (2012) developed a design process for

affordable housing, in which the future residents could be involved from the beginning of the project development.

Despite these studies, no post occupancy evaluation has been conducted to investigate residents' satisfaction with their current affordable housing, and to explore potential improvement for these living arrangements. Further, no previous study has given special attention to the population group of rural-to-urban migrants, which is one of the main target groups for affordable housing in China. Considering the urgent needs for large-scale constructions of affordable housing in China, this is an important research area that warrants more studies.

2 BACKGROUND AND STUDY SETTINGS

This study addresses this gap of knowledge by conducting a post occupancy evaluation of three affordable housing projects in Harbin – a major city with 9.94 million population in Northeast China. Located above 45 degrees north latitude, Harbin is known for its extremely cold winter weather and the longest winter duration among major Chinese cities (Harbin Government, 2016). The city government invested heavily on the affordable housing development. From 2008 to 2013, over 10 billion Chinese Yuan (about 1.5 million U.S. dollars) was invested to plan and build affordable housing projects, which housed over 148,000 residents with a total of 820,000 m^2 living space. However, because of the cold weather, more building areas are occupied by the thermal insulation materials compared to warmer areas, resulting in a lower ratio for the usable areas in the dwelling space. How to make the limited dwelling space more efficient is a significant challenge for the city.

The study settings are three newly developed, exemplary affordable housing projects in the city, with similar locations, dwelling unit sizes and occupancy rates. They are also all mixed income communities that provide both affordable housing and commercial housing. Although the total building area and the population are somewhat different across three projects, the average size and design of affordable dwelling units are approximately equal. These provide an opportunity to pool the data from these projects for analysis.

Project I is one of the largest affordable housing projects in the city of Harbin. Constructed in the center of a newly developed residential area, it is 10 kilometers away from the original downtown area. This project provides seven types of dwelling units for affordable housing, with a total building area of 69,800 m^2. It houses 1,256 low-income families with over 40% of them being rural-to-urban migrants. For Project II, the building area for affordable housing is only 4,900 m^2, which is much smaller than that of Project I. Located 9 kilometers away from the downtown area, it has six types of dwelling units that accommodates 95 low-income families, within which about 60% are rural-to-urban migrants. Project III is located much closer to the city center, being only 4 kilometers away. It provides four types of affordable dwelling units and houses 106 families, among which 53% are rural-to-urban migrants.

3 OBJECTIVE

The primary aim of this study was to better understand the space usage pattern and the environmental needs of the rural-to-urban migrants living in these affordable housing projects. The secondary aim was to provide corresponding design recommendations for future development based on study findings. This post occupancy evaluation was conducted in 2014 and included three phases: initial design analyses, neighborhood surveys, and semi-structured interviews. The first two phases were intended to identify the space usage problems and expectations of the residents. As a follow-up, the third phase was to provide recommendations for future projects in order to optimize space arrangement and improve quality of life.

4 METHODS AND RESULTS

4.1 *Design analysis*

Design analysis was conducted through systematic reviews of the original construction documents, to identify the basic information about projects such as locations, construction times, and design details. We also calculated the average dwelling size per unit and per person.

The three neighborhoods were designed and built in similar years and located in newly developed residential areas, which were several kilometers away from the city center. They were designed based on the same guidelines and built in similar city environments (Table 1). As shown in Table 2, although the building sizes and populations of these projects were different, the average dwelling sizes per household and per person were similar. What is more, the average usable area per household (37.20 m^2) and per person (12.37 m^2) were much smaller than the national affordable dwelling unit standard of 60.00 m^2 and 15.67 m^2, respectively. These results implied that the space might be too cramped for daily use. This situation might be partially due to the low ratio of the usable area in northern cities like Harbin where the weather was extremely cold in winter, and as a result, thick thermal insulation materials are used.

4.2 *Surveys*

Surveys were conducted to obtain information about the current living behaviors, needs, and existing problems from the rural-to-urban migrants who lived in these affordable apartments, and to gain in-depth understanding about the reasons for these problems as well as potential opportunities for improvement. Survey results were also used to guide the development

Table 1. Site plans and photos of study settings.

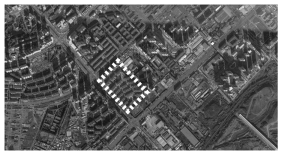
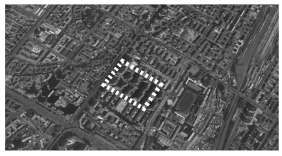
	Project I	Project II	Project III
Site Plan			
Photos			

Table 2. Basic information of study settings.

	Location	Year		Populations		Dwelling Sizes			
						Total Area		Average Usable Area	
	Distance from City Center	Design	Completion of Construction	House-hold	Resident	Total Building Area	Usable Area	Per House-hold	Per Person
Project	kilometers	year		–		m^2		m^2	
Project I	10	2010	2012	1,256	3,768	69,800	46,846	37.30	12.43
Project II	9	2008	2012	95	285	4,900	3,289	34.62	11.54
Project III	4	2009	2010	106	328	6,059	4,066	38.36	12.40
Total	–	–	–	1,457	4,381	80,759	54,201	37.20	12.37

inside the walls.

of the semi-structured interviews in the following phase. In each selected housing project, questionnaires were administered in person to 35 adults living in the affordable apartments, and researchers were present when respondents filled out the questionnaires and available for answering questions. Non-probability sampling and screening questions were used to recruit rural-to-urban migrants.

The questionnaire included seven sections organized according to spatial functions. It asked about respondents' opinions about and preferences for the space usage after moving into the affordable apartments, as well as their personal and social factors that might have influenced these outcomes. The usage efficiency of different functional spaces were addressed in the surveys. Also included was a set of questions about the residents' attitudes to certain facilities in the apartments. Most of the questions were developed by the China Architecture Design & Research Group, and several new questions were added by the researchers based on the specific construction and usage characteristics in Northeast China. The final surveys took 15–20 minutes to complete. After the survey results were collected, valid and complete surveys were included in analyses using Excel 2013. Descriptive statistics were examined.

Sample Characteristics. A total of 90 valid responses were collected, yielding a response rate of 85.7%. The sample included 41.0% of females and had a mean age of 48. The sample households had a mean family size of 3 persons. In terms of education level, 4.5% had Bachelor's or higher degrees; 28.9% was trained in and got the diploma from certain technical colleges; 18.9% had high school diplomas; 17.8% had middle school diplomas; and 29.9% had other types of lower education. The household incomes per month were diverse, with 22.2% in the 3,000 or more Chinese Yuan category; 34.4% in the 2,000–3,000 Chinese Yuan category; 31.1% in the 1,000–2,000 category; and 12.3% in the 1,000 or lower category. As for the occupation status, over 44.4% were unemployed; 30.0% were employed; and 25.6% were retired.

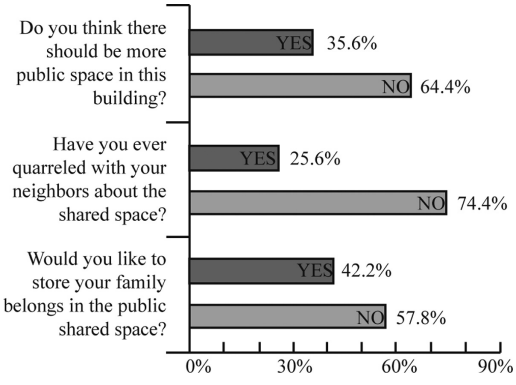


Figure 1. Percentage of respondents reporting opinions about public space in the affordable housing building.

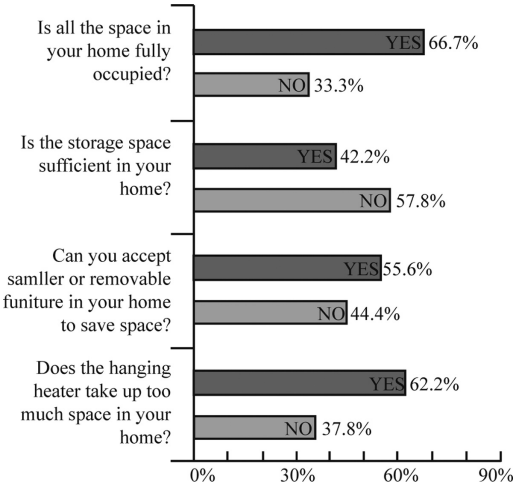


Figure 2. Percentage of respondents reporting general opinions about private indoor space.

Descriptive Statistics. The 34 questions were divided into seven sections based on functions, including two general sections for public spaces and private spaces, respectively; and five sections for specific functional areas including the living room, bedroom, kitchen, restroom, and balcony. In the first section about public spaces in general (Figure 1), 64.4% of the respondents reported there was no need to increase the area of the public spaces in the buildings; 25.6% reported they had quarreled with neighbors for reasons related to shared space; and 57.8% thought they could not store their belongings in the public space, such as public corridors Figure 2 shows results from the second section about private spaces in general. Because of the limited space, over 60.0% reported that all the space at home was fully occupied and there were no extra space to place more furniture or facilities. Only 42.2% considered the storage space to be sufficient in their apartments. About 55.6% would accept smaller or removable furniture because of the cramped space. Further, the survey asked for residents' opinions

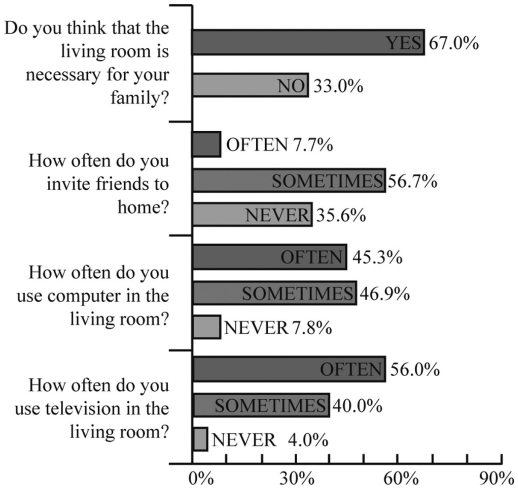


Figure 3. Percentage of respondents reporting specific opinions about living room.

about the steam heater hanging on the wall, which is more common than the underfloor heater and the air conditioner in Northeast China. Over 90.0% of the respondents thought the hanging heater took up too much space in the rooms and made the space more cramped.

In the third section about the living room (Figure 3), 67.0% considered the living room to be necessary for family daily use, but only 56.7% used the living room was to meet friends. Furthermore, 35.6% said they never invited friends to their living rooms after moving into the apartments. In more occasions, they used the living room for family entertainment. The percentage of respondents who used the computers and televisions in the living room was 92.2% and 96.0%, respectively. As for the fourth section about the bedroom (Figure 4), 49 out of 90 (54.4%) thought it would be better to provide floor-to-ceiling wardrobes in order to better use vertical space. In that way, a smaller floor area would be occupied to obtain the same storage volume. However, most of them (78.9%) did not like using bunk beds for saving space.

The fifth section is about the kitchen (Figure 5), which was considered necessary by most of the affordable households (92.3%). About 66.7% of the respondents cooked at home almost every day, and 25.6% cooked at home occasionally. When it comes to the space saving issues, more respondents (62.3%) preferred smaller refrigerators, which could be placed near the stove. Conversely, fewer people would like to use open kitchens and removable stoves to save space. This is probably because of the cooking habits in Chinese culture, which tend to produce heavy smoke from heated cooking oil. In the sixth section about the restroom (Figure 6), 57.8% of the respondents preferred having more space for storage. However, 68.9% of the respondents preferred pedestal pans for comfort although they occupied more space than squatting pans.

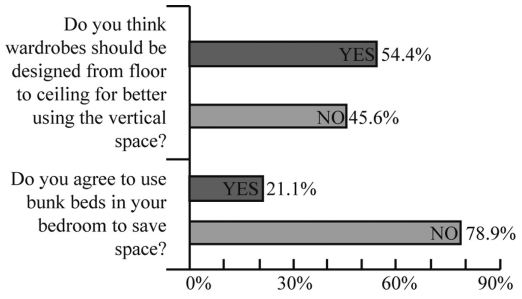


Figure 4. Percentage of respondents reporting specific opinions about bedroom.

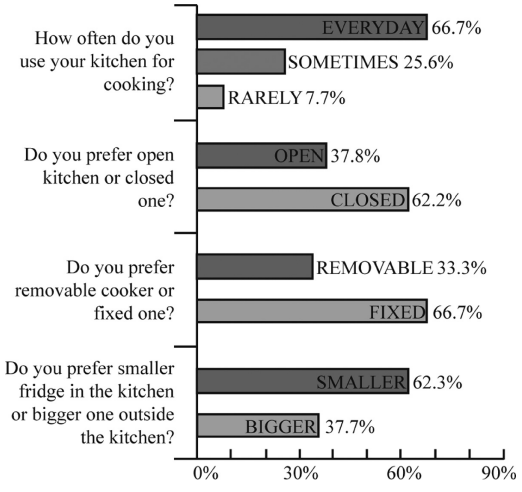


Figure 5. Percentage of respondents reporting specific opinions about kitchen.

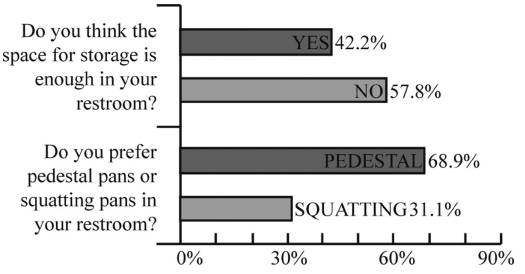


Figure 6. Percentage of respondents reporting specific opinions about restroom.

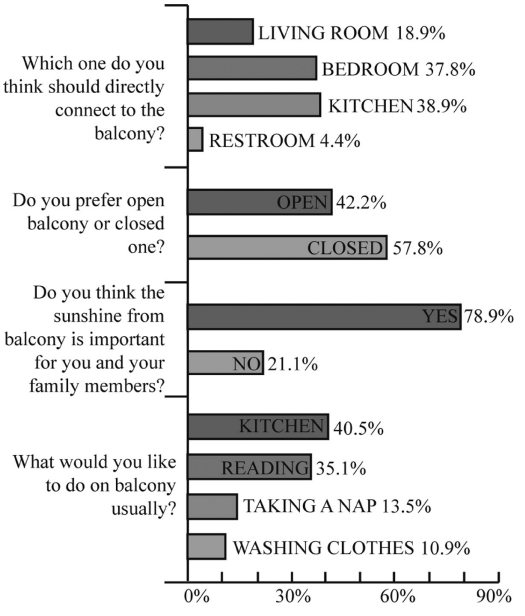


Figure 7. Percentage of respondents reporting specific opinions about balcony.

Figure 7 is the last section and focusing on the balcony. The percentage of residents who considered that balcony should be directly connected to the bedroom and the kitchen was 37.8% and 38.9% respectively, which was more than those who preferred direct connections between the balcony and the living room (18.9%) and the restroom (4.4%). In addition, survey participants preferred closed balcony (57.8%) to open ones (42.2%), likely due to the extremely cold winter in Northeast China. About 78.9% of the respondents thought that sunshine from the balcony was indispensable, and would like to do some reading or cooking there.

The survey results indicated two main problems about the current space usage: (a) the space for storage was not sufficient for most of the households; and (b) the space arrangement did not accommodate multi-functional usage. In addition, it also indicated several possible solutions for improving space arrangement, such as fully utilizing the vertical space for storage and integrating more extra functions to each room. These results were used to develop the semi-structured interview in the next phase.

4.3 *Semi-structured interviews*

Semi-structured interviews were conducted to gather further understanding about the space usage problems and the users' expectations based on results from the two previous phases. The researchers interviewed the residents according to the research protocol and recorded the conversations, drew the current layout of the dwelling unit, and took photos of the space arrangement and environment in the units. The interview protocol included 51 questions, which covered seven sections as those in the survey, and also addressed the three main problems found in the two previous phases. The interviewees were asked whether there were such problems in their apartments, and what they thought could be done to improve it for better quality of life. Content analysis was used to analyze the data from the interviews.

Nine subjects (five females and four males), with three from each neighborhood, were interviewed at their homes. One were over 60 years of age; three

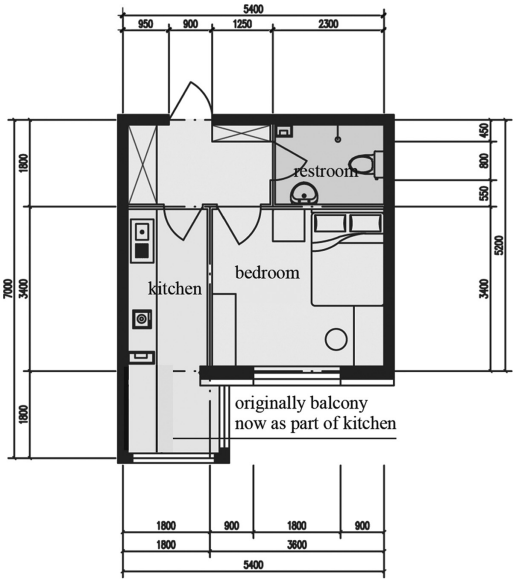


Figure 8. Improved arrangement to combine different functional spaces.

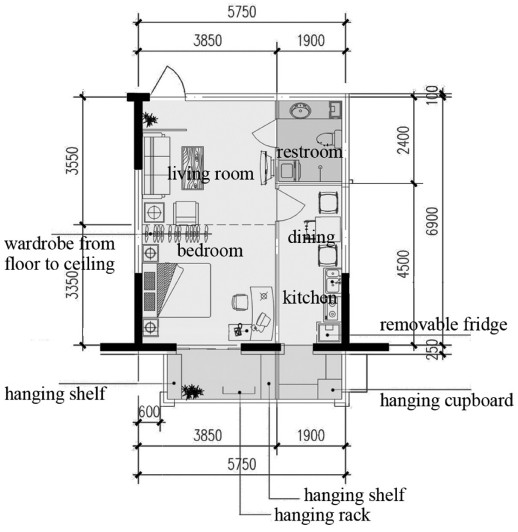


Figure 9. Improved arrangement to efficiently use the vertical space.

were in the 50-to-60 age group; three were in the 40-to-50 age group; and two were in the 25-to-40 age range. In terms of the family structure, three of the families consisted of a couple; one consisted of a son and an old father; three were composed by a couple and their single child; and the other two were composed by three generations including a young child. Residents' durations of living in the affordable neighborhoods ranged from one year to four years. The content analysis reconfirmed those common problems found in earlier phases such as the cramped space for family usage, shortage of storage space, and lack of accommodations for multiple functions in a single room.

Based on the results from this and other previous phases, several design recommendations were provided to solve the identified problems in terms of (1) cramped space, (2) limited storage space, and (3) lack of flexibility to accommodate multiple functions.

Recommendations for better usage of the cramped space. The majority of the participants reported that they could accept smaller furniture, appliances, and renovations of other facilities in order to cope with the cramped space of the affordable apartments. They identified many facilities at home that could be smaller, such as the sofa, table, and refrigerator. However, five out of nine interviewees said they could not accept smaller kitchen sink because of their cooking habits. Some respondents used removable furniture or facilities at home. Two of them used removable tables and chairs in their kitchens, and one young mother reported using a removable baby crib. Several participants indicated that they would like to use an underfloor heater rather than a hanging one to save space. What is more, some of the residents agreed to combine different functional spaces together to improve efficiency (Figure 8). For example, one of the participants connected his kitchen with the living room, so that he could have more space for dining; one older lady took out the wall between the balcony and the kitchen to gain more kitchen space.

Recommendations for increasing the storage space. All the participants indicated that full usage of the vertical space was one of the best solutions to increase the storage space. Most of them prefer wardrobes that fully utilize the floor-to-ceiling space in bedrooms, and hanging cupboards in kitchens. They also like the storage space in the background wall for television, which is a commonly used decoration in Chinese homes (Figure 9). Among the nine participants, six did not like the floor cabinets that can be used for both storage and sleeping, because many people thought sleeping on the floor without heating was not good for health. Further, few people would like to place their family belongings in the public space, outside their apartment, due to safety concerns.

Recommendations for multifunctional usage of the space. A majority of the participants used their rooms for mixed functions (Figure 10). Six residents used their bedrooms for both sleeping and meeting guests, and two put desks and computers in their bedrooms to make it study rooms when necessary. Some residents also used the balcony for other functions: three of them used the balcony as kitchen and dining areas, and one young lady used the balcony to wash and dry clothes. In a special case, one three-generation family put the baby crib in the living room, so that the living room became a temporary nursery. For such multifunctional usage, the size, scale, connection and orientation of the rooms should be taken into account while designing the dwelling unit. What is more, the arrangement of

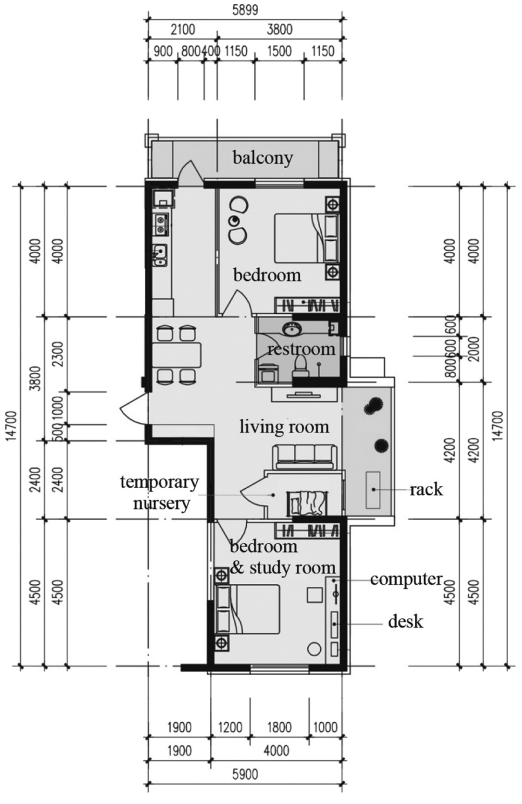


Figure 10. Improved arrangement to use the rooms for mixed functions.

the apartment should be easy for residents to change when necessary.

5 CONCLUSION

Despite the important and informative findings, this study has several limitations. First, a non-probability sampling was applied in the survey, and the results may not be representative of the study populations. Second, the sample sizes for both surveys and semi-structured interviews were relatively small. Third, the analysis in the paper was limited to descriptive analysis and content analysis, and did not explore the impacts of multiple factors on people's satisfaction or quality of life.

Despite these limitations, this research provides insight into the space usage patterns as well as residents' needs and expectations for the affordable housing in Northeast China, with a special focus on the understudied population of rural-to-urban migrants. This is an important yet understudied area with significant design and policy implications. The results provide evidence for possible improvement of spatial arrangement in future affordable housing projects. The post occupancy evaluation reveals three main problems about the space usage, including (a) the space being too cramped (mean usable floor area = 37.20 m^2) for the household (mean size of = 3 persons/household); (b) the storage space being insufficient and the vertical space not being fully used; (c) the space arrangement not accommodating multifunctional usage. Further, the findings also reveal several possible solutions for these problems that can better meet residents' expectations.

The multiple-methods applied in post occupancy evaluation research prove to be informative. Results from different methods can be triangulated, and information from one study phase could become the foundation of the next. For example, the design analysis of the selected projects provided extra support for the analysis of the survey results. Furthermore, the interview results helped provide recommendations for problems identified in the survey phase. Future studies should consider multiple methods when possible, and employ multivariate analyses to examine the impacts of personal characteristics and diverse design features on residents' satisfaction of their living environments and equality of life.

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Permanence to allow change. The archetypal room: The persistence of the 4 × 4 room

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ABSTRACT: Nowadays, the permanence of architecture is challenged as inhabited spaces become obsolete at an increasingly rapid pace. This obsolescence is mainly due to the fast evolution of ways of life, construction techniques, and aesthetic codes.

Instead of trying to meet point by point those fast changes, another way to address obsolescence would be to consider what is not subject to change in the short term.

Through architecture history, traditional housing types convey a sense of permanence. Through their constant improvement process, types leave aside contingent elements only to retain the essential. This sense of permanence can be traced in early domestic manuals as well as in the housing studies carried out by the Italian school of typology.

In all those housing types, the plans display at least one room encompassing a 4 × 4 meter surface. The permanence of such a room is interesting as it allows functional, technical and aesthetic variations. As such, it allows societal variations and can be a lever for future design.

1 INTRODUCTION

1.1 *A world of changes*

We live in a world of constant changes. Those changes affect the inherent characteristics of architecture. Indeed, as well as various consumer goods, inhabited spaces become obsolete at an increasingly rapid pace. This obsolescence is mainly due to functional, technical and aesthetic transformations. First of all, ways of life evolve at a rate that has never been experienced in human history. Social as well as family relationships have never been as diverse as they are today. Secondly, construction techniques are evolving rapidly. What seems to be forefront construction materials and building technologies are outdated even before being implemented. Finally, aesthetic codes do not achieve more stability as yesterday's fashion is already outdated today.

To address those changes, one could try to meet them point by point (Ledent 2015). But several difficulties emerge regarding that approach. Firstly, it is almost impossible to address those changes simultaneously. Secondly, architecture requires time. By the time a building is built, the changes it was trying to address are already passé. Finally, the changes themselves are ephemeral. Hence, anything that seemed to be relevant one day is soon outdated.

1.2 *Archetypes and contingencies*

For all these reasons another way to address constant change would be to consider what is not subject to change in the short term. In that sense, a distinction must be made in architecture between what is permanent – archetypes – and what is changeable – contingencies. On the one hand, archetypes are defined as the resilient and slowly evolving features of architecture. They are the underlying principles of architecture. On the other hand, contingencies tend to change according to transitory cravings. They are the superficial features of architecture, as they experience a quicker depreciation in time. Consequently, any kind of architecture relying too much on the latter would expose itself to a swift obsolescence.

Archetypes give insight into how to address constant changes in our societies. Indeed, by nature, archetypes display permanent features, beyond change. Therefore, they allow for secondary variations on a functional, technical and aesthetic level.

1.3 *Domestic architecture*

The question of resilience in domestic architecture is particularly relevant since it is by far its most important production in terms of quantity.

Traditional housing types exemplify the permanence of archetypes. The interest of such building types lies in their very nature. Indeed, the most prominent characteristic of a type is that it is the result of a long and constant sedimentation process of uses and techniques in order to attain the quintessence of local dwelling needs. Therefore, through their constant improvement process, traditional types leave aside contingent elements to retain only the essential, the underlying structure of housing.

In order to best illustrate this, domestic treatises as well as typological analyses are examined.

1.4 *The archetypal room*

Within those domestic archetypes, the room stands out as a resilient feature. Being the smallest dimension in the human dwelling, the room can be considered as the core on which the principle of resilience can be tested.

2 DOMESTIC MANUALS AND TREATISES

Domestic treatises provide a good overview of how housing was thought but also built and inhabited through history. Indeed, even though those treatises claim to be theoretical, they are always based on real cases. Hence, treatises provide a wealth of information on dwelling constitution as well as local uses and social statuses.

For the sake of a framework that is generally representative of housing history, three treatises are examined: Serlio's, Le Muet's and Durand's. The sample selected stretches over a long period of time (four centuries), and has had a tremendous influence on domestic architecture all around Europe. Moreover, all three are richly illustrated.

In order to examine the persistent characteristics of the room constitution, the attention is drawn to the smallest abodes displayed in the three treatises. Indeed, starting from the premise that the archetypal room is a resilient feature of all dwellings, the smallest dwellings must display at least one such room. Moreover, in many cases, those minimal dwellings form a basic layout from which all other housing arrangements seem to emerge.

2.1 *Serlio, Sesto Libro d'Architettura*

Sebastiano Serlio's treatise is particularly significant since it is one of the first architecture books based on illustrations rather than text. Compared to other treatises of the time, his work can therefore be regarded as an illustrated architectural manual. More importantly, Serlio depicts the houses of the poor unlike his forerunners who believed such dwellings did not require any expertise in art (Rosenfeld, 1978).

Two kinds of building plans are displayed in Serlio's treatise: country and urban dwellings. Among them, the smallest country dwellings display a similar floorplan: two adjoining rooms with a front porch surrounded by a garden. Those dwellings demonstrate a series of differences in the construction techniques (wood vs stone), number of floors as well as a risen ground floor.

In his depiction of the plan, Serlio writes about a main room – *stanza* – accommodating the household. Its dimensions vary from 10 to 13 *piede* (3.5 to 4.5 meters, the Venice *piede* being equal to 0.35 meter). Alongside this room, a secondary chamber can be found, housing either a stable (for the *contadino*) or a kitchen (for the *artefice*).

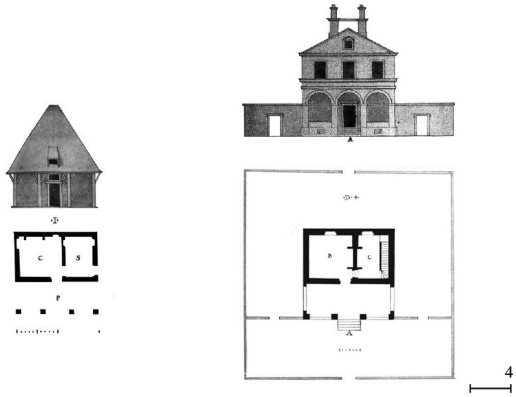


Figure 1. *Casa del povero contadino* and *del povero artefice*.

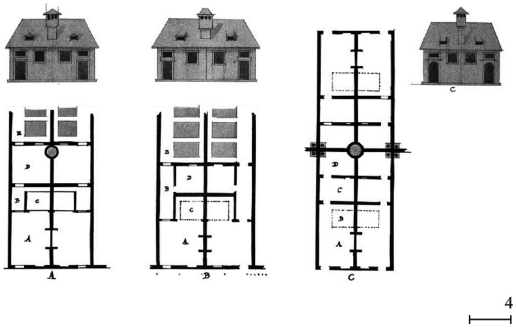


Figure 2. Casa del povero artifice nella citta.

The smallest urban compositions present three double or quadruple row houses of two storeys. Serlio explicitly mentions the fact that they are drawn from real-life examples. Those craftsman houses are located far from the city plazas and places of nobility. They are deep and narrow and are built between two vertical party walls. They all display a main room on the street side with a contiguous sleeping alcove. In the depth, various arrangements can be found with a well, a courtyard and sometimes a vegetable garden.

By definition, urban conditions entail some kind of dwelling congestion. In this case, the houses are stacked alongside the roads. Hence, the width of those houses is crucial in order to provide as many abodes as possible within the city walls. Interestingly, the smallest houses illustrated by Serlio have a width of 10 to 12 *piede* hence, approximately 3.5 to 4.2 meters. Referring strictly to the Italian author, this seems to be a width below which organizing a proper dwelling seems difficult.

The depth of the minimum country houses is equivalent to the width of the urban houses. Those dwellings being the smallest, this gives an indication of the minimal dimension of the room. More interestingly, all the layouts display at least one square room whose sides are equivalent to this depth/width. Hence, all designs display a 4 × 4 meter room. Serlio refers to this room

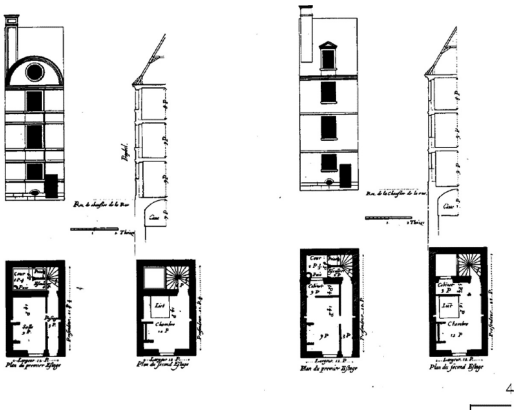


Figure 3. Le Muet, *Première place* and *Deuxième place*.

as the *stanza*, the multifunctional family room of the time. It is a place for family gathering, eating as well as sleeping.

In addition to its size definition, the *stanza* does not present any systematic design in terms of openings or technological means. Indeed, the number, the size and the placement of the windows and the doors are different from one version of the treatise to another. Similarly, the positioning of the hearth varies from one version to the other. Hence, the topological configuration of the room seems to prevail on formal or technical contingencies.

2.2 *Le Muet, Manière de bien bastir pour toutes sortes de personnes*

Analogously, the book published by Pierre Le Muet in the 17th century can also be referred to as a housing manual. It displays various designs for town dwellings that range from very narrow houses to large palaces. They are classified according to *la place,* the width of the lots they occupy.

The first two drawing boards display multi-storey houses. They are set on a 12-*pied* wide plot (4 meters, the French *pied de la toise de l'Ecritoire* being equal to 0.33 meter). Both designs present a combination of interior rooms with a backyard. The staircase is not included in the interior spaces but it is placed at the rear of the dwelling. It can then be accessed through a corridor on the ground floor. This disposition enables the rooms on the upper floors to have a maximal width of 12 *pieds*. The main difference between the two houses can be observed in the depth of the lots that vary from 21.1 to 25 *pieds*. In the deeper design the additional depth is occupied by an additional *cabinet*.

The *première place* proposes one room on every floor of the house. Its size ranges from 9×14 *pieds* (3×4.6 meters) on the ground floor to 12×14 *pieds* (4×4.6 meters) on the upper floors. The *deuxième place* displays comparable rooms to which a narrow cabinet has been added on the side of the courtyard.

Interestingly the same remark applies to both Serlio's urban houses and this case. Indeed, Le Muet does not present any housing design for an interior width of less than 4 meters as if it was a minimal width to conceive a proper dwelling. Once again too, the houses display at least one room encompassing a 4×4 meter surface.

2.3 *Durand, Partie graphique des cours d'architecture faits à l'école royale polytechnique*

In the early 19th century, Jean Nicolas Louis Durand had a tremendous influence on architecture through the publication of his *Recueils*, his *Precis* as well as his *Leçons*. In his books, Durand presents a systematic and rational classification of buildings and building elements. As such, Durand's illustrations were meant to serve as design examples, as a generative typology.

Among the various building patterns displayed in Durand's illustrations, the *maison à neuf cases* stands out as a prototype of a generic house. It is illustrated both in the *Leçons* and the *Precis* where the French author presents various alternatives of the house with different construction techniques. While the exterior appearance of the building varies from one construction technique to the next, the floor plan always remains identical.

The house is designed as a two-storey high square composition with a risen ground floor. The plan is very plain. It displays a nine-square grid drawn on a 4 meter pattern presenting two different sizes of rooms: 4×4 and 4×8 meter rooms. The rooms are arranged according to an *enfilade* principle. No corridors can be found as all rooms are directly accessed from the neighbouring chambers. The composition is very regular and symmetrical. All openings (windows and doors) are equivalent in size, around 1 meter, the sole exception being the front door which is slightly wider. The openings are arranged in one line centered on each room. Minor differences can be found between the *Leçons* and the *Precis.* These relate to the proportion of large/small rooms and the presence of a staircase.

Interestingly, in this theoretical exercise, Durand focuses directly on the 4×4 meter room as the basic module for designing his house. The spaces have no predefined function as if that pattern was able to shelter any kind of program.

2.4 *Resilience*

This analysis highlights the resilience of a 4×4 meter room in domestic treatises. It can be regarded as a basic feature of housing design. In addition to this resilience, this room is remarkable in three other respects.

Firstly, in terms of dimensions, this particular room is able to accommodate any kind of living needs from the polyvalent family room – *la Salle* or *la Stanza* – to bedrooms … No exclusive functional determinism can be found in this layout.

Secondly, it does not seem to be affected by construction technologies as Durand's proposal clearly exemplifies.

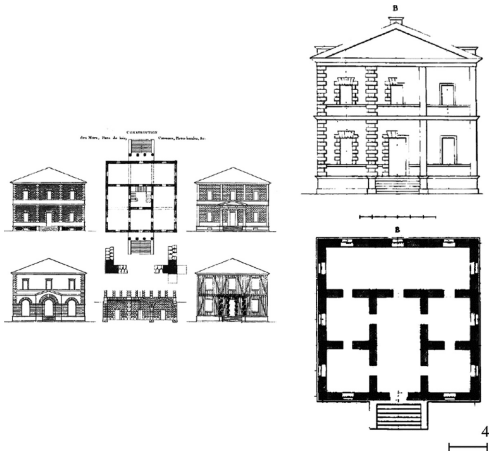


Figure 4. Durand, *La maison à 9 cases*.

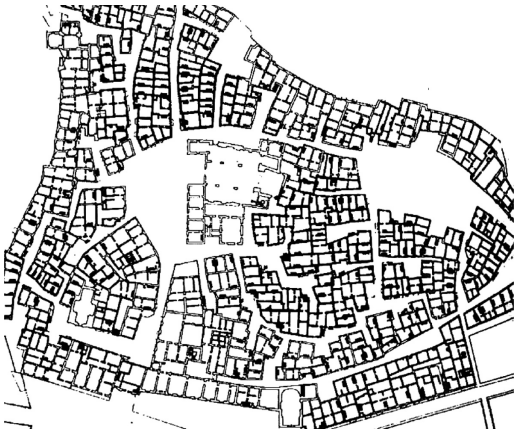


Figure 5. Polignano a Mare, survey by Caniggia and Maffei.

Thirdly, the openings – doors and windows – or any kinds of artefacts that might possibly influence the looks of the space are very diverse. They do not seem to guide the layout of the room.

Hence, this room appears to be a permanent feature able to accommodate variations on a functional, technical or formal level. On this basis it can be regarded as a genuine archetype.

3 THE ITALIAN SCHOOL OF TYPOLOGY

Even though domestic treatises are rooted in empirical studies, they remain theoretical. Hence, another way to analyze domestic types would be to look into what customary domestic architecture has produced in practice. In our western societies, it is generally acknowledged that vernacular types have ruled upon the production of domestic architecture until the 1920's with the advent of modernism. Arguing for a *tabula rasa*, modernist architects tore apart the conventions of the traditional types along with the qualities that local experience had carefully stored in them over the centuries.

Authors such as Amos Rapoport or Ulrich Doepper have explored the scope of vernacular architecture quite thoroughly. But although their analysis is richly documented, it is not systematic. Conversely, the Italian school of typological studies based on Saverio Muratori's method was the first one to carry out a systematic analysis of traditional housing types. Although initially limited to the Italian peninsula, they provide a good overview of the constitution as well as the genesis of traditional housing types before modernist architecture.

3.1 *A method*

Saverio Muratori's method relies on an analysis of manmade artefacts in order to extract its principles of behaviour, formation and alteration. Those principles define the inherent characteristics of each manmade structure. Bringing to light those principles is essential as they act as a reference system for any socio-cultural environment. Muratori and his successors pay specific attention to the traditional and most common building fabric. Unlike the Nolli plan, they do not limit themselves to monumental architecture.

Once those principles are revealed, they can be a keystone for future design. Instead of introducing alien ideas as the modernist movement did, the typological method proposes to design as a continuous interpretation of what already exists. This method presupposes that any architecture project could be closely linked to a prior and thorough typo-morphological analysis.

3.2 *Caniggia, Maffei, Lettura dell'edilizia di base*

Gianfranco Caniggia and Gian Luigi Maffei continued the analytical work started by Muratori. Their book, *Interpreting basic building*, tries to shed light on the immanent laws of the creation and development of manmade structures on various scales: building, city fabric, town and territory.

The focus of this paper will only be on the building scale. According to Caniggia, the major shift caused by modernism can be traced into the way it proposes to understand and produce buildings. He makes a simple distinction between buildings and architecture. On the one hand, buildings constitute the general and anonymous built context. Caniggia refers to buildings as a spontaneous production. Buildings are artefacts erected without the builder having to think twice. As such they are frequently disregarded by scholars. On the other hand, architecture relates to specific emergences. They are signed buildings usually commissioned by the ruling power (e.g. the detailed buildings in Nolli's plan). However, with the advent of the modernist movement, this distinction is no longer meaningful since all buildings are considered as possible emergences. The Italian theorist proposes hence to constrain those emergences and produce buildings that relate to the continuity of typological processes.

The analysis of the creation and development of building types carried out by Caniggia is both syntopic

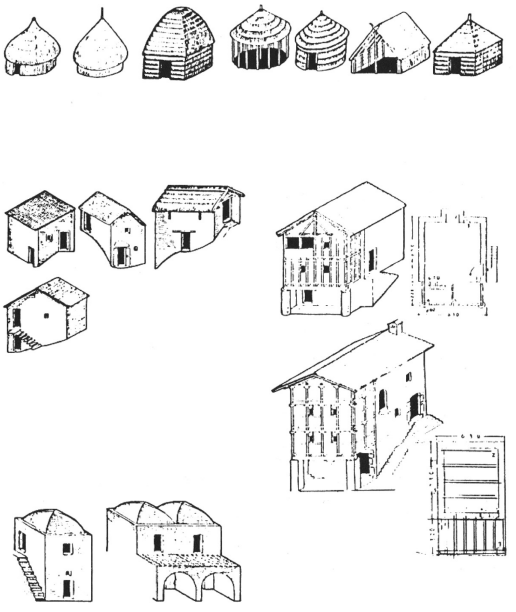


Figure 6. Basic types.

as diatopic as they are found in Florence, Rome and Genoa with comparisons with Como and Milan. The Italian author tries to understand the genesis of local types through a systematic study of ancient building fabrics.

Among basic buildings within the city, the row house – *casa a schiera* – is the most common building type. As such, it can be regarded as a less personified roman *domus*. In their analysis, the authors trace back the origin of the row house to a common root, the mono-cellular dwelling house. This basic root can be considered as the *foundation matrix of the typological process* (Caniggia and Maffei, 2001).

The origin of such mono-cellular dwellings is the elementary cell (e.g. the night shelter in the pastures). Remarkably, this basic cell can be considered a genuine and complete dwelling. Hence, it can by definition accommodate all human needs on a functional, technological and formal level. Indeed, it is able to shelter the functions of family life; provide the dweller with a protective and steady construction; and produce the image of what is acknowledged as a dwelling in the collective consciousness.

Based on this assumption, Caniggia presents the evolution of urban housing in Florence Rome and Genoa as an evolution of this elementary chamber. According to the Italian theorist, this elementary cell can take various forms but always presents a surface of around 25 square meters.

Yet, looking closely at Caniggia's drawings, two elements can be noticed. First of all, the grid on which all the dwelling evolutions are analyzed is a 5 × 5 meter grid. However, all the dwelling walls are drawn on the inside of the grid. Assuming that such a party wall is about 30 cm, the dimension of the basic cell is 4.7 × 4.7

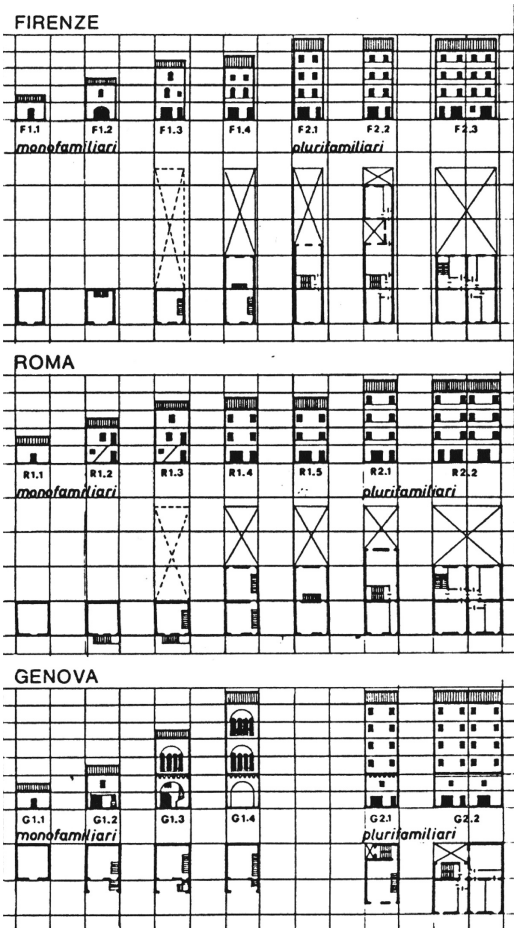


Figure 7. Diachronic mutations of the basic type.

meters in Rome and Genoa while it is 4 × 4.7 meters in Florence. Moreover, in the multi-floor dwellings, the position of the staircase reduces those dimensions by the width of a flight of stairs. In such dwellings, the average width of such a flight of stairs is approximately 70 cm. Those stairs are placed either perpendicular or parallel to the street, reducing the size of the *sala* to a minimal 4 × 4 meter surface. In that regard, the specific analysis of Florence conducted by Caniggia (Caniggia, 1994) adds to the validity of this observation. The *casa a schiera* is presented as an evolution of the *corte-schiera* that displays a minimal distance between the centers of the party walls of 4.5 meters.

3.3 *Resilience*

Once again, looking at the smallest dwellings, the 4 × 4 meter surface seems to be a constant.

Interestingly, the traditional types exposed by Caniggia have survived and are still inhabited today. More interestingly, none of them are occupied the way they used to be a century ago. Indeed, ways of life have evolved, technological knowledge has developed, and tastes have changed. Yet, thanks to their polyvalence,

those dwellings have passed the test of time. Hence, they have proven to be genuine archetypes.

As is the case with the examples exposed by the Italian school of typological studies, the same applies to various types around the world. Traditional building types, through their constant improvement process, allow inner variations on three levels. Firstly, they permit secondary alterations on a functional level. Types do not respond unilaterally to function. On the contrary, they display topological interactions rather than functional ones, syntactical associations rather than semantic ones. This characteristic has allowed local types to be reinvested throughout the ages with new functions or other ways of life. It is the case, for example, with the traditional Dutch *herenhuis*, or the Belgian bourgeois row house of the turn of the 20th century.

Secondly, types allow transformations on a technical level. In most traditional types, structural or technical issues are dealt with genuine architectonic means and not with technology added to the building itself. That is the case, for instance with the *haveli*'s wind pavilions in Jaisalmer, where natural cooling is comprised within the genotype of the house.

Thirdly, types enable evolutions on a formal level. In that regard, traditional European housing types do not command the building's exterior appearance. For instance, Riga's traditional 19th century housing revolves around the same floor plan with a high variety of façades distinguishing the city for its *Art Nouveau*'s identity.

4 CONCLUSION

In a world of constant revolutions, instead of dealing with them directly, a new paradigm could be sought: addressing resilience. This resilience states that the permanent structures of architecture work as a framework (Leupen, 2006a) within which change can occur. This approach can be paralleled with other disciplines such as anthropology or linguistics that claim that deep structures of human behavior exist allowing for cultural or temporal variations.

In the field of architecture, those deeply rooted structures are called archetypes. Archetypes can be regarded as a *degré zero* of architecture. They form a resilient frame within which change can occur on a functional, technological and formal level referring directly to the three founding principles of Vitruvius. Moreover, this resilient frame can also accommodate variations on an individual level, allowing for personal interpretations.

To comprehend those archetypes in the specific sphere of domestic architecture, time-tested housing designs have been looked into through the study of several treatises and typological analyses. The choice of domestic manuals and traditional types is no innocuous exercise. Indeed, by definition, both leave aside contingent elements to retain only the essential. Hence, they are particularly relevant in the light of a quest for archetypes. Interestingly, the examples explored revolve around a basic dwelling cell encompassing a minimal surface of about 4×4 meters. The permanence of such a room in the smallest abodes demonstrates its necessary presence to sustain human dwelling needs. But this permanence also reveals its capacity to accommodate changes on various levels since those designs were able to pass the test of time. As such, this archetypal room can hence be considered as a key element for future sustainable housing designs.

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Versions of collectivity in housing architecture: From the modern to the post-human

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ABSTRACT: Today, collectivity is projected as a key notion in order to cope with an increasing scarcity in an era of multileveled crisis. In such context collective modes of life are suggested as a means towards economical adequacy, environmental sustainability, social solidarity and political request, a tendency that has explicitly affected architecture. In this paper, the ways that architecture of housing realized collective living, as well as the correspondences between meanings of collectivity and forms of housing, are examined. Through a critical overview of emblematic architectural examples from the Modern to contemporary times, an investigation of the social and political function of collective housing, mainly in our era, is aimed.

1 INTRODUCTION

An inherent attribute of our era is a new understanding of the relationship between the individual and the social – in the field of spatial concerns translated as the relationship between private and public space – which is based on two simultaneous transformations: on the shrinkage of the social and the public, as well as the expansion of the individual and the private, to the intermediate quality of the collective. In this sense, the collective has been projected as the new realistic and acceptable version of the social and the public, while at the same time receiving contents and meanings of the individual and the private in a framework of pursuit of a multi-leveled sustainability (Ibelings 2009, Lootsma 2009). Despite the apparent paradox of this widening of the collective, it is a fact that our contemporary world seems to be structured of communities instead of societies, and groups instead of individuals (Jameson 1991).

In this climate, a renewed interest on collective housing is revealed in the last decades. Collective housing, in its literal sense, has marked the era of the socialist transformation, in an attempt to cope both with the housing crisis emerged due to migration to the cities and to construct the new subject of the new society. In the Western world, after a retreat of mass housing architectures in favour of the private house and the suburbanization, which accompanied the elimination of the welfare state (Cupers 2014), collective housing reappears in the period of neo-liberalist capitalism suggesting contemporary ways of common living. The shift from the private house to collective housing is related to a displacement of interest from the individual to a more collective unit, the group. However, such reposition of interest does not seem to imply a retreat of the contemporary individualism in favor of collectivity, in a sense of a reinforcement of the social and the public over the individual and the private, given that individualism is a key of the postwar Western culture (Bauman 1997).

While collective housing has been an architectural suggestion of urban dwelling from the industrial era to our times connected to common living, the certain kinds of implied collectivities, in terms of proportioned junctures between the social and the individual, differ from time to time and type to type. In this paper, I examine the evolution of collective housing from the Modern movement to the contemporary architecture seeking a critical interpretation. Through analysis of emblematic architectural examples and consideration of the context where they have been created, I ask how collective housing architectures dealt with the concept of collectivity in the course of time and especially what is on stage now. Notwithstanding, the examination of the ways in which architectural design managed collectivity is an issue related to the socio-political relationship between space and subject.

Views and ideas are not independent from historical condition and everyday living, and the formation of the relationship between the individual and the social, the private and the public, is related to the ways that people were organized in social entities and performed their living practices. This provided, I am going to examine collective housing in response to the process from the creation of mass society in the late 19th century towards mass democracy of the 20th century second half and the nomad culture of our days, while architectural discourse will provide our study with the ways that the architectural phenomenon was being understood in each period.

2 CONNECTIONS BETWEEN THE INDIVIDUAL AND THE SOCIAL: THE COLLECTIVE SUBJECT

The relation of the subject to the collective quality is one of controversy and disagreement, ranging between a Liberal inherent individualism and a Marxist social human being in the course of Modernity and Postmodernity. The next lines will shed light on this issue.

In bourgeois society of 19th century, the individual was considered as a self-regulated, autonomous entity, though identified in reference to the social norm through the process of labour. Proceeding to mass society in 20th century and the civil society of today, the individual is increasingly separated from the social as a whole, and individual autonomy is considered as an end in itself and acknowledged on the basis of its nature rather than through the possession of social attributes (Kondylis 1991, Sennett 1974). Such subjectivity is based on the extremely individualist end of self-realization released from any external bond, but at the same time is constituted through the embodiment of the Symbolic other and the social externality. While Psychoanalysis and Critical Linguistics uncovered the reality of a decentred subject, which is incapable to be determined by itself (Romanos 2002), socio-political conditions contributed to the transformation of the relationship between the social and the individual.

As long as technological progress has achieved an increase in production, an extended consumerism audience could be searched within a mass of equals, which means that the consumerist mass society needed democracy in order to be legalized (Kondylis 1991). The emerged legal equality of people in mass democracy acknowledged individuality as based on sentiments, emotions and instincts, as well as on the claim for their satisfaction, while society and the state were charged to provide the individuals with the necessary goods and services for the realization of their individuality. Today, while self-realization still characterizes the relationship between the individual and the social, we face a generalized decline of the social and its subject, the society, and the transfer of their responsibilities to the individual being the only referent to its own life. A great plurality of groups, which emerged after the retreat of the national state, provide fields where the individuals participate temporarily and locally in a process of multiple identifications, instead of carrying heavy and stable identities. Instead of implying a moral retreat of individualism in favour of the common good, this political exaltation of the group and the collective represents an alternative possibility which substituted the historically convicted politics of a social totality connected to the economic dimension and the production system (Jameson 1991).

The collective subject has been shaped hand in hand with an increasing radicalization of individuality, which resulted in the end of separation between the public and the private realm and the creation of a secondary reality through marketing and advertising (Ellin 1999). In such context, the destruction of a reasonable distance between the private and the public life led to the withdrawal to an increasingly expanding private zone, and was related to the 'human, all too human' everyday discourse, contributing to the elimination of the Political (Lipovats 2002).

From another point of view, in bourgeois society the collective subject has been identical to the family, which was considered as the political unit and was well articulated in the social structure, functioning as a parameter of a stable self-identity and reserving a supportive significance for the status quo. In the course of the industrial, technological and informational era, the collective subject has been shifted from the family to the social movements and the groups of any kind. In this context, while the postmodern collectivity was of a hybrid nature which allowed to simultaneous references to both individual and the social, the modern kind of group collectivity introduces neutrality as the escape route of any enchaining individual fixation and social commitment (Jameson 2005).

Indeed, the Lacanian Real acknowledged the non-representable as a possibility towards the New (Zizek 1989). Such exception from the Symbolic, which provides meaning to our action and practice, opens a desirable perspective towards freedom, a creative perspective against the iron cage of cultural and social framework. Since the Real can not take place in institutional public space where the dominant versions of reality are represented, it seeks spatialization to brief, liquid, spontaneous, unorganized, void versions of publickness, which break away with any power meaning. The contemporary turn to micro-narratives, micro-politics and micro-economies found spatial correspondence to urban segmentation and dismemberment (Knox & Pinch 2006), and the modern emphasis to collective space – instead of the public space – belongs to this evolution. Collective space is a response to such orientation of our era and seems to adapt a double, contradictory political role supporting both the modern, radicalized pursuit of freedom and the dominant, decentralized system of global networking. In this context, collective housing appears in multiple formations ranging from politically radical to socially conservative spatial groupings, while it also includes both nostalgic and innovative forms of togetherness.

Architecture as a socio-cultural field is intertwined with ideas and conditions, expressing and influencing life modes and practices. In the next chapter, I examine collective housing from the Modern to our era, searching for the meanings and significations of suggested modes of communal life, as well as for the ways with which collective housing responded to the transformation of the relationship between the private and the public in the course of the time.



Figure 1. Collective space and creation of community.

3 HOUSING ARCHITECTURE AND THE COLLECTIVE: A CRITICAL OVERVIEW

In the same manner that prisons are indicative of the cultural level of a society, one could say that housing offers a valid manifestation of the levels of publickness, sociability and openness of a society, in other words of the relationship between the individual and the social. The ways that the individual and the social are each time perceived in relation to each other, significantly specify the architectural variations in which the relation of private and public space acquires meaning as antithetic or complementary, aggressive or conciliatory, pure and clear or blurred and fluid. In this sense collective housing as a place of direct coupling of private life with the social level has been variably formed both in its historical presence and contemporary production (Figure 1).

Although collective modes of life can be traced back to the utopian settlements of the early 19th century, collective housing has been socially connected with the Soviet Constructivism's architectural movement (Cooke 1990, Fernades et.al. 2013). As long as architecture was expected to contribute to the construction of the new world, the new subject had to dwell new spatial types against bourgeoisie's bonds to the family and the single house (Teige 1999). The Narkomfin Building in Moscow, a large scale construction with individual minimum duplex apartments and collective facilities, represented the new aesthetic of a social condenser which would embody avant-garde in the everyday life. Since such housing model contradicted the inhabitants' need for more individual space, alternative typologies suggesting linear arrangements of separate houses for each household were conceived (Bliznakov 1994).

Modern architecture was oriented to mass society, while interior space and ergonomy seemed to be indifferent about the subjective time and the individual histories of the inhabitants, aiming to destroy the bourgeois individualism. Inspired by the communal dwelling typology, Le Corbusier developed a housing type of common living, which resulted in the Unités d' Habitation buildings (Frampton 2001). Marseilles Unité, considered to represent collective housing's approach of Modern architecture in the Western world, was articulated in up-going and down-going interlocking apartments on the sides of five superimposed internal streets, included 337 apartments ranging from units for bachelors and childless couples to those for large families, while a series of social services were also accommodated within the building (Frampton, 2002). Irrespective of its influential sources, the Unité's subject enjoyed privacy and family, while the suggested collectivity was accomplished through urban groupings of individual and collective activities protected within the building, in the form of an association bounding together the inhabitants of a small village (Jencks 1973). Despite his theories on the urbanization of the architectural scale, as expressed in the relocation of the traditional city's street corridors within his houses or in the integration of urban uses within the building, Le Corbusier was critiqued for failing to conceive of urbanism in terms of public space, as he replaced the contingent urban scenery with an intensive geometric technology resulting in a subjective incorporation (Hight 2009).

Opposed to the Unité, Smithsons involved housing in the pursuit of a collective way of life in terms of human association (Smithson 1968). Their suggestion, regarding the urban organization, of the categories of the house, the street, the district and the city and their realization at the Golden Lane project denoted an attempt to advance the urban environment through architectural enforcement of social cohesion and community life. The integration of the streets-in-the-air, where all the family apartments opened, in the residential complex revealed a conception of the private in convergence with the urban. In such view, the public quality granted its primacy to the collective. In specific, against the isolated 'Unité' and 'neighborhood' communities, Smithsons envisioned a collective space with full urban qualities, the shaping of open, urban communities.

Inasmuch the Modern nexus between the collective and the urban quality seemed to be unsuccessful in constructing collectivity in propinquity to the social-public body, Aldo Rossi searched for the lost meaning of the building corridor in order to enhance interpersonal relationships and rescue architecture from the whirl of individualism and consumerism. Gallaratese housing highlighted the corridor typology of the 19th century Milan apartment block, in order to symbolize the varied interpersonal relationships in a life mode occurring in everyday sequence (Frampton 2007, Weston 2004). Aiming to take up the beginnings of Modernism again in order to overcome the functionalism of the International Style (Klotz 1988, Hays 2009), Rossi's phenomenology introduced the corridor as a place of everyday experience where inherent accumulated memories and meanings would be released between the inhabitants.

At the level of interpersonal relationships, though in a different sense, collectivity has also been pursued

by Structuralist architects. While Phenomenology acknowledges interiority over exteriority and, thus, subjectivity over the external world, Structuralism perceives the subject as part of a signifying unified system where it can nevertheless develop its own identity (Gelernter 1995, Hays 2000). The architectural translation of such approach of reality was the consideration of space in terms of structural relations among its elements, which prioritized intermediate areas and collectivity over privateness and publickness. As long as a specific area in a building, settlement or the city, acquires its meaning in relation to the adjacent areas and its position within the spatial structure, there emerge multiply identified areas where differentiated and even antithetical qualities come together. As Aldo van Eyck highlighted, the very essence of the twin phenomena is in fact complementary, not contradictory (Hale 2000: 157). In this sense, the stairways in the residential complex Documenta Urbana in Kassel acquire the public quality of a vertical street being suitable for accommodating everyday meetings of the neighbors, while intermediate spaces created through the double entrances to the private apartments bring together both private and common space qualities.

Another aspect of the structuralist approach in architecture of collectivity refers to the user participation in the shaping of space, as was the case with Hertzberger's Diagoon Housing in Delft, Lima Housing in Berlin or the Central Beheer Office Building in Apeldoorn, where common actions and decisions of the inhabitants gave identity to the neutral areas integrated within the built whole (Hertzberger 1991). In terms of flexibility, and in a more mechanistic way, participatory design in housing was found in John Habraken's (1972) theoretical claims for the separation between 'supports' and 'infills' of the building, where the differentiation between the act of building and the process of dwelling guaranteed uniqueness for the individual units without giving up the idea of the collective. Such considerations for individual freedom tell about a subject who acts individually, momentarily and locally, while it functions as a part related to the other parts of a collective structural whole.

Flexibility and self-realization remain key characteristics of our contemporary reality of liquidness and blurriness. By the advent of the information era and the domination of a synchronic time over space, space and society were segmented into innumerable pieces of a diversified reality (Tscumi 1996). The view of a world as an integrated system of related parts is substituted by the attendance of reality as an inherently imperfect network of combined elements. In such context the consideration of the collective forsakes the connection between the whole-social and the part-individual, and considers the latter in a state of independency. The contemporary significance of groups is a reality articulated in a wide range of (no)commitment. Diversity – and the notions associated to it – makes here the dominant concept under architectural creation.

Sejima's Kitagata Housing in Tokyo provides an exemplary case regarding the segmented, combined, diversified contemporary reality, seeking new ways of collective living. As the architect points out, inasmuch the contemporary collective housing ought to accommodate all kinds of collective living between people, and not just families, its base unit becomes the single room, no more the apartment (French 2008: 178). The overcoming of life stereotypes and the acceptance of difference, as proclaimed in the contemporary intellectual production, are spatialized in a a-hierarchical arrangement of four same sized rooms, each of them corresponding to a distinct domestic use. The rooms are combined in apartments freely, depending on the circumstance, providing a single door to the access corridor for each room, instead of a central entrance door for each apartment. On the opposite side of the block, a fully-glazed corridor-like verandah provides a common spatial field where some rooms are expanded. Here, the distinction between private and public space is neutralized as on the one hand (room) privacy is merged with the collective use and displayed to the public view, and on the other hand it is given extreme concern through the provision of room individual access to the collective corridor area. Such neutrality allows the assumption of a collectivity consisted as an inherent quality of individuality, being open to freedom, while the arrangement – instead of articulation – of individualities makes possible an eventual variety of combinations in a world targeting at innovation.

Instead of combination of ultimate elements, collectivity is structured through the synthesis of already articulated spatial pieces, in MVRDV'S Silodam Housing in Amsterdam. A range of dwelling types is grouped together, according the criterion of similarity, into distinct neighborhoods including 4–8 house units (Costanzo 2006). Organized horizontally and vertically, through circulation and common use spaces, each neighborhood represents a vertical version of collective living in the urban configuration, while being in open connection to the 'public' spaces of the building. As is also the case with the 'sky plaza' in the Mirador building in Madrid, urban diversity is intertwined with the collective quality, displaying the multiplicity of the groups in a building arena where the public space is reconsidered. At the same time, the emerged substitution of the 'house' by the 'neighborhood' belongs to the new morphologies of the city and confesses an arbitrary preference of our era to the collective instead of the individual, as it is already remarked.

In the spectrum of contemporary housing one ought to add the exclusive buildings and settlements, known as gated communities, where a kind of privatized collectivity is constituted as related to exclusion and homogeneity in a world perceived as unstable, dangerous and hostile (Figure 2). Although they constitute solely spatial communities without real human bonds between their inhabitants, they do form contemporary collectivities in terms of private governance and gated territory. Derived from the sharp individualism of our era, gated communities introduce a new form of urban configuration which is structured through the



Figure 2. Exclusiveness and homogeneity in gated community.

networking of integral, private-collective spaces and the decline of public space (Pantelidou 2012, 2015).

On the other side, contemporary housing collectivities following a 'hyper-collective' living mode display in the last decades a considerable presence in a large part of the world (Vestbro 2000), in an attempt of people to deal with the symptoms of today societies. Communal space for basic everyday activities and participation to the maintenance and creation of their common areas compose housing examples of a collective quality related to a social interaction which seems to be absonant to the contemporary individualism.

4 CONCLUSION: RECONSIDERING ARCHITECTURE OF COMMON LIVING

Some approaches to architecture claimed for its representational function and meaning transmission, while others consider architecture as a field of interaction and ongoing process between both user and space and the users with each other. Irrespective of their differences, they all, in a way or another, refer to the issue of communication. As Lacan has shown, communication is never perfect. There will always be something which would have remained unspeakable and incomprehensible through the process of communication, related either to the filter of ideology, or the interference between body and exteriority or the lack of transparency between the signifier and the signified. In such field of uncertainty, architecture of housing draws upon the concept of collectivity aiming either to influence or express or activate the subject.

Architecture of housing is connected to the concept of collectivity through the ways that the latter is being interpreted in the period of the architectural creation. Modern vision of purity and order was supported by the idea of unity, which brings to the forefront issues on freedom and oppression (Bauman 1997). The collective was identified to society and the state, which in postmodern times has been darkened as totalizing and compulsive. Connected to the idea of unity, the collective-social-public was meant to homogenize the private parts, and it was homogeneity that provided one of the major platforms for critique against Modern housing architecture and led the next generations towards diversity, disruption and vagueness.

Architecture of collectivity is articulated to the emblematic dichotomy of Modernity and Postmodernity between safety and freedom (Bess 1996). Community established a pivotal point which gave and acquired meaning in relation to this dichotomy: for the communitarians the community's safety would provide freedom, while for the opposed side freedom was placed outside community's safety. Postmodernity made a clear choice in favor of freedom as opposed to safety and certainty, and the notion of community had to be translated in analogous ways, released from ethical ties. The architectural implications of such choice included the preference to smaller spatial scales, as well as the shift from city planning to urban design. At the same time the environmental crisis and the new demographic data due to migrations and wars imposed the need for urban density, while the mechanism of privatizations set its own decisive parameters to the urban development.

Contemporary collective housing appears in an architectural postwar sequence following mass housing and the expansion of single house urban sprawl, seeking to place together in the urban environment both density and community (Segantini 2008). In this context, we face today a multi-ranged content of collectivity expressed through multiple architectural types. In specific, collectivity as a way of everyday life is suggested in relation to tight modes of co-habitation and sacrifice of privacy, loose links of co-existence in the same place or symbiosis on a common field of dwelling, while architecture of housing correspond to these models of common living by introducing an obvious variety in terms of scale, form and spatiality.

Architecture is always in a communicative process with the world, which means that the variable forms it appears with have to find a minimum answer out there. The convergence of the dichotomy between society and individual to the notion of the group (and community) is closely related to the assignment of the common affairs to the private bodies after the retreat of the national state. The socio-spatial groupings of the individuals have come as an answer to the incapability of carrying life burdens, and the contemporary collective housing in its diversified appearance seem to belong to a large extent to this process. At the same time, the lack of transparency of the subject with itself does not allow for harmony between the individual and the collective, and the contemporary housing of collectivity seems to comply with this. As addressing the contemporary approaches of diversity, density, flexibility, and the reconsidered relationship between the private and the public, housing architecture translates collectivity in reference to individuality and within the limits that the latter poses in the contemporary context.

The demolition of space in the information era and the restoring of time in human lives in the form of a synchronous reality consisted of events and moments is related to nomadic subjectivities without stable binding identities, pointing out to a radicalized, as inherently decentralized, individual constituted in and by multiplicity (Braidotti 2013). Today architecture's

demolition of boundaries between the private and the public, the nature and the culture, the urban space and the building, goes beyond the Postmodern ambiguity and creates new forms of space which transcend conventional understandings of quality and value, referring neither to the one nor to the other pole of the duality. Such orientation to neutrality calls for new ways of individual being and collective life, aiming at destructuring once ever otherness and the inequities coming together. On the other hand, to the extent that collectivity is built devoid of common perspectives and grounds between the inhabitants and, furthermore, without any reference to the social level, a political void is opened where actions of resistance are bent and the absorbent functions of culture and economy are intensified. It seems that the dichotomy between 'community and freedom' has not yet been abolished despite the intentions. Architecture is not the main responsible for such tusk, but to the extent of its cultural and political nature it is entrusted to provide us with places for an ongoing practice of common living towards the fulfillment of the wide spectrum of our human and social needs and desires.

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A more versatile and adaptable dwelling, for a changing society

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ABSTRACT: Dwelling, a central theme of architecture, has always been an unsolved issue, both in the quantitative and qualitative dimensions. Today, dwelling must meet the profound social, labor and technological changes that occurred in recent decades, and brought different and evolving requirements to the house. A clear dissociation between emerging ways of living and proposed housing models, heirs of rationalist modern architecture, can be observed. Addressing this question, several authors have pointed to different strategies as a way to find a more suitable house for the accelerated transformation of contemporary ways of dwelling: flexibility, adaptability, functional ambiguity and spatial de-hierarchization. The article aims to frame these concepts and contribute to the establishment of strategies and design tools developed to promote a more open-use and versatile interior domestic space.

1 INTRODUCTION

Dwelling is a central theme of research for the architectural discipline, in as much the house was, is and will always be, central to human life and human society. The permanent nature of dwelling contrasts with a continuous transformation of the living spaces, since the experiential and social transformations of the human being, over historical time, match a continuous evolution and modification of domestic space.

The issue of dwelling is, thus, for architecture, always a problem to be solved, both in its quantitative dimension – particularly in underdeveloped or developing societies – and qualitative, in a generalized way.

Today, with the profound changes we can witness in society, the new demands that labor issues begin to establish in the home, and the profound changes introduced in the house by new technologies, especially information technologies, there has been a clear dissociation between emerging lifestyles and the proposed housing models.

It can be stated that housing models generally proposed and built today are maladjusted to the inhabitants' needs and that most of the houses people inhabit, heirs of the proposals of modern functionalist architecture, can be characterized as rigid models in terms of their functional predetermination, their spatial configuration and partitioning, and their hierarchy, both of circulation and of dimension of its different living spaces. This situation reduces their ability to adapt, over time, to different functional requirements, both family and work related requirements.

To address this issue, several authors and practicing architects have pointed out different strategies as possible ways to finding a more suitable dwelling to the accelerated transformation of contemporary modes of living.

These include the concept of flexibility (or active flexibility) – understood as the possibility to physically transform the dwelling space, so that it responds, in a more rich and varied way, to the needs of the inhabitants; and the concept of adaptability (or passive flexibility) – understood as the capacity of the dwelling space to be able to fulfill different uses and forms of appropriation, without having to change physically.

The concepts of versatility, functional ambiguity and *de-hierarchization* of the house emerge as possible answers to the idea of adaptability: the first, proposing that dwelling spaces should not be designed as monofunctional, but developed to allow different functions and distinct possibilities of use; the second, understood as the possibility of proposing spaces without functional predetermination, designed as functionally opened, for its architectural features, to different possibilities of use and appropriation; the third, the idea of dwelling *de-hierarchization* understood both as the possibility of proposing a higher equivalence of shape and size of housing spaces (thus avoiding a hierarchical relation between them), and as the increase of possibilities of circulation (and hence of relationship) inside the house.

The article aims to briefly characterize the framework of social, labor, and technological transformations that have occurred in recent years, and have contributed to the need for diversification of housing solutions. The article also aims to frame the concepts of

flexibility, adaptability, versatility, functional ambiguity and *de-hierarchization* of domestic space, drawing on several authors and on different design examples. Although these examples come from different geographical and cultural contexts, European, American, Asian, – thus evidently reflecting cultural, architectural and dwelling specificities – it is understood that they provide design principles and strategies that can be adapted and reused in other contexts. Finally, the article aims to contribute to the provision of a basis for the establishment of principles and strategies for the design of a new home, thought for today and for tomorrow.

2 SOCIAL, LABOUR AND TECHNOLOGICAL CHANGES

Human society exists in constant evolution and transformation. The house as *"a key component of the material culture of a particular society and (...) as a primary territory for the expression of identity and living particularities of individuals who cohabit in it"* (Pereira, 2010) is directly involved in these changes, slowly incorporating and expressing, in its form and organization, the changes in lifestyles of its inhabitants.

However, the acceleration we have witnessed in recent years, in the social change and the transformation of ways of life, lead us to the conclusion that housing, as it today is designed, built and proposed, has become inadequate to the needs of the inhabitants it intends to welcome. It is not surprising therefore that in the introduction to the book *Casa Collage – Un ensayo sobre la architecture de la casa*, Xavier Monteys and Pere Fuertes put the following question: "How many (architects) are actually building a house that people need in the 21st century?" (Fuertes & Monteys, 2001).

2.1 *House and social change*

According to Ignacio Paricio and Xavier Sust in *La vivienda contemporánea – Programa y Tecnologia* (Paricio & Sust, 2000), the major changes that have occurred in recent years, relevant to the topic of dwelling architecture relate, first of all, to the question of profound social transformations.

As the most important of these recent changes, these authors point out: the increased longevity of people; the significant decline in the birthrate and the consequent decrease in the average size of the family; the declining number of marriages and the increase of non-marital and other forms of family life or family grouping; the increase of age of young people leaving the parental home; the delay in the age of marriage and, consequentially, in the birth of children; the increase in the number of separations and divorces and the consequent increase in the number of single-parent families, single-person households and composed families; the emergence of other forms of living together in the house, besides the traditional family household. (Paricio & Sust, 2000). Sandra Marques Pereira adds to this list, signaling out the importance of individualization and diversification of the family composition, and pointing out the appearance of a significant number of couples without children, families of DINK (double-income no kids) and LAT couples (living apart together). (Pereira, 2010).

Apart from these issues, these authors also indicate transformations at the level of growth and redistribution of wealth in society and in terms of values ??and habits of society, as key factors of transformation of contemporary dwelling.

Among a long list of issues, we highlight the ones that seem most relevant to rethinking the contemporary house: the introduction of electrical and mechanical appliances in the home, with a resulting improvement in dwelling comfort; the dissemination of audiovisual appliances and telecommunications in the house; the transformation of family relationships between different generations; the importance given to body hygiene, body care, and to the protection of privacy; the increase in the number of women incorporated in the labor market; the growing equality between the sexes; the growing importance of leisure activities, developed in the home.

2.2 *House and labor and employment change*

In addition to the profound social changes, the transformations that recently have been acknowledged in terms of labor and employment also become relevant for understanding the changes in the habits and ways of life of the dwellers.

On the one hand, we are witnessing a period of great mobility for reasons of employment: many families and individuals have to move to ensure a regular and secure job; many have to move for career reasons or to follow a job opportunity, also as a result of the globalization of companies and the labor market.

This labor mobility raises a number of different issues to housing: on the one hand, the growing demand for smaller homes, for individuals living alone – sometimes temporarily – close to the workplace; one the other, the growing need for houses that can accommodate other models of life and lifestyles, in as much as each individual or displaced family carries with them a set of cultural values and modes of living that determine the use and appropriation of the dwelling space. Also, with the new technological possibilities, the house is now able once again, as in medieval times, to include the workplace within the dwelling structure, for a significant number of different professions.

In fact, this growing trend to be able to work from the home, is becoming an interesting choice for many persons and companies, mainly because of the savings it can mean: personal savings in terms of avoiding travel cost and time between home and work; and company savings in terms of diminishing space requirements in the workplace. Working from home also provides a different way to develop the profession, less conditioned by schedules, rules and

other entrepreneurial conditions and more adapted to the rhythms of family or individual life. For the design of the house, this data also is relevant: the house, as was the case up to the late Middle Ages, can once again incorporate a workspace. Depending on the kind of work developed, the activity may require, or not, an autonomous space with a specific characterization. In some cases, the development of the profession in the home may entail an autonomous relationship of the working space with the exterior, for example. All this should be taken into account, when considering a dwelling for today.

2.3 *House and technological innovation*

Finally, the house has undergone a profound transformation through the technologies that have continuously been invading its interiors. A first period of significant change – especially from the second half of nineteenth century until the beginning of the twentieth – can be associated with the progressive search for modern comfort, through the introduction, in the home, of all the commodities that technology could offer, in the period: electricity, gas, running water and plumbing began to slowly become common in the domestic interior (Rybczynski, 1989), thus assuring a level of comfort that never before had existed in the house.

A second important moment can be witnessed in the middle of the twentieth century, mostly after World War II, and as a direct result of the significant technological advances that stemmed from the war effort. This is the time for electrical appliances to invade the home, a time featured by a significant incorporation of equipment and devices in the house, that were to transform domestic life: washing machines, dryers, ovens, refrigerators and freezers, heaters, blenders, among many others.

More recently, and with an equally great impact on the dwelling, the multiplication of audiovisual and telecommunications equipment came in to transform radically the life of the house. At first, the location of the main audiovisual and communication equipment constituted different *foci* that organized the mode of use of a particular dwelling space: the radio and the stereo system, and the centralizing presence of the television set in the living room; the location of the landline phone in the living room or in the entrance hall, are examples of the relationship established between equipment, space and use.

But the technological evolution of these devices has led to their gradual spread around the house, first with the proliferation of phones and television sets, still as fixed pieces of equipment, in living rooms, bedrooms, kitchens; then with the emergence and proliferation of mobile devices – mobile phones, laptops, tablets, etc. – that don't belong to any space: they are wherever its user is. The relationship between space, equipment and use ceases; there is no longer a focus that unifies the members of the family; each inhabitant establishes his own centre.

All of these issues contribute to the realization that the house is in a paradoxical situation: on the one hand, the activities that dwellers develop in the house are generally the same as they have always been; on the other, there is a major transformation in the way these activities are carried out.

The house today has a very diverse population, with different and varied demands, needs and preferences and, in some cases, of high specificity, generating occupations and uses also of great diversity; the acceleration that characterizes the changes that have been taking place leads us to believe that this is not a closed process but, on the contrary, it is a growing tendency. More and more the house will be the host of different, transforming and evolving lifestyles and modes of living.

For all these reasons, a reflection on how the house should accommodate this present diversity, and try to foresee its future adequacy, by providing a wider range of answers to the growing demands by expanding its usability, seems to be fully justified.

3 RETHINKING CONTEMPORARY DWELLING

> *"What we are looking for is a way of thinking and acting that can lead to a different 'mechanism' (in linguistic terms you would say a paradigm) which is less fixed, less static, and which is therefore better equipped to meet the challenge that the twentieth century society in all its complexity puts to the architect."* (Hertzberger,1991).

In order to meet the challenge facing the design of dwelling, trying to give it a wider range of answers to the growing demands and need for diversity, several authors, starting from the 60s and 70s of the twentieth century, began discussing and proposing the ideas of flexibility, adaptability and versatility as possible answers to a more open conception of domestic dwelling space.

More recently, the idea of ambiguity or functional indeterminacy was introduced in the architectural debate, for which contribute the principles *de-hierarchization* of the internal organization of the house. We shall approach these different concepts, attempting to frame them and pointing out the main contributions of the principle authors who have reflected on them.

The idea of flexibility within the domestic space is a very comprehensive concept with distinct interpretations for different authors. This concept presents itself as an appropriate response to the excessive determinism of the house, as an opportunity to respond to the identified social changes and the evolution of lifestyles; and as a response to present-day dissociation between proposed housing models and emerging ways of living. (Paricio & Sust, 2000). For Monique Eleb-Vidal "flexibility poses the problem of habitat

adaptation to the ways of life of users, while at the same time sets the possibilities of appropriation of dwellings by the dwellers" (Eleb-Vidal, 1995). In other words, flexibility may be the key factor for the possibility of a dwelling design that gives answer to the question of how to propose a spatial and constructive structure – which is by nature static and long-lasting – that can adapt to different inhabitants, with distinct and changing social, cultural, and space-use characteristics. Also, as Eleb-Vidal points out, a design that is more open to a richer and more varied appropriation by the dwellers.

Although more commonly associated with the ability to physically change the shape of the domestic space – through mobile walls, sliding doors and folding panels, etc …– the idea of flexibility must be viewed in a more comprehensive way, as the possibility of creating greater use and greater versatility in the house and should especially be thought of as a matter of potential (Fuertes & Monteys, 2001). As Rem Koolhaas states in *S, M, L, XL*: "Flexibility is not the exhaustive anticipation of all possible changes. Most changes are unpredictable. (…) Flexibility is the creation of margin – excess capacity that enables different and even opposite interpretations and uses of space." (Koolhaas 1995).

In this sense, the concept comprises both the idea of active flexibility and the idea of passive flexibility; these are two types of strategies – which can complement one another – that can contribute to the design of a renewed house, a house more open to different use and appropriation, better prepared for the evolution of dweller use, more able to allow and host changes in family composition and life, and more capable of receiving the future incorporation of new equipment and activities.

By active flexibility we can understand the solutions that are characterized by the possibility that they offer the inhabitants of physically changing the shape of the interior spaces of the dwelling.

In this category we find technical solutions that seek to distinguish, from the outset, in the design process, the fixed and perennial elements from those that may be designed as movable or changeable components; taking advantage of the possibilities of the latter, solutions based on the idea of active flexibility propose the use of moving/moveable parts (or elements that can be installed and removed easily) that can ensure different interior configurations of the domestic space. Among these flexible space-defining components one can find: light construction walls, easy to assemble/disassemble, or even moveable; sliding or folding panels and doors; easy to install/uninstall cupboards, cabinets and wardrobes, working simultaneously as storage and as spatial partitions, etc.

According to Monique Eleb-Vidal, this space transformation approach can be seen in two different ways: as initial flexibility and as permanent flexibility (Eleb –Vidal, 1995).

In the first case, the principle is that future inhabitants can choose the configuration of the interior of their dwelling, thereby participating in the design of their home, but only at the initial moment of its occupation. This approach, with direct implications for the architectural design, but also for the very construction process, is particular interest in the role that each family or individual can play in shaping a specific solution for the internal configuration of the home, thus allowing for a better match between dweller's needs and aspirations, appropriation and domestic space. It is less interesting in the long run, because it does not propose solutions designed to accommodate future change, in family structure and family life, transforming and evolving dweller use, etc.

As an example of the possibilities of initial flexibility we can find John Habraken's Project called Supports. In this housing scheme, Habraken starts from the distinction between what he named support – referring to the building's physical structure and infrastructure – and infill – referring to inside space configuration and equipment. This distinction clarifies what is fixed and unchanging and what is configurable and changeable; it is the infill elements (walls, doors, cabinets, cupboards, wardrobes, kitchen and bathroom equipments, etc.) that ensure the flexibility of the solution as they allow, within the support, the permanent elements of the building, every home to be designed and finished according to the needs and desires of the initial dweller population (Habraken, 2000).

Permanent flexibility, still a proposal based on an active flexibility strategy, proposes technical solutions that seek to ensure the possibility of changing the inside domestic space throughout the dwelling's lifetime.

Monique Eleb-Vidal proposes the subdivision of this concept into three different sub-items: mobility, an idea that implies a rapid change of the dwelling space, throughout the day, depending on the activities that take place therein; evolution, implying the possibility of modifying the internal structure of the home in the long term, according to family change or use transformation over time; elasticity, corresponding to the possibility of modification of the dwelling's usable surface, by addition or subtraction of compartments (or sets of compartments) to house (Eleb-Vidal 1995: 103).

In the case of permanent flexibility, the main idea is to design moveable or moving components that allow, in a simple way and in the short or long time, for the adapting of the house to future change and to modifying use and appropriation needs of the dwellers.

As an example of this type of approach, we can point out Steven Holl's housing design for the city of Fukuoka in Japan, built in 1991. In this housing ensemble, Holl designed a flexible interior configuration for the apartments based on the proposal of a set of mobile elements – revolving and sliding doors, panels and cabinets – to ensure the possibility of spatial transformation of the interior of the house, both on a daily basis and also as a long-term possibility (Holl, 1996; French, 2008).

By passive flexibility – also named by some authors as adaptability – we can understand the idea of ensuring different possibilities of use and appropriation in the domestic interior without physical alteration of its space structure.

As stated by Gerard Maccreanor in his article *Adaptability*: "Adaptability is a different way of viewing flexibility. The adaptable building is both transfunctional and multifunctional and must allow the possibility of changing use; living into working, working into leisure or as a container of several uses simultaneously." (Maccreanor, 1998).

Reis Cabrita and Baptista Coelho, long-time researchers in the field of housing architecture in LNEC (Portugal's National Laboratory of Civil Engineering, in Lisbon) also support the idea of adaptability as central to the design of the domestic interior. Cabrita and Coelho indicate dimensional and organizational characteristics of different compartments of the dwelling as responsible for this spatial possibility (Cabrita & Coelho, 2009).

These authors appoint a set of design principles for ensuring the adaptability of housing interior spaces, among which are: design of the different spaces of the house without significant dimensional variations; design architecturally neutral spaces to minimize the functional determination of each compartment; design and position openings (doors and windows) so as to minimize their possible space-use limitation, and maximize different uses in each compartment; design circulation spaces and areas in order to increase their capability for other uses; design spatial configurations that encourage and multiply the relationship and spatial connection between different compartments of the dwelling (Cabrita & Coelho, 2009).

The idea of passive flexibility or adaptability is directly related to the concepts of versatility, spatial ambiguity and functional indeterminacy, advocated also by several different architects and authors.

Herman Hertzberger is one of the supporters of the idea of versatility as a means for a richer architecture, characterized by a higher possibility of appropriation. In his book *Lessons for Students in Architecture*, Hertzberger clearly states his disagreement with the idea of active flexibility: "Although a flexible set-up admittedly adapts itself to each change as it presents itself, it can never be the best and most suitable solution to any one problem; it can at any given moment provide any solution but the most appropriate one. Flexibility therefore represents the set of all unsuitable solutions to a problem". He instead proposes that "the only constructive approach to a situation that is subject to change is a form that starts out from this changefulness as a permanent – that is, essentially a static – given factor: a form which is polyvalent. In other words, a form that can be put to different uses without having to undergo changes itself, so that a minimal flexibility can still produce an optimal solution." (Hertzberger, 1991).

The idea of functional and spatial ambiguity arises from the motivation to counteract the excessive functional predetermination that most of the current housing solutions – being heirs to modern-movement housing research and realizations – still present.

In fact, under the influence of the process of rationalization of the design process that occurred from the beginning of the twentieth century, the design of the modern functionalist house is primarily based on the idea of optimizing space, being founded on a three different leveled predetermination: an objective determination of domestic activities and functional requirements that the house had to ensure; the determination of the 'right' shape and size of each compartment to accommodate these activities, functions and needs; the determination of the relationship between each of these spaces, also dictated by purely functional assumptions. This results in a housing space configuration, whose spaces are rigidly hierarchical, both from the point of view of its size and area, and from the point of view of its position and relative spatial relationship.

Ambiguity – both functional and spatial – can thus be understood as the possibility of designing and proposing dwelling spaces without functional predetermination, that is, open, because of its features – its area, shape and architectural characterization, – to different possibilities of use and appropriation. Ambiguity points the way for the *de-hierarchization* of the dwelling space.

In *Complexity and Contradiction in Architecture*, Robert Venturi, defending a more passive than active flexibility, introduced the idea of ambiguity stating that "the room with a more general than specific purpose, and with removable furniture instead of movable partitions, provides a flexibility that is more perceptive than physical (…) This valid ambiguity promotes a useful flexibility." (Venturi, 1995).

Xavier Monteys and Pere Fuertes also defend the idea of spatial and functional ambiguity as a means to achieving a house more open to different use and appropriation: "we can assure that the greater the specialization of the house has been, and more undefined spaces have disappeared from its internal structure, the greater has been the loss of flexibility in the dwelling." (Fuertes & Monteys, 2001). These authors argue for a greater formal and dimensional equivalence between different compartments of the house and a greater functional indeterminacy in the spaces design as a means to a more rich and interesting home. Paricio and Sust are also among those who support the idea of an ambiguous partition of the house, as a possibility to expand the versatility of the use of space, without the need for physical transformation (Paricio & Sust, 2000).

Finally, the idea of *de-hierarchization* of the dwelling space, which appears as an idea that brings together some of the previous topics: on the one hand, it refers to the dismantling of the traditional (and modern) dimensional and formal hierarchy of the house compartments, being supported in the same concept of functional ambiguity of spaces. The proposal is thus to establish formally and dimensionally equivalent dwelling spaces, so that this indeterminacy constitutes

an opening to use, that is, that each dwelling space can accommodate the development of various and changing household activities.

On the other hand, it refers to the dismantling of the relationships traditionally established between the different compartments of the house, suggesting that the circulations should be incremented and even duplicated, circulation redundancies should be proposed, in order for the house to liberate itself from the excessive hierarchy of movement between the spaces of the house.

In the search for the idea of *de-hierarchization* of the dwelling space, some authors have pointed out the fact that many of pre-modern urban housing solutions have internal spatial organizations where we can find features and qualities that today we are seeking for the design of a renewed home: low functional predetermination of spaces; formal and dimensional equivalence between compartments; circulation multiplication and increased communication links between different compartments; duplication of entries to the home; existence of different kinds of spaces in direct contact with the exterior of the house.

All these features extend the possibilities of use and appropriation of the house, allowing different models of life and their change and evolution over time. Thus, they constitute spatial organizations that should be considered relevant case studies for the analysis and verification of the ideas outlined; also for the establishment of principles and strategies for a more flexible home.

4 FLEXIBILITY STRATEGIES: SOME GUIDELINES FOR THE DESIGN OF THE DWELLING SPACE

The achievement of flexibility in the domestic architectural space has to be considered from the beginning of the design process, in as much as it is deeply related with structural, infrastructural, spatial and tectonic features. In this sense, it is not a method that can be introduced in a design process; to be consequent, it should be a foundation to the design development.

Without intending to be exhaustive, this final part of the article aims to point out some of the most important design strategies that can be used – and have been by several architects in the last thirty to forty years – in the pursuit of the possibilities of flexibility in the domestic space. Although they are analyzed separately, the most interesting results emerge when different strategies are developed simultaneously, resulting, in the best cases, in dwellings with a radically different spatial configuration, opened to different and changing use, and more adaptable to social and cultural specificities.

4.1 *Building stratification – the mobile and the fixed*

As we have seen, especially for active flexibility, a clear definition of what is fixed and what can be changeable or moveable in the house is fundamental to any design solution. The possibility of a flexible domestic space is conditioned, firstly, by the fixed and permanent elements and the way these may allow for a variable use.

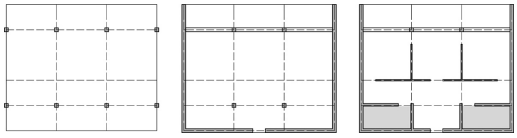


Figure 1. The fixed and the mobile.

Several authors devoted their study to the relationship between the different architectural elements that define the building, focusing on how their design should permit and maximize flexibility and transformation: Habraken (2000), as we have mentioned, differentiated between *support* and *infill*; Leupen (2006) proposes the ideas of *frame* and *generic space*; Brand (1997) suggests that a building is composed of 6 layers: *site*, *structure*, *skin*, *services*, *space plan* and *stuff*. Each one of these authors identifies a set of elements that have longer life cycles and are more difficult to alter, change or remove; and the elements more prone to transformation. They propose a design that ensures the independence of these different layers or elements, so that the change is possible in the less permanent ones, without affecting the others. In other words, in a flexible solution different building layers should be independent, so that one layer doesn't hinder the possibility of change in another layer. In a flexible residential building, structure, skin, services and space should thus be designed as autonomously as possible.

4.2 *Dwelling facilities – rationalizing and liberating domestic space*

Another important strategy for the design of the flexible house is related with dwelling facilities – mainly kitchens and bathrooms, but also technical and storage rooms: their design solution and their position in the interior space. The main idea is to design these spaces as efficiently as possible, to organize/concentrate/arrange them in the most optimized solution; this will have benefits of two different kinds: on the one hand, liberating as much space as possible for the rest of the dwelling's uses; on the other, rationalizing domestic infrastructure – water supply, plumbing, fume exhaustion, etc.

Different design strategies have been followed to attain these goals. These can mainly be divided into two basic options: the design of linear bands of facilities and the solution of designing these facilities as nuclear blocks. In the first case, these technical bands can be set along one (or more façades), leaving the interior of the house free for use and appropriation, or they can be set as an interior band, acting as a dividing element for the remaining space of the house. In the second case, the nuclear blocks, grouping facility rooms, can be set on the periphery of the dwelling – setting the rest of the

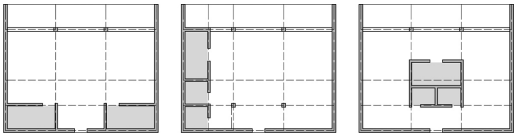


Figure 2. Rationalizing facilities, liberating space.

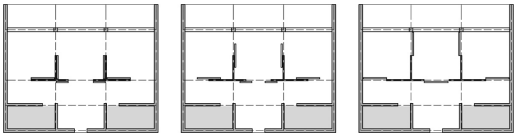


Figure 3. Mobile partitions transforming space.

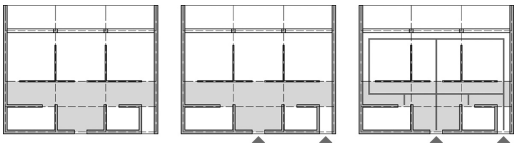


Figure 4. Circulations and entries.

space free, or they can be designed as 'free-standing' volumes, positioned in the middle of the interior space, acting as an organizing element for the dwelling space.

4.3 *Mobile partitions – transforming interior space*

As was argued before, this strategy starts from the understanding and clear distinction between what is fixed and unchanging in the residential building – structure, infrastructure, technical facilities, and tectonic envelope –, and what can be mobile, configurable and changeable: walls, doors, cabinets, cupboards, wardrobes. These components can be designed to be sliding, folding, and moveable components, or to be easily installed and removed whenever necessary.

Based on these possibilities of transformation, the interior space of the home can be altered: different rooms can be joined or separated; the spatial disposition of the house can be more or less divided. These transformations can occur on a daily basis, if the elements are designed for easy movement, or only thought of for long-term change, in a more lasting transformation of the interior structure of the home.

4.4 *Circulations and entries – increasing the possibilities of domestic appropriation*

Another strategy is related with circulation and the definition of entrances to the house. As was argued when discussing the idea of *de-hierarchization* of the domestic space, strong hierarchy of circulation and mono-functionality characterizes modern dwelling models.

The idea behind this strategy is to counter this situation through three types of solutions: firstly, the design of circulation areas – entry halls, corridors, and

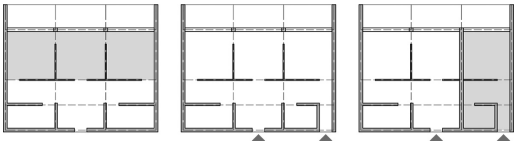


Figure 5. Ambiguous spaces; expansion/retraction of the house.

distribution spaces – so as to render them multifunctional. This proposal is based on the idea of providing larger dimensions and area to these spaces, so as to increase their use potential. Secondly, design alternative circulation paths through the house, so as to increment relationship between compartments, avoiding the 'efficient' mono-circulation of the modern house. Thirdly, based on pre-modern dwelling models that had two (or more) entries to the house, design alternative entrances to the house, connecting different functional sectors to the exterior, so as to increase the possibilities of interior-exterior physical relationship, and thus augment the potential use and appropriation of the dwelling.

4.5 *Ambiguous spaces – increasing the possibilities of domestic appropriation*

This strategy is primarily related to the idea of adaptability. The idea is to design the different spaces of the house – normally named as living room, dining room, bedroom, children's room, study, library, among others – as undifferentiated rooms, both functionally (without pre-determinacy) and spatially. This means designing the main rooms of the house based on an equivalence of dimensions, area, shape, architectural features, inside-outside relationship and circulation relationship (with other rooms). A house based on this kind of design solution will assume the ideas of adaptability and polyvalence as its main objective, proposing an open use and appropriation of its interior spaces by the dwellers, in as much as it is not designed for a functionally predetermined purpose or for a programmed circulation.

4.6 *Expansion and retraction of the house*

Finally, the idea of an elastic house, that can grow or shrink according to dwellers needs, is the last flexibility strategy presented. The idea is to design a housing system in which the apartments can change their spatial limits, through a design that allows for rooms to be separated or included in the house.

Based on this principle, and taking advantage of other ideas like multiple entries and careful location of facilities, design solutions can propose: solutions with groups of houses with varying dimensions and areas; solutions where larger houses that can be split into smaller ones; solutions that allow for the separation of one or two rooms from a house in order to cerate an autonomous working space or a studio apartment; among others.

5 FINAL CONSIDERATIONS

Social, labor and technological changes are reflected in contemporary lifestyles and modes of dwelling, which are also in continuous change. The inherited housing models of the modern period feature a spatial and functional rigidity that hinders their suitability and adaptation to the needs of the dwellers, both present and future.

Flexibility, in its various aspects, presents itself as a possible way for the design of a more adapted and suitable home for each dweller, and also more open to future needs and aspirations. Strategies for the design of a more flexible and adaptable dwelling have been introduced, developed and implemented during the last decades, but their study and application should be furthered, to give answer to the growing need for a more suitable and adequate provision of dwellings, in a time of accelerated social, labor and technological change.

The pursuit of flexibility in the design of the contemporary house is justified because, as Alan Colquhoun once said, "the demands of modern life are so complex and changeable that all attempts by the architect to anticipate them will result in a building unsuitable for its function." (Quoted by Eleb-Vidal, 1988).

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Dutch experiment in co-creation in a collectively commissioned housing project

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ABSTRACT: Only a small percentage of the new homes built in the Netherlands in the last decades have been built by private commissioning (11.2% in 2012, www.statline.cbs.nl). The major players in the Dutch housing market are the commercial developers and the social housing corporations, the latter focuses mainly on the segment of tenants in the lower income category. This contrasts greatly with neighbouring countries like Belgium and Germany. The percentage of social housing is very low in Belgium; more than three quarters of the Flemish people own their own individual house and the development of large-scale housing projects is limited. In both Belgium and Germany, the role of the architect is strongly geared towards the practice of private commissions. It is also a statutory requirement for a client to hire an architect in both countries. This differs significantly to the situation in the Netherlands where the architect focuses mainly on the design of large-scale housing projects. The Dutch Government policy is currently geared towards the encouragement of private commissioning and wants to achieve a significant growth in the segment of Individual project development (IPD) and collectively commissioned housing development (CCHD). (30% of the new homes built in a year) A CCHD project is a building project with self-management: a group of several clients work together to acquire a (construction) site, hire an architect and select the contractor who executes the project. In most cases, the clients are also the future residents of the housing development. Developing a collective housing project means that shared parts such as the facade, foundation and community facilities are collectively designed in consultation with the group, while the individual clients still have much freedom of choice in the design of their own home. This has consequences for the professional role of Dutch architects and the way they react to the changing role of their clients. The design methodology and attitude of the architect in the design process in a CCHD project is very different to the traditional way in which a Dutch architect works. In addition to his design qualities, his organizational and social skills also become important in order to adequately deal with a collective group of 20 or 30 clients. This paper describes the process of developing a CHD project and a case study where an architect has experimented with the evolving design process and the (im)possibilities of co-creation in Collectively Commissioned Housing projects.

1 INTRODUCTION

Until the Second World War was common for residents and business owners in the city to build one or more houses for private occupation or pension provision. The city was built 'step by step' and 'brick by brick'. Each resident and entrepreneur realized their residentials wants, resulting in the current Dutch inner cities, full of variety and surprises, where citizens like to stay, work and/or live. It is a reflection of the way of living (together) and of society (Baas, et al., 2015). Since the mid-20th century a supply-driven development model for housing is the common practice in the Netherlands. This was strengthened by the development of the large-scale VINEX projects in the 90's. Although the supply-oriented development form has resulted in reducing the quantitative housing shortage, there was little regard for the wishes of citizens. Because insufficient attention was paid to the various living requirements of the customers, this supply oriented development became more and more criticized. In response to that, the government stated in a their policy document: Wonen in het jaar 2000": 'Mensen, wensen, wonen, (Ministerie van Vrom, 2000, p. 6) that demand driven development will be encouraged. One of the five core themes in this document has the slogan 'Citizens first' (Ministry of VROM, 2000, p. 6). The citizen is central in the housing policy. This refers mainly to citizens as producers' and not merely as consumers'. Citizens themselves must

be able to shape their lives , make choices and take responsibility (VROM, 2000). Private commissions, whether or not collectively, will be seen as an important means. In addition, trends such as citizens becoming more assertive and individualization, reinforced this renewed focus on private commissioning (Dammers et al, 2007). Private commissioning has both an individual and a collective side. In private ownership, new residents are involved in the entire development process, so that housing preferences are largely realized. This creates a more differentiated supply of dwellings and a greater involvement in the environment. Collective initiatives (collectively commissioned housing development, abbreviated CCHD) on the Dutch housing market are a relatively new phenomenon. During recent years this kind of initiatives increases as also in other sectors, like the energy sector and health care. A shift towards more collective initiatives is particularly perceptible in areas in which working on a larger scale is advantageous. By taking part in innovative networks and cooperations consumers are increasingly becoming producers (De Moor 2013, Rotmans 2012). Rotmans following Toffler, talks about prosumers. This leads to a shift of tasks and responsibilities towards civil society. An advantage of this development is that it leads to more involvement of citizens and a more efficient way in which societal tasks can be carried out. A disadvantage is the larger degree of responsibility of "collective" citizens, such as the need to attain a certain self-organization and the risks that are involved in the cooperation process. Therefore, the question arises whether citizens are able to bear these new responsibilities (De Moor 2013). In view of this, different professionals, such as architects, process supervisors, constructors etc. are involved to support these initiatives. In this contribution, both the possibilities and the limits of collectively commissioned housing development (CCHD) are explored in relation to the changing role of the architect.

2 COLLECTIVELY COMMISSIONED HOUSING DEVELOPMENT

Three forms of development with participation of future residents are, according to Boelens en Visser (2011), Participatory Commissioning, Collective Private Commissioning (CPC) , and Private Commissioning. The focus in this paper is on Collective Private commissioning. Boelens en Visser (2011) define CPC as 'a form of commissioning in which a collective of like-minded private parties acquire a piece of land or pieces of land and jointly decide how, and with which parties, the homes, private spaces and sometimes even public spaces are to be laid out and constructed. The ministery of VROM defined CPC as 'a special kind of project development, where a group of future residents has full legal control over and is responsible for the use of land, design, construction of the houses and the surroundings environment (Maussen et al., 2011). These definitions also apply when seeing CCHD as a process

Preparation	Development	Implementation	Management
Development association Municipality (Local) Municipality (province) Facilitator (Architect)	Development association Municipality Facilitator Architect	Development association Municipality Facilitator Architect Contractor Supervisor	Development association Municipality

Figure 1. Actors in phases in CCHD process.

in which the leading party is a group of individuals, united in an association or foundation, who are also the future residents and have full decision-making power at every stage of the project. They acquire the land and develop, a complex of houses (individual or apartments), with the help of an architect accompanied by consultants and contractor. The group as a whole has control over the entire complex while the individuals separately have control over their houses (Kapedani, 2011).

3 PROCESS AND ACTORS

3.1 *The CCHD process*

The CCHD process can be divided into four phases in which the development phase typically lasts the longest (Maussen, 2011). The stages to be distinguished are: preparation, development, implementation and management. In each phase there are different players with different motives in the process. According to Janzen (2015) the Actor Network Theory (ANT) offersa theoretical basis for the elaboration of these actors. Figure 1 shows de actors in the CCHD process.

The 'leading actors' within a CCHD process are the actors who organize the network. They determine how other actors should act and they have much influence on the process. The four leading actors in the CCHD process are, the Development Association, the Municipality, the Facilitator and the Architect.

3.2 *The role of the architect*

The involvement of users and tenants at an early stage is increasingly crucial for a successful development. Architects become advisors of the client and are often involved in various partnerships. They are mainly called upon because of their communication and process skills.

For architects this approach leads to more is greater equality with the client (Doorn, van, 2014). In some cases, the architect might even be the initiator of a CCHD project. The architect is the expert in the field of technology and aesthetics. He is an important actor in the design phase of the project. The architect is expected to design the project so that it fits the budget, the requirements of the client, meets government regulations and technical conditions. The

architect is commissioned by the CPO group (expert-team Eigenbouw 2014). The architect draws up a contract with the development association in a CCHD project. Because the number of participants in a CPO project may vary, the designs, in many cases, develop overtime. In the design process there are a number of stages; urban design, sketch design preliminary design, final design, and technical design. In each stage the design is further refined. It is important that there is sufficient interaction between the development association and the architect and that both parties can take part in thinking about the design. The architect for instance, can offer various choices to the association, so the association may exert influence the result. In the phase of the urban design/preliminary design the architect and the association jointly look for the allotment that best fits the budget of the participants. In addition, an estimate is made of the number of dwellings, and the main form and layout of the buildings is being elaborated. Since ground costs are a substantial part of the price of a home this is where the foundation for a successful project is being formed. The large commitment of the architect gives added value to the fit that is strived for (Hemmen 2004). This will advance the meeting of individual needs but also the making of concessions for the group. The architect has a double role as a mediator and a designer. At the same time a greater say of the end users means that the architect has to play more modest role as acting as a 'designing advisor' and project manager rather than an architect 'pur sang' The final design follows the preliminary design. Building systems, materials and installations are determined together with the end users. The (collective) option list is worked out, constructions are established and final choices with respect to sustainability are made. The final floor plans of the homes with kitchen and bathroom are worked out. On the basis of these documents the building permit is requested. The specifications and drawings to request the price a contractor are be made in the next phase. In the contract stage, the architect has an advisory role. During the realisation, the architect has the role a supervising consultant. The daily monitoring of the construction is in the hands of a supervisor.

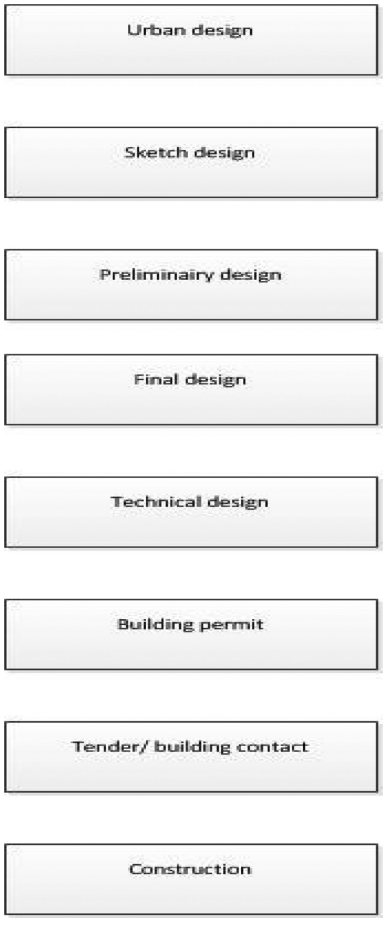


Figure 2. Design phases in a CCHD process.

4 COMPETENCES OF AN ARCHITECT

In these projects the social skills of the architect are important. This applies to cooperating with other parties in the building industry, and also to communicating with end users in co-creation projects. It requires empathy and a certain modesty with respect to one's own ego and taste (Mierlo, van 2014). Guarding the architectural and functional quality, is of course the main task of the architect. The challenge for the architect is to explain the quality of the design and the associated design decisions to the participants. It seems that in many cases, architects should play a less prominent role as an architect. The consumer askes for "real" architecture, the functionality of the solution is more important. At the same time, clients respect for architectural knowledge of the architect. His ability to present integral solutions which are more than the sum of its parts, is also seen as a unique quality of the architect (Doorn, van, 2014). Van Mierlo, (2014) confirms that architects who are able to translate latent needs into successful products in addition to the defined requirements, may surprise the consumer. According to Hermans (2014) the relational and analytical skills of architects and the extent to which they are able to design a high-quality total solution to the problem, are often the decisive factor for success. According to Looysen (2014), the architect should be careful when dealing with the balance between facilitating and taking initiative. That means that an architect has to continuously ask himself the question; 'what can I decide and when is collective decision-making needed?'. This is possible only with preper understanding of the group and the process. Professionals should not deal with various issues among themselves. In the end, the participants in the CCHD project are the principals contractors.

5 CASE STUDY: A COLLECTIVELY COMMISSIONED HOUSING PROJECT IN CASTEREN

5.1 *Introduction*

Project: 34 starter houses
location: Zandtsraat Casteren
architect: van den Pauwert architecten
project architect: T.T. Veeger
Facilitator: BIEB Eindhoven
Contractor: van Bree Someren

The construction of 34 starter dwellings in 2005 in Casteren, (a small village in the south of the Netherlands and part of the municipality of Bladel), was a joint initiative of the municipality of Bladel, together with the village council of Casteren and a "self-build" starters collective. The aim of this initiative was to promote the quality of life in this small village. Due to the increasing house prices in the rural area of Bladel in the last decade, it was no longer possible for starters to buy a reasonably priced house in their own village. They were forced to move away and therefore the average age of the population has gone up dramatically in the last decade. A community with a higher proportion of older inhabitants creates a loss of facilities in the village, such as the primary school, shops, the bank and a doctor (11).

The province of Noord-Brabant considered the project in Casteren as an example for how to deal with the problems of an aging population in the countryside, so they agreed to carry out this pilot project for a period of 5 years. Infill development was allowed without consequences for the maximum housing quotas of the municipality of Bladel. In the "village plan" the municipality provided the opportunity to build with the restriction that the project should not affect the character and urban quality of Casteren. The starting point for the municipality was that the starters collective should take the lead in the development and should take all steps itself to develop a final plan which would be reviewed by the municipality. To allow this process to proceed properly, the starters collective consulted the Eindhoven office bureau BIEB, who is experienced in supporting starters collectives. Besides the design of the dwellings, the urban plan was also developed with the architect. The municipality reviewed the total plan and the subdivisions when it was completed.

5.2 *The process*

The starters united themselves in a collective that had to develop and build the project. This would decrease the total cost of developing the project for the buyers. The municipality provided a location, an abandoned old farmhouse in the centre of Casteren. The municipality prepared the site for construction and sold it to the starters for a reduced price of €166/m^2 excl. VAT and with an average building plot size of 200 m^2. An additional requirement imposed by the municipality that the final price of the housing should remain

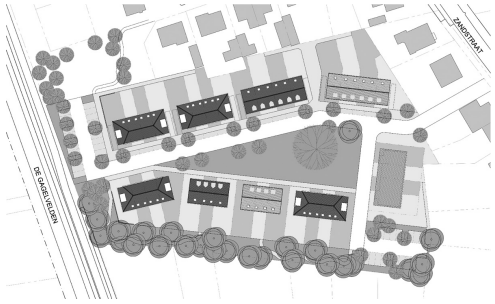


Figure 3. Final urban plan.

below €158,000, ranging in price between €110,000 and €135,000, was succeeded at completion. Another requirement was the introduction of "socially bound ownership" which means that for the next 30 years, when moving, the houses should be sold back to the local housing corporation which puts the house back on to the market as a starter home. Possible increases or reductions in the price of the house will be settled with the ex-starter for 65%, so the price reacts in a certain way to the housing market. In this way, the price of the property will stay in comparison with the housing market but the house will remain available for starters for the next 30 years.

5.3 *The area*

Casteren is a loosely clustered village with an open to very open typology. The village is predominated by semi-detached and detached houses in an informal and traditional rural dwelling pattern. In the centre, there is an ancient triangular village square where the old building structure is preserved, with the church as a landmark of the village at the intersection of the Zandstraat and Kerkstraat. The social services and the cafe are located here. Several other square-shaped spaces are also provided within the village. This theme plays a role in the design of the urban plan for the building plots in the project for the starters on the Zandstraat.

5.4 *Co-creation of the urban plan*

The starting point of the process was the maximum input of future residents in the development of the plan. The plan was developed by the architect, in close collaboration with the group of starters, after an intensive study of different alternatives. To provide the future residents with a better understanding of all the alternatives, the advantages and disadvantages were discussed: for example parking on their own plot or a shared public parking lot, living in a courtyard or individually in separate buildings, etc. The presentations were accompanied with examples of realized projects. The alternatives of "Campus", "Castle", "Strips" and "Es" were discussed (figure 3). After an intensive study of the alternatives, the group chose the plan of the "Es", an infilling with a triangular plaza enclosed by a number of building blocks

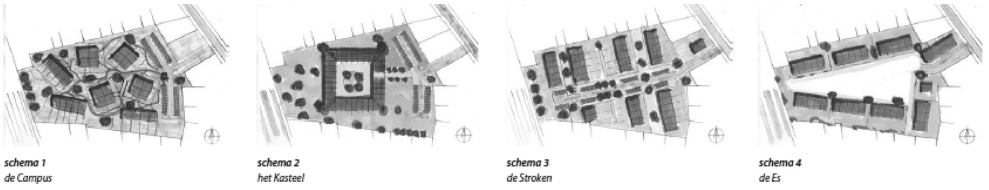


Figure 4. Alternatives in the urban plan.



Figure 5. The Ateliers.

whose maximum length is equal to the size of a long farmhouse. Such a space in a small village is called an "Es" and is a spatial element that occurs frequently in the Brabant landscape.

The village of Casteren has been developed in the last century in an informal way, the houses are built one by one over a long period and they differ in form and architecture. This theme is reflected in the plan so that it connects with the existing character of the village. Variation in height, architecture and shape of the new housing provided a diverse character. A total of 34 houses were realized with a variety in size and appearance and grouped into blocks of 4 houses. Sufficient space is maintained between the blocks, similar to the buildings in the surrounding village. On the west side of the plan, a free view to the surrounding fields is maintained so that it keeps the existing relationship with the countryside. The central square got a "green" character with existing trees. A row of existing oaks where saved on the south side. The plan is accessible from the central square by car. A new path for cyclists and pedestrians connects to the slow traffic circuit in the village. Parking is solved on the road and several houses have got their own parking space on the lot. There are two small parking lots for homes that are not located directly on the road, somewhat out of sight from the main square. The plan assumes a parking ratio of 1.5 parking spaces per house.

5.5 *The design of the houses*

A plan of action was made for the design of the houses so that the urban plan was developed together with the maximum input of the future homeowner in the development of their own house. They could chose a design based on one of the four basic types.



Figure 6. Housing.

In this way, the architect could react on the demands of the starters with their diversity of needs in terms of size, architecture and construction costs.

For two different types, the façade was designed in a modern and a traditional architecture style with the same interior plan. A change in layout of the house was possible for all the starters. The costs were adjusted by the building contractor during tender, so that future discussions in price were prevented. In this way, a maximum of flexibility for the future buyers was ensured.

A special block of four houses named "the Ateliers" was designed in a specific style of architecture. Materials like aluminium cladding, galvanized steel columns, anthracite-coloured brickwork and an aluminium roof were used in the block. Varnished Oregon pine wooden frames combined with laminated beams under the roof and wooden roof sheets creates a warm ensemble. Two buyers chose to incorporate a free-standing spiral staircase to connect the upper floor to the living room giving the atrium a strong spatial effect.

6 CONCLUSION

The amount of collectively commissioned housing projects is increasing in the Netherlands. It reacts to the policy of the Dutch Government, which is gearing towards the encouragement of more private commissioning to achieve a significant growth in the segment of Individual project development (IPD) and collectively commissioned housing development (CCHD). (30% of the new homes built in a year). It produces besides a stronger involvement of future residents in the project and a considerable saving in the final house price (between 15% and 25%). Besides the design of the houses, the new owners are actively involved in the development of the urban development plan in consultation with the architect. This has a tremendous effect on the social cohesion of the new neighborhood. These kinds of projects have consequences for the professional role of Dutch architects and the way they react to the changing role of their



Figure 7. “Building party” starters project de Weebosch.

clients. The design methodology and attitude of the architect in the design process in a CCHD project is very different to the traditional way in which a Dutch architect works. The project in Casteren has been a showcase and has dragged national attention to this way of working. National television has covered the project and it has been an example for many more starters projects. It shows that it could be successful but more study is needed to compare the different methods used by architects in this type of co-created projects.

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The sun for all: Social equity and the debate on best solar orientation of high modernist housing

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ABSTRACT: The Modern Movement of the 1920s developed a preferred housing scheme that arranged parallel building rows to run from north to south, with bedrooms facing east and living rooms facing west. This strict orientation scheme—known as *Zeilenbau* (line building)—was more or less unanimously shared among the architects of High Modernism. However, their arguments for *Zeilenbau* varied widely: improved hygiene; cost reduction in the building industry; accommodating the day rhythm of working families; implementing scientific investigations in the design process; aesthetics; and others. This paper focuses on the discussion about the relationship of social equity and best sun orientation by studying particularly one proponent of this argumentation: Hannes Meyer. Investigating this debate in High Modernist architectural discourse can help us reflect and critique today's newly occurred debate on strict building orientation with its very different emphasis on energy efficiency.

1 SOLAR ORIENTATION IN EARLY TWENTIETH CENTURY HOUSING

Throughout architectural history, from antiquity to today, we find a clear preference to orient main spaces in residential buildings toward south (in the northern hemisphere). Spaces with south windows receive the most sunlight in winter and the least sunlight in summer, which is for both seasons the preferred case. However, the Modern Movement of the 1920s developed a preferred housing scheme that orients spaces to east and west—with bedrooms facing sunrise and living rooms facing sunset. This strict orientation scheme—known as Zeilenbau (line building)—was shared more or less unanimously among modern architects, including Walter Gropius, Ernst May, Walter Schwagenscheidt, Hannes Meyer, Ludwig Hilberseimer, Otto Haesler, Le Corbusier, Mart Stam, and the wider circle of CIAM members. Particularly around 1929, many Zeilenbau schemes were built, such as Siemensstadt (Berlin) 1929, Hellerhof (Frankfurt) 1929, Dammerstock (Karlsruhe) 1929, and Haselhorst (Berlin) 1929 (Figs 1–4).

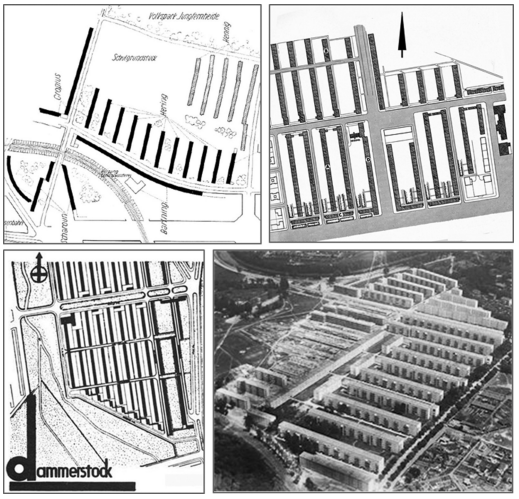


Figure 1–4. Left to right: Siemensstadt (Berlin) 1929, Hellerhof (Frankfurt) 1929, Dammerstock (Karlsruhe) 1929, and Haselhorst (Berlin) 1929 (open sources).

The arguments for this orientation varied widely, thus indicating that justifying a scheme that contradicted the common orientation of many centuries was a problem. These arguments were embedded in the broader topics of the time:

a) Improving hygiene: In the early twentieth century hygienic living conditions were widely demanded and closely connected to urban design. "In radical Zeilenbau, hygiene means exclusively sun orientation," said Adolf Behne in 1930 (165).
b) Implementing scientific investigations in the design process: Basing architecture on increased knowledge of sociology, psychology, technology, construction economy, and environmental studies (wind direction, daylighting, noise) served as justification of building form. Scientifically studying the people's general "life processes" (Gropius 1988: 114; Meyer 1928: 13) was employed to define the optimal housing orientation for the majority of people.
c) Social equity: People of all classes should have equally access to sunlight; providing social housing in the *Zeilenbau* layout was considered the best path to cover this demand.

d) Building for the masses: To accommodate the day rhythm of working families architects determined that sunlight was needed in bedrooms to the east when workers got up, and in the living room to the west when they came home from work.
e) Aesthetics: Despite the fact that most modern architects denied an aesthetic approach to architecture, a repeated formal language could be found in many *Zeilenbau* estates. Only few architects tried to justify *Zeilenbau* aesthetically, for example Georg Lüdecke, who stated that an east-west running building with the main rooms only facing south and the smaller serving rooms—kitchen, bathroom, staircases, etc.—only facing north, became thinner. Such a multi-family house "would look too thin with its low building depth" (Lüdecke 1930: 1480).
f) Cost reduction in the building industry: Lüdecke's argument was also an economical one. Since deeper buildings have a higher floor area–to–facade ratio, less facade surface needs to be built for the same floor area. In his words, the "multi-family house […] needs for economic reasons a larger building depth" (Lüdecke 1930: 1480).

This paper focuses on the discussion about the relationship of social equity and best sun orientation, analyzing primarily one proponent of this argumentation, his writings and projects: Hannes Meyer. His theses will be contrasted by those of modern architecture critic and social activist Adolf Behne who identified *Zeilenbau* and strict sun orientation as inadequately equalizing the society.

2 SUN EXPOSURE AS A CLAIM FOR SOCIAL EQUITY

The general request for more daylight in mass housing had a longer tradition than the debate on best solar orientation in *Zeilenbau*. This request emerged from the critique of dense building blocks in overcrowded cities, particularly London and Berlin. We can find this demand, for example, in Ebenezer Howard's *Garden Cities of To-Morrow* of 1902. In it he contrasted the city in which "the sunlight is being more and more shut out, while the air is so vitiated that the fine public buildings, like the sparrows, rapidly become covered with soot," with the countryside—"that beautiful land of ours, with its canopy of sky, the air that blows upon it, the sun that warms it, the rain and dew that moisten it" (Howard 1902: 16, 13). In his famous diagram of "The Three Magnets" he mentioned "foul air" and "murky sky" as disadvantages of the town, and "fresh air" and "bright sunshine" as the advantages of the country (Fig. 5). Obviously, the Garden City, as the combination of town and country, was intended to combine all advantages. Howard's book was about socio-economic aspects of urban planning. Best orientation of housing was not addressed in his version of the Garden City, but instead the proportion of streets, "so wide and spacious that sunlight and air may freely circulate" (Howard 1902: 39).

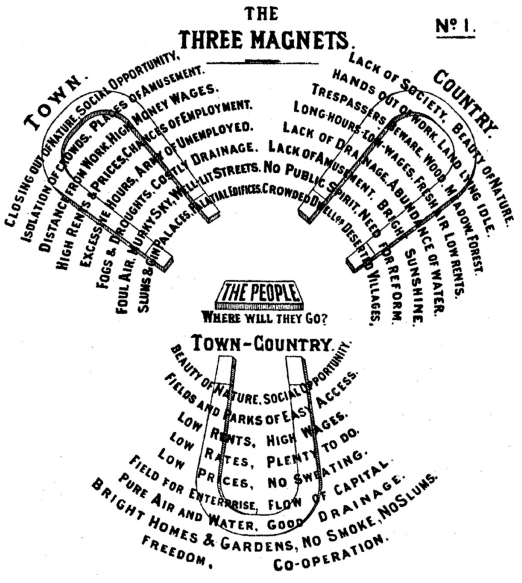


Figure 5. Ebenezer Howard, *Garden Cities of To-Morrow*, 1902: 16.

3 EARLY ZEILENBAU: OTTO HAESLER

Twenty years after Howard's seminal book we can still frequently read the general demand for "sun, light, and air." The question of best solar orientation of housing did not come to the fore before the second half of the 1920s. One of the earliest housing projects that focused on orientation and propagated *Zeilenbau* was Otto Haesler's Georgsgarten in Celle, Germany, in 1926–27 (Poerschke 2015). Haesler's main argument for this orientation was that sun should shine into rooms exactly when people used them: bedrooms in the morning, living spaces in the evening. Over the course of only a few years, his building layouts became more and more specialized by providing small sleeping cells to the east and bigger family rooms to the west (Figs 6–7). Such layouts did not allow flexible uses and had to be occupied very much in exactly the intended way. Voices more radical than Haesler claimed that the masses would learn good living by such strictly defined layouts. Fritz Block, for example, stated in 1927 that a rigorous designation "of all rooms in small apartments should be carried out wherever possible." For Block, this seemed particularly necessary "for the large mass of the working people that must be educated and influenced. […] The worker is highly skeptical of the liberating feeling that we wish him to achieve by new building" (Block 1927: 46, 41). Adolf Rading stated that "there is no purpose anymore of asking occupants; they do not know their needs anymore. […] Therefore it is urgent, as a first step, *on a purely human and social basis and in concert with the economic situation, to determine the housing needs and to build apartments accordingly*" (Rading 1927: 47, emphasis original). This implied that new housing would help occupants learn good dwelling.

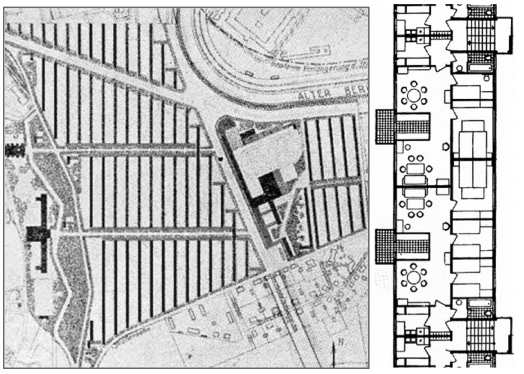


Figure 6–7. Otto Haesler and Carl Völker, entry for the 1929 Haselhorst competition, fourth prize, site and typical floor plan (Forschungssiedlung Spandau-Haselhorst 1929: 97).

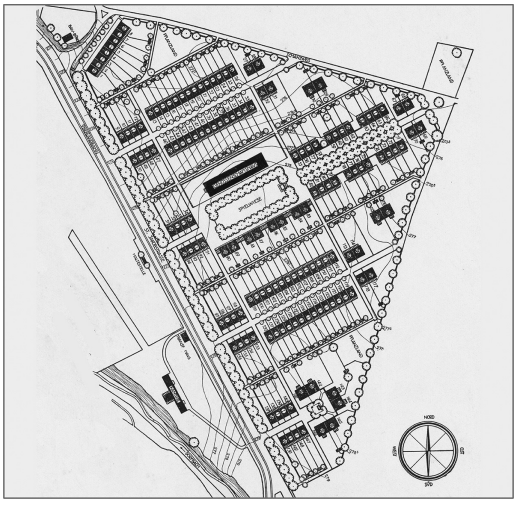


Figure 8. Freidorf housing project by Hannes Meyer 1919–24 (Schnaidt 1965: 4).

4 HANNES MEYER

Hannes Meyer (1889–1954) stands out as one of the architects of High Modernism with highest social ambitions. Already early in his career he became intensively engaged in social questions of housing and urban planning. He was active in the Swiss land reform movement and joined a building cooperative. In 1912/13 he moved to England to live for a year with a relative near London. He visited garden cities such as Letchworth and worker model villages such as Bourneville and Port Sunlight (the latter's name stemming from a popular product of the Lever Company and not from an utopian urbanistic idea of access to sunlight). Before and after his stay in England Meyer worked on housing projects such as the working-class estate Garden City Grünau in the office of Johann Emil Schaudt (1911–12); the estates Margarethenhöhe, Garden City Hüttenau, and the workers estate Breitenborn in the office of Georg Metzendorf (1916); and several other housing complexes while working in the building administration of the Krupp company (1916–18). During the first half of the 1920s he also worked for several non-profit housing corporations (Winkler 1989). All of this laid the basis, as he later stated, "to regard works of art, architecture, or urbanism never outside of the social foundations, from which they emerge" (Meyer 1980: 346).

The first housing estate he built under his name was the Freidorf project in Basel, which he started designing in 1919. After its completion Meyer lived in Freidorf from 1921 to 1926. The orientation of the town houses did not seem to play a bigger role in this scheme (Fig. 8). The estate avoids any building blocks and consists of rows parallel to the streets, leading to gardens unfavorably oriented to the south-east and north-west. Creating symmetric streets and rectangular squares was obviously of higher importance than the best sun orientation of the garden or house. Stated in other words, the appearance of the whole seemed to be more important than the optimization of the single part. Meyer described in 1925 the Siedlung Freidorf, with its parallel building rows of similar appearance and a centered community area, to be a symbol of "simplicity, equity and truthfulness." However, in the same article, he criticized Freidorf already as "a compromise; socially between individual and community, formally between city and countryside" (Meyer 1925: 49, 51).

In 1926 Meyer started a partnership with the architect Hans Wittwer (1894–1952). According to Klaus-Jürgen Winkler, it was Wittwer who brought into the partnership not only excellent design skills, but also a broad knowledge of technologies, and particularly of daylighting, that Meyer quickly absorbed (Winkler 1989: 61). Two spectacular competitions of this partnership became famous, both of which emphasized solar orientation: the 1926 Petersschule (St. Peter's school) in Basel (Fig. 9) and the 1927 League of Nations Building in Geneva (Figs 10–11). Both of them include building wings running strictly from north to south with orientation of classrooms and offices to east and west.

In the journal *bauhaus* the Petersschule project was presented in revised form and included illumination graphs and extensive daylight calculations. For the office wing of the League of Nations Building Meyer and Wittwer asserted that the floor height was "calculated from the illumination coefficient of the work surface" and that the entire complex "was only the result of traffic diagrams, lighting diagrams, insolation diagrams" (Meyer 1927: 6). Both projects claimed that building for a new society necessitated ideal east and west orientation, and, vice versa, that ideal orientation expressed a new society.

At the same time, in 1926, Meyer published in the journal *Das Werk* his first famous pamphlet, "Die Neue Welt" (The New World) which provided an enthusiastic vision of society. Meyer claimed that the "demands we make on life today are all of the same nature

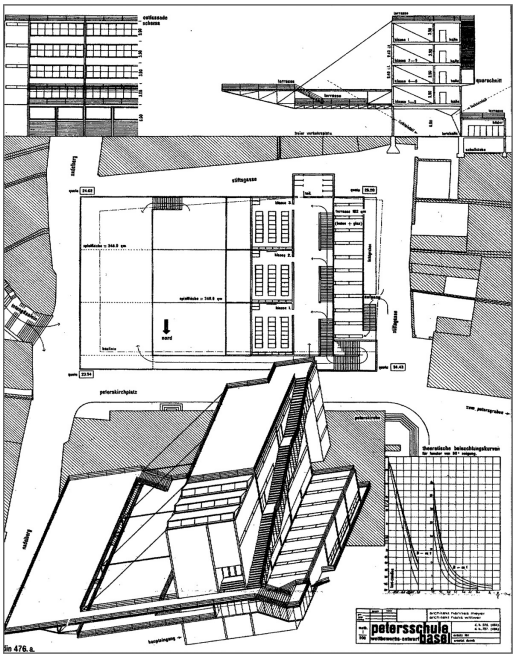


Figure 9. Competition entry for the Petersschule in Basel with illumination graphs (*bauhaus* 1927: 2).

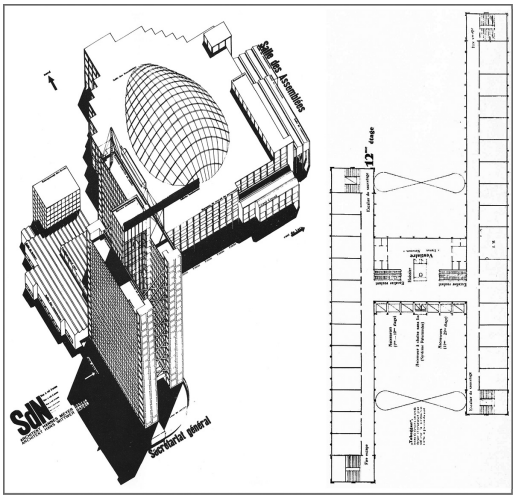


Figure 10–11. Competition entry for the League of Nations Building in Geneva. Isometric view and floor plan of office tower running strictly north-south (Schnaidt 1965: 23, 31).

depending on social stratification. The surest sign of true community is the satisfaction of the same needs by the same means. The upshot of such a collective demand is the standard product. […] The degree of our standardization is an index of our communal productive system" (translated in Schnaidt 1965: 93). Meyer stated that the architect's task is to build for the people's needs, which implied, first, that "the people" had similar needs that could be scientifically investigated, and, second, that it was the obligation of the hour that architects think of themselves as being a part of that same people. These two ideas of equity of people and subordination of the individual under the community, both expressed in standardization, were themes that he carried further and combined with daylighting and other environmental studies. In his pamphlet "bauen" (building), published 1928 in the journal *bauhaus*, Meyer reached a stage where he embraced Wittwer's knowledge on solar orientation and daylighting and related it to his own vision of society:

"[…] in its basic design the new dwelling house becomes […] a biological apparatus serving the needs of body and mind. […]

1. sex life 2. sleeping habits 3. pets 4. gardening 5. personal hygiene 6. weather protection 7. hygiene in the home 8. car maintenance 9. cooking 10. heating 11. insolation 12. service

these are the only requirements to be considered when building a house. we look at the daily routine of each person living in the house and this gives the function diagram for father, mother, child, infant and other occupants. […]

we calculate the angle of the sun's incidence in the course of the year and in relation to the latitude of the site, and with this knowledge we determine the size of the shadow cast by the house in the garden and the amount of sun admitted by the window into the bedroom. we work out the amount of daylight falling on the working area of the interior and we compare the heat conductivity of the outside walls with the humidity content of the outside air. […] where color seems psychologically indispensable, we include its light reflecting value in our calculations. […] we consider the body of the house to be an accumulator for the heat of the sun …

moreover, as one of the final forms in which the welfare of the nations is to be realized, the new housing estate is a purposively organized work which engages the energies of all and in which co-operative effort and individual effort join forces in a common cause."(in Schnaidt 1965: 95–97, modified)

This quote summarizes three themes that clarify Meyer's vision of architecture in its relatedness of daylighting (among other technologies), the individual and the society. First, Meyer demanded the study of the day rhythm of "typical" individuals; second, he called for technical surveys of the environmental context; and third, he proposed that connecting both is a step to achieve an architecture for a new society.

5 BAUHAUS TEACHING

In 1927 Hannes Meyer became a faculty member of the Bauhaus and in 1928 its director. In Meyer's tenure many student assignments incorporated diagramming of sun positions and the insolation and shading within rooms. This diagramming was not restricted to housing designs but was also included, for example, when

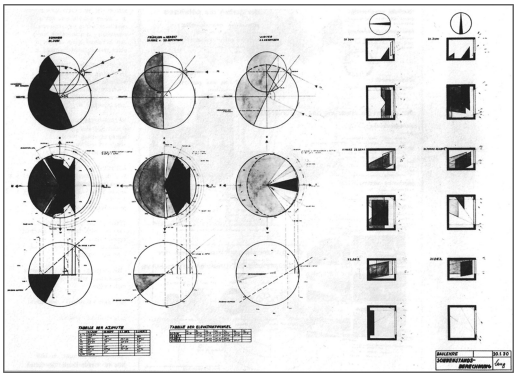


Figure 12. Bauhaus student Lothar Lang's analysis of direct sun and shadowed areas in rooms with different orientations. Assignment for Hans Wittwer's class (Winkler 2003: 78).

designing school projects. Hans Wittwer followed Meyer to the Bauhaus in the second half of 1927 and started teaching environmental technology, including lighting, heating, ventilation, and installation. Many solar analysis assignments resulted from this teaching, such as the one by Lothar Lang (Fig. 12) (Winkler 2003, Kieren 1989). Meyer himself taught "analytical building," part of which was the study of the family members' day rhythms. Meyer's and Wittwer's courses, together, resulted in the reciprocal connection between the topics of daylighting and social architecture. Cross referencing the courses led to the orientation of many spaces—class rooms, hotel rooms, and rooms within apartments—to east and west, defining that direct solar radiation had to enter a space exactly when people used it. (Obviously, this did not allow flexible uses at different times of the day.)

The building projects and competitions during these Bauhaus years showed sun and lighting studies everywhere. The most famous example was the school of the ADGB (Federation of German Trade Unions) completed in 1930 (Figs 13–15). Here, sun studies for the bedrooms were extremely important "for friendly reassurance, for creative rest" (Meyer 1928: 14). A housing example is the extension of the Törten estate. The first part of this estate was designed and built under Walter Gropius's directorship, with the main focus being on industrial fabrication of standardized building elements, while lighting considerations played a minor role. In the second building phase under Meyer (1928–30), streets were organized to run from north to south. Single-family houses paralleled these streets and were designed in three different types as detached, angle-shaped and row houses (Figs 16–17). In addition, multi-family buildings were designed—with living spaces and bedrooms facing south, and bathrooms, kitchens, balcony accesses and stairs facing north (Fig. 18). Only these apartment houses were built.

Mixing north-south running single-family row houses with east-west running balcony-accessed multi-family apartment rows could be seen in several

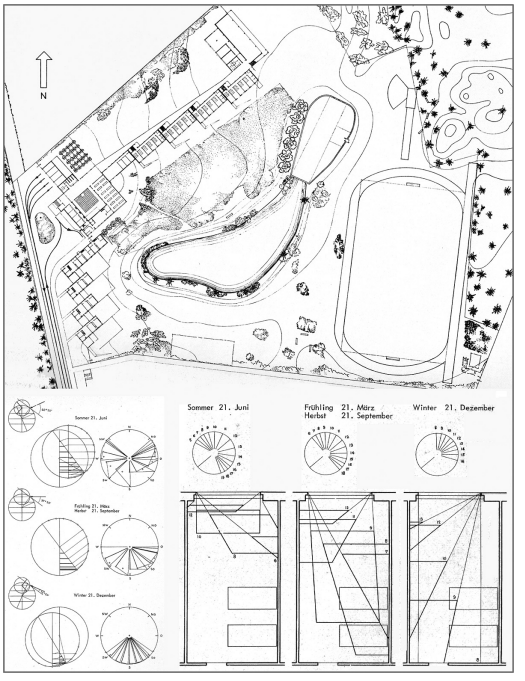


Figure 13–15. Hannes Meyer, Hans Wittwer, and Bauhaus students. School of the ADGB (Federation of German Trade Unions) in Bernau, completed 1930. Site plan and sun studies for bedrooms (Schnaidt 1965: 42, 43, 51).

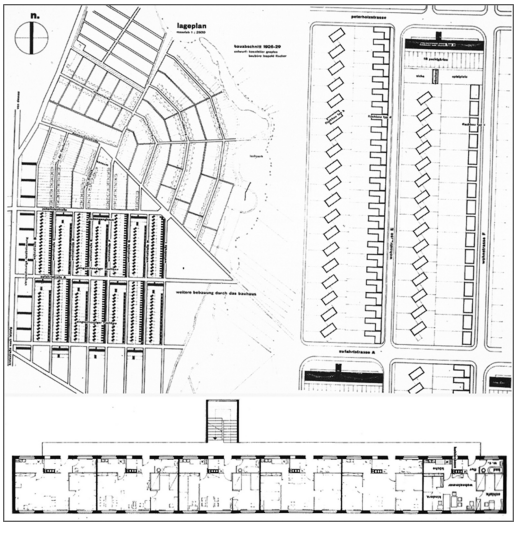


Figure 16–18. Hannes Meyer and Bauhaus students. Törten estate, second phase, completed 1930. Overview, site plan, and floor plan of balcony-accessed multi-family building. (Schnaidt 1965: 38).

other modern housing estates, for example, in Ernst May's Westhausen estate of 1929–31. The two building types were considered to be complementary to each other. High cost-effectiveness might have been

the strongest argument for the balcony-accessed buildings. The two types provided some social mix of occupants while their standard was kept equal. With respect to daylighting the descriptions of the Törten estate emphasized that no north-facing bed- and living rooms were designed in order to "guarantee the greatest possible insolation of the whole apartment" while the serving rooms (hallway, bath and kitchen) "isolate the unit from the traffic on the balcony and from rough northern weather impacts" (quote from 1930, in Winkler 2003: 83). It should also be mentioned that, under Meyer's direction, from 1928 on, several architects started teaching in the architecture program, such as Ludwig Hilberseimer, Mart Stam, and Anton Brenner. Hilberseimer and Stam had strong urban design expertises, including *Zeilenbau*, and certainly influenced the designs and orientation schemes of housing estates undertaken by the Bauhaus students.

Meyer's justification for *Zeilenbau* and rooms facing to east and west was eventually not only one of social equity, but, even further, of achieving a collectivist society. Also Hilberseimer believed in this collectivist approach, when he wrote in his book *Groszstadt Architektur* that the "building of housing, particularly of mass housing, is not subject to individual but to collective design" (1927: 25).

The approach to equity in a collective society took a scientific route. The ideal that all people should have equal living conditions meant, when applied to housing, that adequate standards for the collective had to be defined. One such standard was the access to daylight. The orientation of apartments had to be scientifically justified and, vice versa, the studies of sun orientation were understood to be an example of a scientific approach to architecture. Empirical studies of the people's "life processes" (Meyer 1928: 13), from which insights for design orientation could be gained, were one method of this approach.

After his dismissal from the Bauhaus in 1930, Hannes Meyer lived in the Soviet Union until 1936, where he found new opportunities to conceptualize large housing estates and even whole industrial towns. One example is the development of the industrial town Sozgorod Gorki near Molotov in 1932. Planned for 45.000 people, the design for the town consisted mainly of north-south running building rows. Some of them were turned ninety degrees—similar to the balcony-accessed multi-family houses in Törten—in order to create spatial rhythm, emphasize the street, or connect outdoor spaces between rows to natural areas. Where such building rows followed east-west streets, they were never positioned on the north side of the streets, which would have led to opening the apartments to northern gardens. Also, topography played a role in situating and sizing different functions (Fig. 19).

Ten years later, after Meyer had relocated to Mexico, he had the opportunity to develop another large housing estate for 11.000 workers, the 1942/43 Lomas de Becerra (Fig. 20) (Möller 2015: 66; Schier 1989: 32). The strict scheme of north-south running buildings had again not changed here. While Meyer was very critical of many endeavors of his Bauhaus time, the analyses and findings related to sun orientation were not called into question and served as the general justification for equal living standards.



Figure 19. Hannes Meyer, Development plan for Sozgorod Gorki, Soviet Union, 1932 (Schnaidt 1965: 69).

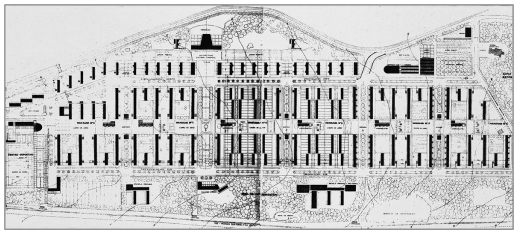


Figure 20. Hannes Meyer, Development plan for Lomas de Becerra, Mexico, 1942 (Schnaidt 1965: 83).

6 CRITICAL COMMENTARY: ADOLF BEHNE

The architecture critic and social activist Adolf Behne (1885–1948) commented in the late 1920s and early 1930s on the *Zeilenbau* housing projects and addressed in particular the topic of sun orientation that he identified as a dogma of the time. He used the debate on solar orientation to exemplify what is at risk in society. In contrast to so many architects who requested the subordination of the individual under the collective, he emphasized individual freedom and the value of diversity within a socially oriented society. Reacting to the debate on housing orientation he expressed that no single orientation preference could ever be the ultimate

ideal for housing and that instead a variety of orientations are necessary to serve the divers lifestyles of a society. On the occasion of a critique of what became the most famous *Zeilenbau* estate, the Dammerstock, he explained his concerns regarding strict orientation schemes:

"Dammerstock would be right if our wind rose had only east and west, if the sun went back and forth between east and west on the shortest way, without touching north and south. But since the sun, from man's view, marks four cardinal points, which deeply became part of our consciousness, Dammerstock seems to be a torso. […] According to the most consequential architects, man has to go to bed toward the east, has to eat and answer mother's letter toward the west, and the housing unit is organized in a way that he cannot make it differently. […] The housing unit that is too specialized does not gain value of living, it looses it. […] Dammerstock's method is a dictator's method; it is the method of an either-or." (Behne 1930: 164)

With his critique of fixed dogmatic orientation Behne pointed to the lack of flexibility in how to occupy rooms in an apartment. The floor plans of modernist housing, including their specificity in solar orientation, did not facilitate different occupations when needed. He summarized: "Social complexity demands a variety of building orientations." (Behne 1930: 164).

7 FINAL REMARKS

Adolf Behne warned in 1930 that the schematic and monotonous layout of building rows with preset room assignments did not reflect the society altogether. This critique is applicable to all dogmatic orientation discourses, no matter which direction rooms are eventually facing. The example of modernist *Zeilenbau* can help in today's newly occurred debate on building orientation. In light of energy efficient building, architects have returned to the preference of south orientation for all bed- and living rooms for the one, purely technical reason of energy reduction. As in High Modernism, architects are convinced that there is only one possible orientation, particularly for housing: this time, however, to the south. As in High Modernism, the argumentation is radical and directly related to one of the most relevant question of the day: this time, however, it is about sustainable building with a minimized energy footprint. Obviously it would be absurd to ignore the energetic benefits of south orientation in housing and the need to embrace centuries-old strategies of passive heating and cooling. In addition, however, the orientation controversy of High Modernism, including its critique, reminds us of the social relevance of such technical questions. It shows that the discourse on solar orientation must go far beyond technical questions and instead target the core question of social meaning in architecture, which addresses the balances of the individual and society. The actual task for architects is to transcend and elevate this technical approach toward meaningful architecture.

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Neighbourhoods with single-family houses growing old

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ABSTRACT: Cities and neighbourhoods are affected by demographic change in many ways. In order to make a successful ageing in place possible, it is necessary to adapt not only flats but also neighbourhoods to the demands of an ageing society. In this context the single-family house, one of the most common building types in Northwestern Switzerland, plays a special role. On the basis of a cross-evaluation of strategies, practical examples and research studies, planning measures for the adaptation of neighbourhoods to the demands of an ageing society were developed and applied to contrasting case examples in the context of test plans. It turns out that neighbourhoods with single-family houses show different potentials for a successful ageing in place. The central criterion seems to be the proximity to a centre or the connection to public transport. While mobile shops and delivery services could contribute to a successful ageing in place in peripheral areas, densification offers a variety of options in central locations.

1 INTRODUCTION

In the future, demographic change will have an ever-increasing impact on society. Cities play a special role in this context. On the one hand, they are confronted with a number of problems caused by this change. On the other hand, great potential to influence this change positively is found in the ways cities adapt, e.g. in the project *Global Age-Friendly Cities* of the WHO (2007). In particular residential areas with single-family houses built between the 1950s and the 1980s virtually experience a 'double aging process': The houses have 'matured' and so have their inhabitants, who as young families once realised their dream of their 'own home', who have aged almost collectively, and who have to decide next whether they can and want to stay in their 'own four walls' in their local neighbourhood.

This article presents results of the interdisciplinary research project *Home and Identity in Ageing Neighbourhoods with Single-family Houses*. The project, led by Prof. Christina Schumacher in collaboration with Dr. Hannes Müller of the *School of Architecture, Civil Engineering and Geomatics,* Prof. Dr. Klaus R. Schroeter and Dr. Christine Matter of the *School of Social Work* is part of the *Strategic Initiative Ageing* of the University of Applied Sciences and Arts Northwestern Switzerland.

2 APPROACH

One of the aims of the project is to develop and test architectural and urbanistic strategies which facilitate a successful ageing in place for elderly inhabitants. As a type of settlement the neighbourhood with single-family houses plays a special role: With a percentage of over 65% of the building stock of Northwestern Switzerland it is the dominant type of building (Bundesamt für Statistik, 2004). Precisely for the settlements built between the 1950s and the 1980s a particularly problematic demographic development is predicted for the near future (Krajewski, 2015). On the basis of a cross-evaluation of strategies, practical examples and research studies, planning measures for the adaptation of neighbourhoods to the demands of an ageing society were developed. In a first step, these measures were matched to the general parameters and the dynamics of the Swiss settlement type 'neighbourhood with single-family houses'. On this basis, two contrasting case examples were chosen. For these the realisation of the measures was evaluated with the help of test plans. As a result, planning strategies were developed for the regarding cases in order to adapt them better to the demands of an ageing society.

3 AGEING IN PLACE

Today's popular label 'ageing in place' usually stands for interdisciplinary approaches or rather attempts to generate options for staying in a chosen environment. 'Ageing in place' is not a fixed and clearly defined term but rather a dynamically changing idea. Although it is today generally understood as the ability "to remain in one's own home or community in spite of potential changes in health and functioning in later life" (SCL & MetLife, 2013), ageing in place is not a cohesive concept or even a theory but rather a kind of organising principle owing its political legitimation to

supranational proclamations and programmes (OECD, 1994). On an academic level the discussion traces back to the early approaches of environmental gerontology and to geographical gerontology, which developed from human geography, and leads up to contemporary concepts of ecological gerontology (Claßen & Tesch-Römer, 2014; Friedrich, 1995; Wahl, Mollenkopf, & Oswald, 1999) and to the different ideas of aging in place (Callahan, 1993; Lee, 2009).

Architecture and urban planning have regarded the demographic change and the resulting consequences on a neighbourhood level as a peripheral topic for a long time. They mainly focused on the planning of age-appropriate housing or inpatient care facilities (Kreuzer & Reicher, 2008). Since a few years the perspective has shifted away from the individual building. Most recent surveys, for instance, underline the relevance of the living environment or rather of the neighbourhood for living in old age (Höpflinger & Wezemael, 2014). For planning, therefore, the question occurs: Which (urban) planning measures and parameters could contribute to a successful ageing in place on a neighbourhood level?

Defining elderly people as a homogenous group with homogenous demands on their neighbourhood would obviously fall short. Referring to the matching model of ecological gerontology (Carp & Carp, 1984; Kahana, 1982), the research project analyses numerous mismatches between elderly persons and their neighbourhood. For these cases (urban) planning measures are developed in order to guarantee an independent and self-determined life in a familiar living environment despite a decline in competences.

4 SETTLEMENTS WITH SINGLE-FAMILY HOUSES

For a long time the privately owned home has been a synonym for the ideal of individual living which embodies autonomy, privacy and identity (Häussermann & Siebel, 1987; 2000; Häußermann, Siebel, & Wurtzbacher, 2004). It represented the desire to live in a green environment, to have family and property (Bourdieu & Steinrücke, 1998; Junker, 1985). It correlates with what is perceived as a normal form of family life and the accompanying settlement type, the neighbourhood with single-family houses, has not been considered problematic for a long time (Aring, 2012; Berndgen-Kaiser & Krajewski, 2015). With the changing demographic conditions, however, neighbourhoods with single-family houses could become a problem for neighbourhoods and cities very soon (Eisinger & Schneider, 2005; Krajewski, 2015). There is evidence that this type of settlement could for the first time lose its attractiveness and population (Berndgen-Kaiser et al., 2014). This development is ascribed to changing employment histories or rather the shift of workplaces (Häussermann, Läpple, & Siebel, 2008). In Switzerland this is most visible in a strong demographic rejuvenation in the urban centres. The suburban neighbourhoods were shaped by the influx of families in the 1970s, in particular. If the ageing residents stay in their single-family houses and if no young inhabitants move to the neighbourhoods in the course of a structural redensification, fast demographic ageing is predicted for these neighbourhoods. The periurban spaces of Switzerland show a similar demographic structure to the suburban spaces. However, they were shaped by the influx of families in the 1990s, and a similar development to the suburban neighbourhoods seems possible (Höpflinger & Wezemael, 2014). In particular peripheral or poorly connected neighbourhoods with single-family houses register a sharp fall in demand (Credit Suisse, 2010).

In order to describe the development of demographically homogenous neighbourhoods with single-family houses, the concept of 'threefold cyclicity' developed by Schnur (2010) is suitable. He assumes structural, planning and demographic cycles for a neighbourhood. The shape of these three cycles and their relation to each other are dependent on the individual, local parameters. For an ideal-type, homogenous neighbourhood with single-family houses one can sketch the following development: Before starting the construction of the buildings there is high planning activity in the neighbourhood. By the end of the building process it rapidly drops. It only rises again with a problematic development of the neighbourhood and a new planning cycle starts. The demographic composition of the neighbourhood is relatively heterogeneous in the beginning. Over the years the neighbourhood with single-family houses is not characterized by nuclear families anymore but almost entirely by elderly single- or two-person households. If they die or leave the neighbourhood new families move in and the next demographic cycle starts. The structural cycle describes the need for renovation in the neighbourhood, according to Schnur. But it could also be understood in terms of the matching of resources and skills of the residents with their buildings and the infrastructures of the neighbourhood. After the completion of the buildings and the move-in there are only few deficits and both the building and the infrastructures correspond to the demands of the nuclear families living there. In the course of time the need for renovation rises steadily, or rather the spatial configurations and parameters might not match the changed

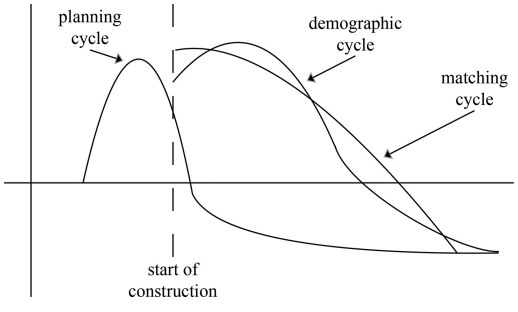


Figure 1. Development of an idealtype, homogenous neighbourhood with single-family houses.

living conditions of the inhabitants anymore. Parameters which were suitable for a nuclear family might not be ideal for an elderly single- or two-person household anymore. A new cycle starts when building and infrastructure are renovated and adapted to the altered demands or new inhabitants move into them. These cycles do not necessarily have to undergo a crisis (Nuissl & Bigalke, 2007). In Switzerland the proximity to an urban centre, or the position at transport corridor, seems to be an important factor for this.

5 CRITERIA AND MEASURES

Although this topic has received relatively little attention so far, a number of planning approaches for age-appropriate conceptions of neighbourhoods exist. On an international (e.g. WHO, 2007), regional (AGS Schwyz, 2006) and in particular on a communal level (e.g. Stadt Bern, 2014; Stadt Wuppertal, 2010) different actors deal with this topic. On the basis of a cross-evaluation of such international, national, cantonal and communal strategies, practical examples and research studies (e.g. Friedrich, 1995; Großhans, 2001; ISRW, 2011; Kreuzer, 2006; Kreuzer & Reicher, 2008; Saup, 1993; Schnur, 2010) five subareas have been identified within the framework of the research project which are central for an (urban) planning adaptation of a neighbourhood to the demands of an ageing society: living space, mobility, local supply, assistance and care, leisure time and (social) activities.

Below the subdivisions and their regarding measures are presented in order to then match them with the general parameters of the Swiss settlement type 'neighbourhood with single-family houses'.

5.1 *Living space*

Living space also takes a central role in a neighbourhood-related perspective. When reaching post-retirement age and in particular with restricted mobility the significance of one's own home can increase strongly (Höpflinger & Wezemael, 2014). Especially in cases of physical limitations barriers can occur in the flat which can sometimes be reduced only with considerable effort. But also change of the household form, e.g. because of children moving out or the death of the partner, can result in a home which does not fit anymore. Here a barrier-free adaptation or moving into a more suitable home in the same neighbourhood can, depending on the individual situation, be the better solution.

As the name says, the spatial programme of single-family houses is primarily directed towards the needs of families. The living space which stretches over several floors is typically dimensioned for two adults and for two to three children. Single-family houses which were constructed between the 1960s and 1970s often do not match today's demands anymore when it comes to the floor plans, the size of rooms and the views to the outside (Gutmann, Pletzer, & Schweizer, 2004). Here a particularly problematic aspect is this building type's resistance to change and conversion (Krause, 2014).

Because of the many thresholds and steps in front of and in the building, staying in the single-family house is often not possible for persons with restricted mobility. In some instances barriers can be removed comparably easily. The additional installation of a lift, however, is a substantial change and connected to relatively high costs (Schumann, 2008). Therefore, the aim to offer a wide range of barrier-free flats for household forms beyond the nuclear family seems hard to implement in this settlement type.

5.2 *Mobility*

During old age the length of single ways and the overall distances covered decrease while the mobility within walking distance increases. With a decline in mobility the access to local supply shops, to medical facilities, or to friends and family can become difficult. Without the possibility of using a car the individual radius of mobility shrinks. Depending on the previous mobility pattern, this can be a sharp break for persons concerned. It can make an independent and self-determined life in the familiar environment more difficult or even impossible (Kirsch, 2015; Kreuzer, 2006). Therefore, a barrier-free, local public infrastructure within walking distance is of particular importance in a neighbourhood. Concrete measures involve, for example, a continuous, barrier-free walkway system, a clear division between the different types of traffic and a good connection to public transport.

Neighbourhoods with single-family houses are regarded as a settlement type which only became possible with the spread of the car. Hence, it is the primary means of transport here and the street areas are adapted to its demands. Planned for residential use only, there are attempts to keep the traffic in neighbourhoods with single-family houses as low as possible. In ideal cases a single distributor road connects the whole neighbourhood. In the core of the settlement transit traffic is avoided through a road network which branches out into blind alleys. Normally neighbourhoods with single-family houses are linked through the bus lines of the public transport system. In the 1980s in Switzerland settlements next to transport corridors were also connected to the suburban train (Bosshard et al., 2015; Häußermann & Siebel, 2000).

In principle the low traffic in neighbourhoods with single-family houses promotes a mobility within walking distance. Furthermore, a basic distinction has to be made between centrally located neighbourhoods, or rather neighbourhoods located at a transport corridor, and peripheral neighbourhoods. In peripheral locations it might not be possible to access offers and infrastructures outside one's own neighbourhood without a car, while this is well possible in well-connected neighbourhoods. Therefore, centrally located neighbourhoods with single-family houses seem to match the demands of an ageing society while peripheral locations show difficult parameters here.

5.3 *Local supply*

The ability to provide for oneself is key to an independent and self-determined life. For this to be possible there should be sufficient supply within walking distance and without barriers in the neighbourhood. This includes for instance: bakeries, newsagents, grocery stores, chemists' shops, banks, hairdressers, doctors and pharmacies. A maximum distance of ca. 500 metres is considered ideal here (ISRW, 2011).

As a product of the Fordist city the neighbourhood with single-family houses is oriented towards residential use only. A mix of uses is uncommon or even forbidden in this settlement type. Furthermore, it is an unattractive position for offers by local suppliers because of the low housing and population density and because of the missing transit traffic (Wölter & Zimmer-Hegmann, 2008). The building typology, a detached house surrounded by a private garden, makes commercial use difficult, too. Because of these factors local supply tends to stay outside the typical neighbourhood with single-family houses. In view of the decreasing mobility and the related importance of local supply, neighbourhoods with single-family houses seem to offer a poor framework for an ageing society.

5.4 *Assistance and care*

Just like independent supply, the fields of assistance and care are important for a successful ageing in place. Assistance makes everyday life easier; care services are essential. Besides conventional nursing homes, local centres for day care or short-term care or forms of assisted living. Assistance services, for instance for shopping or doctor's visits, can increase the quality of life substantially. Outpatient care, in Switzerland Spitex, is regarded as a spatially relatively independent element.

With a high percentage of elderly people even neighbourhoods with a low population density can show a high demand for assistance and care services. Neighbourhoods with single-family houses are generally not a problematic location for facilities like nursing homes, assisted living, and forms of shard living. In particular small institutions and privately initiated projects could be realised here in terms of decentralised care.

5.5 *Leisure time and (social) activities*

After retirement the importance of the living environment as a place for social contacts and for leisure activities increases. Long-term inhabitants could also turn to numerous existing contacts in the neighbourhood (Höpflinger & Wezemael, 2014). By valuing public spaces, barrier-free, high-quality places can be created. Parks or community gardens which are oriented towards persons with physical of cognitive limitations offer attractive leisure activities. Besides clubs and churches, meeting places in the quarter can facilitate finding contacts. Finally, it is possible that community housing projects contribute to a stronger integration of residents in the neighbourhood (Müller, 2015).

In the settlement type neighbourhood with single-family houses public space plays a minor role. Parks, places or particular streets, which can be a stage for public life in an urban context, are an exception here. The private home and especially the private garden let public spaces appear obsolete. Yet, it is questionable to which extent this idea can hold true (Moser & Reicher, 2002). The garden in particular can become a challenge in cases of increasing physical limitations. If neighbourhoods aim at integrating residents through a community centre or café, a neighbourhood with single-family houses are a difficult location. A facility which is located in the town centre usually reaches more residents.

In view of these parameters an upgrading of public space in a neighbourhood with single-family houses seems difficult. A qualification of the adjacent landscape, however, offers a promising approach. In line with the idea of living in a green environment, barrier-free, high-quality places close to nature and with a wide range of leisure activities can be created here. Nevertheless, for an integration of the inhabitants in this type of settlement, community housing projects seem to be more realisable than establishing meeting points in the neighbourhood.

6 STRATEGY CASE EXAMPLES

As case examples two contrasting neighbourhoods with single-family houses in Northwestern Switzerland were chosen. The guiding assumption for the selection was that for neighbourhoods with single-family houses the connection and the proximity to a centre are decisive factors for a successful ageing in place. Case example A is the well-connected neighbourhood. The centre of the neighbourhood is ca. one kilometre, the urban centre Basel ca. six kilometres away. Access to the suburban train is within a maximum of 1.8 kilometres, to the tram within a maximum of 850 metres and to the next bus stop within a maximum of 450 metres. The residents of case example B generally depend on a car. Although a bus line exists, it is not an attractive alternative because of its low frequency. Analysing the structure of the buildings and the settlement and considering the regional contexts suggest different strategies for adapting to the demands of an ageing society for the case examples.

Neighbourhood B shows a problematic future perspective. It is a residential neighbourhood without local supply or other offers. Because of the low population density, a regular local offer is economically not possible and it is unrealistic for the near future as no increase in population is expected. Without a car it is difficult to maintain an independent and self-determined life in the neighbourhood. A successful ageing in place could be made possible by mobile solutions. These might include a mobile village shop, transport services for shopping trips or a market with automats. The latter, for instance, was installed in the

Swiss neighbourhood of Kägiswil in the rooms of a former village shop in the centre of the settlement and offers about 140 products for everyday use (BUNBR, 2014). A further possibility seems to be a supply provided by internet shops. However, taking into account that only 12% of the over 80-year-old Swiss living at home have internet connection, it is questionable to which extent this actually succeeds (Höpflinger & Wezemael, 2014).

Case example A already shows good parameters for a successful ageing in place. Although there are no non-residential buildings in the neighbourhood itself, supermarkets, a number of doctors, a home for the elderly, or rather a nursing home, and even a meeting point for senior residents are accessible within a radius of less than 1.5 kilometres. Only the possibilities of living space show deficits. For case example A the strategy is to create heterogeneous forms of living space. Through this the neighbourhood becomes attractive for households beyond the nuclear family, too, and the overall population can become demographically more heterogeneous. With reference to the above-mentioned model of the 'threefold cyclicity' by Schnur, this would moderate the demographic wave. In order to create diversified possibilities of living space, altering existing buildings seems obvious. The study by Beyeler (2010), for instance, shows that this is possible despite the stated resistance to change and conversion. Still, new living space needs to be created in order for new residents to move to the neighbourhood before a demographic cycle is closed. Two possibilities arise here: An outward extension or a structural redensification. The former seems problematic in the light of the political call for holding back suburban sprawl often discussed in Switzerland. Because a particular potential for inner development is stated for the settlement type 'neighbourhood with single-family houses' and because there is currently a high demand in living space in case example A, this approach seems promising (Bosshard et al., 2015; Metron, 2011). The detailed ownership structure of this settlement type might be problematic in case of a redensification. Yet, investigations such as Gutmann et al. (2004) or Frei's (2011) point out possibilities here. Just by conversions and extensions within an existing single-family house a remarkable potential for living space can be unlocked (Gutmann et al., 2004). Because a number of buildings in case example A do not make use of the existing possibilities in building law, there is further potential for redensification through extension or reconstruction. The Danish community housing projects for seniors (*Seniorbofællesskaber*), for instance, show that very good, barrier-free solutions are possible for new constructions within the building type 'single-family house' (Age Stiftung, 2011). The biggest potential, however, lies in the regarding alterations of building law. Especially properties next to access roads are particularly suitable for a partial redensification of the neighbourhood structure.

Decisive for a success of this strategy is that the neighbourhood takes on an active role in this process. Within the framework of information campaigns it can inform residents about the possibilities of redensification and barrier-free restructuring measures and thus initiate a development in the neighbourhood at an early stage. Especially the cooperation of neighbourhoods with unions and foundations for multigenerational community housing projects seem to be a promising approach. Housing projects like the Zurich Kalkbreite with a broad range of flats for communities, families, couples and singles demonstrate ways of successful multigenerational housing (Weidmann, 2014). Building more densely could in turn make uses possible which would not be profitable in a conventional, decentralised neighbourhood with single-family houses: shops, doctors' practices, a better connection to public transport, a meeting point in the neighbourhood, or care facilities.

7 CONCLUSION

It becomes apparent that within this settlement type individual neighbourhoods with single-family houses show very different potentials for a successful ageing in place. The central criterion seems to be the proximity to a centre and the connection to public transport. Because of the homogeneous use of the neighbourhood, residents rely on local supply outside their neighbourhood. In poorly connected, peripheral locations independent and self-determined housekeeping is difficult without a car. In central, well-connected neighbourhoods, on the contrary, one can resort to public transport or reach the centre by foot. For the less-connected neighbourhoods with single-family houses establishing mobile services and the possibilities of internet shopping seem promising. By contrast, well-connected neighbourhoods have a more comprehensive framework for action. A partial redensification can produce barrier-free flats and make the settlement also attractive for household forms beyond the conventional nuclear family. After all, the redensification of neighbourhoods with single-family houses is an answer to the question discussed throughout Switzerland: How can the growing demand for living space be met without further soil sealing?

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Dwelling and family diversity: Analysis of housing units and households in Lisbon

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ABSTRACT: Western society has undergone numerous changes. Alterations in family composition are the most noticeable. The traditional nuclear family which has been the basis for housing design since the Modern Movement has decreased in importance and other family compositions are now more representative. The paper focuses on the analysis of housing units occupied by different households to ascertain dwelling uses and transformations to satisfy inhabitants' demands and needs. The research is based on case study analysis, through post-occupancy evaluations and enquiries. Two groups of housing units in Lisbon are analyzed, so to understand if contemporary units serve contemporary inhabitants better than one century old dwellings. The main purpose of the paper is to analyze how we use our homes and also to allow for the identification of the dwelling's spatial or functional shortcomings, so that future projects and designs can be more suited to contemporary society and families.

1 INTRODUCTION

1.1 *Scope and motivation*

Portuguese population has evolved and family transformations in the last decades are the most noticeable. The traditional nuclear family which has been the basis for housing design since the Modern Movement has decreased in importance and other family compositions are now more representative, such as single people, double income no kids (DINK), aged person alone and single parents, among others. This transformation of one of the most pivotal society entities has a direct influence in housing design and project brief as well as housing use.

The main goal of this paper is to analyze two different housing units – one from the beginning of the 20th century, the other from the beginning of the 21st century – occupied by different households, with the objective of ascertaining house use and housing adequacy to dwellers' needs and demands, both spatial and functional. This analysis should allow for a realization of how modern society perceives and uses its dwellings and, as a result, the identification of the latter's shortcomings in order to adapt future projects to contemporary society and families.

This research, grounded on the study of contemporary society, particularly on the analysis of the use of the housing unit, functional and spatial demands, should thus allow for a real contribution for the society in which it is based, favoring the improvement of living conditions, highlighting once more the social role of the architect as a researcher and designer.

1.2 *Societal changes*

As afore mentioned Portuguese family composition has undergone several changes in the last decades. These changes are attested in Censuses reports. According to *Instituto Nacional de Estatística* (*Statistics Portugal*) *in the last decade family transformations and that of its place in society have accentuated* (INE, 2011).

The most relevant alterations are the following: decrease of family's average dimension from 2.81 people in 2001 to 2.58 people in 2011 (in Lisbon this value is even lower at 2.4 people per household); a notable increase of one-person families (from 17.3% in 2001 to 21.44% in 2011), with relation to population ageing; the decrease of children (64.76% to 58.79%) and, finally, the increase of single-parent families (an increase of 36% in a decade). As per Statistics Portugal, in the 2011 Census report, *the increase of the proportion of single-parent families in the total of families, of approximately 4pp between 2001 and 2011, reveals the alteration of family living model that modern society has undergone* (INE, 2012).

2011 data reveals that the two-person household is the most frequent, followed by the three-person, single-person and only then the four-person household. The same data show that there has been a significant percentage increase of two-person and single-person households in the last two decades, accompanied by an also significant decrease of relevance of the four-person and five or more-person households in the Portuguese society (Figs. 1–2).

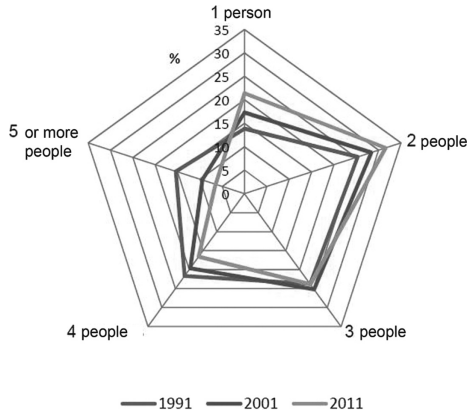


Figure 1. Household composition. Source: Statistics Portugal, 2012 (adapted by author).

	2001	2011
Classical families (number)		
Portugal	3 650 757	4 043 726
Average size		
Portugal	2,81	2,58
(%)	2001	2011
Single person classical families		
Portugal	17,3	21,44
Classical families composed of elderly person (65 or more) alone		
Portugal	8,79	10,06

Figure 2. Table illustrating family average dimension (second row), percentage of single-person families (third row) and percentage of single-person families composed of and elderly person (65 years old or more; fourth row). Source: Statistics Portugal, 2012.

These statistical data support the importance of a reformulation of housing design and functional programme to better serve these new households and their needs.

2 ANALYSIS

2.1 *Methodology*

In order to understand house-use and occupant's needs and opinions towards the dwelling it became evident that Post-Occupancy Evaluation was the most adequate methodology, since it permits the identification of house-use, spatial and functional alterations and the inhabitant's assessment of the dwelling and aspirations regarding the ideal home.

Post-Occupancy studies have become more common and relevant in housing and occupant satisfaction analysis, being central in the work of many architects and teams with the objective of transforming dwelling interiors so that they become more adequate to effective use. In Brazil, POE (Post-Occupancy Evaluation)

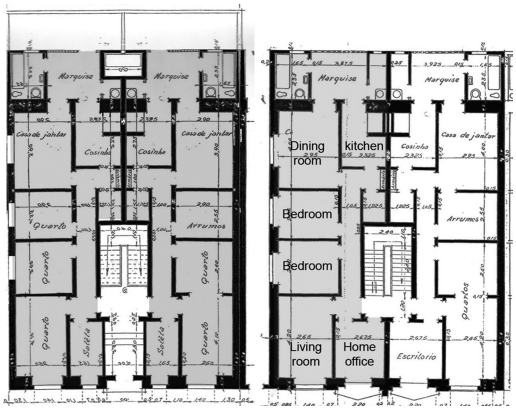


Figure 3–4. Ground floor and first floor plan with indication of analyzed units.

have been having great development, being relevant studies by of Ornstein, Villa and Rheingantz. In Portugal these studies are still in need of greater progression, being relevant the works of Ramos, Pereira (1984), Portas (1979) and Pedro, the last three for the same institution, LNEC – Laboratório Nacional de Engenharia Civil (*Civil Engeneering Nacional Laboratory*).

In this paper a comparative evaluation (Villa & Ornstein 2006) as well as an evaluation with ecological method (Macfarling & Heimstra 1978 *apud* Villa & Ornstein 2006) is suggested. This last method consists of the observation of inhabitant's behavior without variables manipulation. The POE is based on this observation, by means of visiting the dwellings, and also in an inquest divided into two: household characterization and dwelling characterization. The latter aims at understanding the dwellers' satisfaction towards the unit and its room's areas, layout and privacy; the time spent in the unit; the room where the dweller mostly spends his time in; the rooms where he/she develops other activities; concluded alterations and why; which alterations would the dweller like to have done, why and why they haven't been executed already and, lastly, the description of the ideal dwelling.

Parallel to this POE and aiming at spatial and functional configuration characterization, a space syntax analysis (as introduced by Hillier and Hanson) by means of justified graphs is executed, in order to schematize the dwelling's organization.

2.2 *Dwelling characterization*

2.2.1 *Early 20th century building*

Built in the beginning of the 20th Century, the first case-study building is composed of three-bedroom units that are comprised of dining room, kitchen, toilet, kitchen support area, bedrooms (one of the ground floor units initially had a closet space instead of the third bedroom) and a small living room in ground floor units and an office in all other floors.

For this paper three units were analyzed – the two ground floor units and one on the first floor (Figs. 3–4).

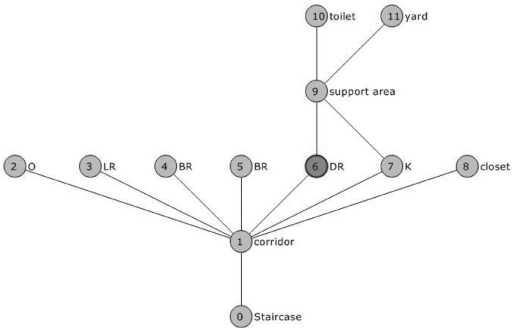


Figure 5. Justified graph schematizing dwelling layout (ground floor unit E). O-Office, LR-Living room, BR-Bedroom, DR-Dining room (darker color), K-Kitchen.

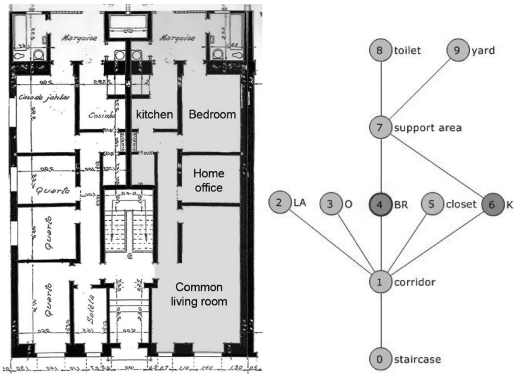


Figure 6–7. Current ground floor unit R plan with current use indication and justified graph schematizing dwelling layout. O-Office, LA-Living area, BR-Bedroom, DR-Dining room, K-Kitchen.

Ground Floor Unit E

Household characterization – single person alone, elderly

Amount of time inside the unit, daily – more than 8 hours/day

Duration of inhabitation – more than 20 years (46)

Currently occupied by a single person (it was once occupied by 2 to 3 people of the same household) this unit has not been altered in layout. The only alteration has been a functional one – the two rooms near the entrance, initially a small living room and a bedroom, were transformed into an office and a formal living room respectively.

As for the dweller's satisfaction towards the unit's area and that of the several rooms, a value of 4/5 was attributed to the kitchen and to the unit in general, although the remaining spaces individually only got 3/5, indicating that they are considered somewhat small. Space for furniture also got 3/5, corroborating the previous result. Nevertheless, the dweller is satisfied with the unit's layout and considers it to be adequate to the family's needs (value 5/5).

Regarding room use, the inhabitant stated that the dining room is where she spends most of her time and where other activities take place such as intellectual work (as in the kitchen and office), watching TV (as in the bedroom) and entertaining. House work is exclusive to the kitchen. These answers show us that the dining room is the nuclear space of the dwelling, which is easily understood when analyzing the floor plan where it is notable that this space is the one with bigger dimensions and better proportions and being situated near the kitchen support area, the one with better natural lighting conditions. This fact is attested by a space syntax analysis, namely the representation of the layout through a justified graph (Fig. 5), where we see that the most integrated (central) spaces are the dining room and the kitchen.

When inquired about alterations the dweller would like to execute, the need for storage became evident.

Ground Floor Unit R

Household characterization – DINK, retirees

Amount of time inside the unit, daily – both less than 5 hours/day

Duration of inhabitation – 5 to 10 years

Unlike the previous unit in the present case-study alterations have been made, prior to present dwellers inhabitation: the three rooms near the entrance (initially living room and two bedrooms) were transformed into one single space – a common living room –; a closet was transformed into an office (without natural lighting) and the dining room into the master bedroom (Fig. 6). These consist of layout and functional alterations and although the dwellers weren't the executioners they agree with them.

With regards to satisfaction towards the dwelling, both inhabitants agree that it suits the family's needs (5/5) although they state that room dimensions aren't ideal (unit area and individual rooms' areas received 3/5). This may lead to the statement that a single-family house is their ideal dwelling, one with *generous areas*.

As for the spaces where the couple spend more time, the husband marks the office (even though he is retired he still develops professional activities at home) and the wife the living room. It's in these spaces each of them develops intellectual work. Entertaining and watching TV pertain to the living room and house work to the kitchen. Neither feel the need of a different space where to develop other activities nor do they express the need or will to do further alterations, either spatial or functional.

1st Floor Unit E

Household characterization – single parent (mother and daughter)

Amount of time inside the unit, daily – both less than 5 hours/day

Duration of inhabitation – 5 to 10 years

This unit has also been altered in both layout and room function. The two spaces near the entrance have been unified and used as a living room (spatial and functional transformation); the two middle bedrooms

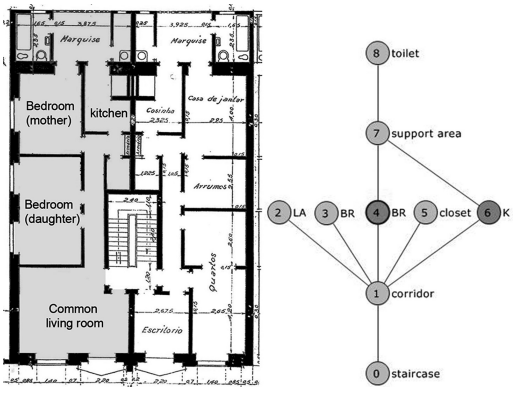


Figure 8–9. Current 1st floor unit E plan with current use indication and justified graph schematizing dwelling layout. O-Office, LA-Living area, BR-Bedroom, DR-Dining room, K-Kitchen

have also been merged together to accommodate the daughter's bedroom (spatial transformation); the dining room was transformed into the mother's bedroom (functional transformation) (Fig. 8). As in the previous unit, these transformations were also carried out prior to this family's inhabitation, the difference being that the mother does not agree with them, the daughter does.

In terms of satisfaction towards areas, both consider that the rooms are well dimensioned (4/5). The daughter believes the dwelling to be suited to the family's needs (4/5) and the mother to be extremely suited (5/5). The daughter highlights the shortage of space for furniture (3/5) and both feel the need for more storage area (especially closets in the bedrooms). When asked about the ideal dwelling, both value characteristics such as *spaciousness* and *good areas*, and the daughter states the need for a bigger bathroom.

Regarding space use both entertain and watch TV in the living room (this space bears social functions as well as common family activities) and both do house work in the kitchen, where the mother also develops some intellectual work, whereas the daughter tends to do the same in the bedroom. Since the mother uses the kitchen for her intellectual activities she asserts the need for a space that would fit this demand. The daughter would like to have a private exterior space, a yard.

2.2.2 *21st century building*

The current case-study consists of a public investment housing ensemble in essence destined to young people but in fact inhabited by all kinds of households (in age and composition). Housing typologies encompass studios, one-bedroom, two-bedroom and three-bedroom dwellings. For this paper, as with the previous case-study, three units were analyzed: two one-bedroom units and one two-bedroom unit (Figs. 10–13), inhabited by households other than the nuclear family.

T1a Unit

Household characterization – single person alone

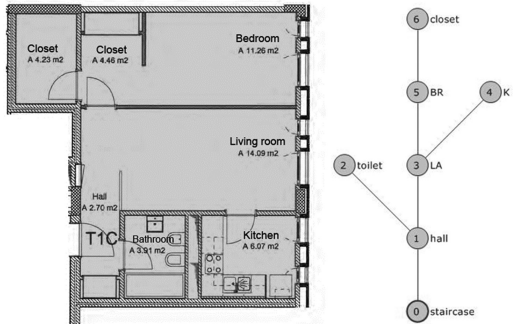


Figure 10–11. Plan and justified graph of the one-bedroom unit (T1a and T1b).

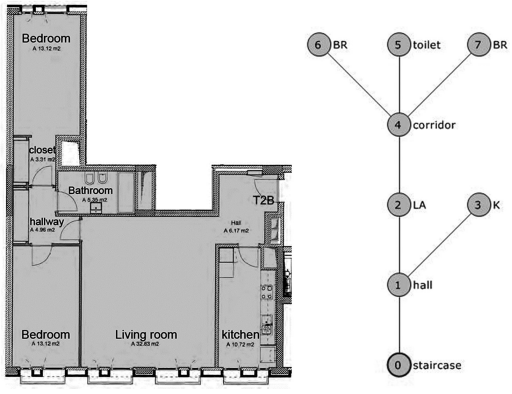


Figure 12–13. Plan and justified graph of the two-bedroom unit (T2).

Amount of time inside the unit, daily – 5 to 8 hours/day

Duration of inhabitation – 5 to 10 years

In this unit a single and simple alteration was observed – the elimination of the separating panel between the entry hall and the common living room. This does not qualify as either functional or spatial transformation due to its little effect in overall use or spatial feel.

Having a total of usable area of 49.85 sm, the dweller's satisfaction towards its dimension is average (3/5), stating a complete dissatisfaction towards the kitchen area (1/5) and an average satisfaction towards the common living room area (3/5). Only the bedroom area and apartment layout are awarded 4/5. In terms of adequacy to the family's needs, the value is less than average (2/5), signifying that the demands of the inhabitant are not met by the dwelling.

The living room is the space where the dweller most spends her time, being the room where she entertains, watches TV and also develops intellectual work. This accounts for the recognition of the need for another space, a home office, to develop this activity, a demand not met in the present dwelling.

When asked which alterations would she like to have done, only aesthetic ones are mentioned which

could be related to the fact that a small apartment does not permit many spatial or functional alterations. As for the ideal dwelling, the inhabitant highlights the aspiration for bigger balconies, a patio and a big kitchen, which are also indicative of the present dwelling's shortcomings.

T1b Unit

Household characterization – single person alone, elderly

Amount of time inside the unit, daily – less than 5 hours/day

Duration of inhabitation – 1 to 5 years

T1b unit is also occupied by a single person living alone, according to whom no alterations have been done to the existing layout. Unlike the previous case study's dweller, this inhabitant, regarding a similar unit, shows a greater degree of satisfaction towards it (4/5) and towards rooms' area (4/5) with the exception of the kitchen which area was classified as average (3/5). The space where the dweller most spends time is the common living room, where she also develops all other main activities – entertaining, watching TV, house work and intellectual work.

The dweller is content with the apartment saying that it serves her needs and therefore characterizes it as the ideal dwelling for the meantime.

T2 Unit

Household characterization – DINK

Amount of time inside the unit, daily – 5 to 8 hours/day (her), more than 8 hour/day (him)

Duration of inhabitation – 1 to 5 years

Like the previous unit, the two-bedroom variant shows no alterations to the original layout. Both dwellers find the total area satisfactory (4/5) but state dissatisfaction towards the kitchen area (2/5) and characterize the bedrooms as being average (3/5). Opinions differ in the degree of satisfaction towards the living room area, which the wife finds excellent (5/5) and the husband average (3/5), as well as dwelling layout which is satisfactory to the husband (4/5) and average to the wife (3/5). The couple spends more time in the living room, stage to other activities (entertaining, watching TV, house work and intellectual work) and state the need for bigger outdoor space. Apart from this, they also highlight as shortcoming the poor natural lighting and construction materials, characterizing the ideal dwelling as one having big balconies, good areas and storage and good materials.

3 FINDINGS

As mentioned earlier, the scope of the paper is the analysis of the relation house-use and family diversity, through the study of two types of units occupied by emergent households. The main goal is to understand how two different units, built a century apart, respond to the needs and demands of contemporary families, and in what degree are these dwellings formally and functionally adequate.

According to the POE based on observation (*walk-through*) and an inquest, it is notable that the older dwellings, in their initial layout and programme, are not adequate to current households and their needs. In two of the analyzed units alterations to layout have been made demonstrating some dissatisfaction towards room dimension and indicating the need for bigger areas. This area increase, attained through room merge, also indicates that very fragmented and compartmentalized interiors (smaller areas) are not presently desirable. The observed interiors may also be an indication that smaller households, by not needing many private spaces (bedrooms), tend to prefer room dimension instead of quantity. The main alteration in two of the dwellings was the merging of two spaces to contain the living room, which leads to the conclusion that common living spaces for social activities are the ones that should present bigger dimensions.

Apart from layout transformations there were also functional ones, *i.e.*, the change in space use. This alteration could be related not with the type of household but with society evolution and its concept of dwelling, privacy and comfort. In all older dwellings the bedroom facing the street gave way to other uses, being the bedrooms relegated to the interior of the unit, therefore more private. Rooms near the entrance and street are used as living room or common living room (living and dining room), with a more public character (to entertain visitors and with a closer connection to the street), for social activities and common family life.

A notable fact is also that of the diverging opinions in the mother-daughter household, the one that presents more differences in the satisfaction inquest. This could be explained by the different needs of the two members regarding the domestic space, as opposed to a married couple that tends to develop activities together in the same spaces and therefore have similar opinions towards them.

As for the results of the newer dwellings, it is curious to realize that the overall feeling of adequacy to the family's needs is much lower than that of the older units. On average, the newer units register 2.75/5 in adequacy whereas the older ones 4.8/5. This could lead us to conclude that contemporary layouts fail to better serve the needs of the households. A possible reason could be the lack of opportunity for transformation of a too rationalized and, in the present case, almost minimal area dwelling: over-rationalized layouts and programmes do not give way to personalization and individualized use. Sust (2000) states that *the reduction of dwelling area makes it difficult to respond to inhabitants' needs and limits flexibility and therefore the diversity of use*. Oliveira (2001) also highlights spatial flexibility as a characteristic that can prolong a dwelling's adequacy, better relating to social alterations and needs throughout its life span. Nonetheless, the degree of satisfaction towards the total area of the unit is very similar in both older (3.6/5) and newer dwellings (3.75/5).

Unlike the older units, in the newer dwellings no alterations were registered, either to layout or space use. This could be related to the fact that current layouts correspond to the expectations of modern society, placing the social functions and common spaces near the entrance and the more private functions and spaces in a deeper level (as represented in the justified graphs) In fact, the average degree of layout satisfaction is 3.75/5 in the newer dwellings, curiously not much different from that of older dwellings (3.6/5). As for room dimension, overall in the newer dwellings a more than average degree of satisfaction was registered, with the exception of the kitchen that registered and average of 2.25/5 (in the T1 units the kitchen is extremely small, 6.07 sqm – Portuguese housing legislation, RGEU, establishes a minimum of 6 sqm for this space, an area that remains unchanged since 1951 when it was first written and when the minimal Modern Movement areas were *in vogue* and when, in Portugal, social housing was the main focus of the architects).

As a similarity between all dwellers, almost all members of the different households develop intellectual work in the living area, when there is no specific room for it, which indicates a demand for introducing such spaces in future briefs. Furthermore, in both cases – older and newer dwellings – people's aspirations are very similar: bigger areas, the need for outdoor space, good location and good lighting conditions.

3.1 *Conclusions*

Although the research is in an initial phase, hence discussing the article only two case studies, the comparison between early 20th century dwellings and 21st century ones made evident that in their original layout and programme the former do not suit emergent households' needs and demands, but curiously, appear to be more flexible and allow for transformations that enable a better adequacy to intended use than the latter. Furthermore, close to minimal interiors (in area and number of rooms) could not be adequate to smaller households inspite of the reduced family composition, one reason for this being the change in working habits that dictates that many people now work from home and have the need for a specific space to develop a professional activity.

The author believes that the conducted analysis was important in the way that allowed for a comparison between two very different housing units – a more fragmented but curiously more flexible older dwelling and a rational and rigid newer dwelling – which permitted the realization that space use and adequacy could probably be finer in non-determinate and non-immutable spaces. From this perspective, it would be interesting to compare results of the same analysis of a loft-type dwelling where nothing is determined and possibilities are endless. It is also important to note the relative limitation of having only two case studies, in a research that is now initiating and that will be built upon a more numerous array of examples.

To conclude, the author considers that it is important to reiterate the relevance of POE as an analytic tool, that allows for the understanding of the needs and demands of dwellers and thus to better design for contemporary and future society, in conjunction with Space Syntax theory that enables a better layout study, clarifying relations between spaces and their meaning and functionality for the dwellers.

It is thought that this paper is relevant in the investigation of Housing and its relation with society and that it can shed some light on dwellers actual needs and opinions towards inhabited spaces in order to better design for the future so that adequacy to ways of living and household characteristics are achieved.

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Equality of energy efficiency for low-income housing in the Mississippi Delta

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ABSTRACT: Within the context of an increasingly connected society, a growing awareness of the concentration of wealth among a small minority, and the threats posed by climate change; access to healthy, affordable and efficient housing is an imperative in the design of equitable communities. Not all sectors of society have access to housing that satisfies even the most basic needs of shelter or efficiency. As architects, we seek to shift this paradigm beginning with an understanding of baseline conditions. This paper chronicles efforts to determine the energy efficiency rates of a sample of low-income housing in the Mississippi Delta as a first step toward developing solutions for fair, sustainable housing.

A clear picture of energy efficiency, or inefficiency, in existing low-income housing in the Mississippi Delta does not exist, and the rate of air infiltration in this housing sector is an understudied subject. Blower door tests are typically performed on new housing to insure they meet current code mandated air infiltration standards, but blower door tests can also be used to measure the "as-is" air infiltration condition of a home. In this study, blower door tests were performed on 27 houses in Greenwood, MS, to determine how many air changes per hour (ACH) are occurring in real living conditions. This data was collected as a first step toward understanding and addressing the health and financial burdens imposed on the homeowner by inefficient housing.

Preliminary results show that older homes have a much higher ACH rate – sometimes too high to even measure – than newer housing. On average, homeowners of typical existing housing are expected to spend approximately $150 during a typical December to maintain 65°F (18°C) indoors – a significant amount for a region where 40% of the population lives below the poverty level (US Census Bureau, 2014) This can be attributed to era construction techniques and a lack of maintenance. Additionally, results show a strong correlation between high ACH rates and window air conditioning units that are not seasonally covered or removed.

The value of this research is identifying the monetary costs and health burdens associated with low-income housing in Greenwood, Mississippi, and providing a framework for responding to these burdens through recommendations to non-profits, housing authorities, municipalities, developers, and architects. The study is a first step within a larger framework, but begins the process of allowing professional architects, academics, and students to define the value of the role of design beyond the aesthetic, applying the expertise of the field to contemporary economic, social, and environmental challenges.

1 INTRODUCTION

1.1 *Energy efficiency, thermal comfort, and utility costs*

As society becomes more concerned with healthy environments, climate change, and conservation of natural resources, architecture has responded with clean, energy efficient housing options.

Energy efficient housing is defined in many ways. Grondzik and Kwok in *Mechanical and Electrical Equipment for Buildings* define efficiency as "the ratio of system output to system input." They define energy conservation as "saving energy by using less," and energy efficiency as "both conservation and efficiency efforts in buildings" (Gronzik, & Kwok, 2015). These simple concepts are the basis for many measures of conservation such as limiting air leakage through the enclosure. The 2015 International Residential Code (IRC) recognizes that a complete air barrier system is necessary for energy conservation. The latest IRC requires the enclosure to be tested and that air infiltration rates not exceed 3 ACH50 in the climate zone in which Mississippi belongs (ICC, 2014). Tighter enclosures prevent air leakage, which conserves the energy invested in the interior thermal environment. As a result utility costs are reduced, which saves money for the occupant.

Interior thermal environments, as defined by The American Society of Heating, Refrigeration, and Air Conditioning Engineers' *Standard 55* are comfortable when "that condition of mind that expresses satisfaction with the thermal environment" is reached (as

cited in ASHRAE, 2009). ASHRAE also states, "in general, comfort occurs when body temperatures are held within narrow ranges, skin moisture is low, and the physiological effort of regulation is minimized" (ASHRAE, 2009). Perception of positive thermal comfort plays a role in the well-being and health of the home's occupants and is partially dependent on the integrity of the enclosure.

1.2 *Recognizing housing inequalities*

Home energy efficiency provides three advantages to an occupant: less fuel is used, which also benefits a larger society, the indoor thermal environment is more comfortable, which helps keep the occupants healthy, and less money is spent, which means more financial resources are available to the home occupant. These important advantages are even more critical to occupants of low-income housing.

Safe, affordable housing is a societal right; yet it is not available to everyone. This fact is well documented in a recently published report entitled *The Art of Inequality: Architecture, Housing, and Real Estate*. The authors of this report state "affordability is generally determined by whether one's income can pay for essential goods and services without causing undue financial hardship. Housing is one of these essential goods" (Martin, Moore, & Schindler, 2015).

1.3 *A broader discussion*

This study examines three samples of low-income housing in the Mississippi Delta, a historically impoverished region of the United States, to understand air infiltration rates as compared to each other and to nationally accepted standards. Air infiltration rates are then used to project the cost burden a family must carry due to heat loss through air infiltration.

1.3.1 *Predicting air leakage*

To fit this study into context within a broader discussion about air infiltration, housing type, and income, a 2003 report by the Indoor Environment Department at the Lawrence Berkeley National Laboratory was reviewed. This study aggregated and analyzed over 70,000 air leakage measurements from across the United States. This data was collected from a variety of sources, the main one being weatherization programs in Ohio, Alaska, and Wisconsin. The purpose of this study was "identify house characteristics that can be used to predict air leakage." In short, the authors found that low-income houses have higher air infiltration rates by almost two times as compared to the amount of a conventional home. They also summarized that older homes are more leaky than newer homes (Chan, Price, Sohn, & Gadgil, 2003).

Since most of the air leakage data came from the Midwest, these conclusions do not extend to the South. The authors say a much in their report:

> *The results for low-income houses, for the difference between low-income and conventional houses, are probably correct for the Midwest but are much less certain for the rest of the country (for which we have no data on low-income homes.) . . it seems reasonable that the Midwest results might apply elsewhere in the country, but this inference cannot be tested with the present data.*
>
> *Chan, Price, Sohn, & Gadgil, 2003*

Within the Southeast, Midsouth, and Deep South, air leakage data was not available from Mississippi, Alabama, Louisiana, Kentucky, or Tennessee. This helps to identify a need for a study such as this one.

1.3.2 *Air leakage by region*

In a study by Grot and Clark, approximately 250 low-income residences across the country were tested for air infiltration. Weatherization techniques were employed afterwards and then tested again for improvements. Houses tested in South Carolina, Georgia, and Louisiana were the closest to the Mississippi Delta in terms of climate and history in this study (Grot & Clark, 1979).

The average air exchange per hour rate at 50 Pascals was 36.6 for all the houses tested. In the houses in South Carolina, Georgia, and Louisiana, the average was 95ACH50. New Orleans, Louisiana had the highest at 195.8 ACH50. No houses were tested in Mississippi, yet expectations for high air infiltration rates are established for this study (Grot & Clark, 1979).

1.4 *Baptist Town, Greenwood, MS*

Understanding the location of this study is important to its significance. Greenwood, MS lies at the edge of the Mississippi Delta, an important agricultural region with great culture and struggle. Baptist Town is a historical African-American neighborhood that claims many blues musicians and most recently, was the setting for the 2011 film *The Help*. This neighborhood has over five hundred residents, though less than 32% are employed and only 28% hold a high school diploma according to a 2009 study on Baptist Town (Community Development Project, 2009). Although a cohesive and active community, it has been left out of mainstream society. The typical housing stock is largely inadequate in terms of accepted comfort and efficiency standards.

As the focus of an Enterprise Community Partners Rose Architectural Fellowship, Baptist Town recently received 11 new affordable homes for its residents. The Mississippi Emergency Management Agency (MEMA) donated these premanufactured "Katrina Cottages" to the Greenwood-Leflore Fuller Center for Housing (via the City of Greenwood) for placement in Baptist Town and sale to low-income families. Through an application process, individuals were selected to be able to purchase a cottage through an affordable mortgage program organized by the local Fuller Center chapter. The coordination of cottage installation took place during 2014 and 2015

and was led by author, Rose Fellow and Greenwood Leflore Carroll Economic Development Foundation (GLCEDF) employee, Emily Roush-Elliott.

1.5 *A partnership with Mississippi State University*

As part of the final stages of the Baptist Town Cottage project, a grant was awarded to the GLCEDF to study energy efficiency rates in the new installation of cottages as compared to existing housing stock in Baptist Town. In partnership with Mississippi State University's (MSU) School of Architecture and Audit Squad – a group of students interested in building performance, this study was developed under the guidance of author and assistant professor, Emily McGlohn.

1.6 *Objectives and goals*

The objective of this study is to measure air infiltration rates of as-is conditions of a sample of low-income housing to determine the average dollar amount a family spends on heating due to air infiltration.

The goal of these tests is to determine the monetary costs and health burdens associated with typical low-income housing in Greenwood, MS.

Another goal of this study is to determine if current efforts to improve low-income housing in this community are paying off in terms of energy and monetary savings.

Long-term goals of this research include a strategy for improving energy efficiency rates and indoor air quality standards in low-income housing. Local housing authorities, non-profits, and low-income housing developers in Mississippi can implement the resulting strategies. Data can be distributed through MSU's vast network of county extension offices. Baseline information is necessary as a first step.

1.7 *Expected outcome*

The expected research outcome is a baseline metric of energy efficiency rates and anecdotal information regarding existing low-income housing in Greenwood, MS. It is hypothesized that the newer, premanufactured housing is more energy efficient, therefore more cost efficient for homeowners.

The long-term outcome of this research is a complete strategy for home energy efficiency improvements for low-income housing in Mississippi that is available to non-profits, housing authorities and others.

2 METHODOLOGY

2.1 *Introduction*

The methodology measures base air infiltration conditions of a sample of low-income housing in Greenwood, MS. Manual calculations estimate energy and cost expenditures due to air loss through infiltration. Through identification of common problematic areas of infiltration, suggestions are made to reduce rates of air infiltration.

2.2 *Sample*

A sample of low-income housing was identified before data collection began. With assistance from the GLCEDF three categories were identified and clients were contacted by the GLCEDF to request participation. Each resident was given a $25.00 gift card to a local store for incentive to participate. Images of each housing type are found in the following section as Figures 1, 2, and 3.

2.2.1 *Housing type A*

The first category, Housing Type A, represents the new installation of "Katrina Cottages" that were donated to the City of Greenwood, MS, by MEMA. Eleven Type A houses are in this sample.

Residents of the Baptist Town neighborhood applied for these homes based on need and income. Assistance in acquiring an affordable mortgage was given by the Fuller Center and GLCEDF. These homes were built approximately 10 years ago as emergency housing after Hurricane Katrina. A surplus of homes exists and it is common to see these buildings in Mississippi repurposed as affordable housing, hunting camps, or rental properties. They are premanufactured and range from 800 to 400 square feet. They are made of are 2×6 stick frame construction, insulated with either cellulous or fiberglass batts, and clad with cementitious lap siding. They rest on a pier foundation.

Participants from this sample have been previously selected from the applicant pool to receive a Katrina Cottage. The majority of these new homeowners have income of less than 30% AMI (area median income) which equates to under $9,000 in Leflore County in 2016. All homeowners are currently living in their cottages.



Figure 1. Image of Housing Type A, "Katrina Cottage."

2.2.2 *Housing type B*

The second category, Housing Type B, represents non-cottage housing completed by the Greenwood-Leflore Fuller Center for Housing – formally a branch of Habitat for Humanity. Six houses in this category are a part of this study. Homeowners in this category applied for these houses through the Fuller Center and have been living in them for more than 10 years.

These houses are approximately 15 years old. Their construction type is typically stick frame with wood siding. Their insulation type is unknown because no efforts to deconstruct these houses took place. They are approximately 1,000 square feet. Participants from this sample were identified and contacted through the GLCEDF.

2.2.3 *Housing type C*

Housing Type C represents typical low-income housing in Greenwood, Mississippi. Eleven houses were selected for testing in this category to match the number of houses tested in Housing Type A.

These houses range in age but were typically built in the 1950s and 1960s with additions built over time. Their construction type is stick frame with wood siding, replacement vinyl siding or other lapboard material. Insulation levels are unknown. All houses selected for testing rest on a pier or raised foundations.



Figure 2. Image of Housing Type B, "Fuller Center Housing."



Figure 3. Image of Housing Type C, "Typical Low-Income Housing."

Selection criteria for this sample are: between 1,000–1,200 square feet, stick frame construction, raised foundation, and local to Greenwood, MS. Participants from this sample were secured through the applicant pool for Katrina Cottages installed by the GLCEDF.

2.3 *Equipment*

The tools necessary to carry out this study included a Retrotec blower door tester and a Bosch laser distance measurer. While other measurements were not necessary, temperature, relative humidity, carbon dioxide, and carbon monoxide were recorded at each house. Tools necessary for this were a multi-meter, carbon dioxide meter, and a carbon monoxide meter. All tools were purchased through previously awarded grants.

Air infiltration levels of each house, tested with the blower door tester, were measured in air changes per hour at −50 pascals (ACH50).

2.4 *Funding and schedule*

Enterprise Community Partners and the GLCEDF funded this research study through a grant to Mississippi State University and the School of Architecture. Data collection began in July and ended in September of 2015. Greenwood, MS, is approximately 90 miles from MSU's campus and day trips were made where 3 to 4 houses were tested in one day. Undergraduate research assistants were trained and hired to assist in data collection. Their tasks consisted of measuring and drawing each house, set-up of blower door tester, and assistance in measuring air infiltration rates.

2.5 *Data collection protocol*

In advance of data collection, a protocol was established to insure uniformity. Students and faculty followed a step-by-step procedure that was developed in the previous semester. This protocol is a modified version of the 2015 International Building Codes air leakage test procedure. Since "as-is" conditions were being tested, not strictly the building enclosure, window units were not removed and fireplaces were not covered. The chart below summarizes the protocol for this study.

Table 1. Data Collection Protocol.

Step Number	Description
1	Gain permission to test.
2	Introduction to the team, explanation of study, and exchange of gift card.
3	Measure the house, and sketch a floor plan.
4	Calculate the square footage and volume of the house.
5	Install the blower doorframe and fan.
6	Open all interior doors, and close exterior doors and windows.
7	Turn gas appliances to pilot light.
8	Record measurements.
9	Breakdown and thank you.

2.6 *Data analysis*

Using Microsoft Excel, the recorded data was transformed by several calculations. The goal of the analysis was to convert ACH50 to kWh, which is easily calculated into a dollar amount.

Calculations were used from several sources including the Energy Star Home Sealing Specification from October 16, 2001 and series of heat loss calculations provided to the researchers by a colleague. These equations are listed below.

To convert ACH50 to ACHnat (Energy Star, 2001):

$$ACHnat = \frac{ACH50}{LBLFactor} \quad (1)$$

where ACHnat = "the natural air changes per hour in a building; and LBLFactor is "a factor based on climate region, number of stories of a building, and sheltering from wind which is used to convert to estimated air changes in a building by natural means, without a fan" (Energy Star, 2001).

To determine heat loss due to air infiltration:

$$Q = 0.018 * V * K * \Delta\text{Taverage} * \text{t} \quad (2)$$

where Q = heat flow in Btu, 0.018 is the heat capacity of air at sea level, V = volume of house in cubic feet, K = ACHnat, Δ Taverage = temperature difference in °F between indoors and outdoors (assume an average outdoor temperature in December for Mississippi of 45°F and 65°F indoor temperature), and t = 1 hour.

To convert heat flow into kilowatts:

$$kW = \text{Btu per hour} / 3412.142 \quad (3)$$

where 1 Btu per hour = 0.00029307107 kW.

Kilowatt hours (kWh) consumed in each house during a typical December due to heat loss through air infiltration is determined by kW*744 hours, the hours within the month of December.

The cost of electricity due to heat loss through air infiltration was calculated by kWh*$.12, the average cost of one kWh in area of the study.

2.7 *Delimitation*

This study measured the "as is" conditions of each house. Air infiltration through the enclosure was not able to be isolated. Duct work, fire places, exhaust outlets and air conditioning widow units were not covered.

Where as 11 houses in Type A were tested and 10 houses in Type C were tested, only 6 houses in Type B are apart of this study. Ideally, an equal amount of houses in each sample would have been tested, but due to time and limited contact with the homeowners, only 6 houses were tested.

The cost results that are discussed later in this paper represent the theoretical electrical cost that air infiltration would impart on a resident. In reality, each home is heated with a variety of fuel types that have different costs per Btu. For simplicity of comparison, it is assumed that each occupant uses electricity to heat his or her home.

3 RESULTS AND ANALYSIS

In this section the results of the 27 blower door tests, an analysis of the results, and general observations of the houses in the study are shared.

3.1 *Air infiltration rates per housing type*

All results from the tests are shared in Table 2 below. Note that a dash in the table means the blower door could not hold pressure in the house. The highest ACH50 recorded is 84.55 and the lowest is 7.76. The averages for each category are at the bottom of the table. The average is used to determine the financial costs for each category.

3.2 *Heat loss and financial cost due to air infiltration*

Using equations (1) and (2) from section *3.6 Data Analysis*, heat loss (Btu) due to air infiltration is calculated for each house, where then the average is calculated for each house type. With heat loss in Btu,

Table 2. ACH50 for each house measured in all three housing types.

Type A		Type B		Type C	
#	ACH50	#	ACH50	#	ACH50
A1	12.4	B1	15	C1	–
A2	9.42	B2	14.9	C2	–
A3	10.75	B3	18	C3	51.15
A4	11.3	B4	23.3	C4	36.05
A5	16.6	B5	20.4	C5	43.25
A6	7.76	B6	24.1	C6	–
A7	8.22			C7	84.55
A8	9.04			C8	–
A9	9.42			C9	–
A10	8.22			C10	25
A11	12.1				
Avg.	**10**	**Avg.**	**19**	**Avg.**	**48**

Table 3. Average amount of heat loss (Btu), kilowatts, kilowatt hours for a typical December, and financial cost for each house type due to air infiltration.

Unit	Type A	Type B	Type C
Btu	914	2,318	4,655*
kW	.26	.68	1.36*
kWh for December	199	505	1,015*
Financial Cost	$23.93	$60.66	$121.81*

*Lower value than reality because 50% of Type C houses were too leaky to hold pressure during blower door test, therefore not included in the average.

kilowatts can be estimated using equation (3). Kilowatts are easily calculated into Kilowatt hours with an estimated time of heat flow.

4 DISCUSSION

As each house was measured, general observations were made about the condition of the building. A summary of these observations follows as well as a discussion of the results.

4.1.1 *Observations of housing type A*

These houses have the lowest average ACH50 as was expected with an average of 10ACH50. They are newer, premanufactured, have central heating and air or a ductless mini-split, and constructed of 2x6 framing. On average, these homeowners spend approximately $24.00 on electric energy due to heat loss through air infiltration a month during the winter. This is 80% less than occupants of Housing Type C – a significant amount of difference.

During the blower door test, common areas of air infiltration were identified. The mechanical closet, around the tub insert, and the washing machine outlet box were consistently a problem in each cottage. These gaps can be filled with caulk or spray foam as necessary to further reduce air infiltration rates. The average ACH50 is 10, which is within range of the IRC standard of 3ACH50. An effort to weatherize these homes can make improvements that bring them closer to ideal air infiltration rates.

4.1.2 *Observations of housing type B*

Houses in this category performed as expected. They are 15 to 20 years old and not intentionally constructed to be airtight. They all rest on a slab foundation, which helped with lowering ACH, and use central heating and air conditioning. On average, Type B homeowners spend $61.00 on electric energy due to heat loss through air infiltration in a month during the winter. This is 50% less than occupants of Housing Type C, and 40% more than occupants of Housing Type A.

Common areas of air infiltration were under doors and surrounding the mechanical closet that directly connected to the attic. A smaller number of houses were tested in this category so these observations are not conclusive, yet improvements are possible with door sweeps and weatherstripping on the mechanical closet door.

4.1.3 *Observations of housing type C*

This category of housing performed the most inefficiently and proved to be the most costly to maintain thermal comfort. Fifty percent of the houses tested (5 out of 10) were not able to hold pressure during the blower door test meaning they were so leaky the equipment could not get a measurement. On the houses that could be tested, the average ACH50 is 48 – 16 times higher than new air infiltration standards set by the 2015 IRC! This extremely high rate equates to a homeowner paying around $122.00 a month in electricity costs due to air infiltration to maintain 65°F indoor temperature during an average December. This is 6% of the monthly area median income, and 16% of the monthly income of individuals who applied for a Katrina Cottage.



Figure 4. Makeshift insulation around a window AC unit. It is apparent that most homeowners do not remove or cover these during the winter.

Major areas of air infiltration in these houses varied and include the junction between the original house and additions, cracks in walls, floors, and ceilings, holes due age and to a lack of maintenance, and window air conditioning units that are not covered or removed. Figure 4 shows an example of an AC unit.

5 SUMMARY

The results of this study highlight several important aspects of the sample of low income housing in the Mississippi Delta. First, the newer, premanufactured housing, Type A, proved to be the most efficient. With simple weatherization strategies, these houses could be improved even further to the advantage of the homeowners. Type B housing performed as expected and did not impose a financial burden on the homeowners. The most surprising result was the cost burden the inefficiencies of the typical low income housing, Type C, imposes on a family. These occupants pay more than 6 times the amount the residents of the Katrina Cottages pay and 3 times as much as occupants of Type B Housing.

These results highlight the need for a strategy to address air infiltration in existing low income housing in the Delta.

6 CONCLUSIONS

6.1 *Follow-up and weatherization kits*

Although the results are interesting, they are meant to inspire change and improve the living situations

of Mississippi residents. In an attempt to improve the observed existing conditions, weatherization kits were assembled and installed in houses with compliant homeowners. The kit included caulk, spray foam, door sweeps, weatherstripping, window film, window air conditioner unit insulation, and two hours of labor to install the kit. Two local residents from Baptist Town were trained to install the kits and were paid for their time.

Although the weatherization kit cannot solve large structural problems, ACH can largely be reduced through simple measures like filling gaps and installing weatherstripping. Currently, the installers are working to offer this to each participant. Plans to return to Greenwood and blower door test weatherized houses are underway.

6.2 *Mississippi State weatherization board*

The United States Federal Government offers a low income weatherization program that is available though most states. Renters and homeowners can apply for complete weatherization of their home. If they qualify, it comes at no cost to the family and includes an energy audit, new insulation, and other measures to improve efficiency. The director of the board is aware of this study and suggested the participants of the study may qualify for complete weatherization. A meeting in Baptist Town is being scheduled for any interested homeowners.

Unfortunately, to qualify for this weatherization program, a house must meet several structural requirements such as a roof with no leaks, a floor with no holes, and walls without major damage. Many times low income housing in this region does not qualify because of these issues. Anecdotally, many of the houses in Type C would not qualify. This means there is a subset of low income families with no options for improvement.

7 NEXT STEPS

This portion of the study is concluded but many new questions have presented themselves. The most pressing issue is the improvement of the typical housing. Basic weatherization kits will not improve the houses enough and the state weatherization program cannot help homeowners with houses in disrepair. It is not feasible to simple tear down and rebuild or move families to new houses. Places like Baptist Town are important to the fabric of Delta communities and must be preserved.

New, innovative ways to solve this issue are necessary. Funding is being sought to continue looking for a solution to place families in healthy, affordable housing where they can thrive. As society makes progress in building efficiency, every sector must be included.

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Housing of prime social need – Polish traditions of socially engaged architecture

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ABSTRACT: The article presents the results of research on the contribution of Polish architectural thought and urban theory concerning the problems of socially engaged architecture. At the dawn of the twenty-first century, we unceasingly encounter the problem of housing shortage; however, changes of the broadly-understood conditions have occurred. Changes have affected the family model, the role of women in it, job opportunities, or the financing of the construction of one's own house. A question arises whether the achievements of Polish architectural thought in the area of socially engaged construction could be of use also today.

1 INTRODUCTION

"The architect should be appointed to solve complex problems, and not only be allowed to do the strictly architectural work." (Wieczorkowie 1933).

Polish traditions of socially engaged architecture date back to the interwar period. At a time when the housing shortage was most acute, and fast-growing cities could not provide lodgings for their newly-arrived residents, the perceptions of the architect's work radically changed. Architects, who had so far offered their services to wealthier customers, began to look for solutions aimed at providing low-cost, functional and healthy housing for the widest strata of society. At the same time one of the "missions" of architects was broadly understood public education, such as identifying new aesthetic and ergonomic qualities, aimed at a more rational use of household space, or promoting the use of modern construction materials.

2 PUBLICATIONS AND DISSEMINATION

The work of many Polish architects of the interwar period and those working shortly after World War II was affected by their leftist social views. The work of architects begins to encompass not only the concept of the building but also the design of the assembly process of factory made items or even finding beauty in the strong rhythm of repetitions (Roguska 2011).

Architects' work began to go well beyond the scope of design itself for the sake of wider community involvement. Catalogues with typical designs of houses of different standards as well as manuals and guides aimed at persons building their houses, issued in Poland since the 1920's, manifested a high level of sensitivity to the existing socio-economic situation. In the first period shortly after Poland regained its independence after nearly 200 years of partitions, we can find in these projects an attempt at determining the national Polish style. In the 1930's, the trends inspired by international functionalism already dominate as does the desire to standardize and even prefabricate in order to reduce the overall cost of investment.[1]

In 1926, Szymon Syrkus, along with Barbara and Stanisław Brukalski, Bohdan Lachert, Józef Szanajca and Helena Niemirska founded the creative group Praesens, which two years later became the Polish section at the Congrés Internationaux d'Architecture Moderne (CIAM).

International Congresses of Modern Architecture (CIAM), which were initiated in the 1920's, regularly delineated the tasks set for the architects. The primary goal was to improve the quality of life of people in degraded urban environments. The discussion which had ensued during the congress was the turning point in the perception of the social role of the architect (Kucharzyk 2011). For the first time the need for teamwork was stressed. In the interwar period, the human dimension in the work of an architect was strongly emphasized.

The development of socially engaged architectural thought was fostered by the work of two married couples of architects: Helena and Szymon Syrkus and Barbara and Stanisław Brukalski.

[1] Standardization and prefabrication in the architecture of the twentieth century stemmed from the philosophy of rationalism and the era of industrialization. Typicality understood as a result of spontaneous processes, in contrast to an intended standardization, has always been a feature of mass architecture and a result of improvement and selection of solutions on grounds of their function, material, tradition, and culture and civilization of different eras in general (Quoted from: Roguska 2011).

The Syrkuses were a married couple of architects, whose influence on urban thought and pro-social philosophy in design spanned also the postwar period. They designed housing estates for the Warsaw Housing Cooperative and the Polish Social Insurance Institution (ZUS). They also designed a few experimental single-family houses implementing the latest trends in architecture. The WSM housing estate in Warsaw's Koło district (construction works began in 1947) is considered as the Syrkuses' greatest achievement in the postwar period.[2] The Syrkuses' design theory relied on standardisation and prefabrication, which was to be primarily reflected in the more rational course of the construction process. In his publications in specialist press, Szymon Syrkus put forward demands that the house should be constructed of such parts, which could be produced at the factory; the production of elements was to be moved to the factory in order to make it a year-round process, free from seasonal restrictions of wet technologies (mortar, plaster). He promoted the introduction of dry assembly using mechanical force and the reduction of structural, building and installation elements to the lowest number of standards possible, which would be the result of long and in-depth research (Surkus Sz. 1928).

Barbara Brukalska (1899–1980) and Stanisław Brukalski (1894–1967) are considered as the leading representatives of Polish functionalism and creators of the concept of cooperative housing development. Since the late 1930's, they jointly designed cheap, functional buildings with simple bodies and subtle elements of art, which were well integrated with the surrounding space (Syrkus H., 1984). After World War II, Stanisław Brukalski was the co-designer of the reconstruction of Warsaw's New Town.

The most active place of exchange of ideas and experiences in the field of socially engaged architecture was specialist press, which was also addressed to a wider public. *Dom Osiedle Mieszkanie* Magazine (House, Estate, Apartment) issued in the years 1929–1939 are examples of journalistic activities of architects and urban planners aimed at promoting social engagement of architects.

In the interwar period, private tenement housing began to wane. Investing capital in real estate for rent, which was popular even immediately before World War I, ceased to be profitable. However, most people were still unable to afford to build housing for themselves. One of the elements meant to stimulate construction business were competitions organized by various institutions, e.g. by the national Bank Gospodarstwa Krajowego. Residential buildings were built under the support of state-backed Cooperatives, local governments (Committees for the Expansion of Polish cities), and private investors under the framework of patronage housing estates (e.g., Solvay factory in Mątwy near Inowrocław).

3 "SMALL HOUSE OF ONE'S OWN"

Polish architects of the interwar period focused not only on design but also on the possibility of financing construction projects. Savings and construction funds as well as loans and mortgages were promoted as a form of support for the development of residential construction.

In the 1930's, one of the responses to the demand for housing were the designs of small individual houses.

The suburbs of interwar Polish cities began to grow significantly. New small houses were erected by small entrepreneurs, office clerks and, less often, workers. Over 80% of these investments were situated in the outskirts of cities. What is interesting, along with the economic crisis of the 30's, the number of building sites, rather than decrease, was still increasing. This phenomenon was largely due to building projects started by people (mainly workers) who had been saving funds for many years to build their own home. It was more economically viable than paying the rent; these persons were also unable to obtain a mortgage on account of their very low income rate. After 1932, when prices had fallen dramatically, building materials also became cheaper while small savings "were actually doubled." Many people were beginning to build with little financial means and were erecting buildings of a minimum size and most often by themselves. These unfinished houses were almost immediately inhabited. From the social point of view, it was important that any such construction exempted municipalities from responsibility for housing shortage. On the pages of national press, socially engaged architects suggested that municipalities should secure land for future development, by buying up and dividing land into plots and then selling them to the poorest investors at preferential prices. The possibility to purchase smaller and therefore cheaper plots would allow less wealthy investors to build their own houses at a relatively higher standard. It would also make it possible to clarify the legal status of properties. The activities of local governments would concentrate on promoting the construction of more economical terraced or semi-detached houses. Other perceived economic benefits of promoting small-scale development included the fact that smaller plots could be located closer to the areas already having access to municipal infrastructure; it would also be easier to provide access for the newly designed plots of the same length and the roads would serve a greater number of connections. When establishing "settlements of terraced houses" one would be also able to immediately allot land to building development intended for public use.

State institutions also dealt with promoting the idea of affordable single-family housing, possibly built by the owners' own means. The 1926 competition by Bank

[2] Among others, their own house in Warsaw (1927–1928), and the WSM estates in Żoliborz (1927–1939). This housing estate was entered in 1992 in the register of monuments (urban layout and housing development with greenery).

Gospodarstwa Krajowego, whose goal was to design standardized low-cost houses, is an example of such activity. The purpose of the competition was to design three types of model houses:

A with two rooms, with the possibility of add a third room.
B with three rooms, with the possibility of add a fourth room.
C with four rooms, with the possibility of add a fifth room.

The competition, however, did not include the design of a model house of the smallest type (with only one room), on account of which it was partially criticized.

Widely propagated were cheap construction technologies (Fig. 1, 2). It was advised to lay the foundations on small reinforced concrete stilts, to build houses with no basement, or merely small circular cellars, to use concrete blocks as well as wooden structures of walls. Flat roofs were promoted (as they featured a smaller surface area to cover) while the attic was considered as unnecessary as long as the building provided another place for storing "junk" and drying clothes. In order to reduce the cost of pitched roofs, their structure was designed to make use of densely spaced boards instead of traditional rafters (Hempel 1933). The body of the building alone could also bring substantial savings, if one avoided having too many windows or made sure to concentrate all fittings in one place. These principles are valid to this day.

Civil engineering exhibitions were of great importance in the dissemination of knowledge. In 1926, the 1st International Exhibition of Modern Architecture was held in Warsaw (*Blok*, 1926). Exhibitions devoted to Low cost Individual Houses were also held periodically. Fully-furnished buildings were erected on exhibition grounds in the 1:1 scale.

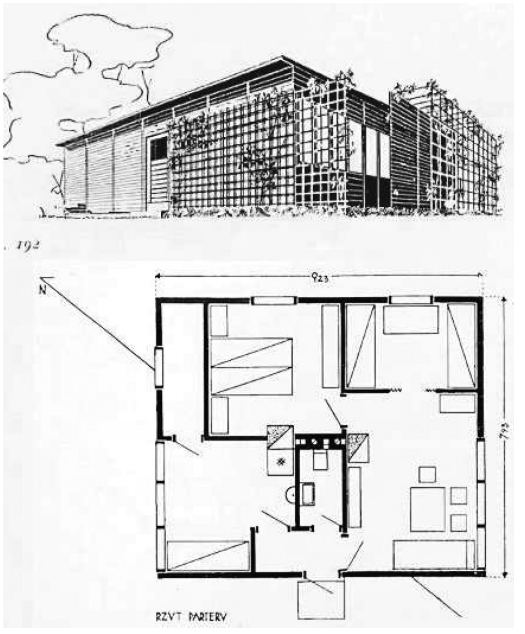


Figure 1. Project of the low-cost wooden. Architects: B. Lachert, J. Szanajca, from: Dom Osiedle Mieszkanie, 1932, (7–8), p. 8–9.

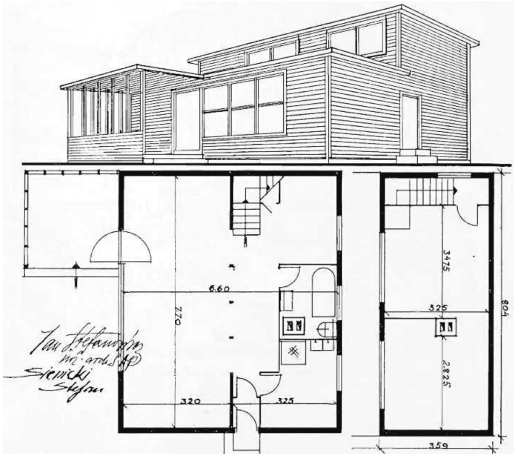


Figure 2. Project of the low-cost wooden. Architects: S. Sienicki, J. Stefanowicz, from: Dom Osiedle Mieszkanie, 1932, (7–8), p. 20.

4 MULTI-FAMILY HOUSING – EXAMPLES OF SOCIAL HOUSING DEVELOPMENT

In interwar Poland, ideological discourse on housing environment was mainly prominent amongst leftist architects associated with CIAM, the group Praesens, and with housing cooperatives, especially with the Warsaw Housing Cooperative. The design of the housing estate in Rakowiec in Warsaw was preceded by an extensive preamble, consisting of several chapters: the functional housing estate, the residential district, transport, collective coexistence. The size and capacity of the housing estates, the division of estates into settlements, childcare, education of youth, food supply, spatial configuration of the settlement (Jałowiecki 2009). The manifesto of the group Praesens read: "Despite modest furnishings of housing units, we do not believe that the design of Rakowiec was a denial of the principles of improvement of housing standards. Housing shortages are compensated for by the common house, designed on the same plot. The house will include a shared bath house, a club, a kindergarten and a mechanized laundry, where the residents of the housing estate will be able to do the laundry more comfortably and cheaply than the owner of a 6-room flat forced to do the washing" (Syrkus H. 1976).

Before World War II, Koło in Warsaw's Wola district became another geostrategic place for building modern housing estates. In the years 1937–1938, the Workers' Estates Society (Towarzystwo Osiedli



Figure 3. WSM housing estate, 2015. Photo H. Trammer.



Figure 4. WSM housing estate, 2015. Photo H. Trammer.

Robotniczych – TOR) was established. TOR existed not onluy in Warsaw but the idea spread over all cities in Poland. [Koło Housing Estate] It was founded for the working class population–people who were to live in small, cheap but modern apartments. After the war, the area of Koło remained popular. Helena and Szymon Syrkus designed for the Warsaw Housing Cooperative (WSM) a housing estate with a variety of three-storey buildings. The design of the estate was completed in 1947 (Fig. 3, 4). In the same year, the construction works on the estate began (ended in 1951). The WSM housing estate was built next to the TOR estate, south of Ożarowska St. Since these two housing estates adjoined, they were distinguished with two names, the former estate of TOR became known as Koło I while the new post-war housing estate was called Koło II.

The architectural solutions adopted while designing the TOR housing estates were aimed at constructing housing of prime social need, while ensuring the best possible framework for living in the neighbourhood. The term "social housing estate" was formulated during the period of Nazi occupation by Helena and Szymon Syrkus, who, together with Barbara Brukalska, were the main promoters of the idea of social housing estates in Poland. Polish social housing estates of the interwar period were characterized, however, by an escape, in their spatial form, from rigid and schematic estates of the row development approach. This does not mean that the guidelines contained in the "Athens Charter" were not adhered to, but other forms of building development were sought, which would make it possible to individualise the separate sections of the estate.

Before 1939, the history of contemporary Polish architecture did not differ from the general trends in the European or world architecture. The split with the European sphere of architectural and urban planning influence occurred only after World War II when Poland was pulled into the Soviet sphere of domination.

The period 1945–1950 in architecture was dominated by reconstruction of the entire state, which literally needed to rise from the ruins. Military action was particularly reflected in the state of the city of Warsaw, of which 85% lay in ruins. For this reason, from the very beginning, that is as early as in 1945, the Office for the Reconstruction of the Capital (BOS) was established under the leadership of Roman Piotrkowski and Zygmunt Skibniewski. In the first place, the city centre as well as the destroyed historic development were rebuilt while the construction of housing estates was carried out until 1956 in the style of socialist realism (Machaczka-Świadek, 2006).

Since 1950's, the construction of social housing estates began to be criticized by the authorities as an example of a bad imitation of the concepts from the Anglosphere. This period can be considered as the start of a new era in residential construction, particularly noticeable in the socialist countries and commonly referred to as the era of mass construction (Kania 2010). The existing norms of the first period of post-war Polish state had a close influence on the development of multi-family housing. The norms stipulated 10 m^2 for employed and studying persons and 5 m^2 for non-working persons. They also provided for a kitchen, a bathroom, and a hallway. The average surface area of apartments was 37 m^2.

The emergence of a new structural unit (this problem had been studied since 1954) in the form of a large prefabricated element – the large panel, led to the adoption of standard 5- and 11-storey types of residential buildings as they proved to be the most favorable ones from the point of view of construction and manufacturing industries. After World War II, the concepts of standardization and repeatability were extended in Poland to include other areas of design. For two decades, series of design solutions were being accumulated in catalogues; they met stringent standards, were adapted to prefabrication, and were designed for repeated use, regardless of the character of their intended future location.

Architects perceived the shortcomings of total standardization and prefabrication, but they could at most demand the so-called open, i.e., flexible standardization. There was no place for a comprehensive theoretical reflection (Roguska 2011).

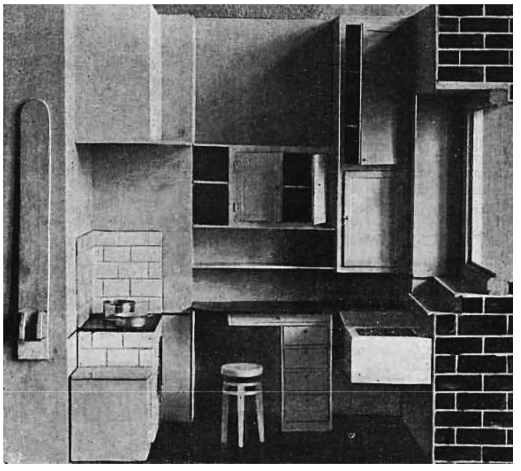


Figure 5. Modern kitchen, the model project. Architects: Brukalski, Source: Dom, Osiedle, Mieszkanie, 1929 (1).

5 INTERIORS

Pro-social approach in the design of the interwar period was manifested not only at the level of urban planning and architecture, but also in interior design. In the Warsaw Housing Cooperative, the group Preasens[3] together with the Workers' Society of Friends of Children (Robotnicze Towarzystwo Przyjaciół Dzieci), branch in Żoliboż, organized an exhibition entitled An Exemplary Apartment. It was located in one of the 120 typical apartments. The characteristic feature of the apartment's furnishing was how it was meant to accommodate five persons in the household's small area. It promoted the rational use of small living spaces through the introduction of convertible beds, bunk beds, and built-in wardrobes. Folding tables, occasional tables, and toolboxes.

Barbara Brukalska, like many other female architects of the first generation of women educated in this profession brought to design a strong build-up of empathy. She undertook to design a small, functional, and organized kitchen, with standardised dimensions and fittings, modelled on the "Frankfurt Kitchen" by Grete Schütte-Lihotzky, but adapted to the conditions of Warsaw's Żoliborz and derived from the knowledge of local habits and realities.[4]

Barbara and Stanisław Brukalski also dealt with furniture design. Their creations were characterized by a rational form, inexpensive materials and modernity.

The interwar period was the time when the first Polish architects began to deal more thoroughly with the problems of designing children's rooms (Kowalska 1929). Concepts presented in the pages of professional press by Polish designers were focused on creating a space where the children could feel at ease and at home, and which they would care for. It was recommended to keep the pieces of furniture simple, preferably white, and to allow for damage during play (Skibniewska 1974). *The strongly socially-oriented idea of a housing unit, freshly crystallized just after the war, collided with the decreed ideology of communism. However, it seems that it was not the above-mentioned confrontation which had put an end to this idea but rather the need to intensify urbanization processes as well as increasing social expectations* (Wojtkun 2012).

6 CONCLUSIONS

The 20-year long interwar period and the times of rebuilding the country after the war, along with the continuation of the idea of a social housing estate revealed new values in the design of housing and living spaces. Visionaries of architectural thought, such as Helena and Szymon Syrkus, Barbara and Stanisław Brukalski, and many other socially engaged creators propagated and implemented solutions improving the living conditions of the inhabitants of the country by designing functional interiors. They made use of the most technically advanced and modern solutions. Of key importance was the multifaceted design phase which involved equal partnership of various stakeholders (local authorities, residents, banks, loans funds, designers, cooperatives, etc.). In a short time, there grew a relationship between designers and residents of buildings, instilling in them a sense of ownership and care of the space and, above all, creating standards of low-cost houses and apartments.

The discussed contribution to the theory of twentieth century architecture should translate into our times, in order to adapt to contemporary realities and restore the role of the architect–specialist, who should not be merely a contractor. In today's era of cities focusing on the development of capitalism, the social role of the architect is disappearing. The soaring number of development investments and mass purchases of real estate by banks have created a barrier in the relationship between architects and users and transferred the decision-making processes from the level of collaboration of designers and residents to the level of investors' economics.

[3] Cooperative society of architects and engineers

[4] Architektura i Budownictwo, 1928, no. 2, p. 73. And Roguska p. 23

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In transit-global migration



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Vietnamese workforce housing research and design

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ABSTRACT: This paper outlines research and design for housing rural-to-urban migrants in Viet Nam, focused on Da Nang City. Global capital flow in primary economic segments – manufacturing, services, and tourism – have infused developing countries with new knowledge and capital. Global forces produce internal migration in developing nations given the transition from agricultural to industrial and service economies. Around 7 million Vietnamese are expected to relocate to urban areas by 2019 to seek entry-level employment in the industrial or service sectors, and will be challenged to afford housing meeting minimum standards. Also, Viet Nam's population is concentrated in low-lying coastal areas vulnerable to storm surge and tropical cyclones. Finding a solution to housing urban immigrants is critical to stabilize and grow the economy. This entails managing the movement, health, and welfare of people and minimizing out of country migration. In response, the Vietnamese government is implementing sustainable and resilience initiatives, and has a low interest loans program to encourage apartment ownership for qualifying individuals.

The research sought design solutions for affordable, sustainable, and resilient housing for Viet Nam's urban immigrant workforce. The authors led research conducted in summer 2014 under the auspices of a Fulbright Specialist Grant in Urban Planning at Da Nang University of Science and Technology (DUT) involving a team of DUT lecturers and students. The team first researched and documented the development of Vietnamese urban infrastructure, planning, housing, and construction. Research on extant affordable housing indicated most were lacking in addressing basic needs of thermal comfort, sanitation, floor area, and social spaces. From these findings, design criteria were formulated, including: (a) Affordability – land, construction, energy, and maintenance cost; (b) Sustainability – embodied energy, passive shading and cooling systems, water re-use, and urban farming; (c) Resilience – structural integrity, water resistance, elevated floor levels, and protected building systems; and (d) Social Needs – community spaces, urban amenities, and unit types addressing varied family types.

A prototype housing block was designed incorporating the identified design criteria. A site was selected in Da Nang's primary industrial zone comprised of 395 hectares, 10 km northwest of the city center, that includes factory, warehouse, school, park, commercial, and housing uses. Housing blocks are subdivided into 5 m × 20 m parcels intended for medium density row house development accommodating multi-generational family living. The prototype housing block structural bays conformed to the 5 m lot width, and 2 story apartment units were stacked and accessed by interior "streets", thereby incorporating row house typology with increased density and inclusion of communal spaces. Given the density, a primary challenge was addressing human thermal comfort and providing public and semi-public social spaces.

The project was presented to the heads of the Da Nang Urban Planning Institute, who noted the merits of the project and who encouraged future research to optimize cost, size, and fit to demographic, environmental, and other conditions. Overall, the prototype housing design appears as a promising first step to find more optimal solutions to the current and ongoing Vietnamese workforce housing problem.

1 INTRODUCTION

Recent global trends include the shift of manufacturing and service functions from developed to developing countries as a means to minimize costs and maximize profits. Significant foreign investment in the developing world has precipitated unprecedented fiscal growth and a radical transition from agricultural economies to industrial and service based economies.

This effect is best seen in China where millions of rural people have moved to expanded or newly constructed industrial cities. A similar phenomenon is seen in Viet Nam, though on a smaller scale due to the significant difference in overall population. These shifts align with recent liberalized policies including the transition from a centrally controlled socialist economy to market socialism, and the granting to individuals the right to obtain long-term land leases.

The Vietnamese government and foreign investors first concentrated on the coastal cities given that they had sufficient infrastructure to connect with the global production network, a larger available workforce population, and conditions to grow the manufacturing and service sectors. The creation of new job opportunities prompted major rural-urban migration, with 6.6 million people relocating between 2004–2009 (Le & Nguyen 2011). The scale and impact of the migration was not fully anticipated, and the government has been slow to respond. Only limited housing and related policies have been implemented to adequately address the crisis. When worker housing is provided – either by government or a factory owner – it is often substandard and lacking in surrounding urban amenities.

2 ECONOMIC AND DEMOGRAPHIC SHIFTS IN VIET NAM

The Nguyen dynasty collapsed after French colonial occupation. The French enlarged and built new cities and transportation infrastructure to capitalize on economic resources in mining, industry, and shipping. After French occupation ended in 1954, Viet Nam was divided into North and South, each with different political structure, causing mass intra-country migration. During the 30 years of the Viet Nam War, Northern residents vacated the cities to avoid airstrikes, whereas in the South, people moved to the cities to avoid rural guerrilla warfare. Sai Gon grew from 1,485,295 inhabitants in 1967 to 3,498,120 inhabitants by 1975 (Tran 2012)

In the 10 years following the end of the Viet Nam War, political uncertainty, U.S. economic sanctions, and other conditions created widespread poverty that fueled significant out of country migration. United Nations High Commissioner of Refugees (UNHCR) statistics indicate that from 1975 to 1997, 839,288 Vietnamese arrived in UNHCR camps in South East Asia and Hong Kong (Robinson 1998).

The *Doi Moi* reforms initiated in 1986 led the transition from socialist collectivized land holdings to a market economy which allowed individuals or entities to obtain long-term land leases. This gave exchange value to land (Kemper *et al.* 2015). In 2001 Viet Nam enacted the Law on Foreign Investment and signed the Agreement on Viet Nam-U.S. Trade. These policies helped spur significant foreign investment, and global economic interests invested heavily in Viet Nam in order to capitalize on inexpensive labor and infrastructure (Huyen 2015). As a result, cities developed economically with associated improvements in living conditions, such as education, health care, and higher wages. Data from 2011 shows average Viet Nam urban resident income of 3,968 USD/year vs. 2,041 USD/year for rural residents (General Statistic Office of Viet Nam 2016). Due to factors including rural poverty, vulnerability to varied crop yields, and poor infrastructure, rural families are motivated to send one or more family member to an urban center for work to raise living standards and diversify income (Nguyen & Locke 2014). The majority of rural-to-urban migrants are unskilled and find entry-level industrial or services positions (Le & Nguyen 2011).

The new urban immigrants provide the human resource for the rapidly expanding manufacturing and service markets. However, rapid urban population increase presents a number of challenges in providing adequate infrastructure, schools, and healthcare facilities. With economic development, the cost of living and housing rise, making affordable housing difficult to secure, and causing such development to be built away from the urban centers in industrial areas that are often polluted, and that have few amenities, such as parks and public spaces. Most affordable housing constructed to date – either by government or factory owners – have been found to lack acceptable space, sanitation, ventilation, and temperature control (Le *et al.* 2011).

3 ENVIRONMENTAL MANAGEMENT

As with many developing countries, Viet Nam deferred more stringent environmental protection policies in order to maximize production. To grow the economy quickly, the country exploited inexpensive labor and natural resources. Significant pollution and Co_2 emissions have resulted from unregulated industrial and energy production (Zimmer *et al.* 2015).

Viet Nam is vulnerable to climate change. In the last 50 years there have been increases in average temperature, rainfall, sea level, storm frequency and intensity, floods, salinity in coastal freshwater bodies, and drought. (Phan & Ngo 2013).

Climate change has caused many negative effects to food and ecological security, human health, infrastructure, and economic growth. In 2008, the Viet Nam government approved the National Target Program to Respond to Climate Change. Legislation on climate adaptation was enacted, focused on: (a) ensuring food security and water resources, (b) actively coping with rising sea levels, and (c) managing sustainable forest growth. In 2009 the Support Program to Respond to Climate Change (SP-RCC), an initiative of the Viet Nam government and development partners, attracted over 1 billion USD for 65 projects from 2012 to 2020 that concentrate on meteorological monitoring systems, forest protection, farming, safety, housing, sustainable development, emissions reduction, waste management, and recycling (Social Republic of Vietnam – Government Portal 2016).

4 HOUSING CRISIS

Assuming the Da Nang population projections are accurate, around 1 million additional people will require housing within the next 15 years. A large percentage of these people are expected to migrate

from the rural areas in Viet Nam, and will be seeking entry-level service or industrial positions. This population's monthly salary is estimated to be around 150 USD, and they will be challenged to afford quality housing. The Viet Nam government has many policies to support foreign and domestic investment, and to provide housing for low and average income people by tax relief and low interest loans. The government plans to support affordable housing with 1.5 Billion USD in low interest loans for qualifying apartment types and individuals (Ministry of Construction 2016). Therefore, the research focused on this primary current and anticipated need for housing people working in the industrial and service sectors in Da Nang.

5 DA NANG CITY

Da Nang is the fourth largest city by population in Viet Nam and the largest city in the south central zone. The city is situated on the main supply routes connecting Ha Noi and Ho Chi Minh City. Da Nang is located on the East Sea and serves as a major shipping port. Its warm weather and beaches draw a large domestic and international tourist population. The city has recently attracted significant foreign investment, and has developed a strong economic base in the service and industrial sectors. For these and other reasons, Da Nang has grown rapidly from a population of around 673,000 in 1997, to about 1 million in 2014. The population is expected to double to around 2 million in the year 2030 (Da Nang Urban Planning Institute 2016).

Da Nang's urban district occupies 241 square kilometers, situated on a low lying plain bordered to the north and west by the Annamite Mountain range, and to the east by the East Sea. The Han River divides the main urban district into west and east zones.

Da Nang is situated at 16 degree North latitude and has a hot and humid tropical climate with two distinct seasons. The rainy season yields an average of 400 mm rainfall per month, and extends from September through March, and the dry season yields an average of 70 mm rainfall per month and lasts from April until August. Relative humidity ranges from 75% to 85% over the course of the year. (Da Nang Statistical Office 2016).

Da Nang is the third largest economic center in Viet Nam after Ha Noi and Ho Chi Minh City. Da Nang's Gross Regional Domestic Product (GRDP) in 2014 was 2.3 billion USD, divided into the following percentages: Agriculture, forestry and fisheries 2.62%; Industrial and construction 36.26%; and Services 61.12%. (Da Nang Statistical Office 2016). The overall economy, as measured in GDP per capita, is significantly higher than that of the whole of Viet Nam, and has grown 700% between 1997 and 2010 (Da Nang Statistical Office 2016).

The latest available population statistics (2010) indicate that Da Nang had 926,000 total residents (722 persons/km^2), with the most dense urban district containing 167,000 residents (19,000 persons/km^2) (Da Nang Statistical Office 2016), comparable to other highly urbanized cities. The six districts comprising the urban core had 700,000 residents (2,800 persons/km^2) (Da Nang Statistical Office 2016).

The row house is by far the predominant type in Da Nang given its accommodation for typical multi-generational family living, small lot size, and ability to include ground floor commercial space. A small percentage of apartment buildings are found distributed in various parts of the city, with a concentration of luxury condominium projects located near the ocean or riverfront. Da Nang has 10 affordable housing apartment blocks, with the majority located at the urban edge (Da Nang Construction Department 2016). A small percentage of villas are built in the outskirts of the city, often in luxury resort developments.

In contrast to Ho Chi Minh City and Ha Noi, Da Nang is a relatively small and newly developed city. The city government has taken a proactive planning role through its Da Nang Urban Planning Institute. Thus, Da Nang has developed urban infrastructure that currently serves the city well, and that is poised to support the anticipated rapid future development. The Institute has completed detailed plans for the year 2030. It is expected that these plans will be implemented with only minor variations (Da Nang Urban Planning Institute 2016).

6 WORKFORCE HOUSING PROTOTYPE DESIGN CRITERIA

6.1 *Occupant accommodation*

Da Nang City 2010 statistics indicate that 57% of people are employed in the services sector, and 33% in the industrial sector. Approximately 50–75% of this population fall below the median income level of 2,000 USD per year (Da Nang Statistical Office 2016). This would equate to around 500,000 people currently in need of affordable housing. The projected 2030 population increase could raise this number to around 1 million people.

A typical migration pattern is seen whereby one or several members of a rural family migrate to work in the city, and send remittances home to the family. After the first migrating individual is established, s/he may be joined by other family members, and and may marry and have children (Le & Nguyen 2011). Family size and constellation may shift, and with it, the need for varied accommodations. Single individuals may be housed in dormitory facilities, whereas families may prefer more private contiguous space.

Based on the available information, the following criteria were formulated: (a) Provide food, education, and health services close to living units to decrease transportation time and cost; (b) Provide varied public and semi-public areas within and adjacent to housing; (c) Provide various unit types to fit the needs for singles and families.

6.2 *Affordability*

Housing development cost is principally dependent on land and building construction costs. Land cost can be lowered by building in edge city locations, and by building higher density. Viet Nam uses hand techniques for primary construction operations. As the economy develops, labor rates will likely increase (Imai *et al* 2015). This may cause more industrialized and pre-fabricated methods to be implemented in order to lower construction cost.

Based on the the research on construction cost, the following criteria were formulated: (a) Retain use of concrete slabs and frames, but consider using reusable forms to speed construction; (b) Consider greater use of small sized prefabricated elements, such as frame elements and wall panels; (c) Consider greater use of slab post-tensioning to decrease concrete volume and weight; (d) Develop modular prefabricated systems to speed construction; (e) Develop rationalized floor and roof slab construction, such as lift-slab methods; (f) Design using rationalized systems and modules to decrease the number of special conditions and operations needed.

Lower construction cost may result in lower rents for affordable housing residents. Other occupant costs may potentially be decreased by use of the following criteria: (a) Minimize electrical utility costs though shading and natural lighting and ventilation; (b) Locate housing near places of employment to lower transportation costs; (c) Provide access to low-cost government loans for apartment ownership; (d) Provide on-site gardens for occupants to grow their own food; (e) Offer retail space useable by residents to generate supplemental income.

6.3 *Environmental control and human comfort*

Because Da Nang daytime temperatures range between 31–39°C, with relative humidity levels between 74%–84%, interior comfort levels are exceeded in unshaded, uninsulated, and inadequately ventilated buildings. Only a small percentage of houses use air conditioning due to installation and utility costs.

The following criteria promise to improve human thermal comfort, while keeping initial construction costs to a minimum: (a) Build houses in compact clustered arrangement for self-shading in the block; (b) Orient buildings to minimize east and west sun exposure on exterior walls; (c) Use shading devices to protect the building envelope from direct sun; (d) Offer occupant control over moveable sunshade elements; (e) Insulate the building envelope and use radiant barriers and reflective surfaces to decrease thermal transfer; (f) Use cross and stack natural ventilation strategies; (g) Orient houses and blocks to prevailing winds during the hottest months of the year.

6.4 *Sustainability*

Vietnamese building construction is mostly comprised of fired clay brick and concrete. Brick, sand, and aggregate are locally sourced. Brick is typically fired using fossil fuel or by burning wood or rice husks, adding to air pollution and CO_2 emissions. Portland cement is highly energy intensive to make, and produces high CO_2levels (Nguyen 2013). The following criteria promise to reduce the carbon footprint of construction in Viet Nam: (a) Replace fired clay brick with concrete masonry; (b) Use recycled glass as an aggregate for concrete and mortar; (c) Use unfired clay brick in low or non-structural applications; (d) Use non-mortar, mechanically fastened masonry to allow building disassembly and material re-use; (e) Use fly ash as a substitute for Portland cement.

In the residential segment, energy use for air conditioning far exceeds any other type of consumption. To decrease electrical demand, the following criteria are recommended: Maximize shading, natural ventilation, and daylighting.

The supply of fresh water is sufficient for the current use patterns and population, and this capacity exceeds what is anticipated for 2030 (Da Nang Urban Planning Institute 2016). Fresh water is supplied to the city from the Annamite Mountains that border the city to the north and west.

Storm water is collected in the city's storm water system, and is processed in wastewater treatment. A small percentage of buildings currently include rainwater-harvesting systems. A majority of surfaces in the urban core are comprised of hardscape materials. Water saving plumbing fixtures are not used extensively.

To improve water quality and availability the following criteria were defined: (a) Use porous paving surfaces to allow water to return to the ground; (b) Use local rainwater collection systems. The rainwater can be used for irrigation, as greywater, or treated for potable use; (c) Use water saving plumbing fixtures.

6.5 *Resilience*

Due to the low elevation of developed lands and their immediate proximity to the ocean, Da Nang is vulnerable to climate change effects, including increased frequency and magnitude of tropical storms, sea level rise, and storm surge. Most buildings are able to resist these effects as they are constructed using water-resistant materials. Compact urban form helps shield many buildings from wind exposure and concrete frames are constructed to resist hurricane force winds. The majority of inhabited floors are situated above flood levels. Da Nang's building stock is more resilient than many other coastal cities; however, improvements could be made. The following criteria should serve to generate more resilient future construction: (a) Elevate the majority of habitable living space above storm surge levels, (b) Designate below grade spaces for service-only functions; (c) Use porous paving and slope grades to swales and retention basins; (d) Maintain high standards for structural design and resistance to high winds; (e) Use building materials resistant to water damage and mold.

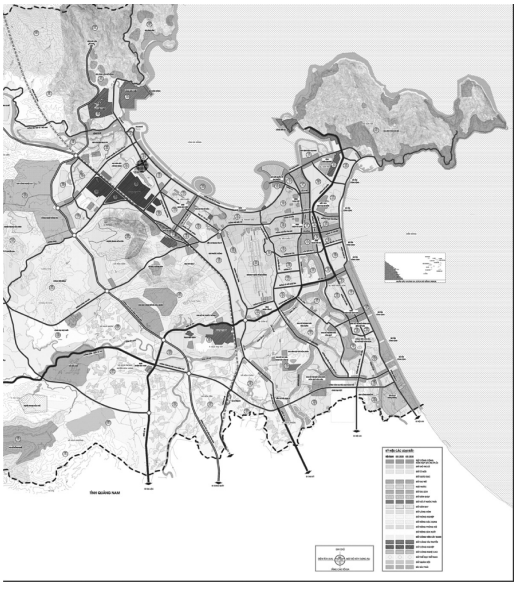


Figure 1. Da Nang land use.

7 WORKFORCE HOUSING PROTOTYPE DESIGN DESCRIPTION

7.1 *Site selection*

The prototype design is intended to address people working in industry, and a site in the industrial area was selected to allow workers to live close to their place of employment. The industrial zone has been planned in detail by the Da Nang Urban Planning Institute. Each detailed planning area typically consists of a mix of uses, including schools, health services, open space, commercial, and residential. Mixed use planning was supported in this project as it provides for more sustainable development by decreasing commuting distances, supporting community interaction, and providing a more vital urban environment. Mixed use is typical in Da Nang and other Vietnamese cities, and conforms to the current urban social and cultural norms. Blocks are typically laid out using the standard 41.5 m deep × 150 m long dimensions, and contain lots 5 m × 20 m. A block in the Hoa Hiep Nam, Lien Chieu District northwest of the city center was selected (Figures 1–3). This block has one long frontage on a major street, and an opposed long frontage on a minor residential street (Figure 3). This configuration offered a greater challenge and allowed commercial uses to be more integrated in the design.

7.2 *Fit with urban context*

In a typical planning project the prototype design would likely be interspersed with 5 m wide row houses. To fit with the neighborhood scale and urban morphology, the prototype is based on a 5 m grid. However, to achieve lower cost development (scale of construction and units per land unit area), a higher density than typical row house development was sought, while still providing public open space (Figure 4).

The intended construction materials conform to Vietnamese norms; however, recycled glass aggregate and fly ash are proposed for the concrete mix, and concrete masonry is proposed for wall infill of the concrete frame. Post-tensioned slabs are designed to reduce concrete volume.



Figure 2. Ariel view of site area.

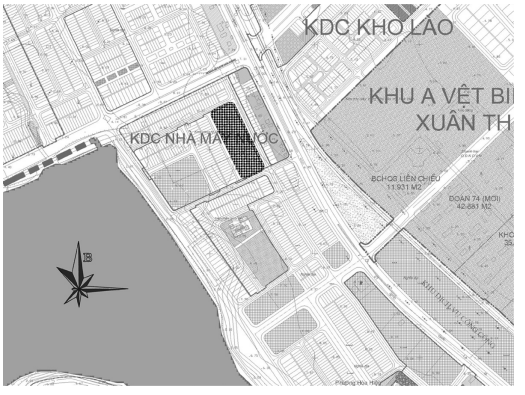


Figure 3. Planning map with building site.



Figure 4. Exterior rendering of prototype.

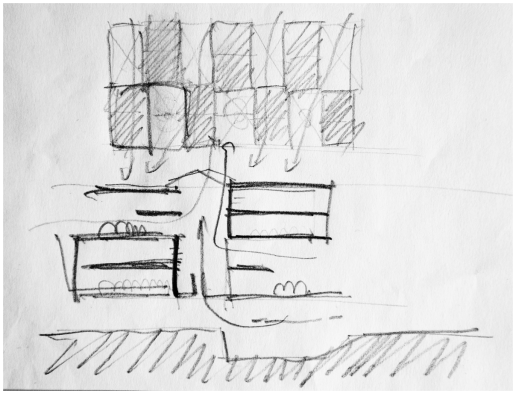


Figure 5. Concept sketch.

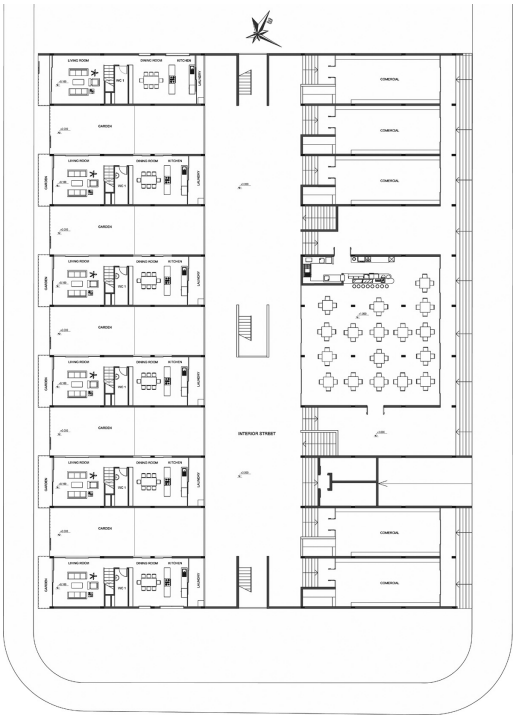


Figure 6. Entry level plan.

7.3 *Building typology*

Vietnamese urban residents are familiar with row house living, and the row house type was adapted using the concept of "stacked row houses". In this concept, a second layer of two-story row houses are placed above a first layer of two-story row houses. The design prototype is therefore a hybrid of row house and apartment typologies. Apartment buildings having typical double loaded corridors do not offer sufficient cross ventilation, and narrow corridor width discourages community interaction. In the prototype design attention was given to the internal circulation space to

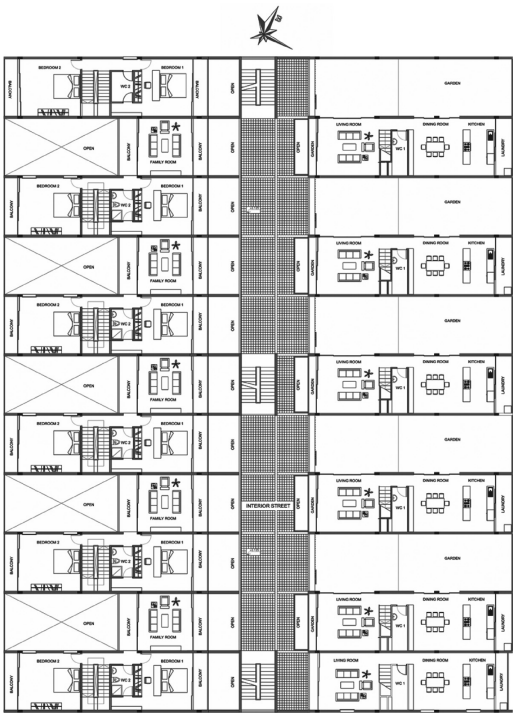


Figure 7. Second level plan.

serve communal activities, while also offering vertical and horizontal paths for natural ventilation (Figure 5).

The lowest level on the commercial side of the prototype design contains parking space. From the parking level people can access the "Interior Street" where they may take the stairs to the apartments, or enter the commercial spaces (Figure 6). Commercial spaces are also entered from the primary street. Occupants or guests of the apartments can also enter the interior street from the cross street, or from a small public space between the two buildings. Multiple access points from commercial and street areas is one strategy used to help integrate the prototype with life in the surrounding neighborhood.

7.4 *Community spaces*

On the second level (Figure 7) two-story apartments are entered on the commercial side of the building. The non-commercial side contains the second floor of the two-story units that are entered at the street level. This alternating pattern of entries to apartments continues up on the additional levels. Each interior street is "single loaded" in that entry to apartments occurs on one side of circulation. The interior streets are wide enough to encourage occupants to gather, and may be planted to take on the feeling of gardens (Figure 8). The width between apartments and the between the apartments and the street offers privacy. Conversely, people in the apartments can choose to interact with people in the interior street. Other common public and



Figure 8. Interior street rendering.

semi-public spaces include commercial ground floor spaces, small park spaces at the end and middle of the block, and a rooftop terrace having social, recreational, and community garden areas.

7.5 *Occupant living accommodation*

The prototype contains five apartment types to accommodate varied family types. Each type uses a row house organization, with the most public space located at the entry, and with semi-public and private spaces located toward the back. Two story apartment types have a stair located at the center of the plan, and contain the most private spaces (bedrooms), and in some apartment types, a family room on the upper level. Several apartment types contain an adjoining garden space.

7.6 *Environmental control and human comfort*

The prototype design could be built in different planning areas, and have varied orientation. Measures were taken to provide shading in any anticipated orientation. Each apartment's exterior enclosure is protected from high angle south sun and low angle west or east sun by an overhang and fin walls. Sliding adjustable louver doors allow occupants to control shading, ventilation, and privacy.

8 CONCLUSION

The rural-to-urban migration statistics show a high demand for affordable workforce housing in Viet Nam. The government's low-interest loan program may be a part of the solution to incentivize the building of affordable housing. However, other measures that concern urban, architectural, constructional, and other issues need to be developed to find more appropriate solutions to improve new urban immigrant's living conditions. The research and design conducted in this phase of work attempted to account for human and cost factors to begin to address the current housing crisis. Design criteria were formulated under the headings of occupant accommodation, affordability, environmental control and human comfort, sustainability, and resilience in order to focus on aspects that were deemed most critical.

The design prototype was a first attempt to address the identified design criteria. By providing greater density than typical row house development, and building away from the urban core, land costs per unit are reduced. Other measures to reduce occupant costs include passive shading and ventilation design features to lower utility costs, providing space for productive gardens, and locating the housing within walkable distance of employment. Incorporated commercial space gives occupants the ability to generate supplemental income. The design encourages community interaction by providing a variety of public and semi-public spaces and connections to the urban public space. Passive design strategies including self-shading in the block, daylighting, shading, building orientation, and ventilation help to improve thermal comfort. By investigating recycled construction materials, rainwater collection, porous paving, and water re-use, and other methods, the design promises to decrease impact on the natural environment. Resilience is addressed by locating inhabited space above storm surge levels, using water-resistant materials, and maintaining high structural design standards.

While the research so far has helped to point out the various issues that need to be addressed, and has indicated some strategies for addressing Viet Nam's affordable housing crisis, still much remains to be done. Additional investigations will need to be completed to lower construction costs, and these measures must be linked with policy and planning by government and assistance grants.

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Knowledge management in post-disaster resettlement housing

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ABSTRACT: The design community's response to natural disasters indicates that designers have difficulty in meeting the complete sheltering needs of displaced people. While many designers propose innovative solutions to emergency and transitional shelters for post-disaster relief, they seem to lack the knowledge necessary to produce permanent homes that successfully address the concerns of the displaced. Post-occupancy research on post-disaster resettlement housing reveals that designers repeat common mistakes, especially with the attempt to emulate the formal aspects of vernacular settlements of the affected communities. While the necessary knowledge is available for successful resettlement design, that knowledge seems to be inadequately managed for easy access and use in the discipline of architecture. Effective Knowledge Management (KM) in post-disaster resettlement design would aggregate lessons learned in resettlement successes and failures, organize an appropriate response to resettlement, build a conceptual framework for resettlement, and disseminate the knowledge among design professionals. In this paper, we discuss the need, approach, and substantives of KM in regard to post-disaster resettlement planning and design. We argue that KM in this particular case should be both 'mechanistic' that deals more with explicit knowledge systems and 'organic' that deals with tacit knowledge. Both are equally important when dealing with KM, because disciplines and professions are guided by mechanical standards of practice that are often taken for granted by the practitioners, but professionals also enlist organic artistry to solve indeterminate problems. A balanced approach to post-disaster planning should have *mechanical* approaches that 1) consolidate the settlement instead of relocating them, 2) design of settlement/dwelling models and variations, 3) make room for adaptations, and 4) adopt traditional practices to housing construction and disaster response. It should also have *organic* approaches that 1) include the users in the design process, 2) study the patterns of settings and activities, 3) provide support structures, and 4) change perceptions on building standards. If these approaches were codified into an operational knowledge management system, it would legitimate disaster resettlement efforts.

1 INTRODUCTION

Natural disasters leave millions of displaced people, and recent conflicts in Syria, Iraq, Nigeria, and Israel/Palestine are creating an unprecedented refugee crisis as well (UNHCR 2015). Whether these people settle in North America, Europe, or return to their home countries, there is a growing need for permanent housing. Architects and planners will be pressed to meet an emerging demand. Post occupancy evaluations on post-disaster resettlement (henceforth PDR) housing reveal that designers repeat common mistakes (Silva 2011). One example of this can be found in Kirinda, Sri Lanka. After the 2004 tsunami, an internationally known architect designed homes for a predominately Muslim community, but the homes failed to provide culturally appropriate privacy and gendered use of space (Silva 2011). Designers attempt to emulate the formal vernacular patterns of the affected communities while failing to emulate the process, values, and meaning associated with the houses (Oliver 2006, Oliver-Smith 1996). In other examples, displaced people are resettled far from existing income sources and social networks (Davis 2006, Oliver-Smith 1991, Silva 2011). Often, newly built homes go unoccupied while people chose to rebuild their destroyed homes (da Silva 2010). Much of PDR failures can be linked to community exclusion (Pyles 2007). In our objectivist-focused search to provide 'shelter and warmth' we have done some things right, but "have failed to recognize the complexity of shelter as 'house' and 'home'" (Davis 2006, p. 147) or included the community in resettlement efforts. The difficulty in disaster relief is not that problems cannot be solved; it is that, uncoupled from behavioral considerations, our solutions become solely physical (Davis 2006, Schön 1987). While many designers propose innovative solutions to emergency and transitional shelters for PDR such as rapidly deployed tents (Davis 2006), rapid development of permanent structures fail to adhere to dynamics of culture. Their speedy deployment "implies that there has been a failure to consult adequately with interested parties" (Alexander 2004, p. 6). People affected by disasters need more than protection from elements, security, and a place to keep their things; they are often deprived of their way of life (Davis 2006). It is very important to make appropriate housing decisions because designers' redevelopment efforts can

either reinforce existing patterns of marginalization (Alexander 2004) or become sources of democratic mobilization (Oliver-Smith 1996).

While the necessary knowledge is available for successful resettlement design, that knowledge is inadequately managed for easy access and use in the design disciplines. In this paper, we argue for formulating an effective knowledge management in PDR. Knowledge management (KM) is a tool for creating, storing, transferring, and applying knowledge. KM is used by firms and institutions to codify their knowledge into a 'task-performing system' that allows them to solve problems consistently – giving them a competitive advantage (Kamara et al. 2002, p. 54). Effective KM in PDR design would first create and aggregate lessons learned in resettlement successes and failures. We accomplish this by making tacit knowledge into explicit knowledge. Secondly, KM would build a conceptual framework for PDR that imbues resettlement efforts with knowledge of local or vernacular processes of housing production. Thirdly, KM would disseminate the knowledge among design professionals and students through publishing research, workshops, and coursework. Lastly, KM will help us organize an appropriate response to resettlement. We accomplish this by creating networks of first responders when the need arises.

2 INTEGRATED KNOWLEDGE

Before describing how KM can help designers, some examination of knowledge is needed, because the failure of PDR is primarily due to an incomplete understanding of what constitutes knowledge. This exercise is critical to developing KM for PDR because understanding the kind of knowledge needed "has a bearing on the KM strategy adopted" (Kamara et al. 2002, p. 54). The epistemological foundation of knowledge itself must be considered before we can assume that there is helpful knowledge out there waiting for us to manage it. We should question the nature of this knowledge, its ownership, and its truthfulness and validity. In our postmodernist condition, we hesitate to make absolute claims on knowledge because it signifies 'truth', and "fails to address the relative, dynamic and humanistic dimension of knowledge" (Nonaka et al. 2000, p. 7). Therefore, to navigate our world we must use heuristic mechanisms that produce contextualized actions. Difficult situations arise when we lack knowledge that is appropriate to the task, and we are left powerless. Sometimes our lack of codified values leads us to take knowledge for granted. In those situations, we risk defaulting to the normative theories and fads that govern our profession (Scarborough et al. 1999), instead of vigilant analyses and substantiated theories (Wiig 1997).

Our epistemological underpinnings give us functional truths that we call knowledge. For example, we may know that trees are living plants, and this knowledge is functional because it helps us derive benefits from studying them. This is an *objectivist* epistemology that "holds that meaning, and therefore meaningful reality, exists as such apart from the operation of any consciousness" (Crotty 1998, p. 8). Therefore, what we think about a tree has no bearing on what the tree actually is. This is only one kind of knowledge that we need for solving problems (von Hayek 1945). On the other hand, a *constructionist* epistemology informs us that "truth, or meaning, comes into existence in and out of our engagement with the realities in our world … Meaning is not discovered, but constructed" (Crotty 1998, p. 9). This means that the tree has no meaning outside of our interaction with it. The temptation at this point is to choose sides, risk forming an unhelpful dichotomy, and miss out on helpful knowledge. Designers could adopt a loose definition of *constructionism* as their epistemological stance simply because of the utility it provides in dealing with culture. However, since they must create physical objects, any framework of PDR must include some degree of objectivism. A heuristic approach will give designers some "conceptual and practical resources" to build a theoretical framework for their task (Maxwell 2013, p. 39–43). This epistemological exercise leaves us with a functional philosophy that allows us to work between objects and their meaning.

Privileging vernacular form over vernacular processes shows that objectivism has dominated the design community's PDR efforts. We have created innovative solutions, but have missed the cultural meaning associated with *dwelling* as a verb (Davis 2006, Silva 2011). Martin Heidegger (1971) argues that humans build as a means of dwelling. The act is congruent with one's livelihood and reconciliation with nature (Rapoport 1988). Here we see that building and dwelling have both objective and constructive meanings. Because of this, constructionism becomes an important *state of mind* to acquire when designing for PDR. However, we should move in between the object and construct, because the need to provide physical structures called 'houses' is governed by implacable realities such as thermal dynamics and gravity. We also need to recognize the contextual 'constructions' of the people we are trying to help. This suggests using *organic* (or tacit) and *mechanical* (more explicit) processes to bring together the cultural meaning with the object (Kamara et al. 2002).

The difference between *organic* and *mechanical* processes can be witnessed in professional practice. Many behaviors in professions are not canonized into explicit guidelines. These behaviors are not necessarily 'in the book,' rather; they are a set of competencies allowing professionals to solve problems by selecting from normative procedures, but also allowing them to reconcile conflicting information (Schön 1987, p. 6). The information available to practitioners to guide them 'solve problems by selecting from normative procedures' is a *mechanical* process while 'reconciling conflicting information' is an *organic* process. Therefore, knowledge as an object and knowledge as a construct are not necessarily epistemological

dichotomies; they are functions of *mechanical* and *organic* processes.

3 KNOWLEDGE TYPOLOGY

We have set knowledge as an *object* in contrast to knowledge as a *construct* and have suggested that separating *organic* and *mechanical* processes helps us reconcile the two. In order to describe how this works and what it means for KM we need to discuss knowledge in more detail. According to Alavi and Leidner (2001), there are five alternative perspectives on knowledge that have implications for KM (p. 109). For the sake of our argument, it is helpful to think of these perspectives more in terms of types of knowledge rather than 'alternative perspectives' because types of knowledge allow concurrent or consecutive use while alternative perspectives force us to choose between them. If epistemological perspectives of knowledge are actually types of knowledge, then they are not mutually exclusive, and understanding them will help us resolve our objectivist vs constructivist dichotomy.

3.1 *Knowledge as an object*

Considering Knowledge as an *object* is part of an objectivist paradigm because it "posits that knowledge can be viewed as a thing to be stored and manipulated" (Alavi & Leidner 2001, p. 110). In the architecture profession, we consider knowledge as an object (Boano & Hunter 2012), which can be codified into building codes, zoning regulations, and design standards. When we consider this in terms of PDR, we understand why designers think that rapid provision of housing solves resettlement needs (Silva 2007). We think in terms of square meters per occupant, building cost per square meter, R-values, and sustainable materials. If people are in need of these things, the quicker we provide them the better. Certain disciplinary expectations could be propagating such practices. For example, designers are often evaluated on the objects they create, and are rewarded if their objects look compelling in architectural publications (Hawthorne 2011). Objective knowledge feeds our need for certainty, which can leave other alternatives unexplored (Ibert 2007); but designers should not abandon objectivism completely. There is useful objective knowledge within design disciplines and a research infrastructure for creating objective knowledge that can address problems in PDR.

3.2 *Knowledge as a condition of having access to information*

Another way of viewing knowledge under an objectivist epistemology is the condition of having *access to information*. This type of knowledge is a condition of having storage and retrieval systems containing explicit knowledge (McQueen 1998). In many cases, the ability to find information is a component of action, but having 'access to information' does not tell us how to use that information (Alavi & Leidner 2001, p. 108). In other words, even if the information is accessible, the person accessing the information needs the capability and desire to act on it. Ian Davis (2006) worked with the United Nations to create guidelines for *Shelter after Disaster*, (p. 147-148). Even with access to this information, the desires of designers often supplant these guidelines (Davis 2006), and top-down approaches to PDR remain common (Twigg 1999, p. 52). The United States' Federal Emergency Management Agency (FEMA) (2011) have explicit guidelines in a report titled *A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action*, but these have not been included in an integrated framework that includes the study of vernacular processes. There is great advantage to having the mechanism of retrievable information, but information alone cannot solve the PDR problem entirely.

3.3 *A process: simultaneously knowing and acting*

Knowledge as a *process* is part of a constructivist epistemology because knowledge is a function of actors responding to conditions in real-time: it is an organic process governed by situations, relationships, and experiences. Donald Schön (1987) observed that this tacit knowledge manifests itself in abilities that often defy explanation. If this tacit knowledge defies explanation, is it no good to us? Nonaka et al. (2000) operationalize knowing-in-action by giving it a socio-spatial dimension. They argue that knowing in action is a dynamic process where organizations and individuals create knowledge in social settings through shared interactions. Austrian economist Frederick von Hayek (1945) discusses the socio-spatial character of knowledge as diffused instances of contradictory knowledge carried by individuals that reveal themselves in time and place. Therefore, tacit knowledge can still be of use to us, if we are situated in the right social context. Knowledge as a process, therefore, can be seen in the dynamic interrelations between people in a given setting.

3.4 *A state of mind*

Another constructivist type of knowledge is knowledge as a *state of mind*. Nonaka (1994) describes knowledge in terms of 'intentions' that seeks to appropriate information from one's environment to apply to a given task (p. 17). As we have argued, the need in PDR is rooted in understanding the affected people's culture. If we consider knowledge to be a *state of mind* in which we build empathy with people affected by disasters, we have the opportunity to branch beyond ourselves to gain emic perspectives (Nonaka et al. 2000). This means the focus should be on anthropological methods of gathering knowledge. Anthropologists have studied people's responses to disasters since the discipline began and can provide needed data on vernacular knowledge (Oliver-Smith 1996).

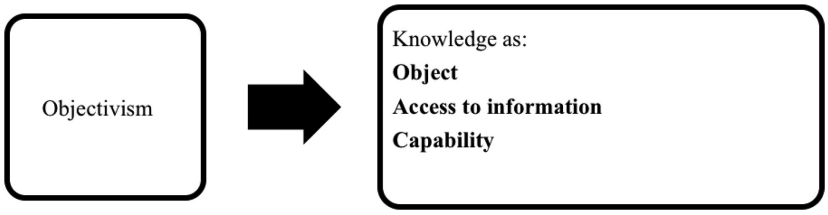


Figure 1. Objectivist Knowledge.

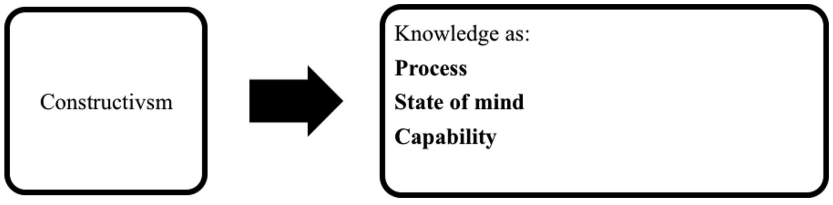


Figure 2. Constructivist Knowledge.

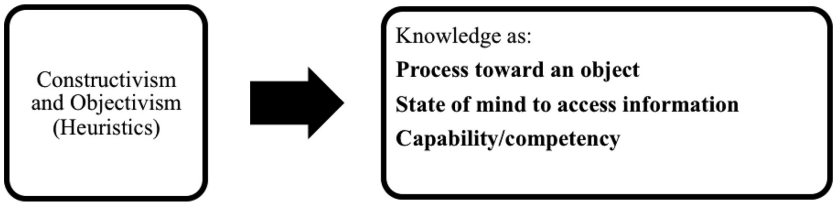


Figure 3. Integrated Knowledge.

3.5 *A capability*

None of the knowledge types discussed so far are self-contained enough to base our KM, because they do not reconcile the mechanical and organic processes that KM requires. Knowledge as a *capability* has become the focus of knowledge management (Nonaka et al. 2000), because this type of knowledge is not limited to either objectivism or constructionism, and it is neither exclusively mechanical nor organic. Thinking of knowledge as a *capability* frees designers from epistemological limitations since it focuses on learning from information at hand and negotiating the environment based on both the object and the construction (Davenport & Cronin 2000). If we need to learn from the tree as an object, we not only need the state of mind but also the capability for it. In many PDR situations, we will also need the capability to learn how meaning is constructed around the tree. If we need to learn the best way to site a house in Java, for example, we need the capability for that knowledge. If we need to know how Javanese people perceive gendered space, then we also need the capability to learn that.

If we have a strictly objectivist epistemology we will think of knowledge as an *object* or *access to information* that will tell us everything we need to know. Even so, we will need the *capability* to extract knowledge from the object in order to use it (Figure 1). If we have a strictly constructivist epistemology, we will consider knowledge as a part of a *process* that can only be understood within a certain context or *state of mind*. Again, we still need a host of *capabilities* in order to interpret the phenomenon (Figure 2).

If we take a heuristic approach, we can think of organic *processes* as movements toward an *object* and organic *states of mind* as movement toward *access to information*. We need to understand the dynamic interrelations of people in time and space that lead to objects (Kellet 2011). Additionally, we need to have an anthropologist's *state of mind* in order to produce *accessible information*. An example of this is Amos Rapoport's (1988) observations on the processes and products of vernacular settlements. In order to understand vernacular structures, Rapoport points out the importance of studying cultural processes that create vernacular forms. Understanding the behavior and human systems of people before they are impacted by disasters, and understanding how people respond to disasters will lessen the chance of making inappropriate design decisions (Oliver-Smith 1996). Thus, an integrated, heuristic approach to knowledge would look like Figure 3.

4 KNOWLEDGE MANAGEMENT FOR DISASTER RESETTLEMENT (KM FOR PDR)

The way we conceive of knowledge will affect our entire KM endeavor (Kamara et al. 2002), so

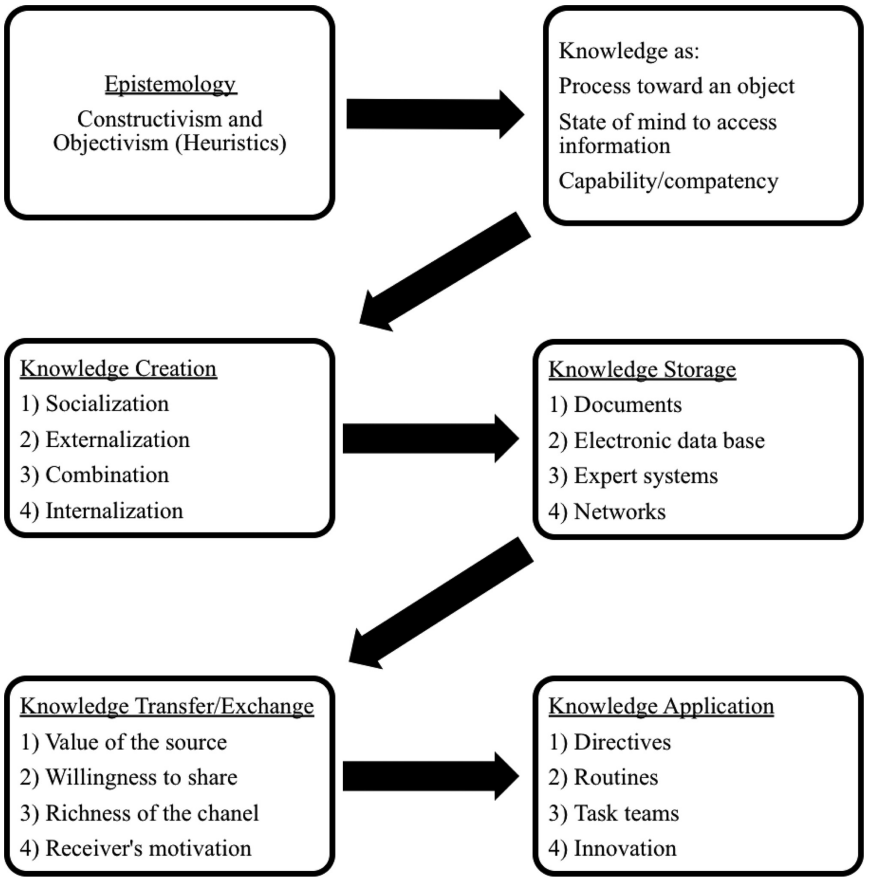


Figure 4. Knowledge epistemology and KM framework.

developing an epistemology based on the capability to negotiate both organic and mechanical processes will affect how KM for PDR works. As briefly stated above, KM is the creation, storage, transfer, and application of knowledge. Knowledge creation refers to a "continual interplay between the tacit and explicit dimensions of knowledge" that occurs on the individual and collaborative level in a shared context (Alavi & Leidner 2001, p. 116). Therefore, before we create knowledge we must have the capability to create the best environment for knowledge creation. Knowledge storage refers to the process of storing knowledge in a retrievable format. Therefore, we must have the capability to know what knowledge to store and how to store it. Knowledge transfer assumes there is a top-down process where experts impart knowledge to capable receivers (Wiig 1997). Others argue that knowledge transfer could be an exchange, in which we learn from other disciplines as well as from local wisdom/indigenous experts (Oliver-Smith 1996). Before we can exchange knowledge, we must have the capability to effectively impart as well as receive it. Lastly, the application of knowledge deals with the tools used to ensure the creation, storage, and exchange of knowledge is carried out (McQueen 1998); before we apply knowledge, we must have the capability to create meaningful and flexible tools to help sustain our efforts. The following sections will give an outline of how KM for PDR might manifest if the extant theories of KM, PDR, and vernacular studies were integrated into a systematic KM for PDR (Figure 4). KM for PDR is discussed for each phase of PDR process, i.e., *preparation*, *response*, *recovery*, and *mitigation* (Chua et al. 2007).

5 KNOWLEDGE CREATION

Nonaka et al. (2000) identify four processes of knowledge creation: *socialization, externalization, internalization, and combination* (SEIC) (p. 8). Each has organic and mechanical elements. According to Nonaka et al. (2000), *socialization* produces knowledge that can only come through a process of spending time together and co-presence (p. 9). Therefore, socialization is based on knowledge as a process. *Externalization* is simply making one's tacit knowledge sharable by making it explicit (p. 9). *Internalization* occurs when the group's explicit knowledge becomes tacit or even habitual (p. 10). Externalization and internalization can be viewed as states of mind with the goal

of making information accessible and operational. The *combination* process synthesizes existing explicit knowledge into something usable by the organization (Nonaka, et al. 2000). To facilitate this process, organizations create knowledge worker systems (KMS) in which 'knowledge workers' operate as individuals or work groups to keep KM goals in the forefront of the organization's efforts (Chua 2004, Nonaka et al. 2000). In other words, knowledge workers are all the people who participate in establishing and maintaining KM efforts.

5.1 *Knowledge creation for PDR*

Silva's (2011) research on PDR efforts in Sri Lanka creates mechanical and organic guidelines or values[(i)]. These are examples of explicit knowledge created through the *externalization* process by field research and literature review. All these have specific applications in KM for PDR.

Mechanic:

1) Consolidate the settlement instead of relocating the displaced (Oliver 2006, Silva 2011) and establish territorial claims (Davis 2006),
2) Design models and variations for housing (Rapoport 1988, Silva 2011),
3) Make room for adaptations and design for incremental growth (Rapoport 1988, Silva 2011), and
4) Adopt traditional practices to housing construction and disaster response (Silva 2011).

Organic:

1) Include the users in the design process (Rapoport 1988, Silva 2011, Turner 1977, Twigg 1999, Zhang 2012),
2) Study the cultural patterns of settings and activities (Rapoport 1988, Silva 2011),
3) Provide support structures (Davis 2006, Silva 2011), and
4) Change perceptions on building standards (Silva 2011).

5.1.1 *Preparation phase*

We need to aggregate these principles through *socialization, externalization, internalization,* and *combination*. The first step is creating what Nonaka et al. (2000, p. 8) refer to as the shared social context where capable researchers will refine these principles and generate more knowledge through close interaction. This interaction can occur in "conference sessions, research seminars, professional association meetings, practitioner gatherings, and official government meetings" (FEMA 2011, p. 2) as well as informal gatherings. Through this, knowledge workers will emerge to fill the various roles of PDR.

5.1.2 *Response phase*

Creating knowledge during the response phase of disaster resettlement would involve making our tacit knowledge explicit and our explicit knowledge operational. We do this through anthropological fieldwork of affected areas. In other words, studying the cultural patterns of settings and activities (Rapoport 1988, Silva 2011). The creation of knowledge for PDR, whether it is in Sri Lanka or Greenwood, Kansas, should include an 'accounting' of the affected culture (Agar 1996, p. 128). By doing rigorous fieldwork, we avoid enframing the affected community based solely on the visual characteristics of their buildings.

5.1.3 *Recovery phase*

Creating organic and tacit knowledge during the recovery phase will happen throughout the design and construction process (Nonaka et al. 2000). This includes observing the process, being involved in the process, talking to others who are involved, and theorizing about it (Agar 1996). The theorizing part is important because it is through theory that knowledge starts to become explicit (Schön 1987). However, creating tacit knowledge is no less important than making tacit knowledge explicit (von Hayek 1945), and in the design field, designers create tacit knowledge through close interaction and collaboration (Schön 1987). This collaboration should not only exist between professionals; in fact, it should rely heavily on participation from the affected community. FEMA's (2011) first three principles for an integrated, community approach to emergency management demonstrate the importance of knowledge creation during the recovery phase. **1) Understanding community complexity**: Since communities are impacted by many factors and interdependencies, it is important to understand the complexity of the setting, including "demographics, geography, access to resources, experience with government, crime, political activity, economic prosperity, and forms of social capital such as social networks, social cohesion between different groups, and institutions" (p. 6). **2) Recognizing community capabilities and need:** Communities can often collectively find ways to address needs (p. 8). **3) Foster relationships with community leaders:** These gatekeepers will help to identify existing activities and activists in which to frame efforts and help as well as help build trust with the community (p. 10).

5.1.4 *Mitigation phase*

In the mitigation phase, knowledge workers will create knowledge through coordinating lessons learned, performing post-occupancy evaluations, analyzing data from fieldwork, evaluating findings against extant theories, and placing the research into a wider theoretical framework. In addition, data could be used to identify possible sources of future risk to the affected community (Alexander 2004), such as mechanical issues like poor drainage and lack of escape routes and organic issues like economic vulnerability and weak social networks (Wickramasinghe 2015). Involvement with

[(i)] These should be considered values rather than guidelines because guidelines are subject to misapplication. For example, if they are viewed merely as guidelines, designers can use them as a checklist without ever truly engaging the public. As values, they are internalized.

the local community will foster reciprocal knowledge creation that will help establish resilient communities (FEMA 2011, Oliver-Smith 1996). FEMA's (2011) fourth principal deals with the knowledge creation during the disaster mitigation phase: **4) Build and maintain partnerships:** Mitigation can be achieved through maintaining public-private partnerships because maintaining local control of the economy helps build resilient communities (p. 12).

6 STORAGE/RETRIEVAL OF KNOWLEDGE

Knowledge is stored in physical documents, electronic databases, systems of human experts, and social networks (Alavi & Leidner 2001). After knowledge is created through the SEIC process, it must then be saved in a retrievable form. This is mostly a mechanical process. However, there needs to be an organic process as part of knowledge storage, or knowledge workers will not know what knowledge is worthy of storage, and what knowledge leads "to [maintaining] the status quo by reinforcing single loop learning" (Alavi & Leidner 2001, p. 118). Making too much out of the storage of knowledge risks turning the whole process into a static paradigm, because it moves KM "towards knowledge as commodity, and away from the localized, socialized context of practice" (Scarborough et al. 1999, p. 673). This implies that people within the social context mentioned earlier are no longer needed because the objective knowledge for a particular task is readily available. Knowledge storage depends heavily on the states of mind of knowledge workers because stored knowledge can lead to rigidity that hinders innovation (Nonaka et al. 2000).

6.1 *Storing knowledge for PDR*

The mechanical process for storing knowledge created in PDR involves organizing research and human contacts into a usable database. The organic process of knowledge storage for PDR is dependent on having a *state of mind* that seeks to *frame* the data within the affected culture's perspective, because without that state of mind, knowledge workers risk enframing affected people by paying attention to limited data (Schön 1987). Anthropologist Michael Agar (1996) warns that an ethnographic researcher's account of a phenomenon needs to 'approximate' the account of the studied group (p. 129). If a designer perceives only chaos and squalor in a particular group's settlement, and stores data accordingly, we may not know how the studied group perceives their settlement. We argue that researchers who study both the process and product characteristics of vernacular settlement have the state of mind for accessing the best information for PDR because they emphasize the cultural meaning, not only of the object (house), but also of the process of building the house. Therefore, a shared social context is not only needed for knowledge creation, it is also needed for storage.

6.1.1 *Preparation phase*

One of the most important aspects of KM is not necessarily know-how, but it is know-who, which means, "knowing who to contact when there is a problem" (Chua 2004, p. 59). Knowledge will be stored during the preparation phase in internal expertise directories (Nonaka et.al. 2000). These expertise directories will include data from previous research on PDR, names of knowledge workers, descriptions of their various roles, and detailed descriptions of the social context.

6.1.2 *Response phase*

The field notes, videos, audio, photos, surveys, and other data collected during on-site research should be stored in physical and digital databases, such as university libraries and relevant government agency archives. These data can be used to build knowledge of affected communities where physical site visits are viewed as too costly or dangerous.

6.1.3 *Recovery phase*

During recovery (or the actual design process) many meetings will be held, site visits and presentations made, and sketches and documents will be created. These should be stored in the databases mentioned above. This is a mechanical process that designers have a long history of doing well. The organic part of this phase means knowing how to conceptualize the settlement's physical characteristics. In some cases, designers will need to change their perception of building standards (Silva 2011).

6.1.4 *Mitigation phase*

Storing knowledge during the mitigation phase will come after knowledge workers actively observe local participants to evaluate whether the design process reflects the goals of political, economic, and social stakeholders (FEMA 2011, Zhang et al. 2015). This will allow us to avoid 'core rigidities' and 'competence traps' that may form if we merely go through the motions. The affected community must always be our greatest source of data; the end-users, not necessarily the designers, will determine what acceptable living conditions are (Silva 2011).

7 TRANSFER/EXCHANGE OF KNOWLEDGE

The social space of KM is created when knowledge is transferred to others. Knowledge transfer is dependent on the capability of the transferor to communicate the information, the transferee to absorb it, and the fertility of the social space where transfers take place (Cohen & Levinthal 1990). With this in mind, the need for a robust social space for KM for PDR becomes clear.

7.1 *Transferring knowledge for PDR*

KM for PDR is an emerging research topic, so researchers with initiative will build the momentum to shape it. The exact nature of social context, in terms of

PDR, is up for debate, but we propose it should include researchers interested in vernacular processes, as well as designers involved with humanitarian architecture that empowers the users. This is why it is important that researchers with empathy for vernacular research become the knowledge workers who channel their knowledge to students and professionals. Knowledge workers, who frame problems in the same way, though coming from diverse disciplines, will have the capability to give and receive knowledge (Schön 1987). Content of KM for PDR can then more accurately be transferred within an intentional framework.

7.1.1 *Preparation phase*

During the preparation phase of knowledge transfer, knowledge workers can enhance their capabilities by, first, placing PDR into a broader framework of vernacular settlements, which creates a robust theoretical framework that legitimates this effort. Second, creating a network of theorists will foster a motivational force to share and receive this knowledge. The last effort to enhance knowledge workers' capability is twofold: 1) Offer continuing education and certification for practitioners who participate in PDR (Silva 2011), and 2) incorporate this knowledge into design schools (*ibid*). Knowledge workers need to evaluate student and professional work based on cultural understanding as well as physical attributes (*ibid*).

7.1.2 *Response phase*

The difficulty of transferring knowledge to other professionals and students during the response phase comes from the sporadic nature of disasters. Knowledge workers can prepare for the disasters but cannot know when they are going to happen. Therefore, the fieldwork listed above cannot be easily planned as hands-on course work, and there is no other way to truly transfer this type of knowledge without fieldwork. However, the purpose of storing this knowledge is to help designers make informed decisions. Therefore, when on-site research is not possible, designers can use the response phase for reviewing data stored in past PDR efforts or ethnographic archives.

In addition to transferring knowledge to designers, it is important to transfer knowledge to the affected community. Knowledge workers do this through taking on roles of community organizers who facilitate community decision-making rather than being the sole decision-maker (Silva 2011). In this way, the KM for PDR will include the affected community as part of the knowledge worker system in a horizontal, reciprocating structure. When disasters do occur, on-site 'rapid ethnographic assessment procedures' can help designer and communities with informed planning (Pyles 2007, p. 324).

7.1.3 *Recovery phase*

The transfer of knowledge in the recovery phase happens through collaborating directly with the community through design workshops and construction projects (Barbosa 2013). The community should be included in the design and building process (Rapoport 1988, Silva 2011, Turner 1977, Twigg 1999, Zhang 2012). FEMA's (2011) fifth principle is **empowering local action**; which deals with creating a reciprocal knowledge transfer between the community, designers, and governments during the recover process (p. 14).

7.1.4 *Mitigation phase*

After the recovery phase, knowledge will be transferred through educating locals about the design process. *Knowledge workers* do this through addressing cultural, economic, and political interests and connecting all stakeholders to broader emergency management programs (FEMA 2011). This process will ensure that the community's entire needs, not just their physical housing, are understood. Since the affected community is usually the first responders in a disaster (Oliver-Smith 1996), it is important that they are aware of resources available to them.

8 KNOWLEDGE APPLICATION

Application of knowledge in KM is more than just the *use* of knowledge. It refers to creating guidelines for *how* knowledge will be used. This does not necessarily mean knowledge should be codified into prescriptions for use. Scarborough et al. (1999) warns that the 'codification and commodification' of knowledge for easy application tends to lose the rich human component of KM (p. 673). One way to direct how knowledge will be used is through independent task teams who follow an organic process that brings intangibles together, filters them through a theoretical framework, and makes action possible (Alavi & Leidner 2001).

8.1 *Application of knowledge for PDR*

It seems impossible to exclude knowledge use or application from creation, storage, and transfer. Indeed, each KM for PDR component mentioned above is dependent on knowledge application for its success. For example, knowledge creation during the recovery phase is dependent on collaboration during the design process. Knowledge is used by knowledge workers and reciprocated by the community. The success of KM for PDR will depend on knowledge workers' ability to receive the directives and internalize them into routines. It is not enough to create, store, and transfer this research and then issue directives for its use. Dynamics of time and space create 'indeterminate zones' (Schön 1987, p. 6) that override directives, and, in that case, far from being helpful – routines will nullify the benefits of KM for PDR. We have already discussed the need for knowledge workers to have a state of mind for contextualizing knowledge and allowing the setting to determine what is and is not important; however, there is a risk that our social context would become an echo chamber that is resistant to interpretation outside of the established framework. Therefore, knowledge workers should create independent task teams to critique their

PDR efforts, independently research the settings to verify if knowledge workers' findings approximate the meaning of the affected community, and verify whether or not rigidity is hindering data gathering and interpretation.

8.1.1 *Preparation phase*

Knowledge workers can use the preparation phase of KM for PDR to create directives. These directives could be based on FEMA's *Whole Community Design Standards*; however, they should also include directives for creating task teams to evaluate the appropriateness of PDR efforts. Task teams should act independently from the greater network of PDR knowledge workers to make sure stakeholders are involved. These task teams should not be members of social context that was created through the SEIC process. They could be members of the affected community, NGOs, government officials, or other stakeholders. However, PDR efforts should not be unnecessarily hindered by learning curves. If time and energy are spent bringing task teams up to speed, that time could have been used engaging the community. Task teams should have some foundation in community organizing and advocacy, as well as knowledge of PDR and design.

8.1.2 *Response phase*

It is important that knowledge workers do not smuggle unhelpful biases into the process that might invalidate their work (Agar 1996). There are many ways that task teams can help validate knowledge workers' efforts during the response phase of PDR. Jane Jacobs' (1961: 440–441) three 'habits of thought' provide ways to avoid that problem. The first habit of thought would allow task teams to "think about process" while knowledge workers focusing on all the other aspects of PDR (p. 441). The next habit of thought requires "working inductively, reasoning from particulars to the general" (p. 440). This is important because inductive reasoning helps identify forces and processes that actually are pertinent to settlements (p. 441). In other words, instead of allowing external data to describe how things ought to be, inductive reasoning will allow task teams to gain the displaced people's account. The last habit of thought will inform task teams that settings provide clues in small quantities that reveal how larger systems work (p. 440). Through this, task teams may find that arrangement of homes, gendered spaces, window placement, outdoor kitchens, and so forth are critical components of settlements. Thinking about process, working inductively, and seeking to understand the particulars of a phenomenon are implicitly discussed above as part of the integral framework of KM for PDR; however, keeping these 'habits of thought' independent will keep them from being diluted by directives, routines, guidelines, and standards.

8.1.3 *Recovery phase*

During the recovery phase, knowledge workers will work with communities to create appropriate housing. This is the fundamental goal of this whole effort. In addition, knowledge workers will work with stakeholders and task teams to create new directives, routines, and codify new standards to be applied in the next PDR effort.

8.1.4 *Mitigation phase*

The work of knowledge workers and task teams during the mitigation phase of knowledge application is to revisit PDR projects to 'verify and validate' that all stakeholders' needs were met (Barbosa 2013, p. 9). This is not only a way to evaluate the fitness of PDR efforts, but also a way to identify tacit knowledge that may go unnoticed by knowledge workers. Identifying tacit knowledge and making it explicit is how knowledge workers can innovate. The whole purpose of this KM effort is to help designers make appropriate decisions in resettlement; therefore, innovation is the key. We need to allow this process to inform us and keep innovating until we get it right.

Table 1 is a draft of what the KM for PDR process might look like.

9 CONCLUSION

Ian Davis (2006) writes about two divergent approaches to sheltering. The first is the 'commercial option' in which governments hire large builders to achieve rapid recover, and the 'livelihood option' in which displaced people participate in decision-making and construction on their shelters and economy (p. 153). The first provides shelter quickly but leaves the people out of the process entirely. This sometimes leads to inefficiency and marginalization (Twigg 1999). The second allows for all of the vernacular process, but takes a long time. When people are in immediate need for housing, the 'commercial option' provides the most direct approach. However, designers can speed up the 'livelihood option' if we have a robust knowledge management system in place. This paper is an attempt to start this conversation, so that future PDR efforts will be more responsive to community needs.

We argue for an integrated epistemology for PDR. Far from being mutually exclusive, we posit that objectivism and constructionism and organic and mechanical processes are integral to managing the complex issues of PDR. Disaster resettlement requires both objects and understanding of the objects' meaning. It is important to bear this position in mind as research on KM for PDR develops, because privileging one over the other could have disastrous consequences.

After positioning PDR within extant theories of KM, we drafted an explicit theoretical framework of KM for PDR. This framework will seek to involve the affected community in the knowledge creation, storage, transfer, and application components of KM as well as the preparation, response, recovery, and mitigation phases of PDR. In addition, we argue that knowledge workers involved in this effort should come from diverse disciplines such as anthropology, community activism, designers involved in community

Table 1. KM for PDR framework.

KM Process	Phases of PDR			
	Preparation	Response	Recovery	Mitigation
Creation	• Create social space where like-minded researches can generate and codify knowledge	• Do field work in disaster stricken locations and with disaster management groups • Local communities will be the source of knowledge	• Collaborate with locals during programming, design, and construction	• Coordinate lessons learned and perform post occupancy evaluations • Identify possible sources of future risk (Alexander 2004, p.7) • Build partnerships with communities
Storage	• Create a detailed description of social space • Create databases of experts • Make a list of knowledge workers and their roles	• Store field notes and record activities with video, audio, or photography • These should be kept in a physical or digital database accessible for knowledge workers	• Maintain design documents and record design process	• Research local participants in their efforts to build sustainable infrastructure • Describe sources of risk in publications or research community and locals (Alexander 2004, p.7)
Transfer	• Place PDR into a broader theoretical framework of vernacular settlements • Create network of theorists to share and receive knowledge on PDR • Develop curricular and professional incentives for studying PDR	• Organize on site data gathering • Help organize and mobilize the community	• Collaborating with affected communities will allow reciprocal knowledge transfer • Empower local action	• Enlist local participants in building sustainable infrastructure. • Teach locals about risks • Inform locals about the design process
Application	• Create independent task teams	• Task teams will evaluate work independently of knowledge workers	• Create new directives, routines, and codify new standards for future PDR efforts	• Task teams will evaluate the work • Identify routines that have developed • Innovate

mobilization, and researchers who appreciate vernacular processes.

Finally, this theoretical framework is a synthesis of disparate theories but remains incomplete. It requires further research, examination, and scrutiny. This effort can only become KM through the SEIC process within a social space that is yet to be created. Socialization can come through discussing these ideas at conferences; externalization can come through publishing PDR research; internalization can come through scrutinizing the framework presented in this paper; and combination can come through bringing diverse disciplines into the KM for PDR effort.

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Jewish neighbourhoods in prewar Poland – an attempt at typology

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ABSTRACT: This paper provides a summary of larger research which explores the most typical neighbourhoods inhabited by Jews in the prewar period. Several case studies reveal different levels of acculturation, different functions in terms of the dominant professions in a settlement, varied periods of Jewish presence, and sizes of the communities. Despite the fact that the multiplicity of factors influencing the physical settings through the everyday use of space may seem enormous, an in-depth analyses shows certain general patterns. While the meaning of certain elements did not change a great deal through the ages, new threads appeared, not only through acculturation and modernisation, but also as a consequence of factors such as the rapid growth of the Hasidic community or due to the influx of Russian Jews at the end of the 19th century.

1 INTRODUCTION

1.1 *Idea*

Physical structures are considered artefacts of the cultures and societies which built them (Rossi 1984). In order to understand the influence of various social groups we need to grasp the variety of cultural patterns and examine their relations with the built environment at a given time. This focus has recently become more and more present in architectural and urban design and morphology research, and the current study, referring to the cultural meaning of physical urban space, may enrich the already defined ontologies, e.g. the one proposed by Lopes et al. (2015) and Beirão (2012).

1.2 *Case study*

The current paper is structured around the case study of the Jewish presence in two central Polish districts: Mazovia and Lodz, in the period before World War II. The complexity of the culture once present there gives us the opportunity to verify its impact on the physical structures and to look for typology which could let us grasp its richness and provide understanding.

1.3 *Content*

After this brief introduction and presentation of the background, the method of classification is defined and afterwards applied. The final part summarises the outcomes and gives an overview of future research avenues.

2 COMPLEXITY OF CULTURE

2.1 *Complexity as theory in urban studies*

The context that has served so far as the main source of knowledge about the culture of usage of space no longer suffices today, in the period of rapidly progressing urbanisation and migrations of large groups of people, who bring their own habits and behaviours. The need to design places that answer actual human needs is becoming progressively more urgent. Lefebvre's call for a single discipline of urban science (2003) requires a more heuristic approach and a more efficient use of the knowledge from various disciplines involved in urban design. The fragmentation and specialisation of science as well as historically established divisions result in huge discrepancies in terminology and in language used by researchers of various backgrounds.

Some of those problems, which exist especially on the margins of social and technical fields, have already been addressed in the field of complexity science (Portugali 2006), namely the relations between the culture of everyday life and usage of space. The cultural background, the way people representing various groups perform activities specific to them on a daily basis yields an understanding of the settings they tend to create, the overall schema inscribing into the more general framework of the cultural structures as defined by Levi Strauss (1963).

This relation manifests itself at all scales, starting with the regional one, when analysing the patterns of people's distribution, through the town level, in which various subgroups choose different places following their preferences related to lifestyle and resulting from their social status, up to the neighbourhood level, where the way people use space influences the sociometric layout of urban structure and also its physical form, while acquiring the meaning connected to a given cultural group.

2.2 *Complexity of Jewish life in prewar Poland*

The processes of the acculturation of the Jewish population which took place in Poland before the Holocaust deserve attention, and not only from their historical

point of view. The longterm stability of their coexistence in a multicultural society was associated with the specific spatial organisation and distribution of various groups and their threads in this vibrant community. The spatial organisation allowed both for the continuation of the former high context orthodox culture, still rooted in the Medieval Ages, and for integration, which was usually reflected by moving to lower context environments.

The form of the physical settings resulted from the spatial practices occurring there. One of the factors affecting the urban environment most was the level of spatial integration, which mirrored the degree of cohesion inside the community. Everyday practices and activities, embedded in the physical urban settings, gave rise to the spatial order which reflected them. Recognition of the culture related behaviours ruling the formation of urban structures requires the in-depth analysis and understanding of everyday Jewish life, which, in its variety, manifested itself in the villages, towns and cities of central Poland.

2.3 *Acculturation processes*

Acculturation manifested itself in two ways, first, as an adjustment to the surrounding culture and progressing Polonisation, which lacked an ideological background, and was prevalent in the rural areas, second, the changes which were based on a strong ideological background, initially from the Haskala and Jewish Enlightenment movement. The second was far more visible in cities, especially within large Progressive Judaism communities.

As Polonsky (2014) proves, the results of the census of 1921, namely the discrepancy between two values: the one on declared religion and the one on declared nationality, indicate the level of acculturation. Taking into account the availability of Polish language education, which catered to the majority of Jewish children between wars, this thesis may be true, as the numbers indicating Jewish nationality were usually much lower than those describing Moses faith, the current study assumes the latter a decisive factor.

3 METHOD

3.1 *Three typological levels*

The hierarchy of types necessary to properly picture the complexity of the various lifestyles comprises three levels: that of region, town and neighbourhood. The upper level, in the form of a database, shows the collection of circa 2500 places where Jews lived before World War II, including cities towns, villages, manors and also smaller settlements, with the Jewish population counting from a few people up to many thousands. The intermediate level refers to those towns or cities which, containing a Jewish population large enough or with a long tradition of Jewish presence characterised with a mixed profile, made the strict definition of Jewish lifestyle impossible as there were various groups of differing acculturation levels, dominant occupations, etc.

The level of neighbourhood refers most often to a predominantly Jewish part of any village or town which used to host a Jewish community. In larger, mixed profile settings it may also refer to a part of a city with a specific character and of lesser or higher acculturation degree. Due to its limited size, the current paper provides the most representative observations only, with the whole systematic and background study presented in a book concluding the current study.

3.2 *Approach, sources*

As the sources are fragmented, showing only pieces of the variety of this culture which vanished abruptly, a more reliable picture may be derived based on statistical data. The current study is based on elaborated results from the First Polish Census of 1921, as the results of the second (1931) were never published in their elaborated, final form. A model, in ArcGIS, has been created, which juxtaposes the census data with other resources, summarising Jewish ways of life in prewar Poland. The model contains information on the size of a Jewish population in a given place (of 1921), its share in the whole population, and the profile of the community. The integration of multiple sources to achieve a more holistic picture of the Jewish culture which backgrounded the current considerations, allowed for a more in-depth understanding of the novelty of solutions and multiplicity of observations. Additionally, it has also provided a backdrop against which an explanation of the form of historical settings becomes available in the way Levi Strauss's structural analysis suggests. Following the methodology proposed by Rappoport (1990, 2003), the appearance of outdoor urban spaces has been of principal concern and served as an additional source of information on the ways of life.

4 RESULTS – REVIEW

4.1 *The regional level*

The demographic dynamics are comparatively high for the Jewish population, yet quantitative thresholds need to be defined in order to assess their representation in the settlement network of central Poland and provide an image at a given moment. In 1921, of the total number of 345 settlements in central Poland with a Jewish population larger than 50, 70 had a Jewish population of 50 percent or more of the total population.

Among the multiplicity of towns and villages in central Poland, some of them very small, others reaching up to several hundred thousands, Jews were present in the more urban ones – in 1921, in the 70 mentioned above, 25 possessed the status of a town, 27 were urban settlements and 10 still villages, most of them quickly urbanising, to become towns in future, or suburbian colonies outside the larger settlement (Table 1). The quantity of settlements with over 50 Jews where they

provided for 30 and more percent of the total population or larger, reached up to 182 (Figure 1). Moreover, nearly all towns in central Poland had their own Jewish community.

Table 1. Jewish settlements larger than 50 people and providing for more than 50% of the total population (GUSRP, 1925).

	Quantity	Jewish population	
Profile*	Number	people	%
Towns	25	1429–6812	50–82
Urban settlements	27	218–3809	50–97
Villages	9	57–1085	53–100
Settlement	1	139	60
Summer resort	1	1108	63
Manors	2	65–148	52–54
Colonies	5	73–270	57–100

* Classification follows the one of the 1921 census.

In the case of smaller settlements, depending on the overall Jewish population in a given region, Jews were generally equally spread within villages, with individual groups often counting no more than 5 individuals, which may point at a single family.

The classification of a town's profile refers mostly to those settlements with a population larger than 50, usually hosting a Jewish *kehilla*, religious community. In the case of smaller settlements, the profile was chiefly rural, with Jewish families catering to the basic needs of the surrounding communities in terms of commerce and often also tavern-keeping. In larger communities, there were also some other basic crafts offered, traditionally tailoring, shoemaking, etc. Additionally, in many manors, small groups of Jews resided, perhaps current or past leaseholders (Fig. 2). The scale of this phenomena varied between counties, depending on the importance of the manor economy in general, and the role of agriculture as such. Nonetheless,

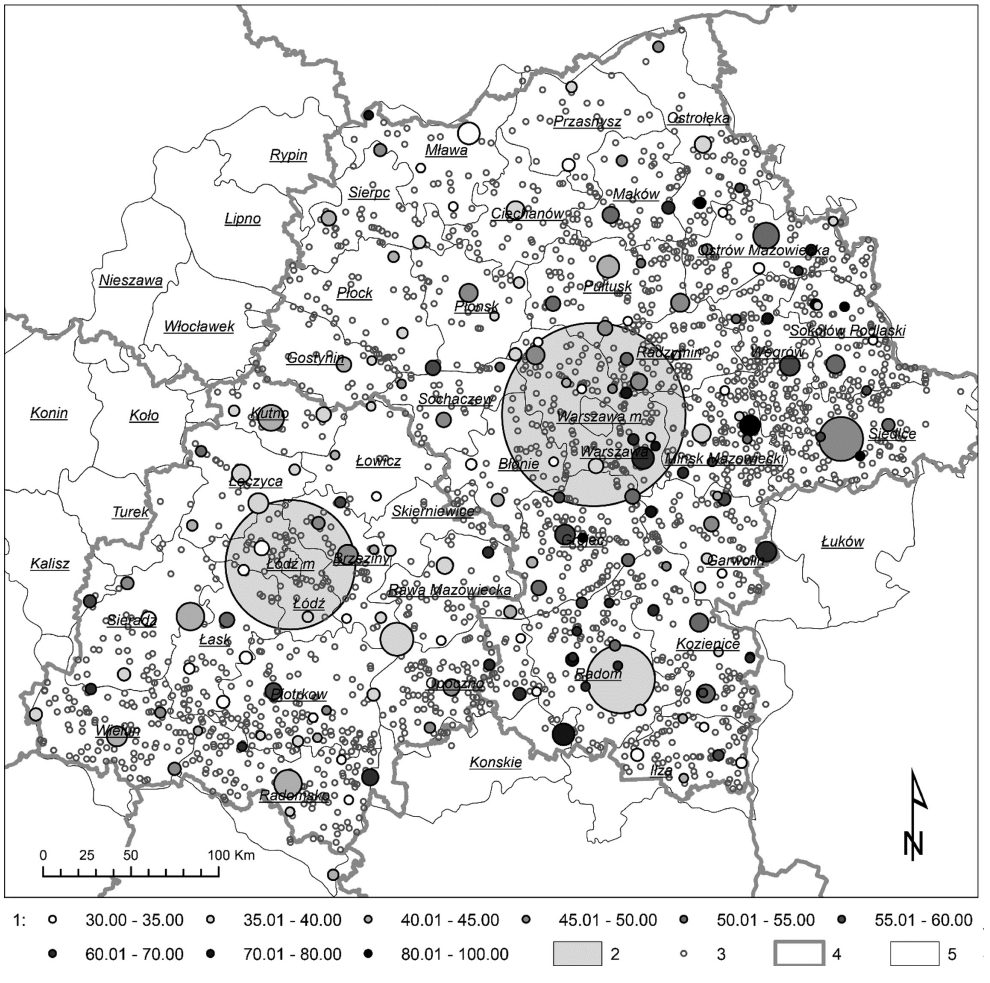


Figure 1. The main patterns of distribution of the settlements with Jewish population share higher than 30% and the quantity over 50 people in the regional scale, 1 – percentage of Jewish population in towns and villages, dots' sizes describe size of a Jewish population in 1921, 2 – regional centres: łódź and Warsaw, 3 – remaining towns and villages with Jewish population, 4 – contemporary voivod-ships borders, 5 – pre-war counties' borders.

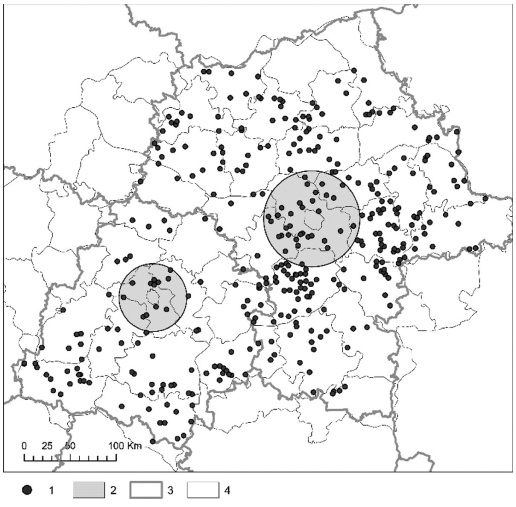


Figure 2. Distribution of manors with Jewish dwellers. 1 – manors, 2 – regional centres: Łódź and Warsaw, 3 – contemporary voivodships borders, 4 – pre-war counties.

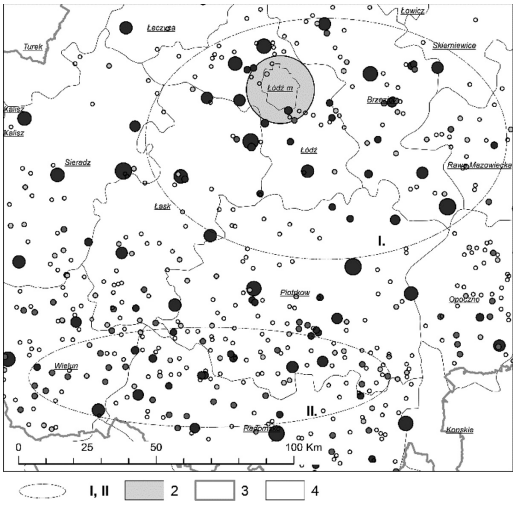


Figure 3. Types of settlement patterns in the regional scale: I – industrial, II – rural, 2 – regional centres: Łódź, 3 – contemporary voivodships borders, 4 – pre-war counties.

in some counties such as Łowicz, apart from major towns, Jews were barely present.

When analysing the distribution of the Jewish population in the scale of a region (Fig. 3) two main patterns are noticeable, corresponding to the two main types of prevailing economies: agrarian and industrial. The main difference between the two patterns refers to the regularity of distribution, and its internal dynamics.

4.1.1 *Industrial development*

The two most important cities in the region, Warsaw and Lodz, considered Jewish metropolis (Guesnet 2015), became at the same time two main nodes of the urban network, attracting people from the surrounding counties. Moreover, the strip of textile industry towns spanning from Tomaszów to Zgierz, already founded in the period of the Kingdom of Poland thanks to the government initiative dating back to the times of Stanisław Staszic, flourished. The main urban centres were those thriving thanks to industrial production, with time, huge masses of people developed specialised services, satisfying both their own needs and those in the regional scale.

When analysing the patterns of distribution of the Jewish population down to the smallest groups, a dynamic emerges, with Jewish settlements gathered along major access roads. It is clearly visible which locations attracted Jews the most, which ways they took to travel, where they stopped, etc. The whole pattern, genuinely dynamic, is more explicit in the regions of Warsaw and Lodz, the two most important industrial and administrative centres of Poland. In the region of Lodz, the locations where the smallest groups of Jews lived spread along the more important roads, e.g., from Lodz to Warsaw through Stryków and Głowno, from Lodz to Koło and Poznań, joining Lodz and Warsaw through Brzeziny, etc. In the areas surrounding Warsaw, Jews located themselves first of all next to the railway lines, some of them built catering to their needs, e.g., of the line to Góra Kalwaria. With time, the railway influenced the development of the culture of summer resorts e.g., in Otwock, Świder and Falenica.

4.1.2 *Rural development*

In the southern part of Piotrków, Radomsko, Wieluń and Sieradz counties the patterns remained more regular, static, with nodes equally distributed, which could have been due to their prevailing rural character. The density of very small Jewish concentrations south from Piotrków Trybunalski grew considerably, which could be attributed to the long term traditions of settling there, probably broken by the short period of Prussian rule. Another reason for settling there may have also been an extremely shallow layer of coal in the region of Bełchatów, with slightly similar phenomena occurring also close to Rogoźno, more to the north. Besides this, the Jewish population was proportionally higher, similar to the overall numbers of people in towns and villages. The high densities, with all their consequences in terms of economic constraints imposed on Jews, could have led to the Jewish expansion into rural areas.

Yet, despite the large sizes of villages in Wieluń county, the Jewish population there was quite limited, provided for up to 10 percent of the total number of inhabitants, except for a few towns and manors. When examining the overlap of patterns of Jewish distribution there with the background settlement pattern, an interesting phenomenon emerges, actually, the total sizes of Jewish rural communities in Wieluń county is similar to those in Radomsko and the south part of Piotrków county. What was different is that in Wieluń county a similar group of say 30 Jews lived within the administrative borders of one village, whereas in Radomsko and in the south part of Piotrków county a group of thirty Jews would be scattered in a few

small villages located one next to another, a cluster structure allowing them to maintain direct links with their community. The similarities in settlement patterns may result from the roles which Jews performed in the rural society, and the demand for their services, which did not differ that much between the two discussed regions (Fig. 3). We must remember the need of a threshold of 10 men over thirteen in order to satisfy minyan quorum requirements for public prayers. Each Jew belonged to a religious community kehilla, with whom they had to maintain easy and undisturbed contacts, which required spatial proximity. So either they stayed in a town where kehilla was located or, moving to the countryside, remained in the proximity of a larger settlement, keeping travel distances feasible.

Similar patterns were observable east from Warsaw, in Mińsk Mazowiecki, Siedle and Węgrów counties. While in the direct region of the capital its influence is clear, further to the east more static patterns prevail. This again could have been the predominating role of the agrarian economy. Nevertheless, in this region the Jewish population share grew much higher than elsewhere, which was reflected in the growth of both small, rural concentrations and larger urban centres.

Table 2. Basic range of communities' profiles.

Profile	Examples	Jewish population	
		people	%
Mixed	Warszawa	310322	33
	Łódź	156155	35
	Płock	7352	29
	Radom	24465	40
	Siedlce	14685	48
Textile industr.	Brzeziny	4979	47
/crafts	Zduńska Wola	7885	42
	Kałuszyn	5033	82
	Łask	2623	54
Industry	Bełchatów	6249	59
	Tomaszów	10070	36
Commerce	Nasielsk	2691	53
	Stryków	1998	48
	Piaseczno	2256	40
	Widawa	773	35
Cult	Góra Kalwaria	2961	54
	Aleksandrów Ł.	2635	32
	Przysucha	2153	66
Summer resorts	Otwock	5408	63
	Falenica	1108	63
	Głowno	1430	59

4.2 *The town level*

The variety of Jewish culture in pre-war central Poland found its reflection in the variety of neighbourhoods inhabited by Jews. Each town had its own history, own specific reasons for development and growth. The Jewish population changed over time, first growing then declining, when the gentile citizens of many towns obtaining a privilege *non tolerandis judeorum* or pogroms purging Jews out of towns. In some towns Jewish zones were created, or they collapsed and even in some cases lost their charters because of fires. Reasons for growth were multiple, in the era of industrial production the most common were related to the development of specific industries, the most often being textile or leather garment production. Despite this, many towns and villages continued as formerly, servicing the neighbouring country with minor crafts and commerce.

Table 2 shows the basic range of community profiles, with several examples for each type. The main typology refers to the professional profile, with the division into market-based, thus commercial settlements, administrative centres, and industrial, in this number, textile industry centres.

There were also numerous religious centres, in most cases growing around a court of a Hasidic or Orthodox rabbi. Among centres of religious cults, the most spectacular examples of rapid growth were Ger (Góra Kalvaria), Przysucha and Aleksander (Aleksandrów Łódzki), all of them seats of famous Hasidic rabbis.

The presence of a specialisation did not however exclude other activities, with commerce and crafts represented in all Jewish settlements. What is more, professional profile changed over time. While smaller settlements maintained their unique profile and specialisation, along with growth as well as with time, their development led to complexity, and the overlap of several characteristics. These processes, accompanied by progressing acculturation and assimilation, made districts inhabited by Jewish groups of specific features such as social status, education, professional profile, religious observation, etc. The phenomenon is most explicit in the case of large metropolis, like Warsaw and Lodz, but it is also observable in cities with long traditions of Jewish presence, in this group Radom, Płock or Siedlce.

On the other hand, rapidly developing towns and villages gained new extensions, such as colonies and suburbs. This rapid suburbanisation proceeded with Jews gravitating to these new urban centres. They took an active part in their development, often informal, just outside a town's administrative borders, on private grounds, as in the case of Lodz Bałuty. In some cases, like in Koluszki, a former village which grew strong due, first, to the construction of the Warsaw Vienna Railway and later on thanks to the connections to Lodz and further to Kalisz and Poznań, with the important railway node there. Several smaller villages in its direct proximity urbanised, this way leading to the growth of the succeeding town and also attracting Jews. Jews who settled in the neighbouring villages in most cases profited from the existing community facilities of the core one, altogether forming a thriving community. Such a cluster may or may not become an actual town, Koluszki obtained its township in the postwar times, in 1949.

4.3 *The neighbourhood structure*

In many towns, the districts inhabited by Jews grew more urban than the surroundings, with the



Figure 4. The sociometric layout of paths and alleys on the backdrop of the reconstruction of the non-existing quarter between Nad Łódką Street, Stodolniania Street and Północna Street in Łódź. The quarter, inhabited mainly by Jews, was demolished by Germen in 1939. The reconstruction has been done for the purpose of the making of large-scale model of the quarter by a team of the Musem of the History of the City of Lodz: Michał Gruda, Adam Brajter, Bolesław Polewczyk, modelling team: Bartosz Michalski, Sebastian Matusiak. 1 – main confirmed commercial paths, 2 – remaining internal paths, hypothetical, 3 – location of gates in tenemants, 4 – unconfirmed gates, 5 – streets, 6 – streets which do not exist, 7 – distant landmarks, 8 – landmarks, 9 – remaining spots, 10 – river Łódka, 11 – buildings' layout based on the model reconstruction 1939, 12 – buildings' layout based on German maps of 1939, source State Archives of Lodz, 13 – plots borders 1939, 14 – buildings 2000, plots borders 2000.

urbanisation pressure and densities higher than elsewhere. Jewish citizens often flocked to historic medieval cores, which usually hosted local markets. There they preferred locations next to the river valley, which, firstly, were available and much cheaper because of the flood danger and, secondly, catered to their needs in terms of religious customs. While the plan of a town after the arrival of Jews remained relatively unaltered, especially when speaking of the network of public streets and squares, the urban blocks became replaced with new, masonry structures of a much more urban character, e.g., in Brzeziny near Lodz. Also, the way space was used changed, from more fragmented and linear, into one integrated around typically Jewish focal points, which reflected the three main spheres of life: *sacrum* – represented by

a synagogue, house of study, ritual bath, *profanum* – concentrated around work – and represented by market place, and *domicile* – in the twentieth century represented by a backyard.

The transformation of the former parcellation, explicit in the plans of towns inhabited by Jews at the turn of the eighteenth century, followed a different social organisation. The community – kehilla very strong, practically independent from the town's regulations, functioned separately from the surrounding town, even if well integrated into its structure, catering to the needs of a town's citizens and visitors. This position had its reflection in the urban structure, with interior space within Jewish quarters seemingly unordered and uninviting to visitors, for Jews serving as extensions of their dwellings and space of interior circulation, the last observation confirmed with the tradition of *eruvim* – temporary cords distinguishing private space during Sabbath.

As a rule, in traditional Jewish neighbourhoods streets were narrower than elsewhere, which is a proxemic feature of Jewish culture, where interpersonal distances are, as a rule, smaller than in the case of Polish culture. Besides this, they used available passages, including informal ones, backyards and nooks for internal circulation within urban blocks, this way enriching the former sociometric layout. A non-existing quarter in Lodz, the one which was demolished in the beginning of World War II by Germen during the creation of the Lodz ghetto, may serve an example of such a network of internal connections within an urban block (Fig. 4). The internal passages served various purposes, some of them official and easy to confirm, as they were used by locals and by visitors as places of commerce, some by turn less formal and used by local citizens only, their exact placement remains subject to hypothesis.

Hubka (2005) attributes the dense, non-geometric spatial layout of the Jewish districts in small towns of the eighteen century to the incremental growth and restrictions placed upon the Jewish community through legal regulations.

The set of features specific for Jewish neighbourhoods, which manifested themselves most clearly in the most prevalent Jewish orthodox neighbourhoods, dissolved along with acculturation and mixing with other cultures. The transition from a high context culture towards a lower definition of context was reflected in the form of urban structures. While architectural forms were typical for a given period, the general atmosphere and idiosyncrasy of the character of the neighbourhood persisted.

The set of main features specific for Jewish prevalent neighbourhoods:

- variety of building forms, diversity of styles, materials, lack of homogeneity,
- much greater irregularity of facades in Jewish neighbourhoods, both in vertical dimension and in corrugation of facades,
- the presence of edifices and forms, both public and private, belonging to Jewish culture,
- the core location of Jews constitutes the most densely populated part of the city,
- alteration of the original form to suit the needs of the community as a continuation of the former state, with respect for the former partitions, etc.,
- a dense and tightly interconnected sociometric layout as a reflection of the rich community life,
- the concentric character of the spatial layout with three main focal points: synagogue, market and courtyard.

The features which are listed in the current paper are explained in more depth in other articles stemming from the current study (Hanzl 2013, 2014, in press).

5 CONCLUSIONS AND RESEARCH AVENUES

This paper provides a summary of a part of the larger research of an exploratory character which exemplifies the most typical neighbourhoods inhabited by Jews in the prewar period. Several case studies reveal varied level of acculturation, different functions in terms of the main professions dominant in a settlement, different periods of Jewish presence and the varied scale of the community. The multiplicity of factors influencing the appearance of the physical settings through the everyday culture of the use of space may seem enormous, however, after in-depth analyses, some systematics is possible. While the meaning of some elements remained virtually unchanged through the ages, new threads appeared, not just acculturation and modernisation, but also, e.g., as a consequence of the huge development of the Hasidic community, or thanks to the influx of Russian Jews at the end of the 19th century.

In the current article, the main synopsis of the data-base model of the Jewish population in central Poland (the current Mazovian and Lodz voivodships) in 1921 are discussed, based on census data. An attempt at classification of larger, more urban centres is given, distinguishing such types as industrial, including textile industry towns, administrative and commerce centres, and religious centres. The settlement network of smaller Jewish concentrations is also discussed, pointing at the presence of more dynamic and more static patterns linked to more rural or more industrial economies, respectively. The regularities of distribution, against varied backdrops of general settlement patterns in different regions, have been noticed, which I believe is the result of the actual occupation profile specific to the Jewish culture and the historical circumstances. The urban growth processes have been noticed and discussed as well.

Further research aims at more in-depth illustration of the above characteristics, with the analyses of individual case studies.

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Refugee shelter: Cheap, fast, lightweight and sustainable

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ABSTRACT: The recent and ongoing conflicts in the Middle East and Africa have brought renewed awareness to the issues facing displaced populations around the world and to the need of providing adequate shelter for them. The housing needs of refugee families continue to pose a great challenge to the international community and to organizations such as the United Nations High Commissioner for Refugees (UNHCR) because they affect a broad range of populations across vast geographic areas and require the resolution of a complex design problem. Currently there are a number of shelter prototypes available for distribution though an assessment of these options suggests that more research could be conducted to propose competitive solutions in terms of overall efficiency and cost. When it comes to designing an emergency shelter the challenge lies in the ability to create a comfortable, healthy and structurally sound yet lightweight building that can be fabricated inexpensively and in a sustainable manner.

The prototype we are presenting would function both as a short term and long term housing solution. The concept not unlike other shelter solutions is based on a flat pack prefabricated modular system that can be assembled in a matter of hours with few simple tools. The prototype is based on a modified version of a structural insulated panel system in order to meet stringent weight and affordability requirements.

The paneling system used for walls and roof is fabricated by laminating Fiber Reinforced Plastic over rigid insulation boards using a formaldehyde free adhesive. The roof panels are thicker when compared to the walls in order to provide adequate insulation in hot climate applications. The assembly of the entire shelter can be completed in a few hours by connecting wall and roof panels with metal clips. The building is safely anchored by means of a ground anchoring system which connects the bottom of the walls directly to the ground. The flooring system is composed of an extruded and interlocking plastic paneling system.

Key design features of this shelter prototype include high insulation value, ease of assembly, access to natural light and affordability. These housing units allow natural cross ventilation and should only require minimal heating in cold climate. A small photovoltaic system provides enough energy to power LED lights and charge a cell phone battery.

This project was initiated in a special study course where students proposed a series of prototypes as part of a small design competition. The project is nearing completion of its design phase and is scheduled to be built as a prototype to verify feasibility before it can be presented to the UNHCR and a number of non-profit organizations.

The recent and ongoing conflicts in the Middle East and Africa have brought renewed awareness to the issues facing displaced populations around the world and to the need of providing adequate shelter for them. Unfortunately the issue of displaced populations is not a new phenomenon and some of the refugee settlements have been in existence for years and in some cases even decades. The largest refugee camps are currently located in Africa and South Asia but overall they spread over a geographic area stretching from Turkey to Thailand and encompass vastly different climate zones. In addition to dealing with difficult living conditions, malnutrition and poor health and hygiene these populations are usually housed in shelters that offer only limited relief against a variety of weather conditions. Many refugee settlements use tents as they are inexpensive, easy to install and provide a very basic form of shelter that may be acceptable in dry climate zones. Nevertheless desertic and semi-desertic climate zones present another problem as they often experience large day and night temperature variations which pose additional challenges in terms of comfort. Based on these climatic considerations alone, shelters ought to be designed as an insulated and sealed enclosure with regards to airflow and moisture while at the same time allowing natural ventilation in order to deal with hot and humid conditions. In addition to fulfilling the requirements we just mentioned and in order to be viable, refugee shelters should be inexpensive, lightweight and easy to transport and assemble. The life expectancy of such structures also mandates that they meet certain durability standards and are able to withstand repeated impacts, wind load forces and moisture intrusion for several years.

There are currently a number of shelters in use ranging from precarious tents to fully functioning prefabricated units outfitted with plumbing fixtures and electric appliances. Recently IKEA developed an inexpensive, lightweight and easy to install shelter prototype that is positioning itself as a balanced solution between cost and quality. The housing unit they developed though does not feature a specific insulation component as it is presented as a temporary housing solution and considered an improvement over the tent option.

Based on the current refugee population; the war in Syria alone has created a displaced population of 4.5 million, there seems to be a need for housing solutions which provide a safe and comfortable environment without necessarily offering other amenities such as plumbing fixtures and electric appliances as it is the case in more long term refugee housing. It seems crucial that while a viable shelter should be inexpensive and easy to assemble it should also offer a climate controlled environment for malnourished populations and families with young children living in precarious conditions.

This project is motivated by a deep concern for vulnerable populations as we hope the power of good design can contribute to the resolution of a difficult housing problem and help people in dire need of better living conditions. Within that context we focused on developing a pragmatic building structure rather than making an architectural statement. The idea is to design a shelter based on a customize version of a Structural Insulated Panel system (SIP) in order to provide structural integrity, insulation and moisture protection. The inherent nature of the panelized system lends itself to a flat pack shipping solution so the design challenge lies in the ability to meet stringent cost requirements and design a kit of parts easy to assemble.

1 DESIGN CONCEPT

Because simplicity of assembly and weight are crucial factors in the feasibility of this prototype the design itself was very much driven by these specific requirements. Another important issue to consider was the overall size of the housing unit as it relates to individual panel dimensions and determines the overall volume of the building flat pack. The dimensions of the pre-fabricated panels were therefore based on the clearance available inside a typical $8' \times 8' \times 20'$ shipping container.

The building concept for the shelter unlike most current SIP construction is based on the idea of a continuous insulated envelope encompassing floor, walls and roof. The floor panels are laid over a rigid framing system which rests on leveling legs. The wall panels are installed along the perimeter of the floor structure and receive shed roof panels which span from wall to wall. Consequently the envelope is also the structure. The dimensions of the floor plan are $9' \times 15'$ with a top of wall elevation of 7 feet on the low side and 8 feet on the high side. This translates into a roof pitch slightly higher than 1 inch per foot. All panels are slightly less than 4 feet wide (to fit inside a shipping container) and composed of a 2-1/2 inch layer of expanded polystyrene (EPS) sandwiched between two layers of .075 inch fiber reinforced plastic (FRP). The FRP panels are flat and come in an off-white mat finish in order to limit heat absorption. They are glued under pressure using a non-formaldehyde adhesive.

The housing unit is equipped with a single door with a continuous hinge and 4 operable windows to bring natural light and allow cross ventilation when needed. All windows and doors are integrated within the paneling system. It is assumed that the housing unit would be installed with its length facing north and south as clerestory windows are located along these walls. The width of the shelter would logically offer limited sun exposure on the east and west therefore limiting heat gain. The clerestory windows placed on the high wall allow light to reflect on the sloped ceiling and increase daylighting inside the unit. The window placement alternates on the opposite long walls in order to balance the amount of light coming from the north or the south and achieve relative good day lighting inside the entire unit. The purpose of these high windows is to enable daylighting so there is appropriate illuminance for a range of daily activities inside the shelter while preserving privacy. A two-foot roof overhang over the short elevations assumed to face east and west shades the windows located on these sides and provides protection outside the front door. Cross ventilation can be achieved by creating air flow between an operable window located inside the front door and a small window on the opposite end wall.

All connectors have been designed to ensure overall rigidity of the structure and weatherproofing. The interior spaces of the housing unit are flexible and can be divided into two separate zones using a lightweight track and curtain system. In terms of access to power, a small photovoltaic system charges a lithium battery which powers 4 LED lights inside the unit along with a cellular phone charger.

2 ASSEMBLY PROCESS

In addition to being inexpensive and lightweight this Insulated Shelter Unit (ISU) prototype displays structural integrity especially as it relates to lateral loads and uplift. By means of a series of appropriate connectors the assembly of the overall structure addresses lateral loads and insures structural continuity from the foundation system to the roof. The flooring system composed of insulated panels is rigid enough to support the occupants' concentrated loads without deformation. Another key feasibility requirement relates to the speed of construction and the ability for two people to complete the entire assembly in less than five hours. The fact that the concept of this housing unit is based on a structural panel system as opposed to a

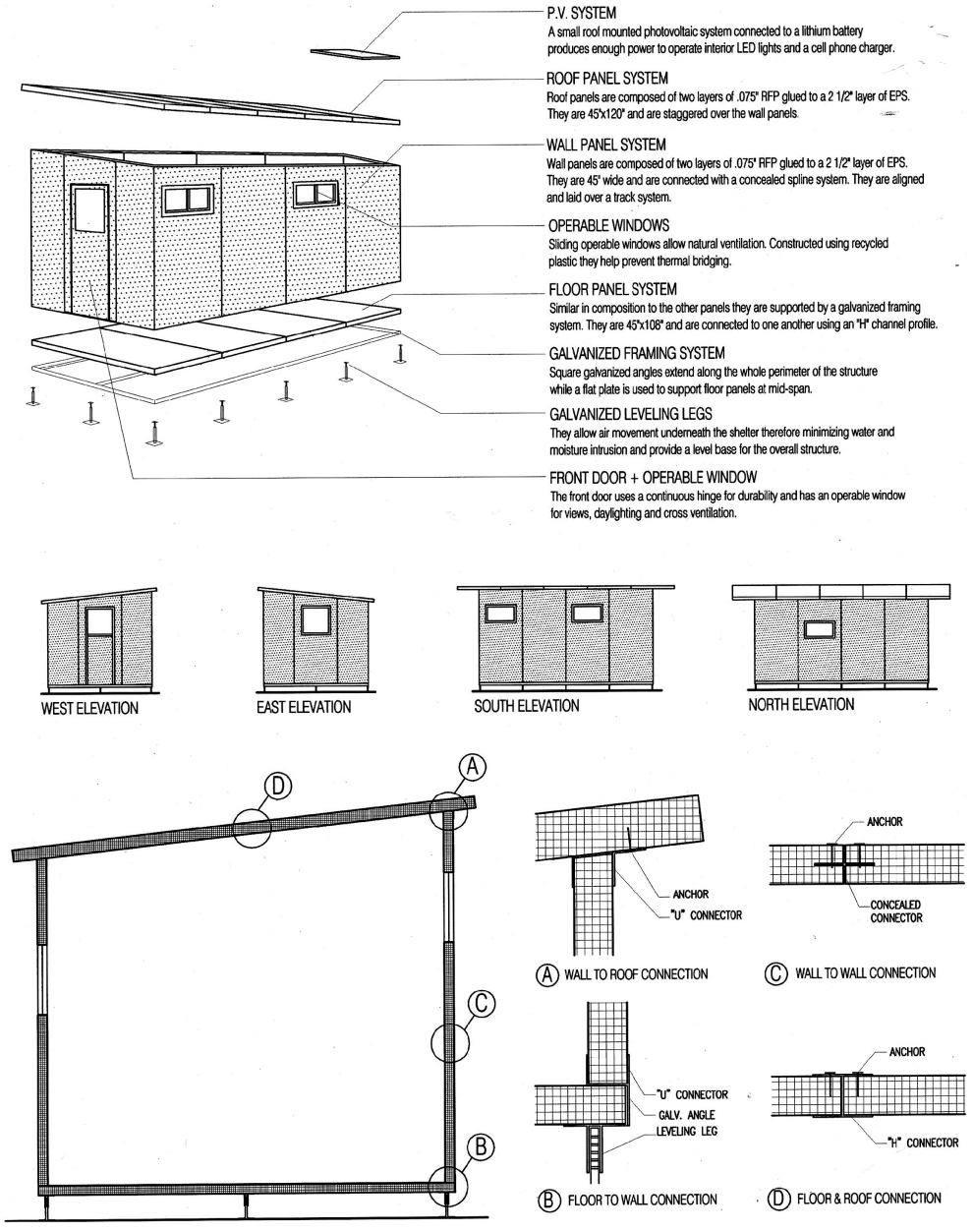


Figure 1. Insulated Shelter Unit specifications (graphics by author).

frame + skin concept does simplify and speed up the assembly process. Another advantageous property of the panelized system has to do with the fact that the Expanded Polystyrene (EPS) insulation acts as a vapor barrier and therefore prevents moisture penetration.

2.1 *Phase 1: Floor framing*

The first step of the construction consists in positioning 2 parallel rows of galvanized leveling legs on the ground. The leveling legs are secured to the ground by means of a galvanized anchor. The leveling legs located along the perimeter of the building receive a corner angle connector whereas the the legs located in the center receive a flat connector. Both anchor/leg and leg/angle connections are achieved with a simple pin system. Once the first two rows of framing supports are laid (perimeter connectors are the only ones anchored to the ground) floor panels are positioned in order to determine the location of the third row of leveling legs. That way the installers are using the floor panels to insure that the floor is square. The leveling of the support frame is achieved by the vertical adjustment of the support angles relative to the leveling legs.

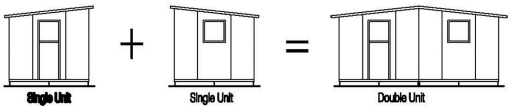


Figure 2. Configuration options (graphics by author).

The angle is able to slide inside the leg and the connection is achieved by placing a galvanized pin through aligned holes. This framing system provides a continuous square angle around the perimeter of the structure and a flat plate spanning mid-way to support floor panels. The purpose of the framing structure is to create a level base and elevate the shelter to protect it from ground water and moisture. The space located underneath the structure is ventilated. Laying out the floor framing structure is by far the most delicate and critical phase of the overall assembly as it will affect the proper assembly of the rest of the structure.

2.2 *Phase 2: Floor*

Once the floor framing has been leveled and anchored, the floor panels are laid and screwed to the galvanized support angles. A spline component is inserted between each floor panel to increase the rigidity of the overall floor system and prevent moisture intrusion from the ground. Screws connecting panels and splines are driven from the top of the floor panels to prevent moisture intrusion inside the shelter.

2.3 *Phase 3: Walls*

Following the assembly of all floor panels a custom connector/track is screwed to the galvanize perimeter angles in order to cover the edge of the floor panels and provide a track for the wall panel. This prevents moisture and rain to penetrate at the perimeter of the floor system. Wall panels are then positioned over the track using an "H" profile connector.

2.4 *Phase 4: Roof*

"U" shaped connectors are placed on top of the wall panels in order to receive the roof panels. The roof panels are screwed from the underside through the connector just mentioned. Depending on the latitude where the shelter is to be installed the roof overhangs can be adjusted to provide proper shading for the clerestory windows. On the short side of the unit the overhangs remain 2 feet due to the need of the roof panels to be staggered above the wall panels and insure overall rigidity. A spline system using an "H" profile is placed between roof panels in order to achieve rigidity and waterproofing.

2.5 *Phase 5: Finishes*

Once the structure is completed a small photovoltaic system is installed on the roof and connected to a lithium battery in order to power four interior LED lights as well as a cell phone charger. A lightweight track system is anchored to the underside of the roof panels to receive a sliding curtain and allow some privacy inside the shelter.

We took the time to provide a detailed description of the shelter assembly as it is key to determining the viability of the overall shelter design. As it is usually the case with prefabricated shelter units they need to be assembled quickly and accurately by untrained people, which presents an additional challenge. In this case the assembly has been broken down into a series of clear and simple steps that can be easily understood. The entire construction process has been planned for 2 people without prior experience working for 5 hours. To further simplify assembly each construction component is clearly labeled and graphically referenced in an assembly manual.

The most delicate phase of the overall process consists in properly installing and leveling the floor support frame. The rest of the unit's construction is very straight forward as different panel components are assembled by means of specific connectors. The size of the building panels were purposely kept to a minimum due to shipping requirements but also to keep their weight to a managing level for 2 people. For instance the roof panels weight 100 pounds which is an acceptable load for 2 people to lift on top of the wall structure. The physical assembly of all the different components can be achieved by using a portable drill powered by the fully charged battery supplied with the photovoltaic system. The entire unit can also be assembled using a screwdriver as the high-torque screws provided will easily penetrate the prefabricated panel.

In addition to an easy assembly the Insulated Shelter Unit (ISU) presents a series of features that are mindful of sustainable design and construction practices. The basic design idea is to create a continuous insulated envelope so comfort can be achieved with no reliance on external energy sources. As an added bonus insulated panels provide good sound insulation which contributes to comfort inside the unit. In that same logic the careful placement of windows on a number of different walls creates daylighting opportunities. Finally the photovoltaic system supplies power in a sustainable manner.

In terms of materials the windows, door and all connectors are made of a rigid recycled plastic. This material is appropriate as it presents good insulation values and does not significantly offset the R-value of the insulated panels. The panels themselves are manufactured by gluing FRP panels to a layer of EPS using a non-formaldehyde adhesive.

A preliminary cost analysis indicates that the ISU can be built for approximately 4,000 USD but we expect the cost to decrease as we explore production processes and material sourcing more thoroughly. Another important quality of the ISU is its ability to be used in a variety of ways. To that end the open floor plan layout along with the placement of windows provide a variety of options in terms of use. The installation of

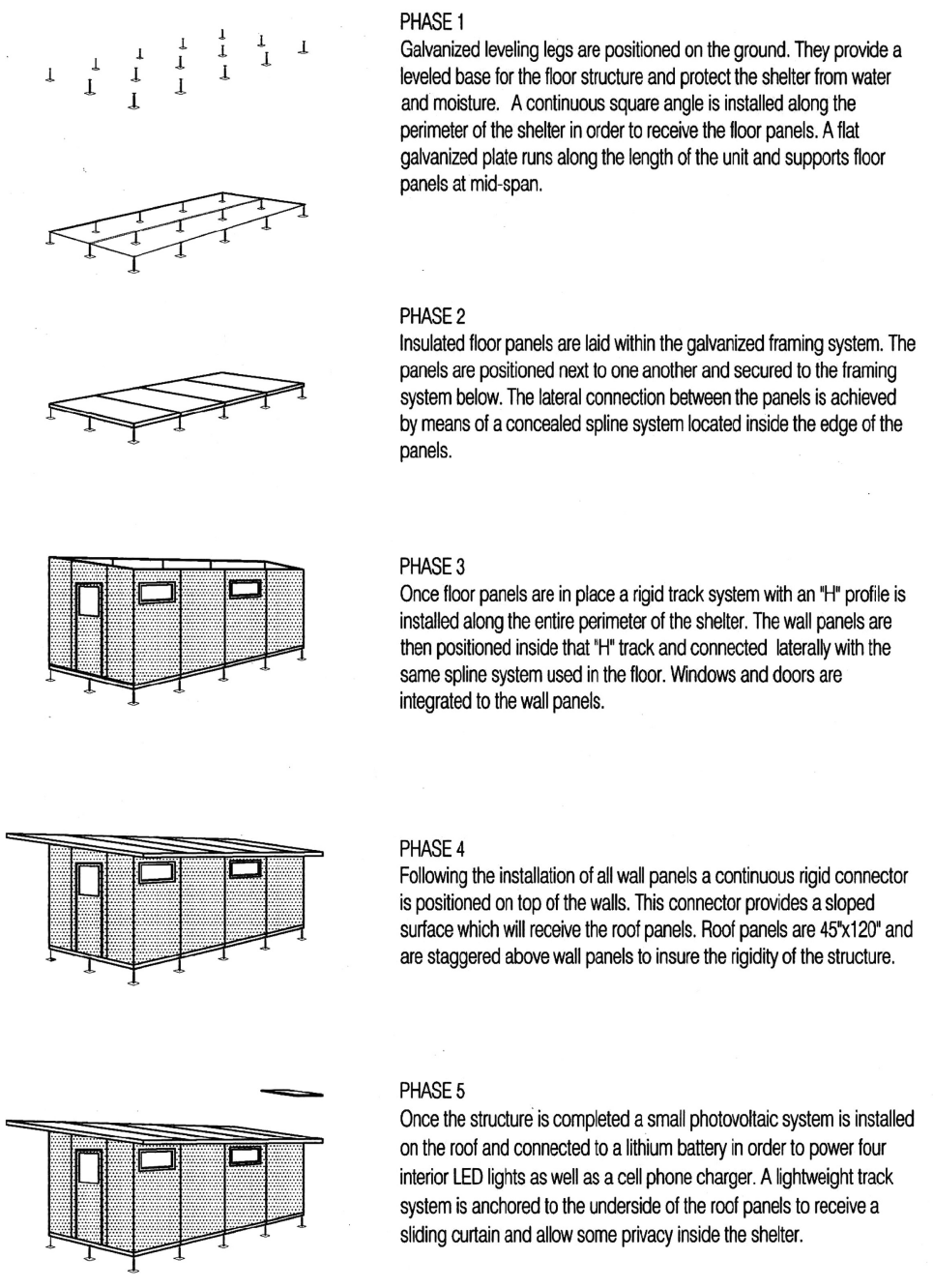


Figure 3. Assembly phases (graphics by author).

the curtain system for privacy is also valuable in that regard.

At a larger scale the ISU can be used as a modular unit and it is possible to combine 2 basic modules in order to create a bigger unit which could then be used by a larger family.

Insulated Shelter Unit Facts

Estimated Cost: 4,000 USD
Weight: 1,500 pounds
Wall, Floor, Roof R-Value: 9.625
Packaging Volume: 140 cubic feet/4 cubic meters

Assembly Time: 5 hours
Tools: power drill or screwdriver

This project which was initiated through a design assignment given to student in a special study course has attempted to respond to a difficult design problem and propose a prototype for an Insulated Shelter Unit that would position itself as a balance solution with regards to function, quality and cost. Although not all technical details have been resolved as of yet the prototype we are presenting remains relatively inexpensive, especially when compared to similar rigid shelter concepts, while focusing on functionality and comfort. The current design for the ISU illustrates a design methodology geared towards looking at every components or assembly sequence and trying to make it simpler, less expensive and more sustainable or in other words develop a socially responsible design approach.

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"Hospitality now!" from meeting migrant needs to rethinking contemporary urban dwelling. A critical review of two studio experiments

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ABSTRACT: When addressing housing issues posed by "south-to-north" migration, architectural thinking seems to settle for redesigning the minimal living unit. The reliance on small, repeatable modules betrays a certain bias toward conceiving of urban development as the accumulation of single-family cells. This holds true whether the migrant's refuge is a high-design cabin or a low-technology shack. Yet crossing the history of population movements with the history of cities reveals that significant urban-scale architectural innovations occur when the housing question is carried beyond the paradigm of tents, cabins and containers. This paper consists of a critical reflection on two design studios at the Bordeaux School of Architecture and Landscape Architecture (EnsapBx, France) that addressed current migration phenomena in order to contribute to thinking about urban dwelling in general, as well as about the role that architects might play and the expertise that they might employ in this context.

1 INTRODUCTION

War and political instability in general in more or less distant countries have provoked an acute housing problem for member states of the European Union. In many European cities, thousands of people who fled their homes in Syria, Afghanistan, Eretria, or Iraq seek shelter in addition to the nourishment and administrative aid that they desperately require. On a daily basis, residents of affluent societies come face to face with scenes that recall the refugee camps run by prestigious international organizations in unfamiliar landscapes seen only on television.

For architecture students who are sensitive to the plight of local homeless populations, or of the Romani people, or of the working poor who can not afford decent housing in the current real estate market in many cities in Europe, it is difficult to ignore this new manifestation of spatial, domestic and architectural distress. The needs of those who incarnate what has come to be called "the migrant crisis" certainly merit the attention of future architects concerned with social justice.

However, the best way to use the architect's skills and tools to contribute to managing the migrant crisis in a humanitarian way is not as obvious as it may seem. Just as conventional homelessness (if it may be called so) is not simply the result of poorly designed apartment buildings or a scarcity of units, solving the housing crisis for the large numbers of foreign nationals who, whether for political or economic reasons, have spent large sums and taken great risks to live more or less temporarily in Europe, is not a classic design problem.

During two consecutive Fall semesters (2014 and 2015), a design studio course at the Bordeaux School of Architecture and Landscape Architecture in France (*Ecole nationale supérieure d'architecture et de paysage de Bordeaux*, EnsapBx) attempted to harness architectural thinking to develop a better understanding of the challenges and opportunities that the current migration situation posed for cities in France and to formulate proposals that might help to improve conditions for people who had been violently uprooted from their habitual place of dwelling. Though the studio was not conceived or presented as a form of research, it appeared after the fact that, as a whole, the student work made it possible to develop a conceptual framework that contributes to knowledge about dwelling in the contemporary city.

This paper presents the context, framing and organization of each of the two versions of the studio, and describes some examples of the resulting student work. For each of the semesters, it classifies student proposals into different categories and discusses how, as a whole, they articulate important architectural issues above and beyond the sanitary, security or human rights considerations generally addressed in relation to migrant housing. Considered as research retroactively, each version of the studio produced a principal result. The first demonstrated the urban dimension of the migration crisis along two main findings: the surprising heterogeneity of the legal status of people and spaces in urban environments, and the efficiency of

reciprocity between individual and collective needs in creating urban infrastructure and amenities. Together, these add complexity to our understanding of urban dwelling, whether or not in relation to migration specifically. The second version of "Hospitality Now!" found that inventive coordination relative to the built environment is as much architectural work as designing new structures. It throws light on the importance of the architect's synoptic understanding of the myriad actors and factors that must be coordinated in order to create possibilities for dwelling, stressing that the ability to design places must be complemented by the ability to design situations that align resources, willpower and spatial potential. As a whole, the two studios develop knowledge about how architecture may not only contribute to adapting cities to significant new population movements, but also help to reconsider the notion of dwelling and the architect's role in its coming to be.

2 PEDAGOGICAL CONTEXT

These studio investigations took place at EnsapBx, which, as one of France's twenty public schools of architecture, delivers the national architect's diploma. The work was done in a fifth-year architectural design studio, which is the last design course that students take before proposing a topic for their individual diploma project (*projet de fin d'études*).

The studio topic was offered in the context of a three-semester program of studies called "Metropolitan Dwelling and Architectural Design". This program assembles theory courses, research seminars and design studios around housing issues, with an emphasis on contemporary aspects of dwelling in urban contexts. The first two studios in this suite cover fundamental aspects of housing design, including standards and norms, lifestyles and practices, overall project economy, and site and cultural specificity. With these bases in place, the third semester of design teaching takes a more experimental approach. It explicitly thematizes the question of dwelling, and by extension the knowledge about how people live that is usually mobilized in housing design. This studio focusses on living situations that challenge common thinking about the relationship between architectural form and domestic life in order to break from generic models of family structure, values, and needs. To this end, the programs that have been used in the recent past include emergency shelters, student housing, nursing homes, and halfway houses.

The design process usually begins by breaking down the standard program for the chosen type of housing environment, usually with the help of texts drawn from historical or fictional literature that discuss ideal societies or, on the contrary, dystopian social organizations. The intention is that students recognize that seemingly natural correlations between spatial forms and social forms are in fact the result of historical circumstances, political decisions, and cultural reproduction. By freeing architectural form and space from the rigid equations that tie them somewhat arbitrarily to predefined social content, it paves the way for using design to explore alternative hypotheses about how people might dwell together.

In light of these pedagogical objectives, housing issues related to population migration and immigration clearly seemed an appropriate topic. The "Hospitality Now" studio was therefore proposed in this third semester of the suite. On the one hand, it would allow students to work on a critical contemporary issue, and perhaps contribute to improving the situation for people living in dire situations, either directly through proposals for better housing environments or indirectly by enlightening governmental and non-governmental agents involved in the matter about certain aspects of the problem. On other hand, studying the migrant experience as a case of "dwelling in the world" would also bring students to reconsider the notion of dwelling applied to ostensibly "normal" people, and thus develop their critical capacity for more standard future projects, whether in an academic or professional context.

3 VERSION I: FALL 2014

The first version of "Hospitality Now! Dwelling Through the Lens of International Migration" took place in Fall 2014. It was co-taught by the author with Luca Lotti, architect and associate professor at EnsapBx, Justine Reverchon, architect, professional firefighter and lecturer at EnsapBx, and Laura Rosenbaum, architect and doctoral student at the school. The studio took the form of a semester-long exploration that concluded with proposals for housing projects in Bordeaux. The studio topic was defined in the context of growing concern over the repeated mass drownings in the Mediterranean Sea and of mounting tensions in Ceuta and Melilla, where immigrants from sub-Saharan Africa camp on Moroccan territory outside Spanish enclaves, hoping to overcome fences, walls and barb wire to set foot in these European outposts.

Stephen Cairns argues that the architectural community tends to uncouple two "profoundly integrated global phenomena": that more than half of the world's population now lives in urban areas, and that, at any one time, "three percent of the world's population are international migrants" (Cairns, 2009: 73–74). Migration has been a constituent feature of urbanization in all periods. It would therefore be important to address the migrant crisis beyond the provision of emergency shelter, and to understand its implications for urban growth. In that spirit, the studio postulated that European cities might anticipate new housing needs spurred by a probable increase in immigrant populations and treat them as opportunities for thoughtful and innovative urban development, rather than as burdensome states of exception.

An initial five-week phase consisted of research into the phenomenon of south-north migration toward

Europe. While this work placed particular emphasis on housing issues, a broad tableau was painted of immigration, with topics including its history, its economic aspects (the cost of safe conduit as well as aspects related to employment and remittance payments), the profiles and itineraries of migrating populations, the governmental and non-governmental organizations involved, and representations of immigrants. The forty-two students enrolled were broken into groups of three or four, each of which produced research on one of the thirteen topics. The objective of this phase was to produce a common basis for subsequent design proposals, with each group sharing its findings through text and illustrated presentations.

This phase was enriched by a variety of material and guest speakers. In order to stimulate research, each group was assigned a film that deals with the subject of immigration, such as *It's a Free World* (Ken Loach, 2008), *Le Havre* (Aki Kaurismäki, 2011), and *Eden is West* (Costa Gavras, 2009). Instructors invited Alessandra Siarri, deputy mayor of Bordeaux in charge of social cohesion, to share her insight on local housing and poverty issues. Later in the semester, anthropologist Michel Agier, who had just published *A World of Camps*, an edited volume including contributions about refugee camps and other informal settlements around the world, gave a public lecture sponsored by the studio and sat on the midterm project reviews.

After the initial research and documentation phase, each group was asked to place their study topic into relation with two other topics that had been developed by other groups. This phase, called "*problématisation*", aimed to identify a kind of Gordian Knot regarding the question of hospitality for migrant populations. The pedagogical hypothesis is that a seemingly intractable problem may be solved by thinking "outside the box", a commonly recognized skill for designers. As projects moved forward, three distinct strategies emerged: working on the interior border condition; situating migration in the context of contemporary mobility; and developing reverse hospitality.

3.1 *Working on the interior border condition*

Some student groups seized on what may be called the "spatial exception" of foreign nationals present illegally in France. With laws voted in 2003 and 2010, France went from a legal framework where the detention centres for illegal immigrants constituted extra-territorial zones in which exceptional laws apply (as in border control zones), to a regime in which the illegal immigrant him- or herself generates that extra-territorial space on the very ground where he or she stands. As Michel Agier points out, with these laws, "extraterritoriality is the foreigner's very place: although he may be physically present, he is administratively held outside of national territory" (2011). The country's exterior is no longer a fixed location to which certain individuals are brought for detention; it precedes each footstep that an illegal immigrant takes. Agier expresses the resulting paradoxical spatial dimension by observing that many migrants are "outdoor prisoners […] cast aside on the inside" (Agier, 2014).

Struck by this spatial warp and its concrete implications for spatial fluidity and borders, students produced a cartography of Bordeaux that revealed that a number of spaces benefitting from exceptional territorial status punctuated the otherwise homogeneous national space. Some of these exist by law, such as border conditions, duty-free zones in ports, and of course consulates and embassies. Others owe their reality to unwritten tradition, such as church grounds where the religious authority can prevent police action in the name of sanctuary, or schools where the director can exercise similar powers for the sake of the children's well-being. Hospitals and city halls were also identified as traditional places of exceptional hospitality. Putting the notion of interior border conditions into relation with the extra-territoriality that had become consubstantial with certain migrants proved to be a potent starting point for some projects.

3.1.1 *Hospitalis urbs*

One proposal imagined that a group of extra-territorial migrants could live together in a building lifted above street level. It posited that the concentration of such individuals in one place could constitute a territory in its own right: a country for statelessness. The building was raised on monumental columns over a small plaza next to a major covered food market in Bordeaux. Floating between the ground and its underside, a horizontal plane structured the ascent while also serving as as a landing for accessing the parking garage on the market building's roof. This plane furthermore provided a permanent covered area for the temporary stalls on the plaza that normally use parasols for protection from sun and rain. The border condition was thus made horizontal (rather than vertical), giving particular significance to vertical ascension in the city, while also playing down the gravity of the situation through its association with more banal, quotidian activities such as shopping and parking.

The site choice was strategic: the "Capucines" was the city's wholesale market before that activity's change in scale required that it move further out from the city center. The neighborhood therefore historically welcomed immigrant populations, from Spanish and Portuguese to more recent North African and Sub-Saharan African populations. As Arnold Reijndorp observes, "[w]hen in a foreign city, immigrants look for places where they suspect they can deal with the situation, such as markets where routines are the same all over the world" (Reijndorp, 2009: 98). The students' hypothesis was that residents of this particular dwelling could benefit from the urban life provided by the market and its immediate vicinities, and perhaps even from work opportunities, without straying too far from their "safe house" located on the other side of their ad hoc border.

The question of who would control the border, and the border's relative impenetrability, was not addressed

specifically in this project. However, it nonetheless drew attention to the many other situations where the threshold between regular public (and thus policed) space and a space of national exception is effective through its symbolic power rather than through brute force, for example the door of a church. The nuances of spatial rights were thus clearly posed.

3.1.2 *Terrific extraterritoriality*

Another project emphasized the notion of the "hospitable city", over and against national and European policies. The student group identified sites in Bordeaux where a border condition could be exaggerated, and where housing for irregular migrants could be associated with other programs that might also benefit from extraterritorial status: programs that would be freed from certain "legislative extremes" that apply to commerce and behaviour on the national territory. In the students' word, their aim was to provide "places that serve as asylum and as entry into the hospitable city". To that end, and in a reverse reference to the principle of *jus soli* or the right of birthplace (or more accurately "right of birth-soil"), all their architectural interventions were separated from the ground and located over the buildings or grounds of institutions that historically benefit from a tacit legislative exception where hospitality and refuge are concerned: City Hall, the Courthouse, Saint André Hospital, and the Cathedral.

For example, the project proposed small towers between the Cathedral's flying buttresses, in which housing units for illegal immigrants would coexist with greenhouses for growing marijuana. More than a simple rhetorical gesture, this intervention blended different aspects of the history of medieval churches as places of asylum, of medicinal herbal gardens, and of architectural experimentation. In another intervention, a tax-free market was installed on the roof of one the wings of Bordeaux's City Hall, serving as a threshold between the street and housing units for refugees. The argument was that, if airports could house duty-free shops by virtue of their extraterritorial port status, then the virtual border condition generated by the municipal government's relative sovereignty could justify a sanctuary for activities considered illegal by the State. While the issue of unfair commercial competition was not addressed, this intervention served to draw attention to the actual heterogeneity of ostensibly homogeneous space, and the potential for further disruptions to provide hospitality at the local rather than national level.

3.2 *Situating migration in the context of contemporary mobility*

3.2.1 *Hotel city*

Some projects recontextualized the migrations under study by drawing attention to broader changes in residential practices that are due to the increased mobility made possible by—or alternatively imposed by—contemporary means of transportation and economic systems. In the project "*La Ville-Hôtel*", one group explored how architecture might articulate the coexistence of diverse kinds of particularly mobile populations, from high-end nomads such as sports and entertainment stars to clandestine migrants, passing through common tourists and business travelers. The project was sited at a strategic location outside the historic center, where a radial light rail line intersects the circular boulevard, affording easy access to numerous important locations in the city, including professional sports facilities, convention centers and of course the central core. The proposed building consists of a type of hotel that integrates an existing light rail station, a new park-and-ride facility, an internet café in the lobby area, a beauty parlor on the top floor, and a small conference facility halfway up.

This strategy, which accepts the world in which populations that differ in terms of means and motivations find themselves subject to the same injunction to move, might be understood in relation to Arnold Reijndorp's notion of the "The City as Bazaar". Evoking the positive effects of globalization, Reijndorp refers to a "new global familiarity, where the rules and the language are the same everywhere, which enables us to travel and explore new environments without encountering any obstacles. […] Through the familiarity of the signs and the transparency of the familiar procedures, that space is democratic: the traveling businessman, the mass tourist, and the refugee can all find their way in it perfectly" (Reijndorp, 2009: 98–9).

3.3 *Reciprocal hospitality*

In another form of inversion, some projects took the migrant program as an opportunity to improve urban life for "legal" residents.

3.3.1 *Shared hospitality*

One group postulated that water, as an element that combines functional and symbolic dimensions, could be the basis of an architectural intervention that resolved migrant needs while providing new amenities for all. Two principle uses of water were explored: food preparation, and bodily hygiene and pleasure. Since kitchens and washrooms would be needed for the housing units, the required infrastructure could be "tapped into" in order to provide public amenities in a currently unserved space. Set beneath the centenary sycamore trees that line the edges of Bordeaux's immense *Place des Quinconces*, the proposal included permanent outdoor kitchens designed for large scale public use, a splash pool, and a bath house and sauna, in addition to the apartments nested between the ground plane and the crown of leaves.

The *Place des Quinconces* houses a transit hub for local light rail and regional bus service, a large parking lot for access to the historic city center, and a fairground that welcomes alternatively circuses, antique fairs, funfairs and open air concerts. It also lies tangent to the riverfront linear park, which is used in particular by joggers, bikers and skaters for sporting purposes.

The project is sited in relation to this co-presence of urban functions and practices that, while diverse, could all benefit from the introduction of water-based functions in public space. In this way, the housing for migrant populations is integrated into urban life and serves as a pretext to provide amenities for multiple user groups. Beyond the standard discourse on the benefits of mixing populations, this project demonstrates how architecture can cast the migrant's presence in positive light by leveraging a technical level of building human settlements (water provision) to generate a symbolic level (shared access to an urban resource).

This project also introduced the figure of users who are neither immigrants nor permanent residents, but temporary residents participating in cyclical official urban events such as circuses, fairs, and other itinerant programs that remain very much part of urban life in France and other parts of Europe.

3.3.2 *Welcoming the natives*

This project is based on three different timeframes of asylum seekers and migrant populations: five days, corresponding to an emergency situation; five weeks to five months, waiting for administrative procedures, for news, for work; and five years, during which one begins to take root in a new country. On a site structured by remnants of city fortifications, a linear park, monumental buildings from the 19th century and more recent houses aligned on the street, the project develops spatial conditions such as the insertion, the articulation, and the lean-to in order to generate a rich architectural ensemble conducive to different forms of appropriation in relation to the three timeframes. A careful survey of neighbourhood commercial, cultural and institutional establishments allowed the group to identify new programs that might act as an interface between the general public and the inhabitants of this specific housing environment, such as a hammam sauna installed in a 19th-century market hall, an outdoor projection space for watching movies in good weather, and a language school.

3.4 *Findings from "Hospitality Now! 1.0"*

The work from this studio recalls two important dimensions of dwelling in urban environments, and increases their understanding by adding the factors of alterity and precariousness that migration entails. First, urban spatial heterogeneity is far more complex than the familiar opposition between public space and private space. Embassies, duty-free zones, elementary schools and church grounds are conditions of extra-territoriality that punctuate the city as an invisible geography of exceptions to common law enforcement. Furthermore, the threshold situations that regulate the relationships amongst these spaces are often effective more by convention and symbolic power than by brute force. The student work also disrupted the illusion of legal territorial continuity through the multiple levels of French government, for example with the relative (if limited) sovereignty of municipal mayors or religious officials with respect to national prerogatives on immigration. In the pedagogical case discussed here, this geography was identified and then exploited in order to develop housing proposals for individuals whose legal status constitutes, in France, a unique case of extra-territoriality. However, the relevance of this finding is not limited to that case. By drawing attention to the effective heterogeneity of ostensibly homogeneous space, the global effect of multiple student design projects contributed to knowledge about the urban substrate for any architectural intervention.

Second, the reciprocity between individual and collective aspects of dwelling in the city operates on two intersecting planes: the social and the economical. Furthermore, leveraging between the two planes allows for increased efficacy. Many students quickly associated housing production with considerations for public life, the latter manifested through proposals for urban activities, amenities and services. This was undertaken not only in the name of the familiar refrain about mixity and integration. It articulated a consciousness about urban efficiency that was sought through double-usage and economies of scale. From this perspective, the design problem at the base of any urban development is how to have the accumulation of relatively small, repetitive interior spaces also produce exterior spaces and infrastructure that correspond to collective needs at the public scale, which are highly diversified and contrasted. City building would therefore be understood as the careful search for equilibrium between the individual and the social group through spatial and infrastructural reciprocity. As a whole, the work is a reminder that the problems raised by population movements are not only sanitary, geopolitical or legal in nature, but also fundamentally urban.

4 VERSION II: FALL 2015

One year after the initial attempt to work on migration issues, the population exodus from Syria, Afghanistan and Eritrea was increasing dramatically. This introduced unexpected dynamics into what had previously appeared to be a stable European spatiality. The disordered suspension of the Dublin Regulation regarding asylum seeker applications by Germany, Austria, and Hungary initiated the confusion, followed by the Czech Republic's and then Sweden's reintroduction of border controls with Shengen area partners. In the context of France's decision to welcome an extra 24 000 asylum-seekers, the second version of "Hospitality Now" was a shorter, five-week exercise that explored how architects might act in this crisis situation. This time, the author co-taught with Justine Reverchon.

Like the Fall 2014 studio, the exercise eschewed the "cabin fever" that often plagues architectural attempts to address migration, in favor of less stigmatizing and more situated, urban solutions. But it also attempted to better incorporate economic aspects into the process, and demanded that students interact with elected officials, municipal technical services and

non-governmental organizations. This was intended both to develop certain practical skills that future architects require and to suggest that not all questions for architects may be answered by designing new objects ex-nihilo.

The studio topic was presented at a movie house in Bordeaux, right before a public projection of Jonas Carpignano's 2015 film *Mediterranea*. The film follows two friends who leave Burkina Faso for the promise of a better life in Europe. While a fictional work, the film articulates with the real events that culminated with the riot in Rosarno, Italy, in 2010. The vivid depictions of the arduous trip across land and sea, the living conditions in urban squats, the hard manual work, the relationship with local populations, and the relations with family at home sustained through digital social networks set the tone for the exercise.

As in 2014, a collective brainstorming session helped to identify a dozen research topics, each of which was developed by a group of students. Each group was expected to produce a chapter for a guidebook for municipalities that intended to welcome asylum seekers, as well a summary project that demonstrated how accommodations could be provided quickly and at minimal cost. Because of the short length of the exercise, project ideas had to be developed almost concurrently with the research.

Two categories of projects emerged. The first identified the temporal dimension as powerful lever for generating spatial possibilities. This may be related to Michel de Certeau's definition of "tactics": practices that play with time in order to counter the spatial domination of those who can project "strategies" onto a given territory (de Certeau, 1984). The second kind of project carefully considered economic and regulatory factors in order demonstrate how new housing opportunities could easily be found by exercising "public power".

4.1 *Playing with time*

4.1.1 *Shared building plots*

In this project, student work consisted of carefully studying regulations concerning construction rights. The group learned, for example, that structures qualifying as "emergency housing" may be erected for a maximum of one year without need of requesting a building permit. The French Law on Experimentation was also studied: it allows local authorities to create exceptional regulation for a limited amount of time.

The group proposed that a few households from the same urban block could alternate hosting a temporary housing unit for asylum seekers in their garden. This would allow the foreign resident to stay in the same neighbourhood (for professional, educational or social reasons), without requiring that any particular host request a building permit for permanent construction, or that the municipality grant such a permit. They proposed moreover that local authorities could reduce property taxes for households agreeing to this measure. This would draw concerned citizens and municipal officials together into the same "tactical" operation, at minimal cost and with minimal risk of third-party objections.

4.1.2 *Heritage as a housewarming gift*

Another group associated hospitality with building heritage. Observing that many national monuments are un- or under-occupied, the idea was that, rather than looking for space in the already saturated social housing stock, heritage buildings could be outfitted for temporary residency.

In this scenario, displaced people would find themselves housed in prestigious or significant architectural works that represent the history of France. In order to test this idea, the group identified a modernist firefighter barracks that had been listed on the national historic monuments register in 2009. Located at the foot of Bordeaux's historic Stone Bridge, the apartment block floats on pilotis above the fire station and affords spectacular views of the city and the broader landscape. Built to house about fifty families, only six of the main building's apartments are currently occupied.

The fire department will be leaving this site for a new facility in 2020. Speculations on the building's future use include a luxury hotel or a relocated School of Architecture and Landscape Architecture. In the meantime, minimal investment for comfort and security improvements would make it inhabitable. This project creates space for emergency migrant housing by exploiting a heritage building's particular temporal condition. This is an example of tactical architectural work situated at the intersection of considerations for spatial quality, regulatory constraints, construction budgets, symbolic dimensions, and urban institutional dynamics.

4.1.3 *Dwelling beyond the cell*

One project resulted in a radical reconsideration of contemporary housing standards by recalling not-so-distant urban lifestyles and linking them to current developments in some social groups. The group started by analyzing France's system of Asylum Seeker Welcome Centers (ASWC, *Centres d'accueil de demandeurs d'asile*, or CADA, in French). Students noted in particular that, while an ASWC gathered all domestic comforts and amenities in one place, it was generally situated far from the city center. This inhibited exchange with local inhabitants and thus social and cultural adjustment, as well as making it difficult to benefit from the advantages of urban life.

As an alternative, the group sought to create domestic conditions for asylum seekers in central neighborhoods. Rather than simply propose to occupy existing apartments, the project took the urgent timeframe and the general housing shortage as determining constraints. It proposed making the most of existing resources, such as the wash facilities in municipal sports facilities and the kitchens in elementary schools, in order to simplify the design, construction and installation of modular units destined primarily for rest

and retreat. The domestic environment thus expands beyond the limits of the "existence minimum" unit, stretching to include facilities marked for special access and thus embracing a broader urban space. This spatiality would of course be heavily structured by time, as access to certain amenities would depend on the operating hours of their principal function.

In a scenario set in Bordeaux's St-Michel neighborhood, the group demonstrated how one such "micro-neighborhood" would associate the basic shelters with a university cafeteria, a hammam, a municipal library, and a fresh food market, all within few minutes walking distance. This proposal of course raised a number of issues, such as strict hygiene regulations for school cafeterias, managing the cohabitation of different populations in changing rooms and shower facilities, and the discomfort potentially induced by separating domestic functions with exterior space. However, by recalling a recent past in which many households used public bath houses and community food preparation and consumption was still commonplace, the project cast light on how contemporary European society's individualistic tendency is progressively mapped onto domestic and urban space.

4.2 *Public power*

4.2.1 *Small town hospitality*

Another group explored the hypothesis that emergency hospitality could be decentralized, with municipalities of all sizes welcoming asylum seekers and refugees in numbers proportional to their populations and means.

Following a national call for solidarity in September 2015, Angoulins (population 3700), a town on the Atlantic coast just south of La Rochelle, expressed its interest in welcoming one or two families of asylum seekers. During a meeting with the town's mayor, the students learned that the local post office's unoccupied staff apartment had been identified as a potential housing opportunity. Located in the town centre, this second-floor apartment would need some improvement before being able to house new tenants.

The students decided to develop an architectural punch list to identify the renovation work, appliances and equipment necessary to make the unit compliant with regulatory standards and appropriate for the expected occupants. This data served to draft a budget for the project, which could be used by Angoulins to request state funding to help with costs. Two scenarios were studied: keeping the large three-bedroom apartment as a single unit, and dividing it in order to accommodate two households. The group intended that their punch list could be used in by other cities facing the same situation.

4.2.2 *Tactical finance*

Some students learned that 7% of housing units in Bordeaux lie empty, often because of the owner's financial incapacity to renovate the apartment. The group looked into the different subsidies and funding available for housing in general, and for migrants, asylum seekers and refugees in particular. The city of Bordeaux alone provides a number of subsidies and bonuses to encourage housing improvement and availability; these funds are linked to criteria such as putting a vacant unit back on the market, asking below market rent, and improving energy performance. The metropolitan government also has a budget line to encourage getting empty units occupied, and the Gironde county government provides general subsidies for renovation work.

The students found that approximately 40,000 euros could be mobilized to make a vacant, substandard apartment fit for inhabitation, one third of which could be financed by the national housing improvement agency (*Agence nationale pour l'amélioration de l'habitat*, ANAH) provided that it be used as social housing for twelve years. In others words, these students designed a financial plan that could demonstrate to reluctant landlords—public and private alike—that it is viable to mobilize unused building stock to temporarily absorb the new arrivals without taking space in existing much-needed social housing. In this project, coordinating funding sources for housing from four levels of government constituted a form of design thinking in itself. The work also revealed that the French government's exceptional provision of 1000 euros per unit destined for asylum seekers ultimately accounted for a very small part of the overall budget that the students were able to assemble, and that it could not stimulate any action on its own.

4.3 *Findings from "Hospitality Now! 2.0"*

Exploiting the temporal dimension in order to free up space for occupation; showing how to distribute the housing demand over a maximum number of municipalities; coordinating disparate funding sources so that seemingly impossible renovations become plausible, even desirable: each of these tactics demonstrates how the inventive coordination of time, space, resources and people is architectural work in itself, even in the absence of new construction. They design the situations that are a prerequisite for designing inhabitable space. This involves specifically bringing together different actors, each of whose segmented view prevents the emergence of potential solutions: residents of a city block, local elected officials, county fire department services, national government agencies for aiding asylum seekers, heritage site guardians, and private developers, for example. Not to mention navigating France's legendary "millefeuille" of administrative and governmental levels. What transpires is a figure of the architect as specialist of the built environment and of the many ways its use can constitute a mode of dwelling. As in the first version of the studio, but through different means, the studio not only contributed to training future architects and to identifying housing solutions for displaced people, but also produced knowledge about the conditions of contemporary architectural practice.

5 CONCLUSIONS

The overarching objective of these two studios was twofold. First, they aimed to address a current housing problem that could benefit from the work of students interested in social aspects of architecture. Second, they sought to use the issue of migrant housing to ask broader questions about how we dwell in the world; in other words, to go from meeting migrant needs to considering urban dwelling as a general, shared phenomenon undergoing important mutations.

To that end, architecture was not conceived solely as an instant remedy to the problem, where the project might be built in an immediate future for the comfort of a few individuals. Architecture was used rather as a way of "figuring the world" such that the political, legal and cultural factors that weigh on architectural and urban production could be better understood. Those factors are also levers for improving the situation for the tens or hundreds or thousands of people who find themselves on the move in unfamiliar lands. Indeed, they may even be more powerful than solely spatial solutions. Many of the projects clearly articulated how harnessing the forces the precede form-making can lead to relevant and efficient proposals, while also drawing attention to some ideas about dwelling that, while we may take them for granted, might better be reconsidered.

A final remark concerns a danger with this studio topic. The fascination with alternative lifestyles and their corresponding architectural forms can cause us to forget that many standards that we take for granted are the result of hard-won battles against poor living conditions. In European history, those conditions resulted when pure market forces reined unfettered by legislation, or when war-related destruction caused severe housing shortages. Witness the veritable shanty-towns or *bidonvilles* that developed like a shameful crown around Paris after the Second World War, or the insalubrious and overcrowded blocks in its center whose demolition and reconstruction lasted well into the 1980s. A careful balance between the enticing prospects of new forms of dwelling and the defense of high standards should be sought, whether for new arrivals or for longstanding populations.

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Integration of Turkish migrants in Germany: A case study in polarities

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ABSTRACT: In 1961, the Federal Republic of Germany and Turkey signed a Bilateral Recruitment Agreement that would answer the demand for cheap labor in West Germany's growing post-war economy. From 1961–1973, German industries recruited 7000 Turkish workers. In 1974, the guest-worker program was halted, yet migration continued due a family reunification program that allowed workers' families to migrate to Germany. This paper examines how from 1974 to 1980 the Turkish population formed ethnic communities in two German cities, Berlin and Stuttgart. Using spatial analysis methods, we show how in Berlin, the Turkish population created distinct ethnic enclaves, while in Stuttgart, despite a similarly high percentage of Turks, communities remained smaller and more dispersed. We theorize that the different developments of Turkish migrant communities in the two cities are due to differences in available housing and variations in each city's social integration programs.

1 INTRODUCTION

In 1961, the Federal Republic of Germany and Turkey signed a recruitment agreement that would answer the demand for cheap labor in West Germany's growing post-war economy by allowing for the recruitment of temporary "guest workers". From 1961–1973, 7000 Turkish workers were hired, most of them in the areas of metallurgy, construction and manufacturing located in larger cities such as West Berlin, Munich, Stuttgart, Hamburg, and Cologne (Wilpert, 1986). Only 15% were women. In 1974, German laws were changed to allow the migration of guest workers' families. This caused the Turkish population in West Germany to increase to 1,546,000 by 1981, making it the country's largest foreign ethnic group and dramatically changing German demographics. (*Daten und Fakten zur Auslandersituation*, 2002).

Turkish settlement patterns within German cities have not been uniform. In Berlin, for example, Turkish immigrants have formed large, culturally distinctive enclaves within the city, while in Stuttgart, the Turkish population has established micro-societies that are spatially harder to pin down. In other words, in Berlin we find a spatial segregation of Turkish migrants, whereas in Stuttgart, the Turkish population appears to be spatially more integrated.

This paper examines the spatial patterning of Turkish enclaves in Berlin and Stuttgart between the 1974 and 1980[a]. Spatial patterns in the two cities are quite different, and we theorize that such patterns are indicative of a paradoxical process based on urban typologies and municipal policies: Turkish exclusion by the German population on the one hand, and assimilation into the German culture on the other.

2 ETHNIC ENCLAVES, SEGREGATION AND INTEGRATION

Housing for guest workers initially consisted of temporary barracks. As residency restrictions fell away, guest workers started to move into urban centers; after 1974, when workers were allowed to bring their families to Germany, the concentrations in the larger cities, especially in West Berlin, Munich, Frankfurt, Stuttgart and Cologne, increased dramatically (O'Loughlin & Gelebe, 1984, 1).

Ethnic enclave theory predicts that enclaves typically start to form by the clustering of immigrants around particular areas of potential labor. In a typical scenario, immigrant workers congregate within walking distance of their employment, defining certain neighborhoods as communities based on ethnic identity. New arrivals follow these existing ethnic networks, further cementing neighborhood identity. This results in a reciprocal process, whereby neighborhoods offer immigrants a sense of economic security and belonging, which in turn attracts more immigrants (Golab, 1982; Massey, 1985; Portes & Manning, 1986).

Alejandro Portes has suggested that enclaves provide a sense of security to their members. Immigrants lacking the necessary skills to enter the primary labor market can avoid the alternative – job markets where they are exploited as cheap labor for unskilled jobs – by seeking employment in ethnic enclaves (Portes 1998). Although ethnic enclaves increase the social and economical capital immigrants have, they also confine such immigrants to a limited economical sphere. For this reason, enclaves have been called "mobility traps", disadvantaging ethnic minorities through a defined

and permanent economical position (Borjas, 1986; Bates, 1987). Douglas Massey has suggested that as the pace of socio-economic mobility decreases, immigrant groups tend to display higher levels of segregation, while rapid rates of economic mobility eventually lead to patterns of assimilation (Massey 2001).

Changes in spatial patterns lead to changes in social processes. In the literature on transnationalism, the immigrant enclave is defined as a space where immigrants transfer their own cultural identity, language and practice to a new urban and national context (Sassen, 1996). Although some scholars view transnationalism as a mere transplant of national identity from the home country to the country of residence (Voight-Graf, 2004; Ehrkamp 2005), others have viewed transnational spaces as hybrid spaces that bring together cultures to form a new hybrid identity (Argun, 2003; Çağlar, 2001; Hall, 1991; White, 1997). This hybrid lifestyle challenges top-down implementations of integration policies, and challenges power relations through dialog (Kraidy, 1999; Hinze, 2013).

Once Turkish families arrived in Germany, German policy prioritized rapid cultural assimilation in order to preserve the characteristics of mainstream German culture. Rather than promoting a form of integration into German society that would allow Turks to preserve their identity and support the Turkish community, the German government has defined integration in ways that opposed what was percieved as traditionally Turkish (White, 1997). While the regular introduction of immigrants into the mainstream culture affects the national identity of the host country, it also creates subjective and socially constructed definitions of "foreigner" and "mainstream" (Alba and Nee, 2005). Popular reactions to immigrants' religious, cultural and ethnic differences have become institutionalized through the implementation of integration policies, as these policies are usually designed to make the relocated population fit into the mainstream (Triandafyllidou, 2001).

The term "integration" has been extensively used in political debates and in academia; however its meaning is rarely defined. Brubaker (2001) and Ehrkamp (2006) point to the ambiguous use of the term without providing a satisfactory definition, while Dörr and Faist (1997) and Joppke (2007) attempt no definition at all as they use the term in their analyses of ethnic diversity. The ambiguous nature of the term, along with the lack of a comprehensive definition, has led policymakers to adopt the term "integration" as a politically correct term to describe the concept of assimilation.

In the next section, we show how the level of spatial integration – defined here as a mixing of ethnicities in the urban fabric – has taken place between the Turkish and German populations in two German cities, Berlin and Stuttgart, between 1974, the year "guest workers" were allowed to bring their families, and 1980, when Turkey's military coup changed immigration patterns once again.

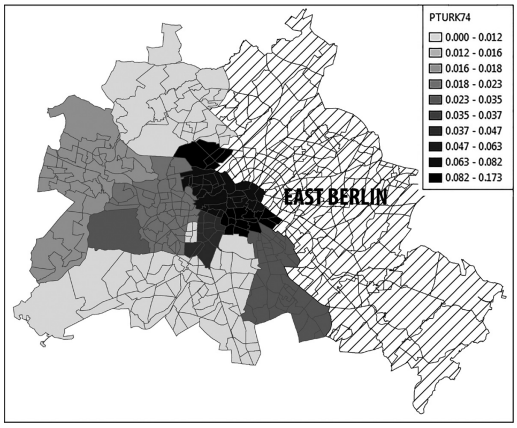


Figure 1. Percentage of Turkish population in Berlin in 1974. *Analysis based on data from the Amt für Statistik Berlin-Brandenburg 2015.*

3 BERLIN

Between 1974–1980 the percentage of foreign nationals in Berlin increased from 7.4 to 10.7, with 53.2 and 49.1 of them being Turkish nationals in 1974 and 1980 consequetively (*Amt für Statistik Berlin-Brandenburg*). Turkish immigrants quickly settled into older, working-class neighborhoods, such as Kreuzberg, Neukölln, Wedding, and parts of Schöneberg. By 1973, when guest worker programs officially came to an end, Kreuzberg had a 18 percent Turkish population. This was followed by 12 percent in Wedding, 8 percent in Schöneberg and 7 percent in Neukölln (*Amt für Statistik Berlin-Brandenburg*). These districts were attractive to guest-workers because they held the majority of West Berlin's tenement housing stock, which was the only cheap housing available to the guest workers (Hinze 2013). The administration of Berlin, fearing that the increasing concentration of immigrants would force out local residents, banned further movement of Turks to Kreuzberg and Wedding in 1975 (Hartmann, Hörsch & Neujahr, 1998). This led to clustering in new areas over the course of the 1970s.

Figures 1 and 2 demonstrate how the spatial density of the Turkish neighborhoods changed from 1974 to 1980 using a Moran I value test[b]. Neighborhoods with a high degree of Turkish spatial clustering can be clearly discerned, indicating that Berlin's Turkish community was spatially represented as physical neighborhoods. This is born out in Figure 3, which shows that spatial dependency increased over time; or in other words, that spatial clusters consolidated. The statistically significant and increasing value of Moran's I index in Figure 3 also shows increasing interconnection of the population between 1974 and 1980. The data thus shows that while the percentage of Turkish population increased within the urban context, this same population settled within or around

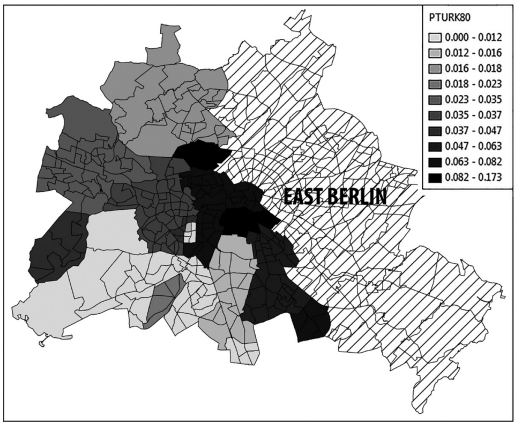


Figure 2. Percentage of Turkish population in Berlin in 1980. *Analysis based on data from the Amt für Statistik Berlin-Brandenburg 2015*.

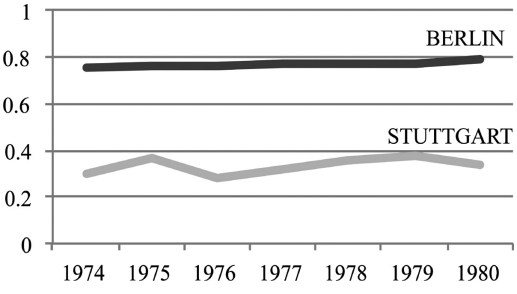


Figure 3. Moran's I value analysis for the percentage of Turkish population living in West Berlin and Stuttgart 1974–1980. *Analysis based on data from the Amt für Statistik Berlin-Brandenburg 2015 and Landeshauptsdadt Stuttgart Statistiches Amt 2015.*

existing Turkish quarters, consolidating a pattern of spatial segregation.

4 STUTTGART

Stuttgart, Germany's sixth largest city, is located in one of the country's strongest industrial regions. Due to its developed technology sector, Stuttgart has attracted guest workers from southern European countries and Turkey since the mid 1950s.

Although Stuttgart had a higher percentage of foreign nationals than Berlin did between 1974 and 1980, the percentage of Turks was not as high as in Berlin – 1.9 percent in 1974 and 3.9 percent in 1980. Due to the two cities' overall population differences, Berlin's 1980 Turkish population was much greater that Stuttgart's in absolute numbers, comprising 114.306 compared to 17.373 residents respectively (*Amt für Statistik Berlin-Brandenburg,* 2015 and *Landeshauptstadt Stuttgart Statistiches Amt*, 2015) (Table 1).

Table 1. Population statistics of Berlin and Stuttgart in 1974 and 1980. Source: *Amt für Statistik Berlin-Brandenburg 2015* and *Landeshauptsdadt Stuttgart Statistiches Amt 2015*.

		Berlin	Stuttgart
Population overall	1974	2.225.392	614.697
	1980	2.179.618	579.947
Turkish population	1974	87.948	11.633
	1980	114.306	17.373
Percentage of foreign population	1974	7,4%	13,1%
	1980	10,7%	17,7%
Percentage of Turkish population	1974	3,9%	1,9%
	1980	5,2%	3,1%
Percentage of Turkish population within foreign population	1974	53,2%	14,5%
	1980	49,1%	17,5%

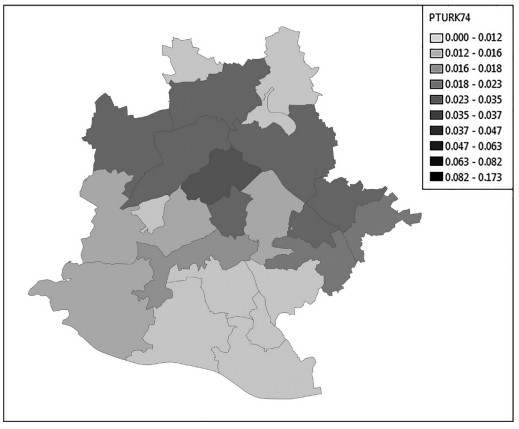


Figure 4. Percentage of Turkish population in Stuttgart in 1974. *Analysis based on data from the Landeshauptsdadt Stuttgart Statistiches Amt 2015.*

Turks originally settled in the outlying industrial wards and around the city center (Figures 4 and 5), and while Stuttgart's overall population density increased from 1962 to 1977, the spatial residential pattern of immigrant residents remained the same; or as O'Loughlin put it; "there is no evidence of a movement of foreigners to specific wards and of Germans from those wards [….] As long as the movement is not to destinations different from those of Germans, dominance of certain enclaves by foreigners cannot occur." (O'Loughlin 1980, 271). Thus, while Stuttgart exhibits pockets of immigrant households at the street and block scale, no evidence is present at a ward (district) scale (O'Louglin 1980, 274).

The lower values of Moran's I index in the case of Stuttgart indicates that while spatial clustering of Turks occurred to some degree, compared to Berlin, this degree of spatial clustering was not as significant. The high value of Moran's I index for Berlin, along with the positive slope of the graph, with the value of the index increasing from 0.75 to 0.79 from 1974 to 1980, indicates a very high level of spatial clustering. The value of the same index for Stuttgart,

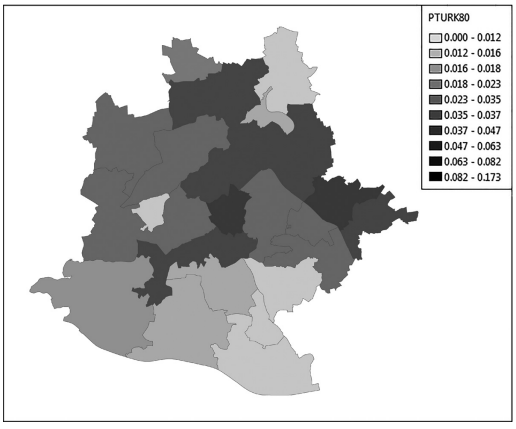


Figure 5. Percentage of Turkish population in Stuttgart in 1980. *Analysis based on data from the: Landeshauptsdadt Stuttgart Statistiches Amt 2015.*

fluctuated around the values of 0.3 and 0.4, indicating a much lower level of spatial clustering. This lack of Turkish spatial clusters and the fluctuating values of Moran's I index for spatial dependency can be taken as a more integrated Turkish community in the district level (Figure 3).

5 DISCUSSION

Our data shows that between 1974 and 1980 Turkish communities showed a greater degree of clustering in Berlin than in Stuttgart. More specifically, we found clear enclave formation in the former and smaller, scattered concentrations in the latter.

We hypothesize that two factors are primarily responsible for the different degrees of spatial clustering. The first is related to each city's existing housing typologies as well as laws regarding access to state-subsidized housing, and the second is Stuttgart's greater efforts to socially integrate the city's foreign workers. These factors have contributed to the distinct patterns of enclave building, assimilation and integration.

When Turkish guest workers moved to Stuttgart in the 1970s, they were quickly faced with the lack of affordable housing in the city. This lack of cheap housing led the Turkish population to avoid concentrating in specific localities (Schwarz 2014). Instead, Turkish workers moved into pockets of existing poor-quality housing, especially in the areas where older and post-war housing units are located. Such housing made up but a fraction of the neighborhoods' total housing stock, avoiding neighborhood concentrations (O'Loughlin, 1983, 202). Much of the Turkish population settled into nineteenth century housing that surrounds the medieval core of the city. Despite the influx of foreign workers, the area retained its social prestige, and many wealthy residents lived side by side with immigrants whose residential locations were determined by the location of their industrial work places (O'Loughlin, 1980, 259). Although a distinction between guest workers and other foreigners existed in the spatial configuration of Stuttgart's urban structure, especially between high-income white-collar workers from northern Europe and low-income unskilled workers from southern Europe and Turkey, the dynamic nature of the migration along with the patterns of chain migration prevented the formation of ethnic enclaves (O'Loughlin, 1980, 264–265).

Berlin, too, had a great deal of nineteenth-century housing, yet in the areas settled by Turks, much of this housing took the form of speculatively built tenement housing that had been left to deteriorate after World War II. Added to this, Berlin's government put controls on access to newer "social housing" (*sozialer Wohnungsbau*), which required a minimum amount of square meters for each resident to control overcrowding (Freiburghaus, 1974). Because of the larger family size of many rural Turkish migrants, entering the social housing market was thus out of question.

Berlin's nineteenth-century housing was originally designed to accommodate families from various social strata within the same structure. A small number of opulent apartments made up the perimeter of the blocks and were reserved for wealthier residents, while a large number of courtyard-accessed apartments remained for workers (Geist & Kürvers, 1980).

This tenement housing, now in disrepair, offered Turks cheap rents and the opportunity to accommodate their families in the smaller units, aiding in the construction of Turkish ethnic enclaves (Figure 6). As Turks moved into the high-density areas of Kreuzberg and Wedding, this situation led to limited interactions between Turks and Germans within the greater German urban context. The school structure and professional stratum also evolved to serve this portion of the community, causing most of the later generations of Turks to be socialized within the same communities and neighborhoods. This situation in turn reproduced the existing segregation at the neighborhood level.

In the context of Stuttgart and Berlin, visibility becomes a very important concept within the Turkish guest-worker migration discourse. The differences in visibility through the presence of immigrants in certain areas of the city, along with the material culture they bring with them, not only indicate a hybrid, transnational culture. The physicality of this immigrant culture becomes a lens for national and international identity and integration discourse.

From the German perspective, rapid assimilation of the immigrant population became socially prioritized as a strategy to preserve the characteristics of a mainstream German culture. Rather than promoting an integration into German society that would still allow Turks to preserve their identity and support the Turkish community, Germans have constructed "integration" as a concept that stands in opposition to what was percieved as traditionally Turkish (White 1997). The problems associated with such policies are hard to deny, as a regular introduction of immigrants into

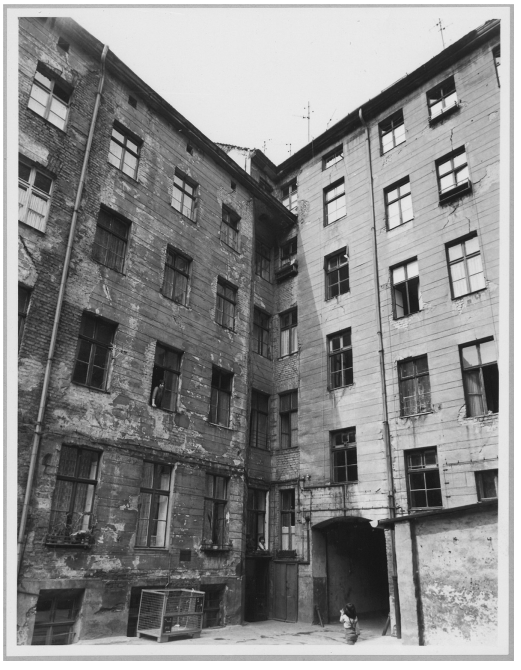


Figure 6. The courtyard of a 19th century tenement house in Waldemarstrasse 70, Berlin-Kreuzberg. Photo by Bert Sass, 1970 (Source: Landesarchiv Berlin).

the mainstream culture affects the identity of the host country as well as creating subjective and socially constructed definitions of foreigner and mainstream (Alba & Nee 2005). Popular reactions to religious, cultural and ethnic differences between newly arrived immigrants and the national mainstream become institutionalized through the implementation of integration policies which were designed to make the migrant population fit the mainstream (Triandafyllidou 2001).

In a country like Germany, where policies of integration are largely produced and implemented at the local level, different definitions of "integration" have led to different implementations of policy. One effect has been the different levels of spatial segregation in Berlin and Stuttgart. In Berlin there were no overarching integration policies until recently. Integration was defined in terms of cultural behaviour, leading to the German authorities imposing an expected behavior ideal on immigrant populations. According to Horrocks and Kolinsky, this has led to a perceived "schizophrenic identity" among Berlin's Turkish population, who perceive themselves as neither German nor Turkish (Horrocks & Kolinsky, 1996). We argue that a top-down approach that defines integration as assimilation is one cause for urban segregation; a point that corresponds to Çağlar's view that by denying organic social and cultural integration, Berlin's Turkish population has been coerced into living in secluded cultural enclaves, not only for economical reasons, but also because by confining immigrants into ghettos, their visibiliy was limited and complexities caused by integration were avoided (2001).

Çağlar defines such cultural enclaves as the ultimate expression of a refusal of cultural diversity that views immigrants as a "spatial and temporal extension of a prior identity rooted in locality and community," (Çağlar, 2001; see also Malkki, 1992). Following this view, the era covered by this study saw the ghetto image in the Federal Republic of Germany as identified with Turks who lived in inner city districts like Kreuzberg, Tiergarten, Wedding and Schöneberg. Although such ghetto formation can be seen as immigrants' refusal to socially, culturally and most importantly spatially integrate, Çağlar points out that the preventative measures taken by the authorities were largely responsible for such segregation (Çağlar, 2001).

Stuttgart has adopted a different approach towards integration. Although central integration efforts were not started until 2001, with the establishment of a network called "Alliance for Integration" (*Bündnis für Integration*), Stuttgart has nevertheless adopted a visionary approach towards Germany's perceived "foreigner problem". In the 1970s, when much of the population still regarded foreigners as guest workers, the mayor of Stuttgart, Manfred Rommel, called foreigners living in the city "Stuttgartians" and took actions to socially integrate this migrant population. In 1971, Stuttgart established the first advisory commitee on foreigner issues (*Auslanderbeirat*) with members taken from the municipal council as well as the community of foreigners themselves. The policies this committee developed aimed to prevent the formation of immigrant ghettos. In order to prevent enclaves, Stuttgart adopted a policy whereby only a certain percentage of any given structure was allowed to be occupied by foreigners (Güneş, 2016). These integration policies, combined with the spatial distribution of the housing opportunities for the immigrant population living in Stuttgart, resulted in less clustering and less visible physical boundaries between different groups within the urban context.

The ethnic enclaves in Berlin were not only consolidated spatially by providing visible borders, but also by social and economic consolidation through the establishment of immigrant networks. Although the existence of Berlin's ethnic enclaves reproduced this social and economic stratification through creating 'mobility traps', they were not entirely responsible for reproducing further urban segregation. The definition of integration adopted in Berlin, which assumed Turkish assimilation as its goal, paradoxically led to the reproduction of spatial clustering and exacerbation of a perceived "foreigner problem".

The approach to integration taken by the Stuttgart government deserves further study. Following the 1970s, Stuttgart took many steps towards the integration of the foreign population, culminating in large-scale policies implemented in 2001. Today, Stuttgart is considered a model study in the field of immigrant integration.

In the light of the contemporary problems related to the European refugee crisis, the studies of integration proved to be necessary and valuable. Although European countries have taken short-term actions such as providing safe and secure shelters to refugees, they are still far from coming up with long-term actions related to integration. Although patterns of current refugees' resettlement into the Europe differ from Turkish-German interaction patterns, our research presents social/spatial outcomes of different integration approaches and strategies. As refugees from some countries, such as Syria, will likely stay in Europe permanently, our research would be a valuable contribution to understanding successful integration strategies for the future.

6 NOTES

a. In 1980, a military coup in Turkey led to a new exodus of migrants, most of whom emigrated for political reasons. This paper examines 1974–80 as the years where Turkish communities became spatially established.
b. Moran's I value tests the spatial dependency of a certain variable. In other words, positive and high values of Moran's I value would indicate higher spatial autocorrelation, meaning high or low values of an attribute are likely to be clustered in space while with negative spatial autocorrelation; locations are surrounded by areas with very different values. The value of Moran's I index is typically between −1 and 1.

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Architecture "with the other 90%" – An African story

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ABSTRACT: Taking direction from the well-received exhibition *Design with the Other 90%: CITIES* (2011–2012) in America, this paper will refer to the notion of 'Architecture "with the Other 90%"'. By making reference to collaborative community-led architectural projects emanating from the African continent to illustrate the shift towards 'Architecture "with the Other 90%"' in addressing spontaneous urbanism in these regions. The main case studies that will be analyzed in the discussion is the Makoko Floating School in Lagos, Nigeria by NLÉ Architects lead by Kunlé Adeyemi (NLÉ Architecture & Design, 2016a) and the Design Indaba 10x10 Low-Cost Housing project by Luyanda Mpahlwa, from MMA Architects, for a family home in Freedom Park (Mitchell's Plain, Cape Town) (Design Indaba, 2016a). This paper's central focus is to illustrate a shift in social responsibility design and approach in Africa by referring to interdisciplinary architectural and design projects that are community-led, participatory, human-centered and promotes active citizenship.

1 INTRODUCTION

As if reciting a litany, the cities of the developing world read as: Ahmedabad, Bangkok, Buenos Aires, Cape Town, Caracas, Dakar, Dehli, Dhaka, Kampala, Manila, Mexico City, Mumbai, Nairobi, Rio de Janeiro, São Paulo and so on. These cities, as most cities in the developing world, are synonymous with spontaneous urbanism and the informal city. Often the terms 'spontaneous urbanism', 'informal settlements' and 'the informal city' sound like politically correct euphemisms for the more loaded words of 'slum', 'shantytown', 'township', 'barrios', 'favelas' that exist in these cities. It is here, in these informal settlements that the collective desire of the community and that of the powers that be often clash. As Séverine Roussel and Philippe Zourgane noted in *Architecture and Vegetation: hybrid home spaces*:

"Spontaneous urbanism is interesting in the sense that it has not been designed by the administration. Thus the relation with power is here different. Those arrangements are the result of body desire, and not the result of regulations and laws. Michel Foucault in "Security, territory, population" reminds us the importance of the link between control, regulation and city: 'It is because a police regulates cohabitation, circulation and exchanges that cities have been allowed to exist'." (2006: 50)

Thus, the spontaneous developments of informal settlements have historically been framed in the negative, as its' formation has not been regulated by an administration. Over the years, there has been an effort to change the negative connotations and discourse attached to the informal city or the unplanned city. One such project, which aimed to address this issue, was the exhibition *Design with the Other 90%: CITIES* (2011–2012) organized by the Smithsonian's Cooper-Hewitt National Design Museum in America. The exhibition showcased architectural design projects that engaged local communities in informal settlements in the design process, which ultimately lead to participatory and co-design processes and practices in these regions. Using the *Design with the Other 90%: CITIES* exhibition as a departure point, this paper will present and illustrate an ongoing tendency and shift in social responsibility architectural projects on the African continent in particular, that are collaborative, participatory, community engaged/community-led and which in turn encourages active citizenship. This shift will be illustrated by referring mainly to the following architectural projects: the Makoko Floating School in Lagos, Nigeria by NLÉ Architects lead by Kunlé Adeyemi (NLÉ Architecture & Design, 2016a) and the Design Indaba 10x10 Low-Cost Housing project by Luyanda Mpahlwa, from MMA Architects, for a family home in Freedom Park (Mitchell's Plain, Cape Town) (Design Indaba, 2016a).

2 DESIGN "FOR" AND "WITH THE OTHER 90%"

The prequel to the *Design with the Other 90%: CITIES* (2011–2012) exhibition was the 2007 exhibition *Design for the Other 90%*, its' premise was to address the fact that the majority of the world's seven billion population live in cities and one billion live in informal settlements within urban areas (Fig. 1). Of which the majority are in the Global South. It is projected that this number will double by 2030.

The exhibition showcased design solutions which tackled the basic needs of 90% of the world's

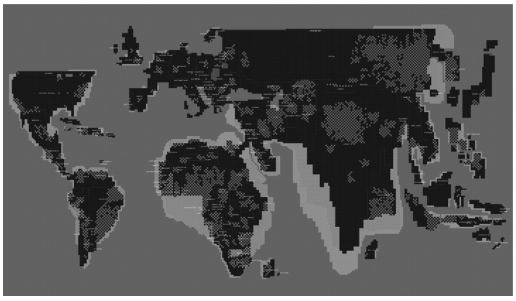


Figure 1. Informal Settlement World Map. Designers: Christian Werthmann, with Elizabeth Randall and Fiona Luhrmann, Harvard Graduate School of Design. United States, 2011.

population in these urban areas i.e. sanitation and clean water and over-crowded living conditions (Smithsonian Cooper-Hewitt National Design Museum, 2016). It also aimed to re-address the fact that in the past design practice in particular, has largely focused on 10% of the world's population in the production of mostly luxury goods. These series of exhibitions by the Smithsonian Cooper-Hewitt National Design Museum attempted to rectify this imbalance and promoted design for social responsibility and social change. Hence, designing for 'other 90%' of the world's population (Smith (ed.), 2007: 19).

In conceptualizing the sequel to the 2007 *Design for the Other 90%* exhibition, the curators heeded the criticism leveled on the first exhibition and replaced the "for the Other 90%" with the more inclusive terming of "with the Other 90%". Which ultimately speaks of including the communities who benefit from the design intervention in the design process. Thus, moving away from a patronizing type of "design tourism" visible in many social responsibility design initiatives in recent years (Arieff, 2011). With regards to architecture and social responsibility, it also heralds an opportunity and move towards creating 'Architecture "with the Other 90%"' and not only "for the Other 90%". Which has become more and more visible recently. As will be illustrated with the case studies below.

3 MAKOKO – "THE VENICE OF LAGOS"

"After today we shall berth in a row
With dreams floating in semblance
Of boats hauling desires to shores
Where there's everywhere on minds
And power settles for repose and luck."

– 'Makoko – Dreams on Water' is a poetry and photography collaboration between photographer Toye Gbade and poet Jumoke Verissimo (Verissimo, 2011)

Makoko has been called both "The Slum on the Lagoon" and "The Venice of Lagos"/ 'The Poor Man's Venice' (Fortin, 2012), the one a disparaging description and the other a more romantic one. However, this does cite a duality of contrasts at play. Makoko, was originally established as largely a fishing and logging community on the lagoon in Lagos (Nigeria), which has thrived informally for more than a hundred years. Its' over one hundred thousand residents created wooden frame houses on stilts in the lagoon to overcome the costly prices of land acquisition and building costs. Thus, making these homes the cheapest housing units available in Lagos (Adeyemi, 2012: 101). Further, canoes are used by residents in Makoko as the main mode of transportation to and from the mainland and on the waterways. Currently Makoko faces numerous problems, of which the foremost issues relate to basic needs of housing, education, sanitation and facilities. The other issues are as a result of the consequences and the affects of climate change, particularly rising sea levels and rainfall. Additionally, Makoko is constantly under threat by developers because of its' prime waterfront location. Which resulted in Lagos authorities forcibly removing and destroying some homes there in 2013. Consequently this led to community unrest, protest action and clashes with the authorities. Further, Lagos is also rapidly expanding and is one of the fastest growing cities in the world, with estimations of becoming a megacity by 2025 with a population of 25 million. Increasingly the local government has been unable to address the basic needs of the growing population in Makoko, leading to overcrowding, rampant disease, poverty, unemployment and crime. Also education levels amongst the residents are low, with many not obtaining a secondary education (Riise & Adeyemi, 2015: 58).

Amsterdam-based architectural firm NLÉ – lead by Nigerian-born architect Kunlé Adeyemi – aimed to address the issue of low education rates in Makoko by proposing the design of the Makoko Floating School in 2010 (Harvey, 2015: 27). There is one English-speaking primary school in Makoko on repossessed land, however the changing water levels make access at times difficult for the local children (Riise & Adeyemi, 2015: 59). Construction commenced on the Makoko Floating School in September 2012 and was completed by March 2013. In the design process, they took into account the rising water levels and tidal changes (due to climate change) and decided on a floating building or 'watercraft' rather than the traditional local building on stilts (NLÉ Architecture & Design, 2016b). Creating a floating or movable building also allowed for the bypassing of having to obtain building and planning rights from the authorities, as is the case when one builds on land. As Adeyemi stated: *"Do you need planning approval for a boat"* (Harvey, 2015: 28). Additionally an A-Frame structure would provide space for solar panels on the roofing and several levels with sufficient space for four classrooms (which is enough space for approximately 100 students) on the 2nd floor and a green recreation space on the 1st floor. The 220-squared metered A-Frame or 'pyramid building' is 10 meters high with a 100-squared meter

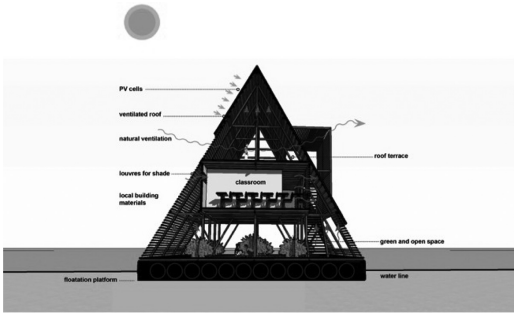


Figure 2. Makoko Floating School Diagram by NLÉ Architects.



Figure 3. Makoko Floating School floatation base being constructed.

floatation base, the building's shape also allows for a low center of gravity for a tall/ vertical structure. The floatation platform of several recycled plastic barrels additionally collects rainwater (Fig. 2).

Throughout the process, NLÉ engaged the Makoko community in the design and building process, consulting and negotiating with the local chiefs (the *Baales*) and the Makoko/Iwaya Waterfront Community leaders. Locally sourced sustainable building materials like Eco-friendly bamboo and wood from a local sawmill were also utilized in the building process and they employed local artisans and community members (Fig. 3). By employing untrained local community members in the building of the structure, it was in the hope of teaching them the building techniques utilized that could be translated in the construction of their own homes (Collins, 2013).

Additionally, the building presents Eco-friendly and sustainable solutions, by using renewable solar energy, reducing waste production and incorporating a water and sewage system and further the transportation system via canoes that has a low-carbon footprint (NLÉ Architecture & Design, 2016b). Adeyemi is adamant that in most of his architectural projects that it is essential to build locally and harness local human and natural resources (Harvey, 2015: 28). This also aligns with the design philosophy of the Rwandan



Figure 4. Makoko Floating School by NLÉ Architects.

architect Christian Benimana who adopts what he calls 'Lo-Fab', which refers to locally fabricated and built architecture and architectural components (Benimana, 2016). The Makoko Floating School is currently being utilized by the local community (Fig. 4) and has also been presented by NLÉ as a prototype building for not only Makoko but other rapidly developing African water cities, like Ganvié on Lake Nokoué in Southern Benin (Adeyemi, 2012: 101). However, more so than just presenting a prototype to address rapid urbanization and create buildings that are environmentally conscious and sustainable, it is the collective community's ownership of the Makoko Floating School that is additionally noteworthy. As Jessica Collins noted when she visited in 2013:

"*Yet a more immediate impact of the new building was the powerful sense of ownership that Makoko's inhabitants derived from it – even before the doors to the school were opened. As the only public space in the area, it has become a vital meeting-point for the community where, when classes are out, market ladies park their boats and fishermen steal some shade to mend their nets".*

4 DESIGN INDABA 10X10 LOW-COST HOUSING PROJECT

As like Lagos, Cape Town (South Africa) is a city of extreme contrasts. Arriving and landing in Cape Town by airplane – like a modern-day Icarus – affords a rose-tinted view of a beautiful natural landscape. Touch down on the N2 national highway en route from Cape Town International Airport and the reality of the city becomes more apparent on ground level. Saddled alongside the highway are the informal settlements of Khayelitsha, Nyanga, Guguletu and Langa, which dissipate as you near the city center. The highway road skirts Table Mountain, swaying you in various directions, if you choose to move towards the sea and Atlantic seaboard and you will be greeted by another city more akin with the French Riviera or the Costa del Sol than the southern-most tip of "Africa". The curator

Shaheen Meerali (1959–) makes a similar observation on a visit to Cape Town in 2001:

"As one drives out from the airport, the usual shanty towns and hamlets which are found in and around the airports of most Third World countries line the streets that pave the diameter of the airport. […] As the view of black South Africa recedes from the motorway and the view of Cape Town 'proper' becomes more apparent, so does the apparent disparity of the colonised and the 'colonisers' abodes. Two cities, twinned by the horrors of the recent past: a geography created by magnetic opposites. Cape Town spawns high rise and Spanish villas, painted white with long winding approach roads lined with fan palms. One has to be careful and water one's eyes by blinking often. The long plane journey might have mistakenly brought you to some wrong destination such as the south of Spain or France, with Le Corbousier [sic] inspired designs of private mansions, Madrid style villas with terra-cotta roof tiles, manicured garden with their bourganvillia [sic] and crazy paving. The schizophrenia does not end there, the further we travel away from the black enclaves, the grander and more exclusive and expensive the white thoroughfares become. […] Cape Town is a divided city: in terms of its economic abilities, geographic location and cultural spaces. […] Apartheid is not post, apartheid is real". (Meerali, 2001: 85–86)

Thus, the above extract postulates that the experience of Cape Town is ambiguous and contradictory and that it is a city of extreme opposites. As on appearance it can be classified as a city that is in reality two cities co-existing as one, due to possessing both so-called "First World" and "Third World" characteristics or having both a European and an African face.

South Africa's Apartheid past has been well documented. Apartheid laws like the Group Area's Act (1950) had a distinctive impact of the urban design of the Apartheid city and Cape Town in particular. The implementation of much of the Apartheid legislation led to the creation of segregated living areas on the outskirts of cities and towns. In 1950 the Apartheid government passed the law the Population Registration Act, which classified and separated people into racial groups as "Whites", "Coloureds" (relating to the descendants of the indigenous Khoi-San and the Malay slaves), "Natives" and "Asians" (Subirós, 2007: 22 & 24). They then passed a law, which made it illegal for people of different races to live in the same area; this was called the Group Areas Act (District Six Museum, 2015). One of the most documented enactments of the Group Areas Act was the forced removals of District Six in Cape Town, as in 1966 District Six was declared a "whites only" area. District Six was one of the most racially integrated areas in Cape Town, were races from mixed race and ethnic backgrounds lived and worked alongside each other in a area in close proximity to the city center and the harbor. There are several harrowing images of houses being razed and of the forced removals of 60 000 inhabitants in District Six to the Cape Flats – a sandy barren wasteland on the outskirts of the city. Presenting a dialogue between the city center and the periphery. The poetic responses to the forced removals resounded and echoed the poignant and defiant stance that memory does not forget:

"Gone
Buried
Covered by the dust of defeat –
Or so the conquerors believed
But there is nothing that can
Be hidden from the mind
Nothing that memory cannot
Reach or touch or call back".

– Don Mattera, 1987 (District Six Museum, 2015)

As noted above, many of the forcibly removed former residents of District Six and it's future generations live in what is known as the Cape Flats, which consists of several outlining 'townships' and suburbs on the urban periphery. One such settlement is Freedom Park in Mitchell's Plain on the Cape Flats. Whereas Makoko in Lagos was as a result of spontaneous urbanism, Mitchell's Plain came about as a result of the forced removal process and the Apartheid regime's social engineering processes, which in turn created peri-urbanism scenarios on the outskirts of many South African cities.

One of the architectural design projects that aimed to address the disparities amongst the citizens in Cape Town, particularly in terms of housing like in Mitchell's Plain, was the Design Indaba 10x10 Low-Cost Housing project (Design Indaba, 2016a). Design Indaba, an independent organization established in 1995 under Africa Interactive, hosts an annual international design conference and exposition and supports/funds several design initiatives through-out the year (Design Indaba, 2016b). The 10×10 Low-Cost Housing project objectives were aligned to the Design Indaba's vision of "create a better future, by design". Ten local architects were teamed with ten international architects from the Design Indaba conference speakers' alumni to collaborate on designing ten low-cost housing projects *pro bono* in 2007. The houses needed to be produced within the budget requirements for the South African government sponsored Reconstruction and Development Programme (RDP) housing scheme. The brief was as follows: "*The objective was to come up with affordable, attractive, innovative responses to the urgent need for housing for the urban poor. Sustainable design, construction and operation principles were to be incorporated*" (Design Indaba, 2016). Thus addressing a sustainable housing need not just in South Africa but also worldwide. The design by Luyanda Mpahlwa, from MMA Architects, for a one family home in Freedom Park (Mitchell's Plain, Cape Town) was the first to get planning approval from the City of Cape Town's local government. Mpahlwa drew on traditional indigenous building methods like the mud-and-wattle technique and instead of using bricks and cement constructed a double-story timber frame house with sandbag infill (Fig. 5).

Thus, constructing an energy efficient house that does not require much electricity or skilled labor to



Figure 5. MMA Architects, 2007. Design Indaba 10×10 Sandbag Houses, Freedom Park (Mitchell's Plain, Cape Town).



Figure 6. MMA Architects, 2007. Design Indaba 10×10 Sandbag Houses, Freedom Park (Mitchell's Plain, Cape Town).

construct. Many community members were engaged and physically involved in the construction of the Jonker family home. This design by MMA Architects received the acclaimed international design award the Curry Stone Design Prize in September 2008. An organization which awards design projects that find solutions to improve people's lives and living conditions around the world. Subsequently, ten such sandbag houses have been completed by Design Inbada in Freedom Park, Mitchell's Plain (Fig. 6).

The direct beneficiaries of this project, the community members were given workshops on the building process. As a result, local members of the community (largely women) gained experience and knowledge of sustainable building methods (Fig. 7) and were employed in this project (Design Indaba, 2016a). Again community involvement was essential in this project's implementation. As Mpahlwa (2007) noted:

"*Sandbag construction was a novel concept, especially in the township context, where single storey, low density […] housing is the norm. The designers thus developed a strong relationship with the community, providing the information and assurance they needed to take ownership and gain acceptance of this experimental housing type".*



Figure 7. MMA Architects, 2007. Design Indaba 10×10 Sandbag Houses, Freedom Park (Mitchell's Plain, Cape Town).

5 CONCLUSION: ARCHITECTURE "WITH THE OTHER 90%"

Both the Makoko Floating School and the Design Indaba 10×10 Low-Cost Housing project engaged the community in the design process and used sustainable processes and low-cost locally sourced materials. Further they also provided prototypes for future sustainable building methods and designs for these communities in these historical informal settlements. Increasingly with projects of this nature, there has been a shift away from the cult of the "Starchitect" and creating 'Architecture "with the Other 90%"". An essential aspect of this type of community engagement in the designing and building process, is "trusting that people can do it" (Smith (ed.), 2011: 4). Further, it promotes active citizenship, collective ownership by the community and collective building. Nevertheless, it is vital to mention, although there have been increasingly more-and-more architectural projects over the years addressing housing needs in informal settlements by non-profit organizations like Habitat for Humanity, What Design Can Do, Architecture for Humanity, Architecture Sans Frontieres and so on, some of these projects have been design interventions by outside volunteers. Creating what Alison Arieff termed as "design tourism" (Arieff, 2011). Therefore the community did not benefit from the transference of skills and knowledge in the construction of some of these structures, to ensure longevity and sustainability of these design interventions. Hence, the need for 'Architecture "with the Other 90%". For architectural practice to adequately address the societal challenges we are currently faced within this present-day, it needs to engage the essential ingredient of the 'human'.

The Senegalese photographer Omar Victor Diop stated at the Design Indaba conference in 2015 that: *"In Senegal we do not have many resources but we have people"*. This statement in essence epitomes much of the story of what many have experienced as a sense of community in most African countries. Often the media's or the popular image of Africa is either highlighting an African 'destination' or 'humanitarian

crisis'. Thus, the image that is presented is not one of resilience and community (namely the spirit of *Ubuntu*). Nor what lessons can be learnt from Africa. *Ubuntu* is defined as follows:

"*According to an old Zulu maxim umuntu nguumuntu ngabantu- "a person is a person through (other) persons". It is only by acting with humanity toward one's fellow man that a person can be one with the spirit of his people and be worthy of veneration after his death. This is the essence of the African spirit of shared humanity that is known as 'ubuntu'. According to Archbishop Tutu Ubuntu 'speaks about our interconnectedness. You can't be human all by yourself, and when you have this quality – Ubuntu – you are known for your generosity"'* (The FW de Klerk Foundation, 2011)

Besides harnessing the spirit of *Ubuntu* and community in building sustainable and humane housing, there also needs to be a process of humanizing spaces like the 'slum', 'shantytown', 'township', 'barrios' and 'favelas'. As the Venezuelan architect Alfredo Brillembourg (from Urban-Think Tank) often recounts of what residents in informal settlements regularly relay to him: *"You call it a slum, but we call it our home"*. Additionally, Brillembourg states that *"Informality is the new normality"* and *"We need a new way of dealing with the city. The laws do not comply with what is happening on the ground"* (2016). The "incremental housing" projects by Chilean architect Alejandro Aravena from the architectural firm Elemental also present new ways of practicing or dealing with the reality of "informality". Where government sponsored housing projects are built incrementally and the remainder of the house is customized or retrofitted by the dweller (Smith (ed.), 2011: 118–119). Similarly, Brillembourg has adapted the idea of "incremental housing' to his ongoing project entitled Empower Shack in BT-Section, Khayelitsha in Cape Town (Urban-Think Tank, 2016). Collectively all these processes and activities lead towards and engage with 'Architecture "with the Other 90%". New paradigms or perspectives are required. By terming certain urban developments as spontaneous urbanism defines and explains the activity engaged by a community as being a spontaneous activity towards creating housing or infrastructure for that community. Whereas the term 'informal settlement' labels the output of this spontaneous activity and additionally in turn also vilifies it, as not being a legitimate place; just because it was not planned by an authority or administration. This is ultimately where the problem lies. These spaces need to be humanized even in our perceptions, only then can we collectively find solutions together.

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Regeneration of barrack complexes as means to sustainable development

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ABSTRACT: In garrison towns, army constituted focal point of social and economic life. Military infrastructure contributed to city's modernization. Through generations, historic army barracks were a reminder of past splendor for the citizens. As a result of turbulent geopolitics in Lower Silesia in the 20th century these objects, once venerated by the natives were handed over to newcomers, for whom they held little sentimental value and then were altogether abandoned and left for ruin. Nowadays, they are sold to private investors who raze them to the ground or disfigure them in the process of adaptation. Regeneration of these versatile compounds is ecologically, economically and psycho-sociologically beneficial, however should be properly supervised, so that they are not deprived of their original characteristics, but serve as evidence of history while fulfilling their new functions. Without them the cultural landscape of garrison towns will become unintelligible to both previous and present inhabitants.

1 SUSTAINABLE DEVELOPMENT AND THE HERITAGE

The word that is the key to understanding today's world is "global". Unlimited communication, world-wide spread of commerce and popularization of international style resulted in unification of standards and tastes. Paradoxically this has led to renewed veneration for regional culture and vernacular architecture. Regionalism is now on demand. In the 21st century people are more mobile than ever, seeking employment, a place to live or vacationing in most remote corners of the Earth. But as they do they look for peculiarities in cultural landscapes to relate to. People who move around have a strong longing to find a place they belong and a sentiment (sometimes unconscious) for what they left behind (Woods, 1982). These regionalisms distinguish places from each other and draw or repel possible migrants and tourists (Stouffer, 1960). The foundation for these regionalisms is the cultural landscape formed in the course of history.

According to a formal definition, a cultural landscape represents the combined works of nature and of man, which are illustrative of the evolution of human society and settlement over time, under the influence of the environmental, economic and cultural forces (Operational Guidelines For The Implementation Of The World Heritage Convention, UNESCO, 2015). In other words cultural landscape is the essence of the identity of a local community. Therefore it must be as versatile as possible so as to fully represent its historical background allowing future generations to understand their origins and preserve the traces of those which have disappeared. Along with natural deposits, cultural landscape is the greatest resource available to man. Cultural and natural heritage form a complimentary resource, which must be preserved for the planet's sake (UNESCO World Heritage Convention, 1972, Article 4).

To preserve cultural landscapes and maintain regional identity that originates in them, but allow progress, the world needs to develop sustainably. A sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Report of the World Commission on Environment and Development: Our Common Future). The concept of sustainable development is based on the idea, that the civilization of man can shape and utilize the environment in such a way that it enables it to function on the highest level of evolution possible, without negative consequences and irreversible changes to local natural and cultural landscape. It has been observed, that most mainstream studies concerning sustainable development take into consideration only natural capital and natural heritage, leaving out cultural heritage. Luckily major significance of cultural heritage to human wellbeing and its potential contribution to social, economic and environmental goals gain ever wider acknowledgement.

For whatever can be said of sustainable development in the realm of natural resources, can also be said of cultural heritage. Both natural and cultural capital is non-substitutable. The function of natural capital can be disseminated into four categories in terms of utility for human wellbeing (Dietz & Neumayer, 2007). It provides the basic life-support functions, the raw materials for production and direct consumption, and assimilates their waste products. But it also provides the visual amenity of a landscape. Same can be said of cultural capital. Cultural heritage also plays an important role in local life-support by providing economic

development and basic amenities, such as dwelling. It attracts investments (via tourism) and facilitates locally-based employment, which in addition contributes to self-awareness of local communities and care for local properties. Correspondingly protection of exceptional heritage properties cherished by people is considered "an intrinsic contribution to human wellbeing" (UNESCO on sustainable development) for its powerful symbolic and aesthetic dimensions. The acknowledgment and stewardship of the diversity of cultural capital enhance the feeling of belonging and contribute to the social cohesion of a community.

Consequently, the fullest and most complete cultural landscape is such that contains the most complete transcription of region's history or more exactly not only historic monuments and cultural heritage, but also historic architecture *sensu largo*, that was not declared monument. This leads to a paradoxical conclusion, that sustainable development which is in its essence a process of change is only possible through a petrification of cultural landscape. According to Werner Hediger, this discrepancy is the consequence of the dual nature of the process. Alike many scholars he distinguishes between "weak" and "strong" sustainability. The "weak sustainability" paradigm implies that the value of a man-made capital is greater than the natural capital (Neumayer, 2013) and is the compromise between economic growth and preservation of cultural landscape. On the other hand "strong sustainability" paradigm demands that ecological and cultural capital be kept intact (Hediger, 1999). It seems clear, that if societies are to evolve and progress in the spirit of sustainable development, it would have to be "weak sustainable development".

Endorsing sustainable economic development is in heritage preservation's best interest. It is the most effective way to save endangered cultural heritage sites (www.sustainablepreservation.org) and should not be curbed. Especially underprivileged communities can only be motivated to care for their heritage by tangible benefits that can be drawn from long-term maintenance as an alternative to other profitable uses, such as looting, agriculture and razing under residential and commercial construction. If heritage becomes an asset not a burden in economic growth it will be willingly cherished and nurtured. This stands in accordance with the World Heritage Convention, which urges State Parties "to adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programs" (UNESCO, World Heritage Convention, 1972, Article 5).

Here we come to the notion of "sustainable preservation". The notion comes from the idea that the most sustainable technique of construction is preservation of existing properties, which saves resources and energy and is ecologically-friendly in terms of recycling. This generally fits the EU urban development policy, which is fixed on reurbanization of cities. This is due to the adopted principles of environmental protection and resource recycling, including priority of land reuse before appropriation of new building sites (Billert).

The preface of the UNESCO 1972 Paris Convention states that deterioration or disappearance of any item of the cultural or natural heritage constitutes a harmful impoverishment of the heritage of all the nations of the world. Understandably not all historic objects can be preserved and only the most iconic, significant and representative – the ones that the UNESCO Convention calls "of outstanding value" – can become cultural heritage under protection (UNESCO, Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972). This term boils down to either a unique artistic creation, scholarly historic value, or typological qualities (ICCROM, Proposals By The International Centre For The Study Of The Preservation And The Restoration Of Cultural Property, 1976). However, interest should be placed not only with the obvious choices, possessing the exceptional features mentioned above, but also with the less evident properties with potential for scientific value if properly exposed (ICOMOS, Proposals Made By The International Council On Monuments And Sites, 1976).

2 MILITARY COMPOUNDS IN THE LIFE OF THE CITY

Maintaining as many historic objects as possible is indeed the way to sustainable preservation not only from an economic, but also a spiritual point of view. Regeneration and adaptation of historic architecture can indeed be the way of establishing prestige and achieving gentrification (Rudnicka-Bogusz, 2012). Especially in societies, which had gone through some trauma – deracination, war, social or economic exclusion, racial segregation – historic objects that connect communities to their grand historic past can help them heal or maintain their identity.

There are many examples of post-war restorations that brought some consolation and closure to the communities. As a part of a post-war nation-unifying movement the Royal Castle in Warsaw which was razed to the ground by the Nazis got reconstructed in the years 1971–84. The Dresden Lutheran church *Frauenkirche*, destroyed in carpet bombing air raids in 1945, lay in rubble for 20 years in the middle of Old Town, until combined grassroots effort of donations and foundations culminated in its reopening in 2005. Also in Leipzig, St Paul's Church was restored due to popular demand. The 13th century church survived the World War II only to be demolished for ideological reasons (Wolle, 2003). In its place Leipzig University built a campus extension. In the beginning of the 20th century the university began modernizing its properties and when the citizens petitioned for reconstruction the church, the university agreed.

However, not only the declared monuments spark this type of devotion. For instance, in 1996 Leipzig

was the scene of a public dispute, when during demolition of a shopping mall from the 1970s, a *fin de siècle façade* of a department store was uncovered. To the citizens the department store represented the golden era of commerce in Leipzig, when rich merchants and entrepreneurs founded exquisite boutiques and shops, where bourgeois could stroll and socialize in the atmosphere of accessible luxury. Through marches and petitions citizens voiced their support in favor of upkeep of the Leipzig soul through restoration of the rediscovered building.

For garrison towns in Silesia it was the barrack complexes that were the focal point of social and economic life. They were also important to the local communities who were living in their immediate proximity, giving them the *genius loci*. Their significance is somewhat proven not only by the economic data showing substantial growth after the arrival of the military, but also by the analysis of postcards from the period. On these postcards only most venerable and noteworthy objects were represented and a significant number of these edifices, among castles and courts, are indeed barracks and officers' messes.

State-funded military infrastructure contributed to city's growth and modernization, added aesthetic value to city landscape and provided locals with jobs at construction sites. Growing military population gave local trade and services a boost (Urbaniak, 2012). Furthermore, large concentration of the military stimulated frequent visitations from high state officials which further added to the prestige. Through generations, historic army barracks were a reminder of past splendor for the citizens, but to the outsiders this urban code was unintelligible.

Military compounds changed the face of the city in more ways than one and left a lasting impression. They were usually situated on the outskirts, where enough space was available for spacious complexes, large drill squares and shooting ranges. Their development required towns to provide infrastructure and amenities, which stimulated the sprawl of these towns towards the outskirts, where the barracks were situated. Streets leading to military facilities were named by thankful citizens in honor of military units that occupied them, e.g. *An den Kasernen* (at present Jagiełły Street in Wrocław) which leads to the former Burgess Barracks, *Kaserne Strasse* (presently Adama Mickiewicza Street in Namysłów leading to the former Dragoon Barracks), *Einundfünfziger Strasse* (at present Długa Street in Wrocław) which took its name from the 51st Infantry Regiment stationed there or *Grenadier Strasse* (at present Hutników in Legnica) (Rudnicka-Bogusz, 2015). Barracks were usually accompanied by extensive shooting ranges and paddocks. When the military vacated the premises they became the foundation for municipal parks, such as Park Leśny (Forest Park) in Lubin – a former shooting range or *der Hag* (a meadow in Municipal Park in Legnica) also once a shooting range.

The bond between communities and the units implanted in them was strong. The rhythm of city life fitted itself to the dynamics of army marching in, marching out or marching through. At the beginning the relation was antagonistic. Before the construction of the barracks, soldiers were traditionally billeted in private homes (Lepage, 2009), which met with general resentment (Davies & Moorhouse, 2009). Gradually the relationship became warmer. Eventually, every time the troop got back to town from a campaign it received a warm welcome. The townspeople organized a feast and decorated their houses with the colors of the regiment or founded frescos for mess halls, etc. (Paetzold, 1998).

3 TYPOLOGY AND STYLISTICS OF MILITARY COMPOUNDS

State-funded investments, which were implemented in provincial cities, were one of the most iconic and prestigious. There were no limitations in resources, when it came to their form and appearances that were supposed to express privilege and authority. Municipalities relayed plots for those investments free of charge, so their gauge was not restricted by shortages of terrain (Bińkowska, 2012). Their construction was a prestigious endeavor and was financed by the state. The edifices, representing central government in local communities, were well funded and strongly built. The barracks, either through evolution or by design, housed several battalions. The troop was accommodated in a single building or a complex. Most compounds comprised numerous buildings of various purposes, organized around a central courtyard. Administrative buildings, such as command and commissariat, were positioned at street front. The complexes were hieratic, compact and spatial. Individual buildings often assumed the appearance of a city palace, whereas complexes constituted of several buildings tended to derive its layout from *entre cour et jardin* palace type or reminisce Godin's *Familistere*. They formed tight, self-sufficient blocks, emulating strongholds.

The increase in construction of barrack complexes falls into two periods, and so the architecture bears features characteristic of these two periods. The first one coincides with the reign of William Frederick I of Prussia, during which the prominence of the military in the Kingdom of Prussia steadily rose up to a point when it became the first power of the state. Buildings from that period represent the stylistic of historicism, usually the neo-Gothic with elements of Romanesque Revival, which brought to mind the basic association of knighthood and strongholds. They were designed in a manner that made them stand out against the background, to emphasize their significance and indicate their purpose. The examples here are the so called Red Barracks in Oleśnica built at the turn of the 20th century, quarters for the Dragoon Regiment in Oleśnica built in the 1870s, Ranger Battalion barracks complex in Jelenia Góra built around 1880 or Grenadier Regiment of King William I barracks in Legnica. More prestigious objects, such as officers'

mess in Oleśnica (built around 1880) or Cuirassier Barracks in Wroclaw were designed in neo-Renaissance to resemble *palazzos*.

The layout of the collective residential buildings utilized the most functional solutions and constructions known at that time. Foot-soldiers lived in two-bay buildings: rooms, accommodating up to 10 bunk beds, opened up to a corridor that ran along one side of the building and led to staircases. There was usually a main, open staircase situated at the center, which led to a spatial vestibule and two auxiliary staircases. Officers and their families lived in multi-staircase buildings, allowing them to maintain more privacy. Additionally, the compounds were comprised of stables, mess halls, armories, lazarettos, baths and watch-houses.

Similarly, Nazi Germany, while steeling itself for armed conflict, developed and tightened the security grid of military training facilities and military barracks in the east of the country. Functionalism – widely utilized at that time for multi-family dwellings - was not overlooked in military architecture. The barracks usually had a multi-staircase layout, occasionally a three-bay layout with rooms extending on both sides of a central corridor. In their urban design, military complexes also utilized improvements introduced in the 1920s and 1930s in the settlements of building cooperatives associated with *Werkbund* movement, such as linear plan, however incorporated in well-tried hieratic block layouts. The most prominent feature was still a central courtyard, around which all the buildings were arranged in a form of a dense compound.



Figure 1. Excerpt from the map of Legnica showing distribution on military compounds.

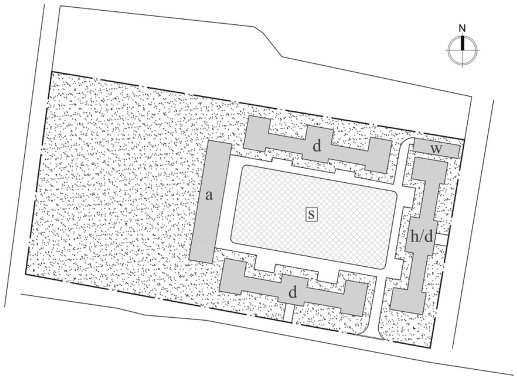


Figure 2. The complex at Hutników Street – (a) auxiliary training facility, (d) dormitory, (h) headquarters, (s) drill square, (w) workshops & warehouses.

4 REGENERATION OF MILITARY COMPOUNDS IN LEGNICA – EXAMPLES

After 1945 some parts of Lower Silesia underwent a complete exchange of population and alteration of nationality. After these territories were resettled, the objects that were most venerated by the natives became unfamiliar and irrelevant for the newcomers. Due to their function, the military installations were inhabited by the Polish or Soviet army. As strategic objects, they were, in most cases, properly maintained. When the Russian troops were withdrawn in 1993 and the Polish Army was restructured, many properties were looted and abandoned. Unused, they degraded. What was once a focal point for town's social life, now became a collection of discarded ruins, with little sentimental value.

Among many Lower Silesian cities Legnica is the one that was mostly influenced by its relationship with the army. Since the end of the first Silesian War in the summer of 1742 until the withdrawal of the Russian Army in 1993, Legnica was a garrison for various branches of the military. Throughout the ages the city owed its privileged administrative position and its economic situation to the presence of the army (for the central budget the army is a liability and expense, but it generates substantial income for the local budget).



Figure 3. Eastern façade of the Grenadier Complex after regeneration.

For example, the grandiose compound of *Grenadier Kaserne* in Hutników Street was built entirely from brick manufactured locally by Gottfried Bienwald's brickyard and laid by local masons; the post-war army music competition held in Legnica was renown in the whole of the Eastern Block, etc.

The military facilities are a token of "little homeland" to three ethnic groups and generations of Legnica citizens. For German compatriot associations from Legnica (*Liegnitz*) these objects are a sentimental reminder of the splendor of their lost homeland (Tomczak, 1997). To the Russian military and their families it's a subsidiary home they once inhabited (wroclaw.wyborcza.pl). To the Poles who settled in the city – a part of town they reclaimed with the withdrawal of occupational army and with proper regeneration of which the city may again achieve prestige (fakty.lca.pl). The care given to the facilities by Polish authorities is a sign of good intention and will of reconciliation, as well as an investment in future good relations with their former inhabitants.

As in other garrison towns in East Prussia and later Germany – e.g. Wrocław (*Breslau*), Brzeg (*Brieg*), Koźle (*Cosel*) – Legnica barrack compounds were distributed on the outskirts of town, creating a ring around it (Figure 1). Nowadays, due to urban sprawl, they are located downtown. The complexes were connected to main exit-roads, some conveniently positioned near main railway hubs. They covered 17 km^2 and comprised of over 1200 properties, amongst which were not only dormitories, but also warehouses, hospitals, schools and an airport, all located in downtown Legnica. Since the barracks occupied such prestigious locations, their degradation became a serious problem for the city officials. A good example is the largest hospital in town – the lazaretto in Złotoryjska Street. On the southern outskirts of town, just off the road, hidden in a tangle of trees, stands an abandoned extensive complex of military hospital. The edifice was constructed in 1937 and comprised of a hospital, a medical school and recuperation center.

The oldest among the compounds is *Grenadierkaserne* – Grenadier Regiment barracks of King Wilhelm I – constructed in the years 1874–1888 right outside the Old Town, at the main western exit-road (Figure 2). The construction of this compound was the key factor that influenced the urban pattern of this part of the downtown (Rodak, 2015). The complex was built on a rural plot of land (Grajewski, unpubl.). The first street that was plotted in this area was the *Grenadierstrasse* (presently Hutników Street), that ran in front of the main building of the complex. In 1889, after the compound was completed, another new street was marked out to run along the southern perimeter of the complex.

The compound consists of three dormitories and a supplementary building – encompassing a vast drill square – and some auxiliary buildings at the back of the premises. The barracks represent a type of monumental, multi-store and three-wing building whose main body is accentuated on central axis and quoins by *avant-corps* surmounted with turrets or machicolations. The *corps de logis* faces the street and the side wings are propelled into the courtyard. As can be seen on archival plans, such stylistics was commonly utilized for military facilities at that time, for instance in Bierutów, Kluczbork or Wrocław – e.g. barracks on Kępa Mieszczańska, Szczepin Barracks (Eysymontt, 1998).

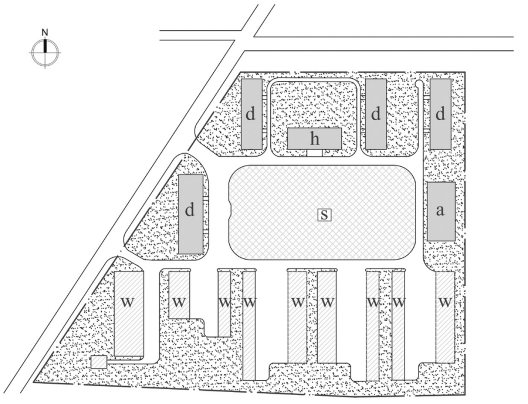


Figure 4. The complex in Złotoryjska Street – (a) auxiliary training facility, (d) dormitory, (h) headquarters, (s) drill square, (w) workshops & warehouses.

Elevations of the buildings are made of red bricks which are diversified with ceramic, sometimes colorfully glazed moldings, cornices, friezes and window casings. The outer walls are formed tectonically, undulating in depth and height, with varying textures. The buildings are two-bay, with a corridor, leading to auxiliary entrances, running along back elevation. In each of the buildings main entrance leads to a spacious vestibule with an open stairwell.

The complex was vacated in 1993 and in 1998 the premises were handed over to a community colleague. In the following years school authorities allotted around 20,000,000 PLN to the regeneration of the compound. Two out of three dormitories were included in the regeneration project, which involved restoration of elevations and woodwork, adaptation of interior, reconstruction of the historic fence. The preconditions were ideal for establishing a school. Spacious dormitory rooms were easily converted to lecture rooms partially thanks to the large windows letting enough light in and partially thanks to the high ceiling, allowing installation of suspended ceiling that accommodates all the extra amenities. The wide corridor, designed to enable instantaneous marching out of a large troop comes in handy during breaks and is essential to meeting the requirements of fire department safety regulations. The voluminous drill square is a perfect place for student meetings and recreation. The stylistic of the complex matches the required grandeur of a scholarly facility as well (Figure 3).

There are however week points to this project as well. Due to safety concerns the buildings can only be accessed via the inner courtyard – through back entrances – while the main representative portals stay shut. The drill square is used as a parking lot, which makes an unpleasant impression and takes up space from area of possible student activity. Moreover the third, southern dormitory remains a ruin.



Figure 5. Unfortunate stylistic choices visible in the façade of the barracks.

In 1935 on the south side of the city, in a park dedicated to a World War One monument, a complex of barracks for antitank defense units – *Kaserne Siegeshöhe* – was built (Figure 4). It comprised six administrative and residential buildings in the west, north and east of a drill square, as well as nine auxiliary sheds, garages and workshops in the south. The buildings were almost ideally situated on a north-south axis, practically making up a layout of a functionalist linear settlement.

Alike other military compounds it was vacated in 1993. In 2006, a social housing association (TBS) began regeneration and adaptation of the complex and in 2010 first users inhabited their new flats. The three-bay barrack was ideally suited to becoming an apartment building. A spatial corridor linked rooms running along eastern and western elevations to two entrances opening to the inner courtyard. The house had three stories, a basement and an attic. During adaptation on each floor, the corridor was divided in two, creating two separate units with autonomous entrances. Large common bedrooms were subdivided into independent flats and equipped with bathrooms and kitchens. The building was retrofitted with amenities: entrances were supplemented with huts and ramps for the disabled, the apartments were given balconies. The attic was partitioned by an additional ceiling, creating *entresol*. The result was around 2800 m^2 of living space and preservation of the compound.

However, even though most of the original tissue was preserved, in the process of adaptation almost all architectural features were forsaken for the comfort of future users and only the original urban pattern is visible today. Originally, the brick walls were covered with plaster and painted in modest beige (liegnitz.pl). The roofs were covered with flat, red terracotta tiles. Windows had wooden frames with muntin and were painted white. The attic was illuminated by means of dormers neatly distributed on every second window axis. The walls were accentuated by brick socle and expressionist ceramic moldings, e.g. in portals. All those features have been discarded. The walls were insulated with Styrofoam, plastered and painted in bright yellow and green. The brick socle was replaced by textured plaster. Wooden windows were exchanged for plastic with no internal subdivisions. The dormers were taken out. To let light into the penthouses the roof was riddled with roof windows and *porte-fenetres*. Raw flat tiles were replaced by glazed molded tiles.

It stands to reason, that the social housing associations operate on a tight budget and cannot afford building materials of the highest quality. Nevertheless, alterations to elevations, roof and questionable coloristic are a matter of style rather than finances (Figure 5). In the case of regeneration of military compounds, just as in the regeneration of post-industrial districts, the strongest point is the charm of historic architecture (Bryx & Jadach-Sepioło, 2009), which in this case seems to have been neglected.

Legnica is an excellent example of all chances and perils of regeneration process. A successful regeneration can bring back not only the objects but also the *genius loci* back to the life of a community. A careless adaptation, even though it returns the objects back to the society, obliterates their context and historic values – its only value is economic.

5 CONCLUSION

Barrack complexes complete the cultural landscape of garrison towns constituting an account of their past and an explanation for the manner in which they evolved. Without them the cultural landscape becomes vague. That is why it is essential that we preserve as many of them as possible. Obviously it would be counterproductive to petrify and preserve these complexes without reintroducing them into the urban space. Luckily, military installations can be easily adapted for various purposes. They are pre-facilitated with necessary infrastructure, which decreases initial costs of any potential investment. Since they include objects of versatile functions – houses, offices, warehouses, chow halls – they provide many possibilities of adaptation.

However, historic buildings, including military compounds, should be dealt with according to the monument preservation regulations, even if they are not regarded as monuments. A successful revitalization must satisfy the criteria of unity and integrity of quality (deriving from setting, function, design, materials, workmanship and condition) (ICOMOS, World Heritage Criteria, 1976). A building cannot be detached from its context, i.e. built environment (a group of buildings with which it formed a complex) or its surrounding landscape. First of all, the compounds should be regarded as a whole, should not be broken up into separate buildings. All the surviving buildings from the original complex design should be maintained, or if they were destroyed in the course of history – they should be represented by neutral objects of the same gauge. Second of all, beside economic and sentimental value, the complexes possess a scientific value – a typological potential – that can place them

in a larger context. Thus, the original features of the architecture should be preserved above all.

There are cases of both positive and negative practices among the many examples of adaptation. That is why regeneration of such military installations should be properly supervised, so that they are not deprived of their original characteristics, but serve as evidence of history while fulfilling their new functions. Barrack complexes form a separate genre in architectural typology, which is why it is important to find a specific recipe for their regeneration.

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Lisbon and Brasilia: Cities and cultural facilities in the face of globalization

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ABSTRACT: Contemporary societies have multiple forms of inter-relation between space and culture which are re-signified in the context of the recent and rapid changes occurring in the technological, economic and social spheres. This context sheds light onto the following question: how do museums and cultural facilities, in their material and symbolic dimensions, unfold dynamics and vicissitudes of such process in local e global levels? This is the core question that guides a research project, conducted by a group of Brazilian and Portuguese researchers, based on a comprehensive approach, embedded on interdisciplinary knowledge yielded by Architecture and Urban Planning and by Social Science. This article presents the first results of a field research conducted in cultural centers located in Lisbon (Portugal) and Brasilia (Brazil). In both cities, the cultural facilities that were chosen as the scope of the research, where a variety of significant cultural events are staged, sometimes are similar and sometimes are different as they highlight social, economic and technological changes through the cultural objects they shelter and exhibit, as well as their own architecture.

1 INTRODUCTION

Museums and cultural facilities have always been stages for significant cultural events of any society, as they exhibit social, economic, technological changes, both by means of the cultural objects they shelter and display, and through their own physical constitution, in their architecture. In contemporary times, these facilities are even more outstanding and an evidence of the relevance taken by culture and the architectural field in post-modernity. Thus, the purpose of this article is to present in detail contemporary forms of inter-relations between space and culture based on an analysis of museums and cultural facilities in their material and symbolic dimensions.

For such, we chose as empirical objects two cultural facilities located in two different cities: the Tile Museum in Lisbon, the historical capital city of Portugal and the Live Museum of Candanga[i] Memory, in Brasilia, the modernist city, capital of Brazil. The scope of both museums are the expressions of grassroots cultures and constructive techniques and they include in their collections significant iconographic records of the histories of these two cities. The methodology of the research was to substantiate the study by connecting two fields: space and culture, through an interdisciplinary approach, based on the knowledge produced by Architecture and Urban Planning and by Social Sciences.

2 CULTURAL FACILITIES IN THE FACE OF GLOBALIZATION

Despite the emergence of the great media-based museums in the last decades of the 20th century, their consolidation as the type of museology that best represents contemporary times (due to its bond to the capitalized circulation of information via technological means) did not prevent, obviously, the permanence and continued adoption of a variety of museums, appearing in other historical moments. And some of them becoming even more necessary today, precisely because they provide several needs observed in the great contemporary museums. Apparently, many of

[i] Candango is the term informally utilized to name the workers who migrated to the region where Brasilia, the capital, would be built, in order to participate in the construction efforts.

the new institutions, inspired in former models, are reinterpretations that were adapted to their new scene of usage, such as the great contemporary museums, which also assume the specificities of past times, with a different semantics according to the new objectives they are aimed at.

And, it is precisely within this wide range of cultural facilities, implemented in the context of the financial capital and therefore shaped according to the needs of such a system to circulate, that we intend to deal here with the sphere of their creation and way of working in the present. These places, providers of knowledge, due to their powerful and historical relations settled between the spacialties they were conceived to meet and the cultural objects they display, consist in our view of excellent objects for study both of the past, the present and even of the future possibilities, in the sight of such relations between space and culture that are preserved, displayed and crystalized in them, in addition to so many promotions, recreations and omissions.

In fact, as many have already noted (Choay, 2001, Ghirardo, 2002, Huyssen, 1994, 2000, Montaner, 2003, Motta, 2000, Ribeiro, 2004), during the neoliberal economic boom taking place after the turn of the 1980's, several features of that moment were favorable to the dissemination of great spatial facilities in the form of museums, such as the hegemonic reorganization of the capital and its proximity with the cultural industry, the technological innovations and their utilization in the architectonic field, the information apparatus of visual nature and its connection with registry and memory, multiculturalism and a number of demands for cultural representativeness, the gradual valuation of educative activities and experiences of self-representation, the implementation or improvement of public policies to foster culture, the growth of leisure and international tourism, the instability of the financial market and the stability of the art market. In addition, of course, to the programmatic expansion of the museums themselves or exhibit facilities taken as places of encounter as well as places to acquire knowledge of the potentialities of contemporary architecture.

However, it is still too early to assess the durability of the success of such contemporary museological dissemination. This uncertainty arises from the fact that there appeared a number of criticisms to the economic formula to which mainly the mega museums were added to, increasingly more sumptuous and costly, due to the attempt by many local governments to reactivate economy by means of disputable public-private partnerships and questionable cultural approaches. Facts such as the fret and loss of attractiveness arising from this huge spectacular presence, which had already become a common practice expected in the new mega projects, began to spawn cases of new and increasingly premature re-openings, new alterations or even franchises in an effort of keeping the great public that had been initially attracted. Moreover, the cyclical economic crises, as that of 2008, affected and threatened not only the viability of several projects of already famous museums, even before implementation, but also the great museums, recently built or being expanded by means of traditional donations which, since then, had their funds diminished, with cases where millionaire expenses were reduced, additional funds were suspended, debts were accrued and some museums happened to be shut down. But, even before such crisis had erupted, critiques and celebrities from the milieu in which such institutions were now competitors, had already exposed the weakness of such utilization of the museums as tools of economic recovery (Arantes, 2000).

In fact, this scenario calls into question how comprehensive and how intense is the process of dissemination that the term "culture" has been going through in the last few decades, supported on economic and technological basis with potential high profitability and reproducibility (Guattari, 2000). This dynamics has enabled different cultural expressions to take on a core and strategic adding up to its power as a provider of citizenship, generation of economic development and the strengthening of a contemporary imagery associated with technology à, as one of the most important means of social representation at this moment, on the verge of transforming its representative spaces into icons of the world architecture. It is precisely due to this reality that, in our view, it seems justifiable and necessary to renew the attention to the different factors – conceptual, formal, and functional – that interact in such objects of study.

In light of this, we also understand that it is more coherent in our investigation to adopt as object of study an architectonic program rather than a building – starting with the external and public areas that are additional to the buildings up to the display rooms, with all of its diversity. Obviously we take them as referents to the topic we are dealing with, to the party adopted or also the spatial arrangement – due to the comparative possibilities that this genre may provide our research with, pushed into the global phenomenon of media dissemination and apparent cultural valuation under a hegemonic economic system.

3 THE CITIES OF LISBON AND BRASILIA IN THE MUSEUM

In order to analyze this scene that becomes consolidated in several cities around the world, the objects chosen in the cities of Lisbon and Brasilia are facilities which are, not incidentally, representative of grass-root cultures, making up the grounds for research, considering cultural multiplicity as an assumption for a broader understanding of Brazil's sociocultural complexity.

The objects chosen were observed in the sight of the history of the creation of such places, their urban implementation, the origin and preservation of their collections; these aspects were reviewed in a both material and symbolic perspective.

This choice also included a number of possibilities in terms of the symbolic potential represented by the two capitals, Brasilia and Lisbon, both in the wake of the competition for a good standing in the hierarchy of the global cities. Naturally, cultural facilities in other cities, in Brazil and abroad, might be addressed here as potential aids of comparative nature in sight of similarities and differences.

In Brasilia, Brazil's federal capital, among dozens of museums located in the planned area of its "pilot plan", a number of them focus on themes associated with the spheres of power regulation in the country and in the city. Looking at the museums located within this plan it is possible to see differences that are fruitful to investigate in relation to their architecture, scale, management and audience. Considering just the monumental axis and its surroundings there are almost 20 museums in Brasilia, most of them are modern projects of monumental nature or operating within a public building. From this set, a case study was selected due to the importance given to a specific component of the history and the culture of the federal capital, that is, the various social segments that served as physical labor force that supported and allowed the dream of the capital to become true, represented in the Live Museum of Candanga Memory, located at the fringe of the city's pilot plan.[ii]

Devised to be the first hospital of the nation's future capital conceived by the then President Juscelino Kubitschek, Brasilia, next to the lodgings for employees, this architectonic project was built in wood in only two months' time and opened in 1957. As a great deal of the adjoining area had been settled by other residents, resulting in the so called Cidade Livre (free city), today the Bandeirante Core, the initial intent of "undoing" such buildings after the inauguration of the modernist city was an idea that was abandoned as the hospital went on in operation and its support facilities remained in use until 1974, when they were finally shut down because the new District Hospital was being built, today the Base Hospital. As it became one of the few remaining architectural representations of the time when the new Brazilian capital was built, the cultural heritage protection securing this complex within the woods where it is located and its change into a museum, the Live Museum of Candanga Memory, which expresses constructive techniques utilized early in the local settlement and by the physical labor of anonymous builders who immigrated to the site under such circumstances (the so called candangos), shelters today settings of the grass-root facilities at the time, reproductions of projects proposed to the capital, exhibits of first photographic images of the capital, a library and, also, artistic workshops are conducted in it. The distinction of this physical place in the city in regard of so many modernist works that are now symbolic landmarks of the capital and of the country and its explicit increasing valuation, especially the new assimilation of the grass-root culture and its representations around the world in the last decades, not only as the result of cultural recognition itself but also as the appropriation of the most distinct representations as new sources of economic capitalization.

In Lisbon, the Portuguese capital, the case study was defined with the main purpose of providing comparative analysis. Out of so many traditional and recent cultural complexes of great impact on to the urban landscape of the city, the choice was the National Tile Museum, managed by the General Administration of the Cultural Assets, located in the premises of the former Monastery of the Mother of God, an architectural construction dating back to the 1500s. Such museum, dedicated to glazed tiles (azulejos), is a highlight as an "artistic expression that draws a distinction of the Portuguese culture in the world" (http://www.museudoazulejo.pt). Over and above the expositive activities, the museum has also the mission of fostering the knowledge of ceramics intended for coating and covering and its production as well as to support the preservation of the existing heritage.

The Museum is located in Xabregas, in the Eastern part of Lisbon, a former area with convents and villas, which turned into an industrial zone with dockings and working-class dwellings along the last century. Now it is facing a period of decline and marginalization associated with the process of de-industrialization and changes in the Port of Lisbon.

The National Tile Museum one of the most representative cultural facilities in Portugal due to its subject, the glazed tile – ceramics for covering and coating use – which became an icon of the covering/coating technique in construction which consolidated itself as a specific expression of the Portuguese grass-root culture in the field of construction, especially after the Portuguese culture merged with the Moorish and Mozarabic cultures.

Since the old monastery was built and founded in 1509 by queen D. Leonor, there was a constant transportation and storage of the most diverse pieces of glazed tile on the site in order to supplement the inner decoration of the building. Indirectly, this yielded a significant collection of such constructive technique. After the monastery was shut down, successive actions were taken within the premises in order to preserve such collection.

In 1980, the collection was integrated into the National Museum of Ancient Art and went through works of conservation and restoration funded by the Calouste Gulbenkian Foundation, thus achieving its emancipation as the National Tile Museum. This great collection, together with several pieces by anonymous makers and its exhibition facilities and also the increasing support activities provided by the institution, embodies a complex which – in a nation known for the valuation of traditions – emphasizes the importance of the grass-root culture both as an element of identity representativeness of this social segment and as a support to consolidate the images of works typical

[ii] Informações complementares, http://www.museuvirtualbrasil.com.br/museu_brasilia/modules/news3/article.php?storyid=73

of socio-cultural groups of stronger economic power. After all, as in the case of the old monastery in question, the popular technique of covering walls with glazed tiles was then also adopted in many buildings where the monarchy, the clergy and the bourgeoisie lived. More recently, such facility began to serve as an auxiliary mechanism in the process of economic revival sought by a variety of cities around the world by linking the cultural, entertainment and touristic domains.

4 CONCLUSION

The context outlined above ignites the following question: How do museums and cultural facilities, in their material and symbolic dimensions, reveal dynamics and vicissitudes of these processes on the local and global level? Among a variety of possible lines of study of museums (from the Greek mouseion: temple of muses), as are generally called the several places where material cultural is displayed, we will highlight their potential as a semeiophoros object, that is, something whose value may be measured either by its material condition or by its symbolic potential as a holder of meanings.

From a material viewpoint, new museums have taken an outstanding presence as actual spectacular mega projects, seen as the movie stars of the architecture world, icons of the present; also, architectonic facilities built in early times, became steady cultural references of their historical moments (Lourenço, 1990). In this context, the most increasing studies of such facilities and their functioning highlight the rise of phenomenon called "museum mania", originating from a sphere of more political-economic than cultural nature (Motta, 2000). This thread has been a source for questioning by a variety of critical sectors, from the cultural and urban fields, who claim it is necessary to argue both the legitimacy of the discourses imposed onto the cities, as well stressed by David Harvey (1996), and the relevance of the cultural representations they display, by lenses that disfigure their essence, as in the cases of exhibits that subtly manipulate their original meanings (Crimp, 2005). The reason why several criticisms emerged lies in the fact that a great deal of the success of these mega projects comes not exactly from the cultural objects they shelter but rather from the ostentation around the creation of a distinguished spatiality, or from the aesthetic aspects in reconfiguring places made representative of an era (Stevens, 2003), such as railway stations, dock and port buildings or industrial complexes that were shut down in the face of new demands guiding the changes in urban configuration (Ghirardo, 2002).

Regarding the second issue of this analysis, the symbolic potential of museums and cultural centers, we highlight the approach by Pierre Bourdieu (2005), for whom culture consists of a field where symbolic battles are fought and by which the inequality between the social classes is maintained. Museums, due to their cultural status, tend to convey feelings of belonging to some people and of exclusion to others, because of the repertoires represented and the languages exposed (Mariani, 1999). Such consideration has been valid for various phases taking place in these facilities along history, since the guardian museums keeping the loot acquired in the imperialist and colonizing expansions in the 17th century, the showcase museums that legitimate the aristocratic and dominant ideology of the States under construction in the 19th century, to the times of the mega museums of the 21st century, devised by municipalities and sponsored by financial corporations (Montaner, 1990).

Considering the dimensions of space that can be analyzed, this article was an attempt to intertwine these sociocultural levels that are perceived in such facilities. As already stated as the purpose of this work, it is essential to get to know the relationship between space and culture arising from the lived experience in such cultural facilities, since the brand of the contemporary societies is the convergence of language between the economic and the cultural spheres by employing especially technology and its visual information multimedia apparatus (Canclini, 2005).

Confronting these empirical objects, analyzed in a comparative fashion and made explicit herein, allows us to understand the dynamics and vicissitudes depicted by some cultural practices in the spaces where they express themselves.

In spite of the great distance in space and time, both museums we have analyzed are similar in terms of their material and symbolic dimensions. Powerful representatives of the culture experienced by the exiting lower class in their specific societies, in the scope of this subject, such museums resemble in many issues commonly found in the field of grass-root cultures. After all, neither of them was built as a cultural facility to display and preserve such representativeness; they were rather turned into cultural facilities as a result of the value they were assigned afterwards. It should be noted that the location of both facilities are a highlight in their own city, seen as museums of grass-root culture; Xabregas, in Lisbon, became very much industrialized during the 20th century and today there is a steep drop in density in terms of population and function; the Bandeirante. Core was informally populated in the fringes of Brasilia's pilot plan. They exist outside the elite's urban circuits, and this tells a lot from a material and symbolic perspective, that is, popular art and culture, for ages segregated and today (re)valued. It is not casual, therefore, that not only in these cases, they are located literally at the margins of the city and society.

These remarks may obviously serve as guidance for further and better considerations about such cultural facilities as well as about the cities that shelter them and the societies that maintain and utilize them.

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Toward a sustainable city-territory in a diffused context: The potential of internal limits

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ABSTRACT: In a context of territories almost entirely artificialized by Man, seeking to distinguish urban from nature might seem not relevant anymore. The urban condition tends to become globalized and decentralized everywhere. Among those context, the diffuse city is made of fragments of heterogeneous urban materials densely inhabited on an 'infrastructured' layer of transport and well equipped with various city's functions. Knowing this, the city's edge condition, which once was facing the countryside frankly, continuously and often peripherally, has also become globalized, decentralized. City's edge is everywhere and nowhere at the same time. And yet, the city and the countryside remain operative concepts in the collective imaginaries. What happened to the urban and natural features in the contemporary city and what are their transformations today? Through the theme of internal limits, this paper will investigate the contemporary relationships between elements of the territory, mainly between the open ones and the built ones towards project strategies for sustainable and ideal urban future.

1 INTRODUCTION

1.1 *An artificialized environment*

The urban question, in the limelight during the recent decades, is today at a crossroad. A United Nations report in 2014 speaks of more than 50% of the world population who lives now in the city. In the twenty-first century, environmental conditions of human being have become mostly urban and spread everywhere on the globe. The context of the contemporary city is new. It occurs through mechanisms and speeds that we barely start to know.

The recent Anthropocene paradigm pushes humans to face their responsibilities regarding the environmental and social conditions of the ecosystem. The paradigm of the Anthropocene (Crutzen and Stoermer, 2000), demonstrates the significant impact of human activity, now able to influence the "Earth system" in the same way than earlier geological forces (Bonneuil and Fressoz, 2013). Indeed, environmental transformations change our relationship to "nature". The soils and open spaces of our territory could hence be considered as a spatial and natural capital. As this Anthropocene paradigm also question the relation between city and countryside inherited from the classical, industrial and modern city, it leads to reconsider design strategies and tools in urbanism.

The 2014 biennale of Rotterdam edition, 'Urban by Nature' did point out this new urban condition as humankind new "natural environment". Nature, among other human artefacts no longer claims to have a pristine character. The nowadays global urban fact acts as a new environment, a second nature, a frame for the development and the relationship between humans (Gugger and Macaes e Costa, 2015). This hybrid condition does not necessarily raise the issue of city countryside as an antagonism anymore but rather as a relationship between elements. This planetary or decentralised urban condition (Brenner, 2014) is the topic of intense urban studies since at least the beginning of the second half of the twentieth century.

Starting from a reading of existing researches on diffuse city in Belgium, this paper will go through the following steps showing how a critical acceptance of the staggered urbanisation can lead to new ways of designing the territory. The hypothesis is to look at limits as materials that can be described and designed to characterise the diffuse city and its territories. Through a short exploration of the dispersed area in the south of Belgian urban sprawl, we will then identify the hints for structuring the transformations of the territory in its relation to open spaces. The ambition is to understand the mechanisms at work and put them into perspective for a more sustainable construction of the territory today.

2 DISPERSION: A DESCRIPTIVE URBANISM

2.1 *Territories of dispersion*

Among those widespread urban conditions, some are characterized by an intense urban sprawl. I will name territories of dispersion those urban situations that have undergone an important descriptive work in urban planning. The European territories of dispersion began with the creation of dwellings, of production areas and of their communication networks, most often in the fertile lower plains. The various studies around

those constitute now a body of researches that has built a common but specific and contextual knowledge of a globalized phenomenon. From this corpus, some readings and resulting models have been used for the exploration of the study area because of their methodology's relevancy, their geographical localisation or for their historical significance.

In Italy, Veneto region's descriptions are exemplary of this descriptive work of the late twentieth century. Since the definition of the so-called c*ittà diffusa* by Francesco Indovina in 1990, in an economical study realized by the department DAEST of the University of Venice IUAV, several other researches have contributed to this understanding effort of the transformations of this horizontal sprawl. In this respect, the work of Munarin & Tosi and Secchi & Viganò, of the University of Venice (IUAV) happened to be pioneers in Europe. "The città diffusa has therefore been constituted from the original centralities of towns and villages: in the outskirts of the village, along the main road, a few modern houses are implanted, a craft warehouse or a middle size commercial area" (Indovina, 1990). The interest of Indovina's research lies in a frame shift which isn't centred on main cities but intends to describe the sprawl without references to any centre or hierarchy.

Such work has been realised about other territories as well. Thomas Sieverts studied the *Zwischenstadt* in Germany, Bauer and Roux the *rurbanisation* in France and before them, Gottman worked on the *megalopolis* on the east coast of the United-States. Beyond usual chaotic characterisation of those places, they proceed with a close reading trying to explain the rationalities and processes at work in these territories. They have led to various precise theoretical and practical studies about sprawl, aiming to define its forms and logics and proposing different definitions such as suburban, *peri-urbain, banlieue*, *megalopolis*, desakota, etc. They have enriched each other with shared concepts. This paper will refer more specifically to the tradition and literature of the diffuse city.

2.2 *Studies in Belgium*

In Belgium, dispersion occurs yet during the Middle Ages but more widely during the industrial period. The developments of railways and tramways' infrastructures coupled with policies on commuting displacement and on individual housing in social laws have been sustaining the building up of a dispersed territory (Seebohm Rowntree, 1910).

Later, during the post-war period, an Arcadian image of individual housing was forged in the collective imaginary. Supported by a law facilitating access to property, each family aspired to build its own detached house on its property. This welfare state context is well described in the text *la banlieue radieuse* (Smets, 1986).

In "Patching up the Belgian landscape", Bruno Demeulder (1999) describes Belgium as "[…] a land of laissez-faire, where the cacophonic juxtaposition of designs delivers surprise after surprise, where an intense poetry lurks side by side with a nauseating banality behind the common place of everyday habitation". Juxtaposition illustrates the neighbouring of projects, side-by-side but unconnected and without relations. Indeed, land privatization and the strong tendency to willing to be owner, are building a disparate landscape, based on suburban individual housing.

On her side, Bénédicte Grosjean, in "Urbanization Without Urbanism" (2010) explains the fine process of construction of the diffusion in so-called "nor urban nor rural" areas. For her, dispersion is based on transportation networks and on worker's cheap-housing access policy.

In "Brussels 2040", a prospective study on the future of the Brussels metropolis published in 2012, the "linear of contact" is developed by Studio as a measuring index, in linear meter, of the contact between built and open areas per inhabitant (Studio Secchi Viganò, 2012). The value of this index is then compared to the one of other metropolis showing its special feature through the relation of this metropolis with its open space. According to this comparison, Brusselian would actually be more in contact with the open space than Parisian.

In addition, the mismatch between the physical limits and administrative boundaries in Brussels Capital District makes its case paradigmatic. The landscape ecology, which underlies the territories, oversteps management's tools and policy of the capital region (Roland, 2013).

This non exhaustive body of descriptive studies demonstrated, each with its assumptions, the importance since the nineteenth century of processes that led to a dispersion of urbanisation, namely through transport system, social laws or a complex administrative and federal apparatus detached from the ground rationalities. It is through these inventive representations and acute descriptions of the city that a knowledge has been built up, being the base for theoretical research and practical transformations.

3 A POST DIFFUSED CITY POSTURE

3.1 *Critical acceptance: from diffuse city toward horizontal metropolis*

The position of urban planning, and even of some urban policy, through the studies quoted here above has evolved towards what one could call a post diffused city posture. Dispersion is not simply stigmatised anymore and a return to the compact city is no longer the only antidote to this so-called pandemic disease. On the contrary, this condition is accepted as an existing data to work with. Almost like an amnesty (Dehaene, 2012), we find traces of this acceptance in papers, conferences or seminars essentially emphasizing the quality of the living environment but questioning the sustainability of this form of urbanisation.

Acceptance allows one to deal and design with this current and existing condition, trying to modify it, to iterate it, rather than to seek its concentric counterpoint

or ideal antithesis. However, this acceptance does not imply the validation of the system as such. In this regard, two prospective ideas try to draw the guidelines, starting from the existing towards an urban ideal: the Horizontal Metropolis and the "ecological re-edition" of dispersed metropolis.

3.2 *Horizontal metropolis and ecological re-edition*

The origin of the horizontal metropolis concept can be found in the prospective vision "Brussels 2040", which one of three parallel studies was made by Studio Secchi Viganò in 2012 (the two other teams where KCAP and 51N4E): "what we call horizontal metropolis is both an image and a concept: it is about a reality where rural and urban, communication, transport and economical systems, are closely linked and interpenetrated". The horizontal metropolis is a theoretical construction analysing the territory as a superposition of layers enabling to imagine the diffuse city's transformation on the basis of its existing rationalities as "spatial and natural capital". It suggests a horizontal organisation of the society as a project for the diffuse city

On the other hand, the critical reading of a potential ecological and economical project for the horizontal metropolis proposed by Michiel Dehaene in the book "Gardening in the Urban Fields" (2012) offers additional finesse that one needs to keep in mind when dealing with what is already there and its future transformations. "This reflection on the horizontal city is not a plea for sprawl or uncontrolled development, but rather for the continued development of the existing patterns of urbanization; not suddenly choosing another model, but rather continuing to garden carefully in the existing urban field". He names these potential transformations an "ecological re-edition", emphasizing the work to be done starting from the previous edition, like an author would add a preface or rephrase paragraphs in a book.

4 FRAGMENT, HETEROGENEITY AND INTERNAL LIMITS: KEYS OF READING

In order to accept to rethink this city-territory, let's try to understand its specific constitutive elements. The image of internal limits refers to open, productive or recreational spaces, inside of the metropolis. Moreover, it insists in a second sense, on the inner morphological resource for potential transformation that lies within the territory itself.

4.1 *The form of the territory*

Unlike compact cities, identifying these territories' form is not easy. Their shapes, however, are not generic, and their descriptions gives access to a form of knowledge and of understanding (Viganò, 2012). The territories of dispersion are characterized by a configuration that disseminates the various urban functions and materials, supported by topographic, hydrographic, geological rationalities and whose flows, dynamics and movements are organized through large communications networks, including roads and railways.

Within this scattered portrait, fragments are still recognizable. Contemporary city's increasing development is often driven by individual, capitalist or private logic. The growth of 'pieces of cities' has been made with little or no regard to issues of public spaces and relations to the context. Those fragments and heterogeneous urban materials with large linear developments increase their mutual contacts but they also generate in-between spaces and leftovers. Paradoxically, the resulting relations between elements are impoverished, materialized by fences, barriers or lack of public spaces. Nevertheless, the fragmentation of the contemporary space generates a specific urban structure presenting unusual situations carrying a lot of potentialities.

4.2 *The internal limits: open spaces inside the metropolis*

A particular attention will be given to the "open" elements with the intuition that this "non-urban" plays a fundamental roll in the characterization of this type of city. According to Gilles Novarina, "the contemporary city is like the black spots of a leopard skin. It surrounds, inside it's mesh, cultivated farmland, woods and wasteland. The nature and the countryside, until then situated outside of the compact city, become integral parts of the *città diffusa*." The incorporation of this urban nature within the diffuse city makes it particular regarding limits' concerns since dispersion "abolishes the boundaries between town and country" (Novarina, 2003). The research assumes that this special condition from the point of view of fragmentation, of the proliferation of limitations and intimate interweaving between built and open space, is an ideal observation field to investigate urban and nature relations nowadays. Within this framework, the research to investigate a study area in its particular relation to the urban nature's limits into a prospective purpose.

4.3 *A study area between Brussels and Charleroi*

A study case will be chosen to support our arguments. This is a part of the Belgian diffuses city located between Brussels and Charleroi, deliberately leaving these urban centralities out of frame to focus on the description of the area in-between.

Dispersion of urbanisation within Belgian territory appears as a large oval shape around Brussels metropolis, extending from the Euregio Lille Kortrijk Tournai to the west to the province of Limburg to the east, and from northern Antwerp city to southern Walloon Brabant province and the necklace of post-industrial cities situated in the coal mining valley on the bottom of the illustration.

This drawing shows pattern of urbanisation represented as long filaments joining denser points and creating together a mesh, a continuous network of artificialized spaces. It is not uniform and one can

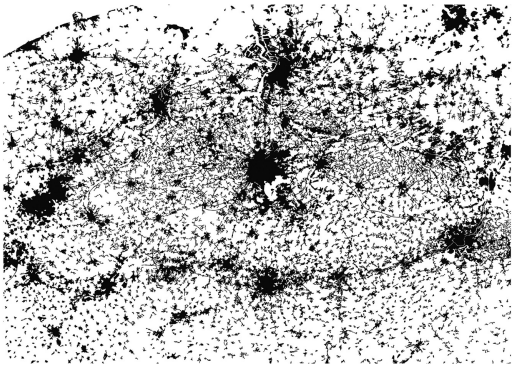


Figure 1. Diffuse city in Belgium, frame 200 × 100 km (Source: drawing elaborated by the author based on corine land cover 2006).

distinguish in figure 1 the differences between northern and southern parts. Notably, in Flanders (north), building plots are saturated and new conditions of dwelling are being defined in order to preserve open space. In Wallonia (south), open space is still a resource but its management could be enhanced.

Showing on a higher resolution the Walloon region land uses (COSW, *carte d'occupation du sol en Wallonie*), the figure 2 delayers its main features: built areas, forest and green spaces, cultivated land and agricultural land. Analysing this part of territory, south of Brussels, one can observe an important plots, parcels and land use fragmentation and an interweaved mix of built spaces and open spaces. Networks are willingly left aside to focus on the opposition between built and open environments. Those should be further investigated both as connectors and barriers, acting on a larger scale.

The agricultural and forest areas which are and which are not in direct contact with a built parcel, are pointed out above one another in figure 3. This starts to reveal a figure for a project. The spatial capital and the intimate relation between those elements can be the carrier of a territorial project, facing question of sustainability or public spaces.

Crossing this cartographic overview with a fieldwork on site, on can figure out that current urban mechanisms are supporting a way of conceiving limits that share responsibility in the constitution of a low quality interface between different allocation areas. These specific findings are making clear the need to reconsider more widely some urban design tools and to question the limits on this specific territory.

These succinct delayering of the territory allows to list several assertions about morphological situation and some hints for structuring the transformations of territory in its relation to open spaces.

– Few parcels of open spaces (agricultural or green spaces) don't have contact with built neighbourhood.
– Reciprocally, many built plots have contact, view or access to open spaces.

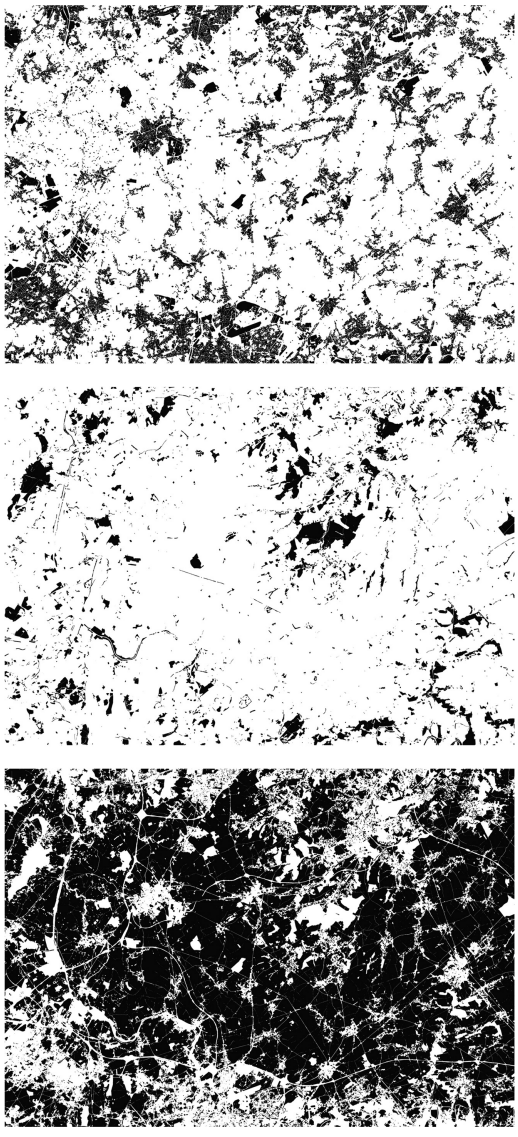


Figure 2. Delayering of territorial elements: built, green and agriculture. Frame 40×20 km. Area between Brussels and Charleroi (Source: drawing elaborated by the author based on cosw).

– These plots are equally distributed throughout the territory and not really grouped into one place, but rather spread all over, like the leopard skin or like pointillism. Only bigger patches of cultivated land can be found in the centre, due to the higher plateau in between the Senne valley (Brussels) and the Samber valley (Charleroi)
– It also presents a continuity valuable as an ecological and sustainable quality. Such as corridor, continuity allows species to flow and moves through, brings air to temperate some places through green areas and foster soft mobility and recreative path.

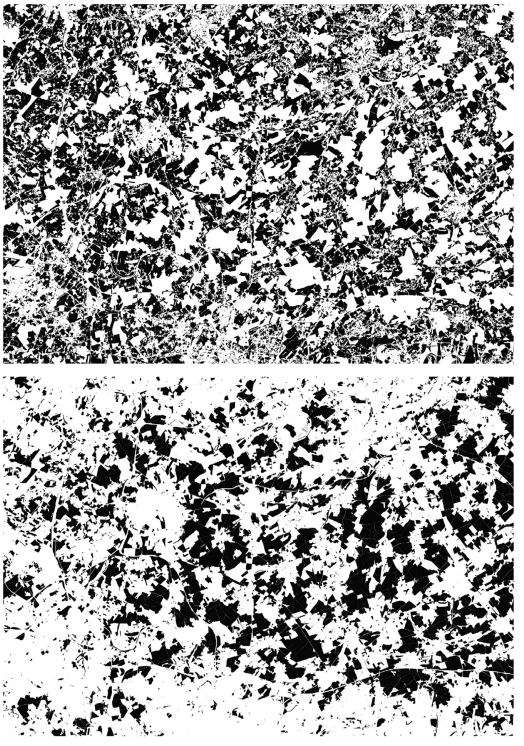


Figure 3. The internal limits. Frame 40×20 km (Source: drawing elaborated by the author based on cosw).

5 LIMIT AS A PROJECT: PROSPECTIVES AND TRANSFORMATIONS

This short analysis seeks to show that urban-rural relationship, in its contemporary reconfiguration, both asks and brings hints for a conceptual shift into design concepts, strategies and tools in order to transform the existing situation into a wished urban environment.

5.1 *A conceptual tool*

More than a physical reality, limit is also a widely used concept that has been developed in urban planning in issues such as city's form, growth, densification, spatial justice or environmental quality. Beyond the fact that limits act as spatial, sociological and anthropological "devices" of separation and ownership (parcels, defensive walls, etc.), the concept of limit is present in the social organisation of territories and of course in the urbanistic field, explicitly or not, within conceptual tools, regulations or policies. However, instead of being the monopoly of urban planning limits as a concept, its constitution benefits of a large amount of contributions from other disciplines and some theoretical fields have greatly enriched the meaning of this concept: the fragment, the edge, the *lisière* (Vanbutsele, 2015); or even concepts such as inversion (Cogato Lanza, 2005), porosity, or isotropy, convened in various urban projects are clearly underpinned by the theme of the limit.



Figure 4. Relation between open and built elements of the territory (Source: pictures of the author).

A contrario, spatial barriers and social injustices only increase in today's societies. Some gaps seem stronger than ever, building a city cleaved between poor and rich people, not without that the planners have

had some responsibility in it (Secchi, 2013). These trends are building very contrasting cities producing simplistic shaped intervention whatsoever offering few urban quality.

Social and spatial relations organised on a territory are represents through physical marks on its ground and in its soil. André Corboz speaks of the territory as a product, a project and a form (2001). Indeed, the actors of the ecology at work on a territory are producing, drawing and designing its form everyday through the transformation of our living realm. The territory is hence a support, both built artefact and intellectual project. It is in this sense that we propose to rethink the question of limits no more as a barrier, an edge or a line, but more like a frontier, an area of exchanges, a deep and porous space.

5.2 *Transformation on the edge of the metropolis*

In urban planning today several iconic or ordinary projects as well as urban processes and dynamics are at work in the transformation of our cities. The question or urban nature is being reconceptualised through those projects dealing with edge issues. But, they are mostly taking places within the periphery, in the margins of big cities or in the outskirts of metropolis, and seldom in the "internal limites" of the territories.

Among landscape or urban projects, concepts such as Michel Desvignes' *thick edge*, Bernard Reichen's *limit as a concept* for the SCOT of Montpellier (Masboungi, 2005), Studio Secchi Viganò's *antipark*, or the Metropolitan Landscape studied by Bas Smets leave some room for thinking. Some large urban visions and consultations, recently commissioned like Le Grand Paris, BXL2040, The Great Moscow, or the CUB in Bordeaux also defined the edges of extensions area of these big metropolis (figure 5).

Each of these examples make use of scenarios, visions or projects to imagine the wished urban future of these metropolis, based on a specific relation to void, open spaces or to the city-territory. Proposals are often quite innovative and conceptually powerful, allowing to drastically rethink an urban way of living more in adequacy with natural rationalities. Nonetheless, it must be noted that such examples only take place in high-density area or mid-size metropolis. Less dense contexts show a lack of policy, project or thinking. Some first hint should then be proposed for the diffuse city.

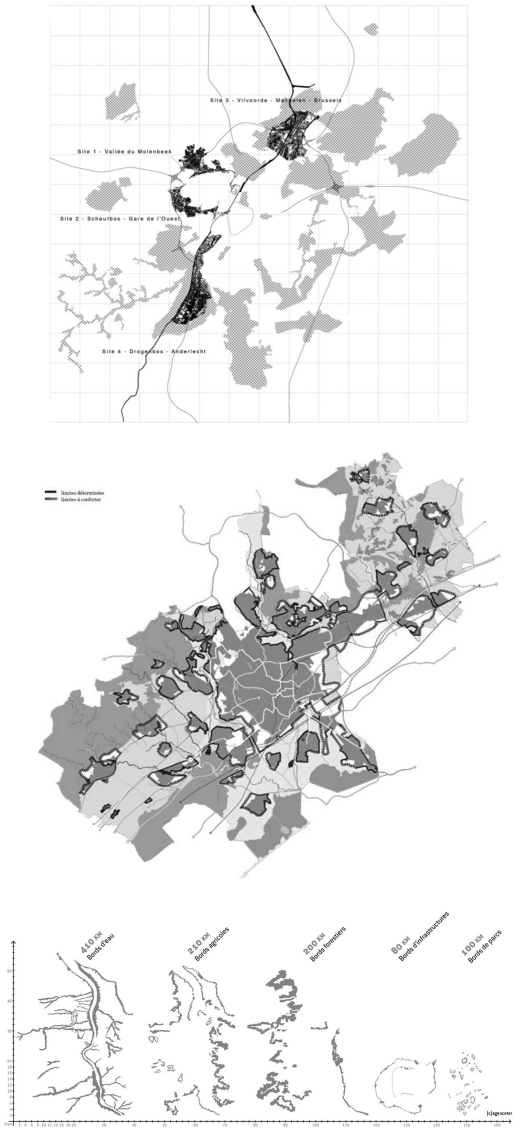


Figure 5. Limit as a project, examples of project dealing with metropolis' edges (Metropolitan Landscapes Brussels, SCOT Montpellier, CUB Bordeaux).

5.3 *Transformation in the diffuse city*

One of the challenges of this research lies in the conceptual construction of the object "limit" as a dynamic element and working agent, able to undergo the changes and to welcome synergies, rather than being the secondary result of two elements. Especially in a context of scattered urbanization where it seems that no vision or project is at work for its development.

As stated above, by borrowing some models in other disciplines as landscape, environmentalism or agrological and biological sciences, the concept of limit has been transformed and can still evolve. If we consider for example the concepts of *lisière* or ecotone, the notion of edge becomes a thicker line, able to manage flows, exchanges and dynamic processes, a thick boundary. The first reading of the area between Brussels and Charleroi has shown how numerous are the situations of confrontations of different land use. We see in this morphology a potential for projects. We can even extend this re-reading to the territorial scale and to the relation between different urban elements, joining the proposition of "ecological re-edition" of Michiel Dehaene: the existing horizontal territory is taken itself as a resource for its own "ecological re-edition."

Besides, I sought to show the intuition that most of those territories are built today out of the theoretical discourses presented above. And if one recognizes that individualisation of today' society is a key feature of the diffuse city, one must consider that the limits are not only considered between heterogeneous fragments but also between homogeneous elements, from one to another, between a house and the next one, an individual to another. The interface between territory's materials is an issue whose importance is increasing generating the need of a territorial reflection on the management of open space as a common resource. And looking at the actual construction and evolution of the diffused territory, we think that there is an urge for it to be socially, economically and environmentally more sustainable.

6 CONCLUSION

As a conclusion, let's see how this argumentation can help to identify the hints for structuring transformations with the ambition to tend towards a more common and sustainable construction of the territory for tomorrow.

First, the emergence of an important descriptive work on situations of diffused urbanization has been presented and how this work has sought to describe urban-rural relations. In addition, the descriptive look to the study area, helps us to understand what has become of the atavistic relation between city and countryside.

Second, I developed the posture of a post diffused city, showing the models of the horizontal metropolis and of the ecological re-edition of the territory, as possible ways to work with the existing rationalities and morphology for design the city and territory.

Third, the figure of the fragment in the contemporary city has been underlined and the multiplication of edges, barriers and gates issues as they build a fragmented territory. Nevertheless, the particular configuration of the Belgian dispersed territory, in its fragmentation and individualisation, generates a double potential: a spatial and natural capital and a possible conceptual shift about diffused issues.

Then, I enlighten the existing way to rethink limit as a project through the benchmarking of edge projects for the metropolis. Those models or methods should then be confronted to situations of sprawl in order to point the ideal future of that kind of urbanity. In a further step, the research could be continued in the form of research by design project by reflecting on scenarios and specific cases. The ecological and collective re-issue of the territory can summarize this general thinking.

Finally, among the specificities of the contemporary city, I believe that places of limits are a space of differences and potentials, especially in the post diffused territories, aware of their rich and hybrid condition, no longer trying to solve a city-country opposition. The "internal limits" summarise this point, using the term internal to describe both the open spaces geographically situated within the metropolis and the fact that the resource for this potential transformation lies within the territory itself. This perspective tends to design a more sustainable metropolis offering horizontal relations between elements and individuals and pursuing a stronger ideal for a *vivre ensemble*.

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Imbricate ecologies: Rethinking the city-nature relational challenge

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ABSTRACT: The overlapping of the urban and the rural under planetary urbanization presents a welcome challenge to the relationship under which the city and nature are thought: As this overlapping upsets the simple liberal relationships of integration and opposition that were possible through the historical distance between city and nature, their overlapping presents morphological and ecological imbrications –natural, human, and urban- that bring back to the fore urban-nature relations of particular relevance to urban sociology and urban ecology. This research adopts a socio-ecological approach to rethink early modern urban definitions that yielded desolate ecologies and versions of Darwinism to isolated or metaphorical studies of human and natural ecologies. It relinks the urban definition and production to the spatial dynamics inherent from the geo-ecological relationships between overlapping urban-natural dimensions. Canonical models for thinking city-nature relationships are excavated for urban-natural, socio-spatial imbrications under planetary urbanization.

1 INTRODUCTION

Among the images that planetary urbanization produces, two images stand out in their significance to the study of the nature of this urbanization: The first image is central to urban growth and is exemplified by urban movements to reclaim urban parks and natural areas within cities such as the Gezi Park protests in Istanbul during the 2013 summer, and the civil movements that reclaimed Beirut's historical pine forest as a public space. The second image is spatially peripheral to urban growth. Instances of this image are found in china's expanding urban centers: The growth of conurbations in china and the transformation of neighboring villages into fast growing cities – like Shenzhen and Guangzhou – with urban villages of their own brings Geddes' concept of the regional city to ironic dimensions where natural regions disappear, as it literally takes today a whole region to make a city.

While the first image emphasizes and confirms the importance of natural areas within cities for sustaining healthy urban living, the second – that of the gradual disappearance of the country side – shows offset outlook of nature from an urban vantage. Their central and peripheral locations within urban growth illustrate protracted tensions in the sustainability of the relationship that binds nature with urbanization. The fact that these anecdotal images flank the ecological relationship between cities and nature illustrates the persistence of such a problematic relationship radially across urbanization processes, where remedying solutions are mostly sought on urban levels while urban-natural confrontations peripherally persist.

While urban sociologists first signaled modern civilization by the growth of great cities (Wirth 1930), the advent of this contemporary growth as described above is depicted in images that are not categorically dissimilar from Sumner's description of primitive societies as human groups scattered over a vast territory. The major transformation in this latter image towards planetary urbanization is a scaling up of human groups into cities and towns that coalesce rather than scatter to cover vaster territories, and the subsequent disappearance of nature under this urbanization cover. The natural spatial tenet of modern civilization being the settlement of nomadic people (Wirth 1930) under such a covering is today unfounded. Also, the simple distinction between city and nature is no longer possible as the city is no longer this rough jewel on the breast of nature as Geddes described it a century ago (Geddes 1915). Rural-urban overlaps under planetary urbanization complicate the relational patterns between urban and natural environments beyond the morphological and the social transformations that permeated the disappearance of the rural as the modern cities first outgrew their peri-urban extensions. These overlaps call for an analysis of some of the urban models that thought growth processes to date, and the ecological relations that had bound nature and city. While acknowledging canonical models such as the urban concentric expansion as a natural growth process (Burgess 1925), or other socially centered urban dynamics like Harvey's movement of dispossession by international capitalism (Harvey 2008), this analysis seeks to question the following:

– First, The ecological approach to the growth of modern cities as inherited through modern urban sociological theories especially as these were influenced by post-Darwinian evolutionary theories. It is questioned here whether the human ecological approaches to theorizing urban growth have

emphasized the human metaphorical aspect of the evolution of species over more complete ecological readings of city growth.
– Second, the human outlook, or the transformation of such an outlook to the relation that historically bound cities to nature as characteristically distinct, until cities as social and built environments culminated to second natures (Lefebvre 1976). Consequently, this puts into question whether or not social revolutions must be urban, or ecological.

The paper will approach these two questions from various urban, sociological and ecological approaches with the aim of spotting tendencies for severing the spatial relationship between cities and nature, especially as influenced by growth. Latent permutations of dematerialized demarcations between city and nature will be mapped under their respective ecologies towards an assessment of the nature of the ecology of growth. Ecologic morphologies that thought city and nature – like Geddes' Valley Section (Fig. 1) and Leon Krier's rural-urban Transect (Fig. 2) will be revisited as ecological imbrication models under the changing nature of urban growth.

2 MODERN CITIES AND HUMAN ECOLOGY

2.1 *Ecology, economy and socio-urban theory*

Ecology had dominated socio-urban thinking in early sociological writings on cities since the establishment of the Chicago School. As it will be further shown, the impact of the partial ecological approach by the human ecologists isolated to a large extent the human centered ecological study of cities from their natural environments. This was, however, due to the integration of ecological thinking within socio-urban research through the economic dimension. The economic accent of social thought in early modern writings on cities was impacted by an emerging pecuniary and statistical analysis of cities and citizen. It streamed urban ecology more towards a human than a geographically centered ecological thinking.

Georges Simmel's influential analysis of the metropolis and the psychology of the cosmopolitan heavily draws on the transformation of society under a capitalist economy. His description of such an urban character under the influence of economic exchange defines the psychology of the individual as an ambiguous accommodation in continuous adjustments to external socio-economic forces. His adaptation of the Durkheim's social *anomie* is based on the comparative analysis of rural life versus the metropolitan way of life, which displayed for Simmel an environment of threatening currents and discrepancies (Simmel 1903). Simmel describes an ecological transformation in the relationship to environment from rural to metropolitan habitats: Under feudal ages, the freedom of men was simultaneously bound up with the law of the land and the corresponding feudal social orbit. The unfree man was the one with mere feudal associations. This relationship with environment together with its social implications is rendered for Simmel superfluous under the metropolitan way of life that offers richer social contacts and associations by virtue of the narrow spatial proximities. In Simmel's description of this relationship between personal freedom and the spatial environment he correlates the enlargement of social circles and the personal freedom together in transcending the visible expanse of the city, which expands on conceptual and economic bases to dominate its hinterland. As such, in its expansive domination of its natural extensions, as well as in the socio-economic forces it exerts on citizen, the city's self centeredness ignores nature under the economic premise of early urban modernity.

Simmel's conception of the city was a sober correspondence between the calculative exactness of the modern economy and a scientific sociological preference to transform the world into an arithmetic problem that could be solved. His approach to the city as transcended by the urbanite and as itself transcending its limits is commensurable with later developments in ecological readings of the city that took a strictly human ecological turn.

2.2 *The city, numbers and human ecology*

Numbers constituted the sociological gate to a human ecological approach to urban environments during the twenties. They formed the basis for socio-urban studies of cities with various urban and ecological implications. For Ernest W. Burgess, the analysis of urban elements that are subject to numerical measurement was key in identifying urban growth. The introduction of the concentric zone model of the city, and succession as a metabolic growth process drew organic metaphors from plant ecology to pass city growth and a latent social disorganization as natural processes within the city. Growth and succession together ultimately defined mobility as the natural pulse of urban life. However, mobility remained for Burgess a tool to measure land values and describe city growth, as a wayfinding tool for citizens to organize their life patterns in the city, and find their congenial social worlds (Burgess 1925). Despite his awareness of the appearance of vast urban aggregates – conurbations – in Europe, America and China as "a new feature in the distribution of man over the earth" (Burgess 1925), his ecological outlook was directed more towards metropolitan areas than towards this new distributive feature and its wider ecological impact.

Another numerically inherent reading of the city was Louis Wirth's definition of an urban theory based on population size, density and heterogeneity. Wirth saw in the human concentrations in gigantic urban aggregations a "distinctive feature of man's mode of living in the modern age" (Wirth 1930). His seminal essay Urbanism as a Way of Life acknowledges continuous variations between rural and urban ways of life, yet subordinates an "ecological order" within his urban theory to the physical structure of cities that mainly comprised for him of a dense population,

typical patterns of social relations, and typical forms of collective behaviors. Greatly influenced by Simmel, Durkheim's social theory and Darwinism, Wirth built his urban theory on the effect of numbers and densities in the production of differentiation and specialization within socio-urban structures. Population numbers and density as objective indices permeate Wirth's ecological perspective of urbanism. He accounts to their effect the organizational and the functional facilities of cities, which in their turn account for the dominance of the city over its hinterland (Wirth 1930). For Wirth, The increasing population of great American cities with their social contrasts and biological characteristics defined the thinking of cities and their growth. This human ecology dominated Wirth's urban theory at the Chicago School of urban sociology.

In his Theories of Urbanism, Claude S. Fischer contrasts this determinist ecological approach with a compositional – or nonecological – theory that attributes differences between urban and rural ways of life to the composition of different populations. He distinguishes between determinist and compositional theories in their disagreement on the relationship of urbanism to the viability of the personal milieus that form the experiences and behaviors of individuals (Fischer 1976). Fischer's differentiation of these two urban theories points out a major discrepancy in the conception of the relationship between social life and environment. While determinist theory develops an urban approach based on the city as milieu for social organization, the nonecological or compositional theory describes social organization as social worlds protective of ethnic mosaic and of vulnerable individuals.

Herbert Ganz, a major proponent of the compositional theory argued that Wirth's urban theory is based on demographic factors – numbers, density and heterogeneity – rather than ecological factors. He proposed an urban definition based on social characteristics like class and life cycle, rendering the Wirthian relationship between settlement type and the way of life spurious. For Ganz, "the sociologist cannot, therefore, speak of an urban or suburban way of life" (Ganz 1968). He suggests that concepts like urban or suburban are not especially relevant for the understanding of the ways of life, but are rather – together with number, density and heterogeneity – "ecological concepts which describe human adaptation to the environment" (Ganz 1968).

2.3 *The dematerialization of the relation to geographic environment*

The disappearance of such a distinction between society and its habitat under geo-sociological predicates is then strongly linked to the growing economical basis of urban living. It reaches its peak in John Friedman's World City Hypothesis. There, the city and its growth are connected to global economic forces more than to local dynamics or regional extents. There, we find the second level of the removal of an urban ecology from its relationship to nature. The industrial city still maintained its dependence and growth along harbors and river basins as Saskia Sassen explains in The Urban Impact of Economic Globalization. While the industrial city still maintained the mirror of its economic growth in the city itself including its industrial and banking service cores, global cities today are primarily characterized by international financial flows (Sassen 2000). These flows, for Sassen, have overshadowed both in terms of values and power the industrial as well as the commercial sites of global urban environments and relocated these relational values from the parts of the city to global financial markets. She argues that the transformation of the economy of cities from a material to a financial and service based economy transforms the geography of global economy and strengthen the role of cities (Sassen 2000).

Sassen describes a narrowing down of the geography of the global economy due to the concentration nature of a growing direct foreign investment. She shares together with John Friedman a common perspective of this new geography along an East-West axis. As the trading of raw materials ceded between African and Latin American countries on one hand, and on the other hand, northern countries in Europe and the United States in favor of financial flows with centers in Asia, North America and Western Europe; the latter formed an east-west urban growth axis following global economic growth patterns, despite peripheral hierarchies with centers of secondary growth.

For Friedman, such a world city formation brings along spatial and class polarization on different scales relevant to the position of a nation within the hierarchy of the world city formation, but equally on the metropolitan level. Friedman attributes the various forms of spatial polarization – the ghettos, suburban squatters, ethnic enclaves – to class polarization, which is commensurable with huge income gaps, large-scale immigration from rural areas or from abroad, and to the evolution of jobs.

The transformation of the economic basis of societies under global economies, therefore, augments socio-spatial metropolitan problems and produces similar spatial types to the urban environment of early modern cities. The ghetto, urban sprawl and Urban Villages persist throughout various economic bases of cities – industrial, commercial and financial – as economy unsettles the relationship between a society and its habitat.

2.4 *What is natural about human ecology?*

The naturalization of such problematic areas of the city was theorized since the foundation of urban sociology. In "The Natural Areas of the City" Harvey Zorbaugh advocates a human ecology as an urban anatomy that composes the city of different unplanned natural areas as a response to their growth (Zorbaugh 1926). Such an organization is brought about by the competition of communities who are segregated as the city overgrows natural areas into natural groups. Zorbaugh invites those who would like to control the city's growth to

take into account the ecological facts that are inherent from this natural ecology: competition for position, segregation over natural areas, and succession. His discussion of the Chicago zoning ordinance's attempt to control land value reveals the importance of considering natural organizations and natural groupings as they intersect with injected blocks or use districts. He suggests a futility of an attempt to control the growth of the city and its inevitable succession, but rather sees a potential success in an urban economy that recognizes the natural organization of the city, population grouping, and a natural process of city growth (Zorbaugh 1926).

Similarly in his essay titled "Human Ecology" for the American Journal of Sociology, Robert Park attributes the natural functional areas of the city to the factors of dominance and competition. He breaks, however, from social Darwinism in his acknowledgement of the cultural level that distinguishes the human society from a plant and animal society. The human ecological basis of the city accounts for Park neither to a purely economic nor to a purely geographic ecology, but to "symbiotic society based on competition and a cultural society based on communication and consensus" (Park 1936). Park leaves room for a biotic competition in urban environments – mediated by other men, technology, and by institutional structures – and another cultural superstructure – a sublimated symbiotic society – that limits competition and the freedom of the individual by customary culture. Such sublimation enhances the weakening of a geo-ecological approach to studying urban environments and rather elevates an already diluted human ecological approach to the city into a cultural super structural level. While the inherent dualism within such a human ecology – competition and consensus – removes the toll of its association with social Darwinism, it nevertheless justifies urban inequalities and natural areas as natural processes subject to competition and succession, and further removes the regulation of these processes from the natural environment and endorses it in cultural institutions which themselves become the common habitat. Despite their difference, the determinist and the compositional theories advocate a human adaptation to urban environment. They equally alleviate the accent put on competition and what it justifies under social Darwinism – exclusion, colonialism – and relocate it either in the city or in the citizen. The human ecologists looked to humanize the city by naturalizing it.

3 CONTIGUOUS NATURES

3.1 *City-nature integration and opposition*

In the socio-urban tradition as analyzed above, the struggle to humanize the industrial cities of the early twentieth century dominated the work of urban sociologists, and dissociated the city from its environment. Robert Park notes an isolation model upon which nature rested until its destruction by commerce (Park 1936). Economy as we have seen had justified theories that thought the ecological struggle that dominated modern urban sociology and made necessary the rethinking of the biotic basis of the new modern world. These theories lacked more contiguous approaches of nature and city and isolated cities from nature.

This isolation did not, however, prevail all early modern urban thought. At the horizon of Patrick Geddes' thinking of the evolution of cities, for example, stands healthy living as the completeness of environmental, functional and social relations. With great clarity Geddes posited the urban ecological challenge as a coexistence challenge: "Cities in evolution and people in evolution must thus progress together" (Geddes 1915).

Yet, this parallel evolution is not ready-at-hand within the relationships that historically bound city and nature. Relations of distinction and sometimes opposition of city and nature often maintained their respective ecologies theoretically distinct. The shortcomings of a partial thinking of city and nature were, however, mainly addressed in urban ecology, where these distinct natures – city and nature – came to contiguous relations.

Anne Whiston Spirn maps the historical roots of ecological urbanism to the contributions of landscape architects and urban theorists. These took various approaches to the place of nature within cities, and the other way around. Landscape infrastructure, including urban parks were largely adopted by Frederick Law Olmsted to promote healthy urban environments through assistive processes to natural infrastructure (Spirn 2011). This has developed to the distinct discipline of landscape urbanism, which seeks to design geographic territories of augmented socio-political, economic and environmental outreaches. The Golden Horn Cultural Valley Project in Istanbul is an example of such an infrastructural culture-led approach to cities and their natural environments. It illustrates how the restoration of an estuarial ecosystem improves urban livelihood and economic growth. The premise of such landscape urbanism projects augments urban-natural contiguity hand in hand with economic growth.

Ebenezer Howard's Garden City model is another relevant model that brought nature and the city together. The debate over the Garden City model as Spirn explains is of a sustainable nature: To build new cities in nature or to re-naturalize existing cities. Lewis Mumford, like Patrick Geddes, emphasized the natural, historical and cultural relevance of cities within their regional context. McHarg revolutionized the evolutionary approach to ecology. His perspective of nature as process and of place as a morphological evolution resulted in an evolutionary approach to ecological urban design.

Under ecological urbanism, cities become part of the natural world. They are habitat, but are also ecosystems that make adaptive participation in larger, enduring ecosystems (Spirn 2011).

3.2 *The axis and the patch: The geometry and the politics of the relation between habitat and outgrown nature.*

Ecological contiguity has as co-requisite prolonged ecological imbrications like the ones found in Leon Krier's European Transect model (Fig. 1). This model and its application into the rural-urban Transect by Andrés Duany and Elizabeth Plater-Zyberk emphasize fractal overlaps between natural and built environments along various community development zones, with a strong sense of investment towards urban centers to minimize urban sprawl. In contrast, the suggested east-west linear growth axis under the World City Hypothesis evasively end-runs prolonged imbrications and urban densification. It promises no less dangerous ecological consequences than other forms of complete urbanization. The advents of the latter would inevitably be towards the limits of complete urbanization the reduction of nature and its complete replacement by the urban second nature: The future world of the generalized socially produced urban (Lefebvre 1976).

Whether cities are thought of as equally natural, or nature as a concept rather than a thing or a place (Spirn 2011), cities under complete urbanization would have to live under adverse ecological conditions; like in Mike Davis' apocalyptic ecological prospects of sprawling, decadent Los Angeles (Davis 1999), or drawn under the crushing weight of the produced urban space. The image of the activist pleading for the preservation of the urban park dreads and subscribes to both hypotheses. There belong all efforts to render cities sustainable. The patch as the trace of growth and nature reduction remains very significant for such ecological resistance.

Research spanning two decades in Stockholm demonstrates the significance of the patch to urban green infrastructure in remedying the effects of urban growth on the widening distance between urban consumers and the ecosystems supporting them.

In providing a space for human interaction with nature, patches generate ecosystem services that help connect cities to the biosphere (Andersson et al. 2004). The patch also is commensurable with urban practices that develop landscape within cities along heritage walks and urban parks, like the Freedom Trail in Boston. The Garden City apotheosized this natural integration too. Yet, the garden city is also prone to disappear, like the rural becomes peri-urban and urban, as is the case in Beirut's peri-urban transformation. What remains of this level is the patch: With grim prospects, under-pollinated, and together with the remnants of rural houses to which they belonged, they command a respectful grin as they persist under the smear of urban dioxide. The patch is inspiring and cities should not let it go.

Or, should the east-west growth axis theory go unhindered, then a biospherical split is imminent: North and south of the east-west growth belt. The Sci-Fi prospects of such a split are open, including apocalyptic natural disasters and environmental wars.

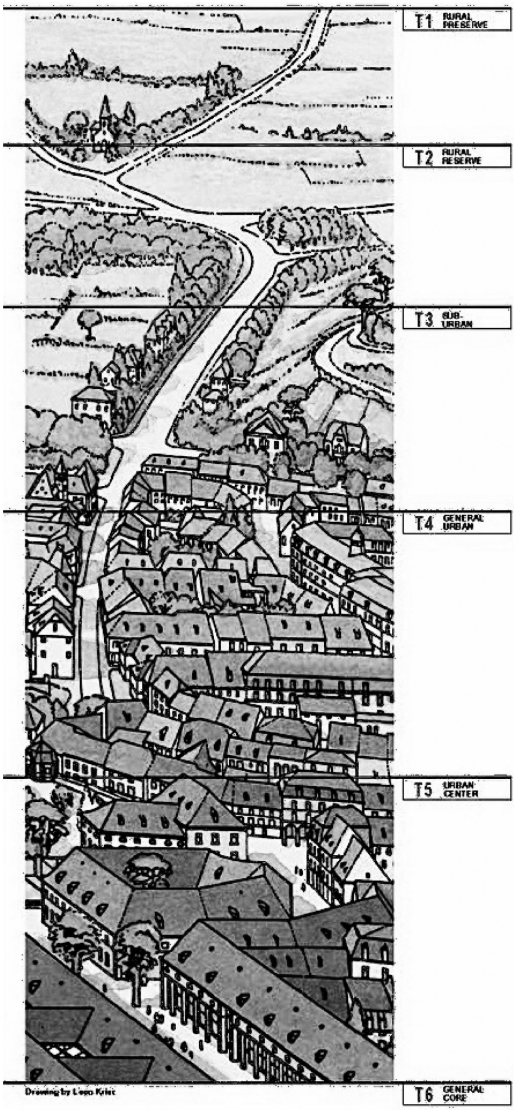


Figure 1. European Transect (Krier, 1978).

Together with this, an other socio-cultural split might well occur, whereby nature lovers would inhabit the peripheries of the belt, and in the core-belt strands of agglomerated conurbations would be financial enterprises, economic agglomerations, urbanites. And probably somewhere in between, the slums of working immigrants might one day coalesce and finally revolt. This is the triumph of the concentric zone model, of the radial growth model perfecting its realization: The up scaling of the ideal republic with its indifferent separation from the nature that surrounded it becoming one global second nature. Like Fifth Avenue draws a line between Central Park and New York, so would a line be drawn between a world city and nature, should the approach to scattering new urban centers across countries like china become a common practice

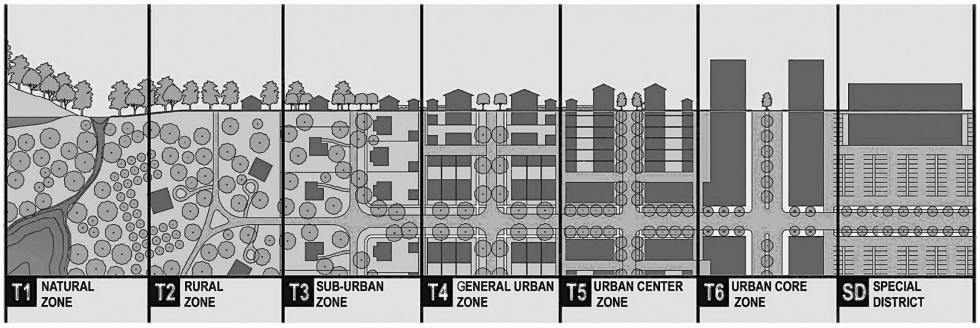


Figure 2. Rural-Urban Transect (Duany Plater-Zyberk & Company, 2008).

under pretexts of regional development and comparable urban rural growths that aim towards economic equity rather than ecological equity.

4 IMBRICATE ECOLOGIES

4.1 *Naturalization models*

Growth processes considerably sever the maintenance of nature, including the small natural patches in the city. Densification, for example, problematizes the possibility of maintaining a small-scale imbrication that weaves together city and nature. The economically driven nature of growth is in conflict with the economy of small natural patches. Densification maximizes built up areas to save rural lands. However, with densification, the green patches in the city disappear. Ecologically sustainable chances are considerably higher when socio-cultural awareness is raised as to the importance of urban natural imbrications across all scales of nature. The protests for reclaiming urban parks in cities like Beirut and Istanbul become useful tools against the disappearance of small-scale natural patches due to the transformation towards more urban ways of life. They are occasioned by infrastructural transformations, which isolate areas of the city, including natural areas and urban parks from their historical natural extensions.

This question preoccupied Geddes in his analysis of the evolution of cities. In his description of growing regional constellations he emphasizes the importance of regional surveying to determine the nature of growth. He pointed out two natural scales in face of this growth: The remaining natural reserves that may separate the growing towns and villages into conurbations, and any remaining possible gardens. (Geddes 1915). This vision differs from Duany's transect planning model insofar as the latter suggests a presupposed natural continuum intersected with transitory, yet fixed zoning categories and static growth. As these sparse along the transect section, they pertain from outside in to the hamlet and the village going in towards the city with its urban core. Yet there is no assurance as to immobilize the growth of this core and the destruction of the fractal model across which nature penetrates the section of Duany's transect (Fig. 2).

This growth phenomenon is a notorious reason for the severing of ecological wellbeing of cities across the world. Barcelona, Istanbul, Paris and Beirut among others are examples of cities that outgrew their centers to connect with nearby towns and villages, eating up significant natural lands. Rural emigration further contributes to the longevity of this ideal model. Therefore, the transect scenario suggests a static imbrication of natural and urban areas, but not an imbrication of the natural, human and urban ecologies which are at play within such morphological imbrication. Also, suggestions to scatter new urban centers as means to even urban-rural developments in China and elsewhere in the world present challenges to the thinking of such a sought after imbrication of the ecologies. One of these pressing challenges is the possibility that these new towns may occasion the same conditions that necessitated their creation in the first place: uneven development of rural and urban areas, and the accompanying urban malaise and neglect of rural ways of life; the creation of the slums and emigrant enclaves. Together with financial economical systems and foreign investment, this inevitably leads to increased land values and building booms, which leads back to city growth. Saskia Sassen argues that the globalization of economic activity and the generalized trends towards urban dispersal do not preclude the creation of territorial nodes, which are still needed for the accommodation of the management and the infrastructure of financial systems (Sassen 2007).

The other challenge that new towns present is a diminishing regional relevance of cities. This regional relevance, in addition to history created for Geddes masks through which cities reveal their spirit at each period of their evolution (Geddes 1915). The mask, however, is also lost in the creation of new cities as cities lose their unique place within their regional constellations. As the relationship of work and place lose their significance, the valley section (Fig.3) in which Geddes draws the regional relevance of cities from the primacy of occupation to natural contexts also loses significance.

Nevertheless, the chances that new urban insertions as substitutes for the growth of global cities is a prospect worth investigating, especially if it could enhance the imbrication of their latent ecologies

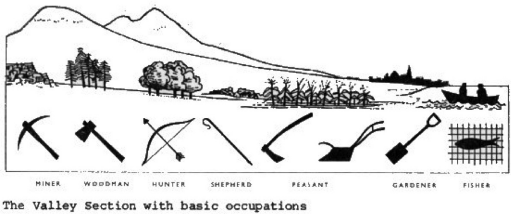


Figure 3. The Valley Section (Geddes 1909).

through the creation of new growth poles. These may enhance the control of growth through the introduction of linearity through polarization.

Like the complete separation between nature and city, which results in the replacement of a natural ecology by a human, similarly, the seamless overlap of natural and urban areas is likely to reproduce growth models. Yet, the possibility that scattered growth may enhance the imbrication of ecologies renders linear growth or other models worth studying. Models of relationships between urban and natural ecological environments that valorize the integrative objectives of the transect model and the patchy relevance of the city within nature, and at the same time nature within the city on the smaller scale of integration should be sought. While geometric propositions are possible, the interest of this paper is rather to signal the relevance of studying relations that bind geometric relational patterns between city and nature and, on the other hand, ecological separations or imbrications as byproducts of such geometric relations under dynamic ecological conditions.

4.2 *Nature, city and revolution*

A central problem faces such a thinking of imbricate ecologies. This problem under the theory of complete urbanization is the ungraspable boundaries of urban environment. As cities grow, their boundaries disappear, and cities become their own environments. Henri Lefebvre marks the complete urbanization of the world as a moment in the history of the transformation of the notion of place. The ultimate transformation at the horizon of urbanization is into a critical urban phenomenon that subordinates the agrarian to the urban, under the complete urbanization of the world (Lefebvre 1970). This ultimate transformation informs an urban centered revolution for Lefebvre. He describes the urban as a virtual world that assumes the concentration of everything, including nature, within temporal, and socio-spatial differences internalized within it, and detached from nature. Urban revolution as an axis stretching from pure nature to complete urbanization presents for Lefebvre the theoretical need for an analysis of urban society, towards the formulation of an urban practice as a concrete need. It should be no news then, that the importance of urban thought today is more pressing than ever. Harvey agrees with Lefebvre that revolutions today must be urban. However, the internalization of the concept of environment within the urban, and consequently, the urban nature of revolution are not in conflict with the environmental relevance of revolutions. Henri Thoreau's civil and nature contributions exhibit a balanced concern of civilization and nature that inspired both environmentalists, as well as key political figures like Leo Tolstoy and Gandhi. His concept of nonviolent resistance rests on the exclusion of the self from the need of governmental power, which originated in Thoreau's nature retreats. As such, civil revolutions have environmental underpinnings.

The fifth assessment report of the Intergovernmental Panel on Climate Change identified evidence that extended territorial emissions from developed countries – which include all GHG emissions within a city's territory – are substantially high (Seto et al. 2014). The report forecasts significant emission raises in China by 2040 due to population growth and urban expansion. The report proposes spatial planning as a tool for climate change mitigation. This includes macro strategies like regional planning, urban containment, and complete communities, in addition to other mitigation scales including urban planning and design strategies, like urban regeneration, infill development, and traditional neighborhood design, among others. Two things become clear: First, that urban planning and design are today more necessary than ever. Second, that environmental and urban revolutions are not dissimilar at their horizon. Protests to reclaim the natural patches of the city are symptomatic of urban and environmental longevity. Yet, the other image that concerns the urbanization of urban periphery requires a more silent urban revolution at the level of urbanism.

5 CONCLUSION

This research studied the theoretical axis that spans central relations between nature and cities under planetary urbanization. It was shown how the economy-centered approach of urban sociology naturalized the modern city under Human Ecology. The dematerialization of the relation between the city as a human economic habitat and its geographic environment dominated socio-urban thought throughout post-human urban ecologies concurrent with urban phenomena like the world city hypothesis. The various urban ecological approaches to locate cities as habitats back within a larger enduring ecosystem were largely conceptualized through radial sectional strategies, permeated by the idea of growth and natural re-integration. It was argued that such strategic models suggest static natural-urban morphologies that are easily destroyed by densification, rather than dynamic ecological overlaps. Landscape infrastructure and other small-scale infrastructural models like the patch were suggested as ecological models resistant to urban growth. While these should be of interest to architecture and urbanism, their mode of resistance to planetary urbanization inspire revolutionary overlaps that are urban and equally environmental.

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Urban biophilic environments-a novel lexicon for trans-disciplinary practice

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ABSTRACT: The interdisciplinary research group, URBN STEAMLAB, integrates evidence based design with fundamental research processes in science, engineering and technology to create novel strategies and solutions for sustainable urban living and architectural interior spaces. Here, trans-disciplinary research is conducted to lead to new built outcomes and urban living spaces that are sustainable and include natural systems. This paper details a novel project driven by such concerns. *Algal Biophilic Interior Environments* is an in-home architecturally integrated hydroponics system that addresses the issues of healthy food availability in the urban environment and is the product of novel working methods. The design includes sustainable, effective, and testable interior systems that are suitable for growing algae cultures and plants on a small scale in the urban row home interior. These small-scale consumer-sized interior growing units will act as interactive infrastructural units in an urban row home.

1 INTRODUCTION

1.1 *Interactive space*

Design research is shifting the language of the built environment. Trans-disciplinary research is conducted to lead to new built outcomes and a growth of urban environments that are sustainable and include natural spaces. This paper details the fluctuation of design lexicons to produce architectural solutions for the urban environment that are sustainable and research driven, and includes a novel project driven by such concerns. The research lab, URBN STEAMLAB, integrates evidence based design with fundamental research processes in science, engineering and technology to create novel strategies and solutions for built sustainable urban living and architectural solutions within that environment. The research team combines the use of traditional STEM-based (Science, Technology, Engineering and Mathematics) innovation and research methods with STEAM-based (Science, Technology, Engineering, Arts and Mathematics) design methodologies to provide opportunities for problem solving and discovery for both scientists and designers in service to a new type of interactive interior, one that serves and augments users health.

Usman Haque, in his essay "Architecture, Interaction, Systems", codifies all interactive architectural experiences as one of three types: "reactive", "single loop" or "multiple loop". Each experience is defined by user interface with the environment and the growing complexity of these transactions. He claims that the more complex the interaction, the more satisfying the space to the users. This complexity and interaction between inhabitants and the systems of the building creates a kind of intimacy and control for the users that can be quite satisfying. (Haque, 2006) This assertion taken a step further can encompass projects such as those discussed in this paper. There is a necessity to have interaction in our architectural and interior environments: one that is created through the ever complex and varying needs of users and environments. Haque draws on Gordon Pask's work and the thesis that "*We can consider … architectural systems in which the occupant takes prime role in configuring the space s/he inhabits, a bottom-up approach which would result in a more productive relationship to our spaces and to each other."* (Haque, 2006).

We can look to the environmental theory of user affordances developed by Gibson and detailed by both Lang and Kopec. In addition, the idea that behavior settings which allow users to control their environments can allow these users to have a positive or negative reaction to spaces (Kopec, 2012). Haque is proposing more than control, however- he is proposing a relationship with space that is dynamic and complex (Haque, 2006). This theory of space making is one that the *Algal Biophilic Interior Environments* project detailed here falls firmly within. The team believes that this view of space-making draws us ever closer to a complexity that our current climate necessitates in all design. As such, the design of interior environments as multidisciplinary problem solving becomes paramount to creating space in the 21st century.

This thesis has led to the examination of new typologies for urban living. Thus, the design of sustainable materials, products and strategies for long term, environmentally friendly city living is crucial for the overall health of the planet and its human population.

2 COLLABORATIVE METHODS

2.1 *S.T.E.M. + design*

Current research shows that exposure to natural systems can improve human health. (Frumkin, 2001) The URBN STEAMLAB working processes and the *Algal Biophilic Interior Environments* project discussed here respond to this challenge through prototyping a process for innovation in sustainable urban living with a practice/research and collaborative process that examines bench science outcomes and tests prototypes in physical environments. This practice is part of the shifting lexicon of design practice towards human centered and "hard" research based approaches.

At the current time, traditional STEM fields are struggling to retain a competitive edge in the United States. Acknowledging this, the federal government has made STEM education a national priority for the coming years, recognizing that the US needs to produce one million more STEM professionals than are predicted to graduate over the next decade. Addressing the recruitment of students into STEM fields, a 2014 conversation with trainees in STEM fields at the Northeast Scientific Training (NEST) Programs Retreat proposed some solutions to this situation: 1) include a social justice component in the students' training, 2) train the students in communicating STEM to non-scientists, 3) train the students in STEM to STEAM (Science, Technology, Engineering, Arts and Mathematics) technologies, and 4) provide access to invested mentors. URBN STEAMLAB uses innovative methodologies and processes to incorporate these solutions into its activities. By introducing design into the traditional STEM disciplines, this program orients researchers to the possibilities of engaging with STEAM disciplines as a way of creating innovation. It also addresses a social justice component by exploring one of the major problem solving challenges of our age – the growing need for sustainable urban living solutions in today's cities. In 2000, the Environmental Protection Agency (EPA) concluded in the report "Our Built and Natural Environments" that urban ecosystems directly affect natural habitats and ecosystems, endangered species and water quality via habitat fragmentation, consumption of land and the replacement of natural ground cover with synthetic, impenetrable surfaces. Thus, the design of sustainable materials, products and strategies for long term, environmentally friendly city living is crucial for the overall health of the planet and the human population. In general, the silos of discipline have created a lack of exposure for designers to traditional STEM research and for STEM researchers to design opportunities. Both groups lack opportunities that might be relevant to the future technologies deployed in the marketplace. In addition, the design of spaces must now be more research driven than ever. In their book "Design Informed" Chong, Grant and Martin assert that design professionals are not exposed to research methods as part of their training or practice. This creates limitations for them in today's complex practice environment. (Chong et al., 2010).

2.2 *Informed design*

"Few design professionals are trained as researchers or even sensitized to critically evaluate research quality. Our academic settings and professional practice rarely place value on rigorous methodologies for creating and interpreting the information used to inform design. Even the basic steps of scientific method—define the problem, create a hypothesis, test, and document—are seldom followed by designers. Hopefully, the profession will make clear to our educational system that we demand some level of research knowledge as part of basic design education, because it will be as important to our professional success as design and technical capability. In the interim, we can share experience to establish a baseline of professional credibility in Evidence Based Design." (Chong et al., 2010).

The novel process of work described here creates a cycle in which STEM team members are gaining exposure to creativity, design and iterative practice, while the STEAM team members gain exposure to evidence based thinking and research practices that are valuable and unique. All team members work through human centered research practices which include building empathy for users and closely examining their needs and outcomes – this is necessary for operating in an innovative environment. In this way the conception of how participants interact with the environment and how the environment can create opportunities and resources for them builds on Haque's original, more subtle conception of space and interaction for experiential richness.

2.3 *Team and processes*

URBN STEAMLAB is made up of Scientists, Engineers, Architects and Designers. The current project is a collaboration between a bench scientist, an architect and design professor, a masters student in Interior Architecture and an engineering student, with input from other students, researchers in engineering and public health. The novel work process creates opportunities for students, faculty and researchers to work in an interdisciplinary manner on projects using a set of engagements that involve bench science, laboratory based processes, human centered empathy building and iterative studio based development. Team members start through learning skills in both design thinking and laboratory experimentation. The Science based team member maintains a bench science laboratory into which URBN STEAMLAB student participants are trained to follow protocols and culture micro organisms. At the same time, the team is given a set of iterative design thinking exercises to grapple with. These start as simple brainstorming techniques and end with systematic matrices that create ongoing diagrams of possible ideas and directions. In addition, deep dive techniques including interview, shadowing,

and personas are explored. The outcome is that the team learns to combine both iterative design thinking and laboratory experimentation. For the science based participants this creates new modes of creativity; for the design based participants this allows them to explore evidence, research and design as engines for these new types of spaces.

Following both practices in their thinking, the science work is lead by the exploration of micro-algal cultures and the ways that it can survive with multiple environmental factors in play. Team members are then are asked to deep dive into the human problems in the urban environment, especially those in neighborhoods that are underserved in terms of health, food and nutrition. As the solutions grow in complexity team members "flow" together with roles being assumed by lead researchers that have conceived of positive directions. In addition, the process exposes undergraduate students to the cultural and social aspects of the relationship between research, design and problem-solving.

By doing so, this project brings the STEM to STEAM practice of design, innovation and research into strategies for sustainable urban living. Those participating in this course as novice recruits will be exposed to this STEM to STEAM way of practicing, which will enrich and broaden their learning experience. Mishra et al. weave a vision of multidisciplinary learning that leads to creativity and enhanced problem-solving, sustained by opportunities for interactions between disciplines that support creative thinking through both technology and human interaction (Mishra et al., 2013). This research group is both process and outcomes driven and the chart below illustrates the working methods deployed by the group.

Novel Processes in URBN STEAMLAB	
Activity	**Objectives + Outcomes**
Theme: Paths and Trajectories. Build project goals and team	Develop faculty/student/mentor relationships
Theme: Gathering and Identifying. Research users and precedents. Engage in initial design thinking exercises.	Develop research/ innovation skills. Targeted research/ design proposal.
Theme: Users and Stakeholders Focus on human users. Deep dive techniques for empathy are deployed. Hands-on research/design	Develop research/ innovation skills through human centered design. Identify strategies for engaging with user groups.
Theme: Synthesis and reframing. Discussion and implementation of creative thinking and problem solving strategies	Develop familiarity with research/ innovation/ design tools.
Theme: Brainstorm initial solutions and ideas. Ideation: matrices development.	Develop ideas for prototyping/ research.
Theme: Development. Initial discussion of prototyping modes and skills, development of idea matrix	Develop individual research/design skills. Prototypes
Theme: Prototype Examination and Ideation. Prototyping and visualization exercises.	Develop initial physical prototypes/ collect data. Create and deploy group prototypes.
Theme: User Testing and Synthesis. Prototype revision.	Initial and revised prototypes/ models both physical and envisioned. Test prototypes in the field.
Theme: Synthesis Presentations and discussions	Prototypes and research notebooks that track research progress.

Figure 1. URBN STEAMLAB Novel Processes and outcomes.

3 PROJECT DEPLOYMENTS AND PROTOTYPING

3.1 *Project description and parameters*

The current URBNSTEAMLAB challenge is the design of sustainable, effective and testable consumer hydroponics systems that are suitable for growing algal cultures and plants on a small scale in the urban interior. The project, *Algal Biophilic Interior Environments,* seeks to create opportunities to ameliorate the urban food deserts currently in force in many urban areas through education and exposure to food production. According to the US Department of Agriculture (USDA), food deserts are low-income communities, with households living on tight budgets, that lack large grocery stores and supermarkets selling fresh produce and healthy food options like fresh fruits, vegetables, meats, and dairy products (USDA, 2015). The outcome of the project will be a new typology for urban living, one that includes a self-contained building system and interface that allows the inhabitants to produce food, clean the air, and through the deployment of double skin and passive wall systems to augment the heating or cooling of their spaces. The urban row home is the natural locus for the project and the architectural implication of introducing this new research-driven technology into this historic building type are considered as part and parcel of the solution to the urban issues in our environment.

With its impetus in the examination of ways to test the feasibility of algae micro-ponds to create nitrogen rich water fertilizer used in an indoor setting this project – *Algal Biophilic Interior Environments* – has

evolved into creating in-home architecturally integrated hydroponics systems to address the issues of healthy food availability in the urban environment. The design includes sustainable, effective, and testable consumer hydroponics systems that are suitable for growing algae cultures and plants on a small scale in the urban interior, including the design and prototyping of small-scale consumer-sized interior growing units that can act as interactive infrastructural units in an urban row home. Thus far the team has identified four (4) typologies that they are working towards: stackable units, window units and two types of panel units. These typologies have been classified through an examination of the interior space and types of row home in the urban area adjacent to the team's practice and a STEM-based analysis of the growing habits of the algae culture. We have deployed consumer grade 3D printers to create initial prototypes. Initial laboratory tests included small units to support algal growth, these micro ponds as we call them. Cyanobacteria being photosynthetic organisms like plants, require light (either artificial or natural) for growth. Cyanobacteria were introduced into nutrient media in the micro-ponds at a defined concentration, placed either in a growth chamber, on the laboratory bench far from a window, or on the window sill of the lab. Their growth was monitored daily. The micro-ponds supported the growth of the cyanobacteria for several days – as shown by the absorbance rates in figure 2. The project deploys algal cultures in service to the fertilization and production of food. For this project we install cyanobacteria, which are bacterial organisms that are critical for the primary productivity of their environments. Certain cyanobacterial species carry out nitrogen fixation, a process that enzymatically converts nitrogen gas obtained from the air to nitrate. This process enriches the nutrient availability of the surrounding cyanobacterial environment. Many cyanobacteria grow well in aquatic environments, and have been used as genetic and physiological test model systems for increasing food production by plants.

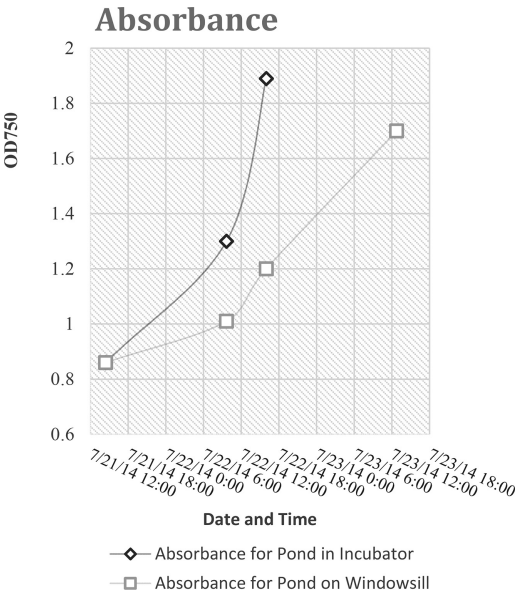


Figure 2. Measuring growth of algae over a 3 day period using optical density (OD_{750}) measurements.

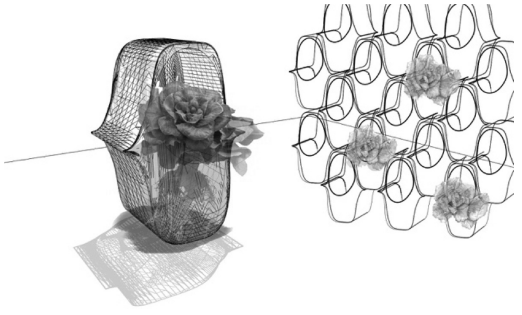


Figure 3. Initial Rendering showing the latest closed prototype.

3.2 *Prototyping*

This project began as a way to test the feasibility of using algal micro-ponds to create nitrogen-rich liquid fertilizer in an indoor setting, garden or yard. It has evolved into creating an in-home hydroponics system to address the issues of food production in the urban environment, and models the use of design thinking processes in basic research. This portion of the larger project includes designing and prototyping small-scale consumer sized portable interior growing units that can act as decorative and interactive units in an urban row home, while still growing cyanobacteria to generate fertilizer. URBN STEAMLAB teams worked on designing and generating a prototype pond system and testing cyanobacterial growth in it. The image below shows successive prototypes and an initial rendering of the latest unit.

The prototyping process was integrated into the lab-based cyano growing phase and the forms adjusted in response to the growth of the microalgae. The project has migrated from an open design to a closed upright unit as the absorption and the evaporation of the medium has shown that the algal culture will not grow as well when the water surfaces are completely exposed.

The team believes that this prototyping process will become more and more exacting as they continue to culture algal strains and move into the growth of plants. The introduction of sensors and interactive technology in the project will afford the users new possibilities in the production of food in their interior urban environment and may lead to methods for ameliorating the lack of availability of fresh produce in the underserved environment. This project aims to synthesize design, innovation and research and to link and utilize them in terms of real life process and experience. Charles Owen has spoken and written about the strength for science and design processes in tandem with each other in service to innovation, as each discipline brings certain



Figure 4. Printed Prototypes showing the evolution towards more closed design lower right.

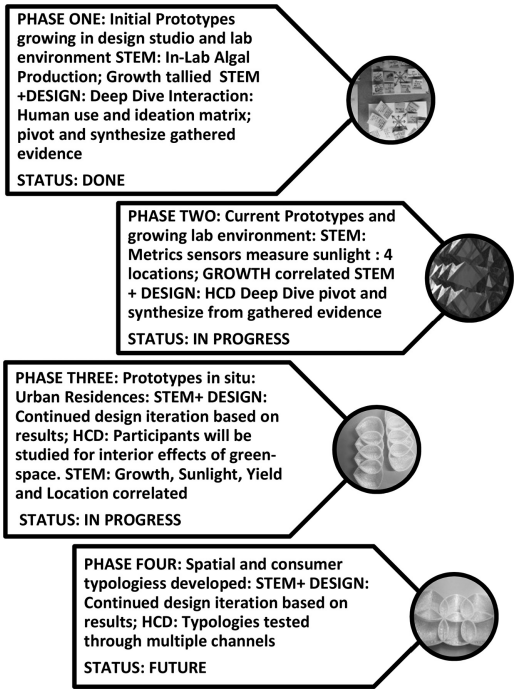


Figure 5. Project Process chart.

strengths due to the inherent nature of their objectives and approaches (Owen, 2007).

The argument has long been made that design, when included as an early part of problem-solving, leads to more satisfactory levels of creativity in dealing with complex problems. URBN STEAMLAB aims to create experiences in which the basic tenets of design thought become part of the non-designer's lexicon when experimentally approaching the realm of novel solutions for sustainable living in the urban environment. This approach, coupled with mentor engagement, will move projects in directions previously unimagined and expose students to innovation in ways that will serve them in their chosen academic and professional paths.

3.3 *Plants and interior environments*

In J. Benton Jones's marvelous compendium on hydroponic growth, *Hydroponics: A Practical Guide for the Soil-less Grower*, he lists the advantages and disadvantages of soil-less growing as explored by both Jenkins and Wignarajah. The team found that the positives of this type of growth, which included: no need for soil, no labor required for working the soil, high density high yield possibilities, conservation of water, and the easy control of disease (Jones; 2012) aligned perfectly with the urban condition, which includes lack of space, lack of land and the need for dense production. In addition, the process of growing in the interior environment creates the opportunity to introduce natural features into the residential environment in the urban grid. As stated above, natural elements have a health-enhancing effect (Frumkin, 2001) and this effect will be measured through prototypes placed within the community. Produce collected will be tracked carefully to understand the possible impact on eating habits. Certain health metrics for the volunteer participants will be tracked to see if there is any overall outcome in terms of heart rate weight and diet. The project process program and plans for integration of research and design are shown in the process chart Figure 5.

In this project, we also explore the development and use of novel materials and structures for the construction of the algal hydroponic growing units. As this work progresses we envision developing materials and micro-ponds that contain embedded or built-in sensors that monitor cyanobacterial growth. This self-contained system will allow users to monitor cyanobacterial growth without removing the algae from the medium for measurements. Prototypes have cycled through many forms: the current prototype will stack and integrate into the exterior wall on the interior surface as a way of insulating, producing food and creating the health enhancing Biophilic effects of natural space in the urban environment.

4 CONCLUSION

4.1 *Interior intervention/façade intervention*

"The facade is one of the most significant contributors to the energy budget and the comfort parameters

of any building. As energy and other natural resources continue to be depleted, it has become clear that technologies and strategies that allow us to maintain our satisfaction with the interior environment while consuming fewer of these resources are major objectives for contemporary facade designs." (Aksamija; 2013)

This project is essentially seen as becoming part of the interior surface of the façade of an urban row home: as such the next critical phase will include situating the prototype in the street and rear-facing interior walls of the row home building type. The project team is currently exploring a prototype that allows both stacked units and a stack effect for the spaces, thereby creating double skin facade-like effects in the interior. In this next phase the effects of an additional heat gathering and radiating surface, such as the stacked growing units, could act as an inner skin and, if vented correctly, augment the energy outlook for the conventional row home. (Aksamija; 2013) This project creates user interactivity, affords control of the interior and creates a bio wall for residential use that will produce food. Its future permutations will explore the façade and energy effects of the proposed system as well.

The neighborhood in which this next phase will take place, Mantua, is a community in Philadelphia that lacks access to fresh food as stated above. Predominantly an African American community, Mantua has a poverty rate of 43.2% (The Philadelphia Inquirer, 2016), which is much higher than the national's average of 15% (US Census Bureau, 2015). The average income of Mantua residents is $30,995 with an 18.2% unemployment rate (The Philadelphia Inquirer, 2016). In 2014, Mantua was singled out by President Obama as one of five economic "Promise Zones" across the country that will receive federal backing for community revitalization through the Promise Zones Initiatives (Moraff, 2014). As a site for initial prototyping Mantua holds within it the possibility for being a prototypical urban row home application with a real need for fresh food that will drive the outcomes for users in their residences. *Algal Biophilic Interior Environments* contextualizes project-based work in relationship to the future language of new practices in the built environment and the inculcation of STEM based research practices and human centered processes for built innovation. The project described here embodies new practices in the built environment and the urban communities that need fresh food, energy efficiency, and calm, healthy interiors. Novel outcomes that lead to new thresholds of human/environment relationships will continue to be explored in this project, due to a process that is inherently cross-disciplinary, and the practice "space" of a team including both bench scientists and designers has been laid out as a possible model for future application. The *Algal Biophilic Interior Environments* project activates the interior terrain of the row home, along the lines of Haque and Pask mentioned earlier, and posits a brave new interior – with the activation of self-sufficient urban living conditions.

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Out in the open

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ABSTRACT: Open space, especially before the variety and diversity of the built environment, seems to be the most identifiable and distinctive approach towards an efficient and reliable guaranty to control metropolitan sprawl. Act-ing at different levels of planning and design, as well as crisscrossing various fields from landscape to urban, from environmental to societal sciences, from heavy infrastructures to intangible flows, the open space system may provide high quality places accessible to all. The links between morphological evolution and the main urban models used in the planning process are pinpointed, giving evidence of to the role of open space in the process of land transformation. Chelas was specifically addressed for its key role in various levels of planning and design. This paper examines the final results of a research conducted at the Faculty of Architecture, University of Lisbon and at the School of Architecture in Barcelona (ESTAB-UPC), funded by the FCT.

1 THE POTENTIAL RING OF METROPOLITAN LISBON

Lisbon, as a municipality and city, plays a key role in functional terms and in a broader metropolitan context, since the metropolitan axes of greatest opportunity converge in its crown. Whereas at a metropolitan scale the Lisbon crown stems from the formation of an infrastructural ring, the intensification of uses and infrastructure that interconnect there contribute to a specific impact on the forms of growth of its urban fabric. This is particularly important in areas open space, which are stimulated by the urbanization of Lisbon and at the same time requested by the dynamics induced by its metropolitan area, contributing to situations of further fragmentation, fringes and incomplete fabrics.

At the intersection between these phenomena and scales, Chelas acquires paramount importance, particularly due to the potential role it plays in a latent axial relationship with Barreiro, which is likely to develop as a result of changes in the rail network.

Considering the need to highlight the role of open space in the evolution of Lisbon's fabric, the identification and characterization of morphologies – in progress in space and time – result from careful observation of the available cartography and graphical representation, taking into account the internal structure regarding the way open space relates to the buildings and the infrastructure network, defining their limits and the explanation of its use through spatial characteristics. In these circumstances, understanding how the changes of this *metropolitan kneecap* occur can contribute to consolidating more specific knowledge of both the metropolitan configuration and functional structure and of the morphological elements.

2 CHELAS: FROM A BASIS TO A FABRIC

The Chelas Valley is part of the potential crown of Lisbon, in the Olivais-Chelas sector, which stands out due to the pre-existence of rustic areas and the urban development of the twentieth century, where some of the most important experiences of Portuguese modern urbanism can be found.

The process of the city's division into sectors, mainly due to the axial development of its urbanization towards the north through *Avenidas Novas*, contributed vastly to the autonomy and circumscription of this area of intricate urban formation, in which the open space has always played a key role: a rural setting increasingly filled by extensive areas of shacks, houses, infrastructure and, more recently, becoming a large public space of the city.

The area under study is a rustic space that was progressively urbanized. It stands out in Lisbon due to the spatial discontinuities that are fundamentally a result of intermittent urban intervention in the twentieth century, albeit relevant as to the innovation of the proposals and the architects and authors involved. It is an eastern area characterized by social conflict, miscegenation of uses and urban forms, which originated in the contrasts between the industrial riverfront (Marvila), the discontinuities between occupied zones (Chelas) and the new interventions in the proximity (Parque Expo).

Due to its adjacency to the planned Terceira Travessia do Tejo[1] (Third Tagus Crossing), it was expected it would become an important international central

[1]A bridge which, had it been built, would connect Barreiro to Lisbon, thus materializing a possibility long considered.

point, taken into account in the Lisbon Municipal Master Plan.

Having always been considered an infrastructural reserve, the available space, together with its central position in Lisbon, a municipality that has been losing population and economic importance (e.g. to Oeiras), the greater connectivity opportunities are provided by the following:

– At present, the direct connection to the main road network (particularly roads with motorway profile), railway beltline and proximity to the conventional speed railway line to Porto and the current Portela Airport,
– In the future, the proximity to the high-speed railway Gare do Oriente, in Lisbon, and consequent direct access to the new airport on the south bank and link to Europe.

This allows us to identify a new metropolitan axis that will reorganize, from a functional point of view and due to its hierarchy and nature of its centrality, the very metropolitan area, which encompasses Barreiro, in itself equally well positioned as an area of opportunity.

Its location, which is key in terms of extended metropolitan structure – in the Lisbon potential crown and bordering the remaining metropolitan area – provides an opportunity to study an area which, although always present in the urban plans for Lisbon, had not attracted much scientific attention, not always for positive reasons. Existing papers have almost always addressed either social issues or housing public policies, specifically its Urban Plan, focusing on *built-up areas*. That is, works that have suppressed the base structure that liaises (or not) with the space of the city.

Thus, this analysis aims to contribute to the study of Chelas' urban formation, making its morphological characterization, identifying the transformation processes that gave rise to its current configuration, and giving prominence to the space that is unoccupied. This work is based on a diachronic interpretation defined by a *window* that allows examining the morphogenesis of Chelas at three stages of its urban development (1991, 1950 and 2008).

The systematization of the identified morphological classes allowed highlighting three distinct, parallel, and complementary processes prevalent in specific moments and present in the transformation of the selected sample in Chelas:

1 *Parcelling as the basis for transforming the territory,* in a still relatively traditional way, clearly opposing the rural to the urban and with diverse morphological classes, which is directly linked to the Lisbon rural crown circumscription process; in this case, pre-existing structures and the way they are adapted play a key role.
2 *The modern paradigm and the segregation of open space:* disjunction and specialization – spatial and functional – as the key open space segregation agents as a whole, using fewer morphological classes, which is aided by the axial urbanization of the city and corresponding sectorization; in this case, with emphasis on the introduction of urban concepts that are remote, as much as possible, from existing strata, giving them new forms and meanings.
3 *A new protagonist in the Project of the City* – with particular emphasis on open spaces, acknowledging their potential in terms of comprehensive ability to structure the city itself, resorting to the use of large-scale architectural elements, such as parks and spaces separating areas with very different characteristics.

The empirical observation of the city space and the field visits, supported by other documents, notably city plans, enabled outlining an approach, also theoretical, regarding the culture of contemporary European cities.

Although this analysis applies to a specific situation in Chelas, the study conducted in Lisbon makes us believe that the methodology, processes and identified morphological classes are sufficiently representative and can be applied to future studies, understandably with some reservations given the local specific conditions.

Despite all the hitches and detours, one can say that almost all of the *Chelas Urbanization Plan* has been accomplished. This includes the construction of urban parks and the final details to ensure urban continuity.

3 A NEW PROTAGONIST IN THE DESIGN OF THE CITY

The urgent housing allocation contributed to a focus on the *built areas* of the Plan, which only recently have been supplemented – functionally and spatially – with elements that allow an authentic *idea of city*.

Whereas modern design urban fabrics are characterized by functional specialization and spatial disjunction, the idea of the city endorsed in the post-industrial period highlight, in the first instance, the problems relating to the maintenance and conversion of obsolete fabrics that are emptied of their functions and, more recently, the notion of a metropolitan city in which open and built spaces alternate and mutually potentiate programmes, forms and projects with transversal features.

It is therefore evident that the city does no longer have an exclusively urban nature in the process of occupation of rural areas or in ongoing *urban development*. Rather, it is the result of multiple induction processes relating spaces with different characteristics, which the literature of the last decade has generalized as *metropolization*.

As soon as the city started to undergo large-scale development, several authors, such as McHarg (1969), Gregotti (1972) and Dematteis (1995), have explained the need to seek ways of intervention using projective concepts and thorough knowledge of each territory – i.e. the basis of the metropolis, rather than resorting to a functional rationale.

In the US, *Landscape Ecology* (Forman et al.), a school with roots in Germany from the early twentieth

century that has spread throughout Europe, is also referred to. More recently and specifically focusing on open space as the protagonist of the metropolis project, the concept of *Landscape Urbanism* (Waldheim, 2006) and *Metropolitan Landscape* (Tatom, 2009) emerged advanced by landscape architects and urban planners whose cross-cutting interventions focus on interface and transition areas, also contributing to the renewal of the assumed aesthetic parties of contemporary urban design (i.e. the landscape architects working in urban projects James Corner, Enric Battle or João Nunes).

These issues have been integrated into various interventions in cities like Barcelona, especially with regard to the relationship between the compact fabric of the city and areas of scenic interest developed using various forms, such as interventions to mitigate the impact of major roads on urban spaces. Reference is particularly made to public space projects, such as the motorway junction in Trinidad Nova, by Enric Battle, and the Agrarian Parks in their relationship with the land use of metropolitan space (Sta Maria del Gallecs and Llobregat), as well as the urban reform of the Besós River (Clos, 2008), similar to interventions made in Italy and France (Llop, 2009).

These are crucial topics in the approach to city design since, on the one hand, they enhance open space as an inalienable element of a consistent and effective urban planning and, on the other, consolidate new approaches to it, in a period that immediately follows the emergence of strategic planning in Portugal[2].

Following formal urbanization and physical and functionalist planning, new mechanisms have been introduced aiming at making the intervention in the city more flexible by seeing plans as processes. However, in the case of Lisbon, the Strategic Plan (1992) was accompanied by a Municipal Master Plan (1994) using instruments also inherited from a modern base, namely through the definition of *Planning and Management Operating Units*, quite rigid zoning and urban parameters that were no answer to multi-scalar situations and did not allow the effective coordination between various levels of planning and the actors involved. These issues became, in the last decade, essential factors for a change in the approach to planning (Faludi, ed, 2008).

Likewise, it was found that the dissociation of urban fabrics from fabrics associated with open space, with a relevant and necessary focus on urgent issues of urban renewal and housing, accentuated dislocation and fragmentation situations regarding open areas, which were gradually taken up, sometimes without the necessary global view of the city.

Therefore, the key issues focus on areas of transition and infrastructural overlap, especially regarding the relationship between settlements and ring structures that have been acting as city limits at different times from the mid-nineteenth century onwards, following an industrial rationale. In this case, this means the ring roads and the railway beltline in which the five centralities provided by the revision of the Master Plan of Lisbon are anchored: Alcântara, Sete Rios, Praça de Espanha, Chelas and Estação do Oriente (CML, 2010).

Following recent changes in EU's policy and programmes, as well as some intervention strategies that have introduced a new model in terms of city design (i.e. London and Barcelona), the review process of the Municipal Master Plan of Lisbon introduces a new approach to the city's project, which, in this case, is particularly interesting for i) an architectural combination of the various elements that compose it and ii) an integrated and reciprocal view between urban and open areas, as opposed to the previous period when open space issues were not necessarily and directly related with urban planning issues[3].

Specifically in Chelas and with regard to the role of open space perceived as a city design booster, the analysis of its urban transformation process allowed identifying two different aspects: i) potential uses, consisting of areas of opportunity for future interventions, although fragmented and resulting from the overlapping of higher capacity infrastructure; and ii) open space project, integrating the areas subject to qualified interventions, provided for in plans and projects contributing to the overall consistency of the city.

It should also be noted that, at various times, the area under study was considered in urbanization plans with reasonably distinct goals and limits – Urban Plan of Chelas and the Valley of Chelas, in 1965 and 1998, respectively – although always relevant and necessary, or resorting to models of occupation of areas confined to zones or neighbourhoods (Bairro dos Alfinetes and Quinta do Marquês), under the various programmes aimed at housing and urban renewal (*PimP, PER, Viver Marvila*).

The latest debate includes detailed plans with greater structuring ability, such as the Hospital Group, whose developing preliminary proposal[4], despite the weaknesses that are typical of urban design with too much focus on isolated built areas, gains a new dimension for giving prominence to open space as a binding element of Chelas' various *built zones*.

Two situations arise dialectically: identifying areas of potential uses that stimulate new centralities; and the emerging approach to the Open Space Project as a built support of the city, which will be discussed below.

3.1 *Open space design*

The design of the open space merges with the actual city project. It presupposes an architectural and urban approximation that enables, in the project's approach to the city itself, the various components – urban, rural and more hybrid ones – to meet, exploring new forms

[2]The prestigious Valmor prize in Lisbon started to distinguish interventions in landscape architecture in 2003, which clearly shows its growing importance in the context of the city.

[3]Previously allocated to various Municipal Departments.

[4]Project: CML, Pedro Falcão de Campos, NPK and ABAP, 2009.

of intervention and promoting, in the process, not only a critical view, but also a conceptual one, through which the aesthetic dimension of the metropolitan landscape is also renewed. After all, the aim is to find among the fragments the opportunities to rebuild a mosaic of continuities tinted by cohesive fabrics from different origins.

In a way, this view is close to the notion of *porous city* (Équipe Studio09, Bernardo Secchi and Paola Vigano, 2009b: 3), which explains the need to design the support of the city itself[5] , giving continuity to other city projects developed from a global intervention perspective.

The analysis of the various planning and management documents available (Table 6: *Instrumentos de Planeamento e Gestão, Acções e programas com incidência na área de estudo* – Planning and Management Instruments, Actions and Programmes focusing on the area under study), indicates that open public space – in its various components and scales – is repeatedly mentioned as a key element, especially in the area under study, but only recently operated upon, or so considered.

The actual *Chelas Urbanization Plan – Plano de Urbanização de Chelas* (GTH, 1965: 87) considered the *free areas* as key, offering them a total of 291.16 ha, or nearly 57% of the total intervention area. Free areas comprised walking areas, parks and playing fields, including Parque Oriental, Parque do Vale Fundão, Clube Oriental de Lisboa, and urban gardens.

It was anticipated that the green areas would play various roles: i) creation of collective public recreation comprising sports and cultural equipment and the framework for certain routes for pedestrians (GTH 1965: 82); ii) protection against the consequences of the proximity of polluting industries, establishment of slope areas and the edging of fast transit routes (GTH 1965: 82). The analysis pointed to the three forms of open space design which, nevertheless, are interconnected in space and time, resulting in a dynamic system using the following:

– structural elements of the city in terms of planning and urban design, such as sports facilities and fields and urban parks;
– collective spaces close to buildings, thus to people, in the various activities and programmes from the perspective of urban renewal, such as the areas identified as infrastructural finishing features;
– gardens associated with notable buildings, more reserved and of limited access.

It can also be concluded that despite the various trends and urban models referring to open space as essential to the city design and later the actual Chelas Urbanization Plan, the investment in the areas of the park and the completion of the network of public spaces is only recently starting to be a reality, finally allowing acknowledging this area as a city.

3.1.1 *Result of planning and urban design*

The analysis of the plans shows that the intervention, in terms of the open space project, began by sticking to the emergence of reserved nature spaces (*gardens associated with noteworthy buildings*) in erudite architectural sets, with the notion of public equipment in the marginal area of Lisbon being introduced later.

Since the urban fabrics of Marvila were modest in terms of typological range due to its popular and industrial origin, the emergence of playing fields adjacent or linked to the residential areas of the working class and factories, which still persist nowadays, stands out. While very poorly equipped, these sports fields represented an innovation in relation to the concept of urban equipment, albeit at the expense of a network of public spaces, which in this case were rare, in a space that was becoming densely built.

Their location favoured their relationship with the Marvila and Picheleira older fabrics. In the case of the former, the field close to Fábrica Nacional de Sabões and *Clube Oriental de Lisboa* in the former Bairro Chinês, located in Quinta do Marquês de Abrantes, to the south and north, respectively, of Marvila station and Azinhaga dos Alfinetes, one of the main lines of rustic urbanization of this area of the city, stands out.

Until now, this type of equipment has been gaining ground in the city's fabrics. From simple playing fields, they evolved into more elaborate sports areas and include fields for sports practice aimed at more advantaged populations, such as tennis in Mata de Alvalade or golf at the Bela Vista Park, occupying a significant area of open space. With regard to these two types, their location and contribution to the rehabilitation of the area, then provided for in the Chelas Urbanization Plan as Parque Oriental de Lisboa, must be emphasised.

As a complement, in the *built-up areas* associated with equipment, the system of collective spaces is also being equipped with playing fields, mainly those included in the school equipment areas, such as D. Diniz High School in zone I or the Amendoeiras/Olival Neighbourhood. It is, after all, a fragile situation in a city marked by serious social and economic problems.

The *Chelas Urbanization Plan* carefully addresses open space as a fundamental element of urban design. However, its non-execution led to a perception that these changes did not differentiate much from high density suburban areas of other municipalities of the Metropolitan Area of Lisbon, promoted publicly or privately, only focusing on the full urbanization of rustic properties directly connected to road intersections.

Thus, although the process has been quite different – in this case there was a conceptual decision to integrate its various areas – what stands out in the face of the long-running process is, in practice, the exclusion of spaces that have become increasingly reduced due to the overlapping of built-up areas and

[5] Le projet de la ville poreuse ce n'est pas le projet d'une ville, mais le projet du support de cette ville. […] Le projet d'une ville poreuse élargit la section des rivières, utilise les espaces non utilisés, sous-utilisés ou résiduels pour créer ou renforcer les zones humides. […] La ville poreuse est une ville où la biodiversité percole et où les parcs ne séparent pas.

large infrastructures, contributing to an *indifferent* landscape.

This process contributed to an intermittent landscape of the city, in many ways similar to areas like Odivelas, Damaia or Pragal. Paradoxically, the resumption of place names of the old estates to introduce an idea of "neighbourhood" (Lóios, Armador, Amendoeiras, Olival, Condado, Alfinetes, and Flamenga) coincided with the logic, probably associated with real estate marketing, adopted in areas of more diffuse or extensive metropolitan occupation (i.e. urbanization of Quinta da Ramada in Odivelas, among many other examples in the Lisbon Metropolitan Area), as well as with a certain socio-political view of city space.

More than being an opportunity for action, this situation illustrates the urgent need for qualified intervention in these areas, which is why some of the newer parks in the city are located in Chelas, helping to strengthen the idea that there will be more urban parks in the eastern side of Lisbon than in its western side, very still dominated by the Monsanto Forest Park.

In the adjacent areas, Parque do Vale do Silêncio and Quinta Pedagógica stand to the north, both in Olivais, and Parque José Gomes Ferreira, also known as Mata de Alvalade, is located in the west, close to the Bela Vista Golf Club, and Parque or Mata da Madre de Deus stands in the south.

Indeed, the location and characteristics of the parks in Chelas result from its physiographic characteristics, with two privileged areas making up the wet system and the structuring corridors system of the city (CML, 2009e, *Plan 2 – Planta de Ordenamento: Estrutura Ecológica Fundamental/Planning Plan: Ecological Fundamental Structure)*, making the first interpretation of the physical geography of the place: Chelas and Vale Fundão valley systems. This situation is guaranteed by the *Estrutura Ecológica Integrada*/*Ecological Integrated Framework* (CML, 2009e, *Plan 3*).

The organization of a large area over the Chelas valley system becomes thus clear – Bela Vista, Quinta da Montanha and Frades Vicentes – between Avenida Gago Coutinho and Alvalade, to the west, Olaias to the south and the Armador, Flamenga and Lóios neighbourhoods to the east.

It is an area of scenic and environmental value, as set out in the Lisbon *Plano Verde/* Green Plan and later included in the review of the Municipal Master Plan (CML, 2009 and 2010), consisting of several concatenated parks and forming the City Eastern Park, as initially proposed in the Chelas Urbanization Plan.

The Chelas Urbanization Plan set out that the planned green spaces included two key issues. On the one hand, the provision of equipped green spaces or collective recreational public parks, and, on the other, the necessary protection from nearby polluting industries close to highways. In addition to the proximity benefits for the new populations, it was also advantageous to the city, since this equipment would address needs, especially in the eastern area, by preventing the spreading of industrial pollution in specific weather conditions (GTH 1965: 82). The plan foresaw the City Eastern Park and the Fundão Valley Park with an occupancy of 16% and 7%, respectively, of the total area under intervention. (Map 19: *Ocupação do Solo*/Soil Occupation, GTH, 1965).

The City Eastern Park would be located in the west, on the western strip most strongly restricted of the intervention area. Apart from the steep slopes, very much changed by erosion and extraction of sand, partially classified in the *Plano Verde/Green Plan*[6] and referred to in the PDM review as Geo-monument (CML, 2009e, Plan 6 – *Planta de Ordenamento: Património Geológico e Arqueológico*/Planning Plan: Geological and Archaeological Heritage), it was a very limited area due to its proximity to Portela International Airport.

This was the hilliest part in the intervention area of the Chelas Urbanization Plan, with percentages above 15%, which prevented other type of occupation, especially built-up areas. Despite these constraints, the sunny orientation to the east, south and west, together with the panoramic view of the city and the river enabled by the higher points, indicated the need for a landscape study coordinated with the Plan (GTH, 1965: 83), with the slope between Picheleira and Casal Vistoso being considered a particularly sensitive area.

In recent years, the Bela Vista Park (*Parque da Bela Vista. Plano Geral da Zona Central/*General Plan of the Central Zone, 2005) was set up there, adjacent to the Golf Club on the north and the Bela Vista South Park (*Parque da Bela Vista – Sul, Zona Central/Bela Vista Park – South, Central zone*, 2008).

Bela Vista Park (85.0 ha) is divided, through Avenida Marechal Spínola, which prolongs Avenida Estados Unidos da América, into a central and south areas. Still retaining some traces of the old estates, including sections of Azinhaga da Belavista and a water mill, it offers wooded areas of meadow and lawn, with the highest points being privileged viewpoints over the city. It also includes sports facilities and maintenance circuits (CML, 2010).

The valley area bordering the southern railway line on both sides is expected to be subject to scenic intervention, which this work considers to be of *potential use*. Pre-existing sections include Quintas da Fonte do Louro in the north (severed by the construction of the railroad) and Quinta da Montanha.

To the south, Frades Vicentes Valley, between Olaias and Picheleira, is an area that is also expected to be requalified with regard to its landscape (Preliminary Proposal, *Plano de Pormenor do Parque Hospitalar Oriental*/*Detailed Plan of the Eastern Hospital Group*). This area of the park will be extended to involve the Chelas Convent, contributing to the heritage significance of its architectural complex.

The completion of planned interventions will enable finishing a continuum of interesting landscape in the

[6] Proposal for a preliminary municipal ecological structure.

eastern area of Lisbon, strengthened by the proximity to Mata de Alvalade. Mata de Alvalade (21 ha), or José Gomes Ferreira Park, has its origin in the Charca and Narigão estates, which were expropriated to create the Alvalade neighbourhood. It is characterized by a relatively dense forest, whose clearings accommodate several facilities, such as picnic parks, viewing points, playgrounds, and a fitness circuit (CML, 2010).

The Vale Fundão Park (9.0 ha) has urban features and is characterized by an open forest area with large clearings (Parque do Vale Fundão – Concurso público internacional de manutenção e limpeza/Vale Fundão Park – Cleaning and Maintenance International Public Tender, 2008). It is an area of scenic interest, with some sports equipment, such as a football field, a sports centre and public swimming pool, surrounded to the east by the Amendoeiras/Olival neighbourhood. It has traces of the Alfundão or Lebre and Val Fundão old estates, such as a water mill and some paths, facing urban gardens zones in the south and east. Its eastern boundary is a section of the channel of the Alviela rivulet, an interesting pre-existing feature from a heritage viewpoint duly protected by a protocol between the CML and EPAL (CML, 2010).

Regarding housing, school equipment and local commerce, by 1991 only zones I, N2 and J, i.e., the current neighbourhoods of Amendoeiras/Olival, Lóios and Condado had been built, for which reason the transversal links between these zones and the completion of the proximal exterior and public spaces were vital (DCH 1991: 37). The need for a quick-start of the infrastructure and architectural projects for the M zone (Armador neighbourhood) was also considered to be primordial to attain an urban balance.

It was in the context of the Chelas Plan[7] review that *Parque Urbano do Vale Central*/*Central Valley Urban Park* was proposed. It is an area surrounded by the N1 and N2 zones, today Lóios and Flamenga, respectively. The proposal for the Central Valley Urban Park had as main objectives the creation of a close by free recreational area, where maintenance charges were to be as low as possible, so as the green structure was close to existing natural conditions (DCH 1991: 53). The park ended up not being accomplished, although the place encompasses an extensive area of urban vegetable gardens (2008. Chelas) that require planning in future and fulfil, in practice, the role that was attributed to them.

In the late twentieth century, Chelas resumed a key role in the planning strategies of the eastern area of Lisbon, especially considering the upcoming Expo '98, thus renewing the possibility that a bridge to Barreiro would indeed be built (Silva Dias, Francisco 1991: 9–11).

Anticipating that Chelas' central area would become an area of *Estruturação Urbanística Terciária*/*Tertiary Urban Structure,* as identified by the Municipal Master Plan (*Classificação do Espaço Urbano/Urban Area Classification*, CML, 1994b), which would contribute to defining the U.O.P. 27 titled *Centro de Chelas*/*Centre of Chelas*, the main concerns were focused on the interstitial and incomplete areas of the built-up areas (*Unidades Operativas de Planeamento e Gestão/Planning and Management Operating Units*, CML, 1994b, PDM). This is evident, especially in the urgent cross-connection to the city and the establishment of a *centre* for diverse uses that encompassed the Zone O of the Chelas Urbanization Plan and whose allotment would be developed by Ambelis, in the proposal for the Central Area of Chelas (CML, 1995), or *Quadra Central*/*Centre Court*.

In the studies conducted at the DCH – *Departamento de Construção de Habitação*/*Department of Housing construction*, prior to the intervention in the Chelas Central Area[8], the project would materialize, somehow in a hard way, through a large-scale built structure based on a plan for a highway intersection. This area had already been regarded as essential, especially as a means to overcome the central valley[9].

As a complement to the planned park areas, at the time still important degraded spaces, such as the Relógio Neighbourhood and the area of Quintas Fonte do Louro and Montanha, the preparation of this study shows mainly a concern with the planning and the attainment of outdoor green spaces integrated into the *built-up areas*, using proposals for that purpose.

3.1.2 *Infrastructural finishing features*

The infrastructural finishing features arise out of the predominance of a highway system both in the perimeter of the area under study, expected to act as a parkway, and in the fasciculate collective spaces separating the area for motor vehicles and the spaces for pedestrian circulation. In the case of the latter, there is also an area that just finalizes a specific infrastructural channel, usually with a paved or green area, not always promoting its exclusive use by pedestrians.

This is particularly important in some areas of Chelas, in the form of a central space of built-up areas, accentuating barriers and the difficult circulation between different areas. Examples include the main axes of Zone I (Amendoeiras/ Olival), Zone M (Armador) and Zone J (Condado), which, despite some uneven passages, are different from the others, such as the Chelas Central Avenue (Avenida Central de Chelas), because they are urban areas with functional interest and are directly related to the built environment and housing. They are mere space-channel or kneecap areas, usually sufficiently reduced so as not to open future opportunities for use, such as the area north of Chelas Central Avenue, which may in future

[7] Coordinated by Architect Francisco Silva Dias, CML- DCH, May 1992.

[8] *Quadra Central de Chelas*, 1997–2000. Project Team: Frederico Valsassina Arquitectos, PROAP outdoor areas. Source: PROAP.

[9] Study by Architects Elias Rodrigues and Helder Tércio (DCH, 1991: 37).

be part of the Parks system, finishing off the Zone N2 (Lóios) to the north.

3.1.3 *Gardens associated with outstanding buildings*

Gardens associated with notable buildings are qualified spaces of erudite origin in conjunction with notable buildings due to their typology, like a palace or monastery. That is, it means an architectural approach to a set where the garden has a recognizable aesthetic value. It was found that many of these situations have evolved from private property with very limited access in terms of public occupation.

Although the gardens continue to be restricted with regard to access, in terms of design they are confined spaces of architectural interest built on higher density areas, deserving special mention. Their location on the urban fabric allows us to identify situations and peculiarities we would not normally notice otherwise, like in Rua do Açúcar.

One notes that this type of garden is found predominantly i) along the old beach road, today known as Açúcar, naturally in accordance with the most architecturally notable buildings, such as the Mitra Palace; or ii) associated with the noble buildings of the estates with a close relation with the fabric of Marvila, such as *Quintas das Salgadas*, *Alfinetes* or Marquês de Abrantes.

These examples characterize various moments in the history of the gardens, ranging from the formal parterre ones that benefitted from being at different heights (Mitra Palace) to organic sets that used existing water to create natural reflection pools (*Quinta das Salgadas*).

The analysis of Silva Pinto's cartography also allows concluding that some farms did not have a true formal garden. However, the alignments of trees along direct paths formalizing noble entrances and agricultural fields offered a form of landscape architecture adequate to the central buildings, such as Quinta do Armador, or Quintas das Teresinhas and da Graça further north, since then included in housing spaces as equipment, which the maps show to have been progressively enriched with trees or new spaces associated with leisure and contemplation (Quinta do Leal).

Despite the densification and the urban expansion over the rural areas, especially on the front of Marvila, Beato and Poço do Bispo, the areas left open as public parks, gardens or marginal occupation spaces (such as Quinta do Ourives) are the areas whose increased permeability is critical because they coincide with important water lines or traces of marshes that no longer exist.

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From structures to landscapes – towards re-conceptualization of the urban condition

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ABSTRACT: This paper presents an original approach towards the phenomena of re-naturalization of cities and indicates its possible consequences for the urban design and planning strategies. It focuses on the ongoing shift "from structures to landscapes" in understanding urban conditions. While modern architecture introduced geometric compositions against the background of nature, early modern theories of architects and sociologists started the pursuit toward a new perception of urban reality. Studies of later researchers supported by emerging philosophical re-interpretations continued questioning the oppositional character of natural and artificial, and juxtaposed the rigidness of a plan with the direct experience of urban geography. It contributed to an important shift towards understanding the city as a landscape, and consequently urbanism as landscape urbanism. The processes of re-naturalization of cities are influenced by this shift, which results in new genres of public spaces and building typologies based on the inseparability of the natural and the built.

1 INTRODUCTION

The problem of re-naturalization of cities today is both important and complex. Cities are changing and most of them are expanding, often chaotically into suburban territories. Many are growing at a pace that could not have been predicted even one decade ago. Economic, social and cultural changes provoke mass migrations, resulting in more than half of the human population living in cities. It would be hard to suppose that the need for contact with the elemental qualities of nature, an environment delineated by meadows, forests or green hills, which have been kept for thousands of years in the most archetypical memory of human beings, will disappear with these processes. Actually, it is not hard to notice that nature is introduced and re-introduced to our cities.

The question remains though, how to find an intellectual interpretation of the re-naturalization processes and how to re-conceptualize this new condition. The ways in which nature appears in cities goes beyond solutions that could be traced back to the concepts of John Claudius Loudon, Frederick Law Olmsted, Daniel Burnham or other great masters who undoubtedly gave an important impulse to the advancement of landscape design as a creative discipline. Some forms in which nature is re-introduced to our cities resonate with the heroic land art works of Richard Morris, Robert Smithson or Walter de Maria, who revealed new territories for artworks located between culture and nature, while stimulating the artistic and architectural imagination of the next generations.

Not denying the influence of the above-mentioned sources, this paper provides argumentation that the true shift, which has changed the forms of the presence of nature in our cities, came with the more general re-interpretations that took place at the verge of the nineteenth and twentieth centuries. Early modern theories of Georg Simmel, Walter Benjamin or Siegfried Kracauer marked the first steps in a pursuit toward a new perception of urban reality in which the natural and the man-made started to be perceived as an inseparable whole. Blurring the borders between the natural and the built, integrating objective knowledge with direct experience and accepting the city as an active environment contributed to the conceptualization of the city as a landscape. This was a pivotal concept that opened new perspectives toward forms in which nature manifests itself today in our cities.

2 TOWARD "CITY AS LANDSCAPE"

2.1.1 *Green parks in cities*

It became clear in the nineteenth century that densely populated and rapidly growing cities demand new solutions that focus on introducing nature into the urban fabric. John Claudius Loudon was one of the first who believed in the necessity of long term planning for providing a coherent urban system of green spaces. His plans for green belts for London and settlements immersed in nature, published in 1829, predated Ebenezer Howard's ideas and the Garden City movement for more than half a century. Almost three decades later, in 1857 Frederick Law Olmsted and Calvert Vaux proposed a project for the Central Park in New York, starting the practice of leaving green areas in cities as a common value, which marked a new

era in urban planning in America. Urban parks were supposed to compensate for the harshness of rapidly developing cities. Rocky slopes, vast plains and idyllic scenes were rooted in imaginary visions of rural scenarios and had to bring relief to hard-working people. In landscape planning architects paid a lot of attention to the composition of elements and the coherence of the final effect. It is important to notice however, that in their relation to the structure of the city, parks were defined as clearly delineated and usually fenced green islands surrounded by urban fabric.

This definition was to be changed for the first time in Chicago in 1893, when John Wellborn Root, Daniel Burnham and Frederick Law Olmsted for the World's Columbian Exposition redesigned the vast areas south of the city centre. A new conceptual challenge appeared – to create neither a green park nor a group of pavilions, but a coherent whole, a new harmony between built structures and re-shaped nature. A whole new environment was created: new buildings were erected, marshlands were dredged and sculptured into lagoons, and canals were cut through the city structure that led to a large water reservoir with an artificial island. The fair was supposed to be a case study for the future look of American cities, but in fact, this romantic vision clashed with common social problems and the visual chaos of a rapidly growing city (Kostof 1985). Daniel Burnham and Edward H. Bennett continued the ambitious redesign of the Chicago lakefront in 1909, proposing landfills to extend shoreline parks into the bay area, freely sketching their new boundaries between land and water. Nevertheless, with the Great Depression and political threats those plans gradually lost their impact and popularity.

2.1.2 *Early modern theories of movement*

While concepts of Loudon, Olmsted, Vaux, Bennett and other great masters still remain clearly visible in currently applied landscape design strategies, today's processes for re-naturalizsation of cities have been deeply influenced by an important shift that took place at the end of the nineteenth and the first decades of the twentieth century. Interestingly, it was not focused on nature. With the emergence of early modern theoretical concepts, architects, sociologists or even filmmakers launched the pursuit toward a new perception of urban reality – the city as a landscape. Urban space started to be perceived in motion, from the perspective of walking – a concept embraced by Charles Baudelaire and later expanded by Georg Simmel, Walter Benjamin and many others. There is a strong interrelation between the specific "wandering practice" and the emergence of landscape experience in the urban environment, as Heinz Paetzold highlights (Paetzold 1998). Anthony Vidler (2000) indicates that a wanderer "sought to recapture the primal resonances of natural paths in the urban labyrinth". Urban space resembling "volcanic landscapes" was cut with "nomadic routes" (Vidler 2000). Walking through the streets, creating new paths and discovering yet unknown places, resulted in the application of certain geographical metaphors and techniques for depicting "urban topographies", as for example "urban mapping". This noticeable change in the vocabulary marked a very specific launch toward the conjoined presence of the natural and the built in urban form, and also created conditions for understanding many different components constituting urban environment as one whole.

The shift toward denying the opposition between culture and nature has been related to questioning the long lasting dichotomy between objective and subjective in the perception of the city. Urban space sublimed into the notion of landscape was no more a neutral scenario but rather a concept constructed in the eyes and mind of the observer. Consequently, the act of walking through cities not only provided neutral knowledge based on purely visual stimuli but also became the source of a closer, haptic perception. Such ideas were rooted in the late nineteenth century theories of Alois Riegl, who delved into relations between movement in space and perception, distinguishing between close perception in movement – *haptic* and the static, distant one – *optic* (van de Ven 1980).

Since then, the impact that space exerts on the walking observer has become an irreducible factor in many descriptions of urban territories. It also became a fertile leitmotif in early modern cinematography, investigated at that time by such filmmakers as Siegfried Kracauer, Sergei Eisenstein, or Fritz Lang. As Guliana Bruno (2001) points out, the moving insights into the life of the early modern city, so well conveyed by cinematic images of that time, were a powerful source of experiences which made them parallel to walks through eighteenth century gardens. Moreover, as Bruno points out, "Historically, the activity of site-seeing developed largely through garden strolling, especially through picturesque gardens". In both environments the landscape "moves" the observer, both in the literal and metaphorical sense, letting the internal and external geographies overlap (Bruno 2001). At this point it is worth noticing that the eighteenth century gardens could be considered as brave experiments on achieving the unity of the constructed environment by integrating nature and architecture, often by means of in-between elements like grottos or fragments of walls.

2.1.3 *Modernistic compositions*

In spite of the potential of those ideas, modernism marked a strong comeback to rationalistic suggestions and solutions for urban planning that offer sober compositions of geometric blocks against the background of nature. It is true however, that a significant part of modern strategies dealt with the issue of the re-naturalization of cities. Construction on pillars left an abundance of space beneath the building, which at least theoretically allowed the nature to smoothly pass through. High-rise buildings allowed the possibility of leaving vast open spaces around, which could be conceived as green areas and aimed at compensating the lack of nature in cities. There were masterpieces built, like Lafayette Park in Detroit designed in 1956

by Ludwig Hilberseimer and Ludwig Mies van der Rohe, which even today still offers a very interesting quality of life "halfway between the city and the countryside" (Del Bo 2013). On the other hand, it is important to notice that the modern approach to nature was extremely anthropocentric, as Wolfgang Welsch argues (2002). According to Le Corbusier's declaration issued in 1925, architecture has to be a "seizure of nature by man" and "an act of man against nature". As Welsch comments, it is one of the manifestations of the "hopelessly misguided modern picture" that could be expressed as "man against the rest of the world" (Welsch 2002).

2.1.4 *Environmental concepts*

While modernism was thriving and geometrically perfect plans were admired from the bird's eye view, the quest toward blurring the opposition between nature and culture, objective and subjective, man and the environment had continued. The idea of "kinaesthetic consciousness" with the concept of the body as the centre of experience presented in Husserl's phenomenological writings, along with the later investigations of Marcel Merleau-Ponty, formed the influential background for critical re-interpretations of the relation between human being and the urban reality. Equally important were the pragmatic theories of John Dewey. According to this philosopher, while experiencing we are immersed in the environment, not distanced from it. Dewey's ideas undertaken later by Arnold Berleant gave impact to the emergence of environmental aesthetic in the last third of the twentieth century (Wilkoszewska 2006). Environmental aesthetics goes beyond the appreciation of the isolated object of art proposing aesthetic appreciation of both natural and human environments (Carlson 2011).

Although environmental thinking had rather limited influence on the twentieth century urban planning, it was an important factor in the emergence and development of art in the sixties and seventies, mainly Process Art, Environmental Art and Land Art. Hans Haacke's words can be regarded as symptomatic for artists' aspirations of the time: "make something (…) which always looks different, the shape of which cannot be predicted precisely, make something that cannot "perform" without the assistance of its environment" (Robins 1984). Artists such as Michael Heizer, Richard Morris or Robert Smithson renounced the construction of art objects "in favour of the creation of experiences related to the environment" (Lailach 2007). Sculptures were not created as "independent configurations" but "as a way of intensifying, of making the landscape itself into another space" (Robins 1984). Heizer's "Double Negative" project of two deep cuts through the plain of the desert invited the visitor to experience the impact of such "another space". Artists were experimenting with elements – with massive earthen forms, geometrical shapes covered by grass, water, qualities of light, or the energy of lightening.

Noticeably, walking was recognised as the most sublime artistic act. George Trakas constructed



Figure 1. Broken Circle by R. Smithson, Emmen, The Netherlands. Photo L. Nyka.

"transforming passages" and let the viewers travel along articulated artistic paths. Some artists like Nancy Holt or Robert Smithson became involved in the idea of making passages though or over the aquatic pools. Smithson stressed the importance of the physical presence of water. In order to cumulate this experience in his Broken Circle project, the viewer walks along the shoreline and continues the journey along a circular structure, gradually discovering the situation of remoteness and isolation (Fig. 1). Fading paths, stones carefully arranged in lines, and cuttings through the earth for creating subdued passages marked the new forms of artistic expression. Artistic endeavours were not focused on creating art objects against the background of landscape but rather on making an intervention seamlessly integrated with it. Most of the works were experiments on the unclear borderline between the natural and the built. As such, they revealed original paths toward discovering new relations between architecture and nature that are manifested so remarkably today in the landscape of the city.

3 RE-NATURALIZATION OF CITIES

3.1.1 *From urbanism to landscape urbanism*

In the last two decades of the twentieth century perception in motion, the value of connecting paths, and understanding the city as a changing environment became visible in urban interpretations once again. Researching philosophical and anthropological interpretations of everyday practices, Michel de Certeau analyses the "rhetoric of walking" and argues that making shortcuts, poaching on others' territories, or creating individual paths could be interpreted as opposition to modern strategies dedicated to the masses (Certeau 1984). Recognising different spatial narratives has become a stimulating source of concepts both in research and education. As Vaso Trova notices, "sequencing, setting boundaries, revealing or concealing, gathering, opening, etc. are common cultural practises with strong spatial character found in all kinds of urban contexts, as well as in design projects at different scales (Trova 2008). As a result, a new set of aspirations has appeared even in the official

documents issued by municipalities, as for instance: how to make a walk through the city "kinaesthetic" and "haptic" (Abbate 2005).

The idea of movement as a source of urban experience and conceptualization of the city itself as an active and changing environment has resulted in the re-emergence of the concept of urban space as landscape (Nyka 2006). This shift from structures to landscapes in understanding urban condition brings about important redefinitions. Firstly, it opens new ways toward incorporating many different factors, from environmental conditions to social and cultural forces into design project. It should be emphasized that urban planning is not isolated in this regard – the notion of a landscape is evoked nowadays in many fields of research, from archaeology to the humanities. Referring to the construct of landscape enables understanding of many facts and places, shaking them off from their analytical isolation, as Christopher Tilley argues (Tilley 1994).

In effect, elements of nature along with their visible and invisible influences are discovered as valuable components of urban landscapes, and they are being re-introduced to cities. Sound, as an integral component of any environment, is consciously integrated into architectural forms (Borucka 2015). Water appears inside to support the elemental qualities of architecture (Nyka 2007). Natural and built integrate in conceptually new ways, challenging the long-lasting opposition between culture and nature. Accepting the integration of natural elements and the man-made structures in urban design contributes to the formation of hybrid landscapes. Urbanism transforms into landscape urbanism and becomes a powerful notion. It is based on the assumption that there is no juxtaposition of the object and its environment – they are intertwined into one inseparable whole, being a part of both, a cultural and environmental context. Consent for the open coexistence of the natural and the built in the constructed urban landscapes gives new insights into the idea of re-naturalization of cities.

The ongoing process of re-naturalization manifests itself in different layers and can be seen in many scales, both in urban planning and design strategies, and also in original design solutions for buildings. This issue has a long tradition of research carried out within the Master Programme design studio in the Faculty of Architecture, at Gdansk University of Technology in Poland.

3.1.2 *Buildings as landscapes*

Students have answered the question of topographic characteristic of the built form on the basis of individual design concepts. In many cases public spaces of buildings have been conceptualized as paths, spread between interior and exterior, organized as the connecting lines that lead the observer through different environments. Projects have been focused on investigating the characteristics of the interior pathways, the way they constitute public space of the object, and relate it to the surrounding. One of the basic findings

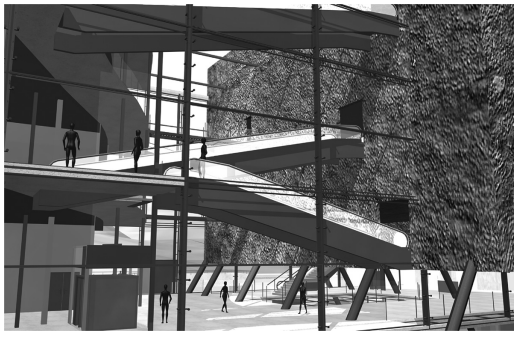


Figure 2. Shi-ga Museum. MA diploma project, author: P. Szewczyk, supervisor: L. Nyka. Gdañsk University of Technology.



Figure 3. Himalayas Expeditions Museum. MA diploma project, author: M. Skołucka, supervisor: L. Nyka.

was that the organization of spaces along the connecting lines dissolves the boundaries between inside and outside.

With unclear contours between the inside and outside, buildings are designed as landscapes. Walking through buildings becomes parallel to walking through geographical formations – valleys, plateaus, or passes (Fig. 2). Greenery is allowed to pass through interior spaces, architectural structures merge in their composition with the tectonics of land, interweaving with natural elements. This reference to the characteristics of landscape is fully interrelated with the search for haptic qualities of architecture. In the Himalayas Expeditions Museum project, the visitor is gently guided along stony walls, exposed to wide openings directed toward the high mountains scenery. Then the way continues among topographical formations, including the icy climbing block located in the hall (Fig. 3 & 4). In such a situation the building is not only located in the environment, but takes its sense from it. It is shaped to encompass the surrounding and invites it to the interplay with simple concrete walls.

While these kinds of architectural experiments have initially been implemented predominantly in situations with open landscape, they are gradually being introduced to cities. A good example of this is the design proposal for the Design Factory, which is to be located on the Gdansk University of Technology campus (Fig. 5). Design Factory will be a space where students can conceive, develop and implement interdisciplinary and transdisciplinary group projects. In the presented

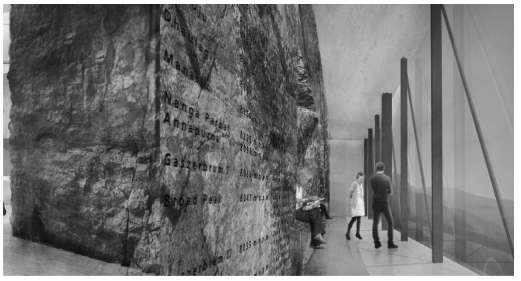


Figure 4. Himalayas Expeditions Museum. MA diploma project, author: M. Skołucka, supervisor: L. Nyka. Gdańsk University of Technology.



Figure 5. Design Factory. Architectural design studio. Authors: P. Puciłowska, M. Gerszewski, R. Gajda. Studio leader: L. Nyka. Gdańsk University of Technology.

design solution, an ascending path connects two parts of the campus and gently cuts through the green hills. This simple gesture gives the designer an opportunity to engraft into the slope a barely visible architectural structure. Cultural context, time-related programmes and environmental conditions – particularly the necessity to interconnect the existing green spaces into a coherent system – were integrated into the design concept. It is believed that the hybrid spatial characteristics of this object based on the presence of greenery that pours into the building, earth formations, and minimalistic geometry of the interior structure, will stimulate students' imagination, providing an inspiring scenario for innovative projects.

Numerous experiments on the re-naturalization of cities through architecture involve applying media and interactive technologies. It has already been proved that technology may effectively support the sensorial qualities of space (Urbanowicz, Nyka 2012). Moreover, it could be noticed that the strong urge toward re-introducing nature to cities coincides with the interest in exploring the role of media images in urban landscapes. When properly implemented they can collaborate with the environmental characteristic of buildings and urban spaces.

3.1.3 *Constructed urban topographies*

Numerous processes of transformation that take place in post-industrial areas provide inspiring opportunities for undertaking experiments on landscape urbanism. Development plans for such territories are not only focused on creating continuities of public spaces that would reconnect them with the city centres, but also on strengthening ecological systems. This gives a chance for the creative re-invention of relationships between built form and nature. These issues became dominant in the project focused on urban renewal of the former port territories located north of Gdansk on the Vistula River in close proximity to Wisloujscie Fortress.

The student's objective was to locate there a Media Technology Institute with a whole set of accompanying spaces both open and enclosed. The Institute was supposed to serve not only the students but also a broader community of people willing to visit exhibitions, attend some courses, or just come by while walking along the neighbouring shoreline areas.

To answer these demands different patterns of paths were sketched as a first step toward integrating various parts of the area together and relating them to the system of pedestrian circulation routes. Subsequently, the concept revolved around the ecological forces that have been shaping the area for ages. In fact, the boundary between land and water has been changing here many times throughout history, which became very inspiring. Firstly, alluvial deposits brought along by waters had been altering the shape of the riverbed, creating temporary islands and shallows. Moreover, the land was cut by differently shaped water moats built as a part of fortification systems. Those waterlines were often accompanied by monumental bastion formations. Referring to this history of changes, the Institute has been designed as a set of geomorphic volumes spread over the area, incrusted with new waterlines and a whole set of artificial islands (Fig. 6). Not only are the geomorphic forms in some way site-specific in this place, but they also do not compete with the Wisloujscie Fortress. Moreover, the green areas that spread along shorelines and continue to the roofs of the buildings increase the amount of biologically active surfaces. In effect, it could appear that located on the blurred boundaries between the natural and the built a new genre of urban environment is emerging.

This pursuit of the site-specific characteristics of cities is supported by the ongoing ecological shift. There is a strong surge in urban planning to go beyond the methods of, as De Meulder (2008) expresses, "clean urbanism" – devoid of any influence of primal natural conditions (De Meulder & Shannon 2008). Today architects and urban designers are relating their projects to characteristic geomorphologies, with water flows or ecological continuities. This strategy goes beyond the idea of decorating the city by means of introducing nature.

Wolfgang Welsch warns that the oversimplified strategy of decorating the city with nature leads to failure. "Nature, or other transhuman aspects, is not to be additional ornament, but must be inherent to, must co-determine the very form of architecture" (Welsch 2002). All this contributes to the perception of a city



Figure 6. Multimedia Art Center. MA diploma project, author: A. Popławska, supervisor: L. Nyka. Gdańsk University of Technology.

as a site-specific construct negotiated in particular geographic and topographic conditions.

In effect, even small parcels in the city can be understood as a part of the broader ecological systems. The role of an architect is to make the environment visible by means of both built structures and natural elements. In this meaning, the environment is constantly re-discovered and re-created by the architect and urban designer. Nature is consciously and willingly involved in this re-creation of cities. This situation extends the traditional vocabulary of architects who work on artificial topographies, green corridors and passages through urban structure, or reclaim historical water canals and reservoirs. Importantly, re-conceptualizing the urban condition as landscape condition involves understanding it not so much in terms of picturesque image, but most of all as a human environment with its potential to foster creativity and to stimulate both personal and collective experience.

3.1.4 *Between anthropocentrism and ecocentrism*

At this point it is important to look closer at the ongoing conflict between anthropocentrism and ecocentrism – two opposite approaches relating to the presence of nature in cities. The ecological one is often criticized for its too narrow perspective, which is reduced mainly to the recovery of biodiversity and care for ecological systems. Unfortunately, as many landscape designers comment, nature is recognized within this approach in a very limited and traditional way. Environmental advocates continue to attend to an objectifable nature that they believe remains external to culture, James Corner indicates (Corner 1999). At the same time followers of the anthropocentric approach tend to neglect natural qualities of the environment – as opponents argue.

It seems however, that no matter if the attitude toward landscape is conservative or advancing the discipline, there is a growing agreement that there is no such thing as nature; nature is being constantly transformed by man (Wilkoszewska 2006). In this context the two approaches, although different in background and objectives, may not be in direct conflict. Even with growing sensibility toward ecological values, it is hard to imagine returning urban areas to their former ecosystems. Equally hard is to believe in a convincing and culturally ambitious landscape project created in isolation from natural flows and forces.

4 CONCLUSIONS: NEW LANDSCAPES AND SOCIETAL CHALLENGES

We can see clearly today that we introduce to cities our concepts of nature. In urban environments we may encounter adventurous nature augmented by media images, or engrafted into intermediate elements that are neither buildings nor topographies, and which are in some ways analogous to those introduced almost three centuries ago by Alexander Pope and William Kent. In the processes of re-naturalization of cities it is important to realize that there is no such thing as nature, there are different natures: naturalistic barren lands, pastoral scenes, green passages cutting through buildings and technologically enhanced ephemeral gardens. By understanding and taking advantage of this situation of an under-defined or openly defined nature, architects may shape the urban environment so it has the power to inspire us and make our lives more creative.

While the new genres of public spaces and building typologies are emerging, a crucial question appears as to how this refers to social changes. First of all, it is critical to realize that landscape does not only respond to social changes; landscape is a mirror of a changing society. Through history there has been a convergence between artistic vision of the landscape and social changes that transform cultural landscapes, as Denis Cosgrove argues (Cosgove, 1998). Landscape is a way of perceiving the world. Landscape is a social product; it is a consequence of the collective human transformation of nature (Frydryczak 2014).

As Cosgrove (1998) points out, the idea of landscape evolved and was elaborated for a long time as a product of elite consciousness, until its impoverishment in the late nineteenth century; "The significance of landscape declined again during the period of major social change in the late nineteenth century. (...) It no longer carries the burden of social or moral significance attached to it during the time of its most active cultural evolution" (Cosgrove 1998). It seems however that this decline was rather a crisis, the unavoidable erosion marking the starting point for its transformation and reappearance in urban conditions. Landscape appears today as an important category for the interpretation of urban spaces and a powerful tool for their integration. Conceived in different scales, it fosters the emergence of new methods for stimulating urban renewal with new genres of public spaces and building

typologies based on the inseparability of the natural and the built. Nowadays, landscape can be seen in this process of reappearance as a creative environment for human activities, with its power to stimulate people and support their identity within the particular cultural and geographical conditions in which they live.

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Transdisciplinary design framework and a NZE future for the city

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ABSTRACT: Our Transdisciplinary Design (TDD) mode of inquiry has evolved over eight years and is globally transferable, replicable, and scalable. Our conceptual framework for TDD encompasses hybridized progression, co-production, and manifestation. Building on the body of transdisciplinary scholarship, we call our framework "Speculative Normativism". Built on a foundational, "comprehending vision", linear in the temporal dimension, highly integrative, and shaped by complex contextual perceptions, capacities, and flows, the method is made operative within the "Territory of Hybridization and Co-Production" where design agency, transformative action, and co-production moves past singular disciplinary expertise toward projective contributions. To illustrate our framework, we tell the story of co-production among academics, students, professionals, and the community to address grand challenges, create a Net Zero Energy (NZE) prototype structure which collects solar energy, rainwater, creates a public realm to support active learning and training, and generates energy, educational opportunities, and equity in Detroit. The prototype represents a catalytic act in a larger vision to achieve a NZE future for the city, and launch a next generation in TDD.

1 INTRODUCTION

1.1 *Transdisciplinarity in action*

We wish to share the story of our evolving transdisciplinary framework and associated method, and a now eight year collaboration between architects, urbanists, engineers, and STEAM educators at both the University and Elementary level, funders, partners, and in co-production with the Detroit community (broadly defined). The research, pedagogy, and design is led by studio [Ci] and collaborating faculty in the Colleges of Architecture + Design and Engineering at Lawrence Tech University (LTU) in partnership with the Detroit Public Schools (DPS), the Tireman neighborhood of Detroit.

Our Transdisciplinary design collaborative is inspired by and contextualized within an emergent paradigm of architecture and urbanism labs and firms which embrace systemic and hybridized methods and engage diverse disciplines and partners to address sustainability through infrastructure networks at the scale of the ecosystem, including rvtr (Thun et al., n.d.), Lateral Office (White, 2012), and P-Rex (Berger, 2009). Currently, studio [Ci] is in the process of implementing a Net Zero Energy (NZE) project to advance the design and technical disciplines by generating not only renewable energy, water, and waste reduction, but also scalable and replicable public realm, educational and training opportunities, and a new economic model for the Tireman neighborhood of Detroit. The prototype project evolved out of a broader vision to make a 20 sq mile (5038.3 hectare) neighborhood of Detroit a NZE community, to achieve an alternative, equitable, and sustainable ecosystem for the city, and design generative infrastructure interventions for energy, density, and nature. We proposed an "energy farm" which hybridizes photovoltaic energy and rainwater collection systems into an innovative canopy and public realm that achieves shared goals for the cultivation of the next generation, and achievement of urban sustainability, growth, and equity (Bodurow, 2010).

To test the vision, our transdisciplinary team has designed a NZE structure which collects solar energy and rainwater and supports education and training in an outdoor classroom with learning gardens. The prototype will allow us to test our design for large scale generative NZE infrastructure at the Sampson Webber Leadership Academy (SWLA), a pre K–8 Detroit Public School (DPS), and surrounding neighborhood context (designated Innovation Ecological in the Detroit Future City Framework). The Team has designed, modeled, and will eventually build and test the [sw]LAB NZE prototype (Figure 1) with seed

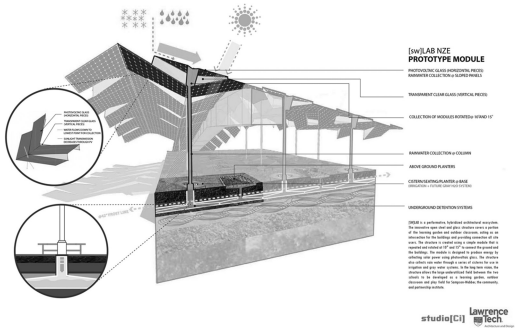


Figure 1. NZE prototype: Illustrative section.



Figure 2. Long term vision (studio[CI] 2014).

funding from a Ford C3 grant and other supporting funders.

1.2 *Background and goals*

The prototype is part of a phased, long term vision for DPS/Sampson, the site, and the Tireman Neighborhood, and represents a catalytic act in what will be a larger, replicable intervention across the DPS system and city of Detroit, reinforcing NZE/STEAM lesson plans for school children and community members, and support the long term vision of a NZE neighborhood. Our design method requires that the prototype achieve aesthetic, performative and equity goals. The project, part of a larger, long term vision, creates an "energy farm" by hybridizing photovoltaic energy and rainwater collection systems into an innovative canopy structure. The more ambitious long term vision includes a NZE canopy, neighborhood scale, collectivized micro grid, a partnership research and training institute, and enhanced public realm (Figure 2).

The prototype was scheduled to be installed in spring 2016 and is designed to be a replicable prototype to generate renewable energy, conserve and manage water, and reinforce sustainability lesson plans which engage children and train community members through active learning. The prototype is designed to generate more than energy: it has catalyzed the stabilization and sustainability of the school and neighborhood. The Team's transdisciplinary approach incorporates "hands-on" involvement, education, and training into a project advancing not only the technical disciplines and trades, but allow students, teachers, and residents to engage in and be empowered by the initiative.

Through our TDD mode of inquiry, we asked:

- How can elements of renewable energy, water management, and outdoor learning and training be hybridized into a NZE structure and replicated to create NZE Farms?
- Can we create a neighborhood energy district (micro-grid), cooperatively owned by residents?
- Could our design intervention encourage a new educational trajectory for Detroit school children and our students through exposure to STEAM/NZE and transdisciplinary lesson plans and active learning in the public realm?
- Might we impact the disparity between wealth and poverty in Detroit and move to a more sustainable economic model?

The prototype is the result of six previous years of extensive applied research, dissemination, and design/development. Detroit's vacancy perpetuates entrenched social, economic and environmental disparities and inequities. We speculate that vacancy can be generative: of energy, wealth, and educational opportunities through NZE infrastructure.

Detroit is positioned to leverage vacancy as an asset (Bodurow, 2010). We believe our NZE, generative use design can provide a criteria-based approach for collective decision making and sustainable growth; and our design progression and interventions tested in the Tireman neighborhood, can serve as a replicable model for the entire city. This approach proposes a new economic model transferring and repurposing publicly held vacant property into a cooperative model of ownership and management for residents, generating training opportunities for the emergent renewable energy/knowledge based economy and wealth for the neighborhood. We intend this project to serve as a catalyst for the eventual sustainable redevelopment of Detroit.

The overall goal of our project is to create a unique hybridized, generative infrastructure. The NZE prototype has provided opportunities to advance the scholarship of several disciplines, for students to learn about transdisciplinary and NZE design, and to encourage the economic transformation of a resource constrained urban community. The primary objectives of our co-production include:

- Hybridize disciplinary knowledge and methods through a new conceptual framework to address several grand challenges of urban sustainability (energy independence, poverty, and equity).
- Achieve Projected Performance: prove that the energy and water collection metrics can be achieved and sustained; prove that the garden beds will thrive through the integrated drip irrigation system.
- Create an "outdoor classroom" that reinforces and supports lesson plans which provide educational opportunities for Pre K-8 school children and training opportunities for community members in NZE and for the knowledge-based economy.
- Accomplish a successful experiment and test. This prototype/pilot project will confirm the potential for replicability across the DPS system, the neighborhood, and the City of Detroit and beyond and support new research and design trajectories.

2 ANALYSIS

2.1 *Theoretical framework*

The origins of Transdisciplinarity in research and education can be traced to 1970 (Balsiger, 2004) through the social and political sciences, and the humanities. In 1987, Romanian born Basarab Nicolescu, a

theorist physicist, founded the nonprofit CIRET (the Centre International de Recherches et Etudes Transdisciplinaires) and eventually the UN study group on transdisciplinarity. Nicolescu describes transdisciplinarity as "the science and art of discovering bridges between different areas of knowledge and different beings" identifying three pillars: complexity, multiple levels of reality, and the logic of the included middle." (Klein, 2004). However, Nicolescu is critical of societal stakeholder involvement, which the Network of Transdisciplinary Research has prioritized. (I2S, n.d.)

Julie Thompson Klein, perhaps the most prolific scholar in transdisciplinarity over three decades, states "Transdisciplinary approaches" are far more comprehensive in scope and vision" and "with "transdisciplinarity"… gaps between the real and the ideal are most apparent (Klein, 1990). Initially the purview of European academics, today the method is referenced in all regions of the world (Lawrence, 2015). Increasing, transdisciplinarity, because of its essentially holistic systemic approach, is a method used to address the grand challenges facing the globe (climate change, poverty, et.al), is equated with efforts to achieve sustainability, and has moved into the design and spatial disciplines. In the first peer reviewed journal on transdisciplinarity (Lawrence and Després, 2004), and the subsequent 2015 update, architects and urban planners were included. In 2011, Springer published a volume addressing Architecture and Urbanism (Doucet and Janssens, 2011). This volume also contains a thorough definition of transdisciplinarity as distinct from other methods of combining expertise for knowledge production (multi-, inter-, post-, cross-, supra-, meta- et al.). "Transdisciplinarity is at once between disciplines, across disciplines and beyond any discipline, thus combining all the processes of multidisciplinarity and interdisciplinarity." (Lawrence and Després, 2004) A review of all recent scholarship reinforces the proliferation of transdisciplinarity in the last decade. As Klein asserts: "The current ascendency of transdisciplinarity (TD) is marked by an exponential growth of publications, a widening array of contexts, and increased interest across academic, public and private sectors." (Klein, 2014).

Our approach, framework, and methods are clearly transdisciplinary, if we are to accept the nature of previously described transdisciplinary research – which are characterized by "hybrid nature … tackles complexity … accepts local contexts and uncertainty … oriented toward action … addresses societal problems but also contributes to their solutions … bridging the gap between research and decision making in society". (Lawrence and Després, 2004) and (Doucet and Janssens, 2011) We operate in a context (primarily Detroit, MI, USA) "where social, technical, and economic developments interact with elements of value and culture, including … energy … sustainable development, and urban land and waste management … quality of life." (Haberli, et al., 2004). Our own working definition of Transdisciplinary Design (TDD) is "an immersive, collaborative, and integrative design centered entrepreneurial pedagogic, research, and practice approach, expanding diverse disciplinary boundaries to address complex systems, and to achieve urban sustainability through resultant design interventions from the scale of the structure to an [urbanized] ecosystem." (Bodurow, 2013).

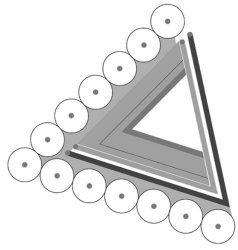


Figure 3. Transdisciplinary Design (TDD).

The notion of "gaps" (ala Klein) informs our definition and framework. We embrace the notion of expanding disciplinary boundaries and believe identifying the new territories for design agency and action is essential to our TDD framework (Figure 3). It has proven critical in moving all contributors past their singular disciplinary expertise toward projective contributions, trajectories, and ultimate manifestations. As the Holistic Education Network states, transdisciplinary inquiry 'involves multiple disciplines and the space between the disciplines with the possibility of new perspectives 'beyond' those disciplines … focusing on the inquiry or issue itself." (Hent.Org accessed 17 FEB). Indeed it is in this "space between": the new TDD territory where innovation is born and thrives in our collaborations.

> speculation, n.
> 1. The faculty or power of seeing; sight, vision, esp. intelligent or comprehending vision. Now arch.
> a. The exercise of the faculty of sight; the action, or an act, of seeing, viewing, or looking on or at; examination or observation. Obs. 4. a. The contemplation, consideration, or profound study of some subject.
> Etymology: < late Latin speculātiōn-em, noun of action < speculārī to speculate v.
> Oxford English Dictionary (accessed 21 FEB 2016)

2.2 *Conceptual framework*

We are inspired and challenged by the observation that "many contributions during the last 10 years lack a conceptual framework." (Lawrence, 2015). We offer our own conceptual framework for Transdisciplinary Design (TDD): that of "Speculative Normativism", which we have evolved over the last eight years, with more intense maturation in the last three.

In our experience, the TDD method is essentially speculative, not merely responsive, reflexive, or

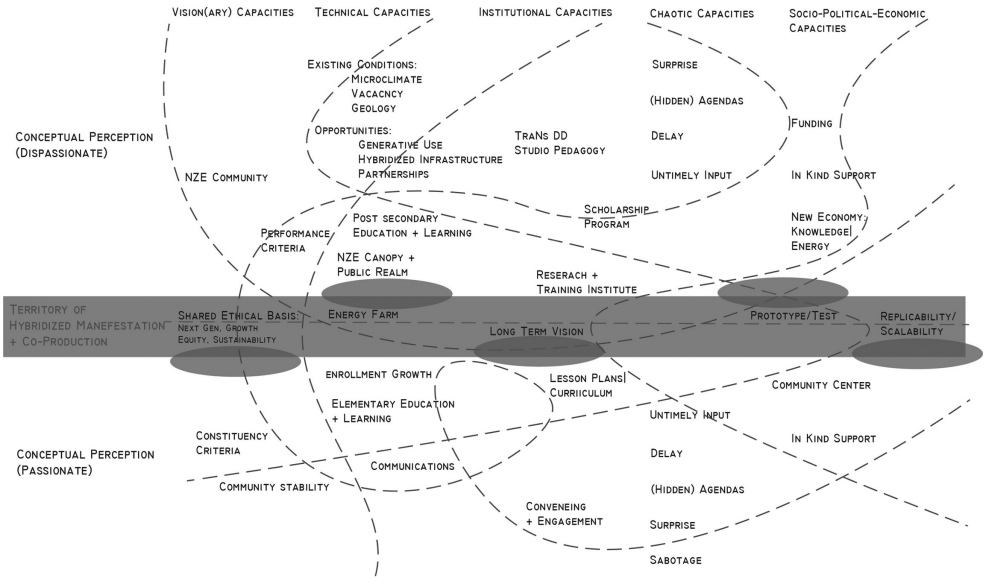


Figure 4. TDD: a new Speculative Normativism.

reflective as Schon and others have proposed (Schön, 1983). I mean no disrespect to this extensive body of knowledge, nor the scholars who created and propagated these theories (Schon was one of my first Professors at MIT and shaped my intellectual and professional future). But in order to make transdisciplinary mode of inquiry operative with an eye toward relevant manifestation outside the academy, we have included transformative action in multiple contexts (in the lab, the classroom/studio, and in the field). Our approach goes beyond the typical methods of inquiry in the spatial disciplines (drawing, modeling, etc.) to incorporate diverse generative techniques and settings, paired with active learning and co-production with diverse team and community members who bring additional capacity and expertise. Further, we do not define our method as "problem solving" or even "problem seeking", as framed by Dunne and Raby, though we do operate "between reality and the impossible" (Dunne and Raby, 2013). We have found the need for a "comprehending vision", which builds on indigenous critical mass and capacities, unites disciplines and diverse participants, allow for the integration of inputs and, eventually, co-production and successful manifestation. Our interpretation is supported by Klein, who asserts: "Transdisciplinarity requires deconstruction, which accepts that an object can pertain to different levels of reality, with attendant contradictions, paradoxes, and conflicts." (Klein, 2004).

We call our conceptual framework "Speculative Normativism" with an eye toward creating that "comprehending vision" of what is not only possible, or probable, but what should be. We feel that TDD must simultaneously have a basis in contextual and conventional social norms, yet also be prescriptive in nature, leading to an ideal standard or model. Our conceptual framework is inspired by what Klein identifies in her writing as "post-normal science and wicked problems that break free of reductionist and mechanistic approaches" (Klein, 2014). As designers, we wish our vision and expertise to result in built form. More importantly, we aspire to generate not only transformative action, but replicability, and therefore, an enduring paradigm. Linear in the temporal dimension, our TDD progression is highly integrative, influenced and shaped by multifarious contextual perceptions, capacities (including vision(ary), technical, institutional, chaotic, and socio-poli-econ) and the flows which deliver select outcomes to the territory of "hybridized manifestation" and ultimately implementation.

We have created an illustration of our conceptual framework of "Speculative Normativism" (Figure 4). Our observations are that there at least two "Contextual Perceptions" or realities in TDD: Dispassionate and Passionate. These exist on opposing sides of what we have named the "Territory of Hybridized Manifestation+Co-Production". The two quadrants are not necessarily divergent, though generally, the "Dispassionate" quadrant (and its associated inputs, forces and, production) is comprised of more technical methods, and the knowledge and experiences which are derived from these. The "Passionate" quadrant is, generally, comprised of more qualitative methods, knowledge and experiences. However, the two quadrants occasionally intersect and overlap, and participants operating within each share operative methods. The resultant co-production, illustrated on the central axis, are the manifestations which actually carry forward into implementation. Thus, this central axis represents not only intersection, but the "Territory of Co-Production".

capacity, n.
Etymology: 15th cent. capacyte, <French capacité , <Latin capācitāt-em

Oxford English Dictionary (accessed 25 FEB 2016)

1. a. Ability to receive or contain; holding power. Obs. (in general sense).

4. Mental or intellectual receiving power; ability to grasp or take in impressions, ideas, knowledge.

5. Active power or force of mind; mental ability, talent.

6. gen. The power, ability, or faculty for anything in particular. Constr. of, for, or inf.

We have identified five "Capacities" on the upper axis: Vision(ary), Technical, Institutional, Chaotic, and Socio-Political-Economic. The notion that capacity implies not only volume, but power, both individual and collective, justifies the terminology. Each of the five capacity categories contain diverse and rich talents, inputs, and forces which, in general, provide positive momentum to drive the TDD progression forward (and sometimes, keep it in stasis or present friction). On the matrix, we have arrayed in each quadrant for purposes of explanation, the specific "dispassionate and passionate" methods, inputs, and deliverables from our own NZE project. Visionary capacities are essential, as asserted, for speculation of a projected and prescribed future state. In our NZE project example, vision originated in the dispassionate quadrant, but was enriched and expanded by input from the passionate quadrant. Technical Capacities included many spatial disciplines (as described below, and also including structural and geotechnical engineers) and elementary, primary and secondary administrators and educators. Institutional Capacity came from a variety of players: Lawrence Technological University, Detroit Public Schools, and the public, private, and NGO sectors in Detroit, each with their own power. Chaos is ever present (it governs the universe!), sometimes occurring in small quantities, sometimes overwhelming. Indeed, dealing with chaos, ambiguity, and uncertainty is *de rigueur* in TDD. Examples include: (hidden) agendas, political and economic obstacles, extended timeframes, escalating costs, constant fundraising, irrational decision making, exhaustion, defection, etc. Socio-Political-Economic Capacities represent the dual blessing and curse of funding, funders, in-kind donations, and partnerships. Most positively expand co-production, but often divert focus and exert uneven influence. This capacity category also intersects with the vision(ary) category, in our case, the intention of creating a new knowledge/energy economy for the neighborhood and city. Note: all capacities are illustrated in equal size and weight, though in reality, these capacity categories fluxuate and exert their power unevenly throughout the TDD progression. Similarity, inputs and forces possess inherent dualities, and often transgress capacity boundaries.

Nature reminds us that "while matter cycles, energy only flows" (Callenbach, 2008) and is then converted from one form to another. Flows are illustrated in the matrix to acknowledge the limitations of two dimensional diagramming of such a complex, four dimensional endeavor as TDD. Flows also portray the integrative nature of our TDD progression and reveal the cross-cutting influence of the five capacities categories and their associated outcomes on the hybrid territory.

The "Territory of Hybridized Manifestation + Co Production" (again, the territory of TDD) is linear and temporal, implying origin and a projected future. This territory contains the consensus manifestations which generally move forward into implementation. An example is "Ethical Basis", which was the result of discussing and documenting shared values and goals. In our experience, inputs from either quadrant often stand alone as discreet and complete, while the manifestations which migrate to the hybrid territory tend to evolve and eventually manifest. While these consensus manifestations are generally discreet (e.g., the NZE Prototype) some have associated "gray zones" implying potential for additional trajectories, and so are illustrated as such.

2.3 *Analysis [method, empirical research]*

Our method is influenced by Mason White's notion of Disciplinary Thievery "of co-opting strands of a discipline's operative or, possibly more severe, a discipline's nomenclature, language, and identity." (White, 2012). We aspire to create new territory for architectural research and practice and new roles for designers through this melding of disciplinary expertise. Building on seven years of collaborative research, design, and co-production with each other, our students, and community constituencies, our NZE project has engaged designers in diverse pedagogic, research lab, and generative settings.

Founded as a transdisciplinary design collaborative (addressing environmental and grand challenges requires it), studio[Ci] authored the "Convergence of Intensity" [Ci] methodology and unique GeoDesign interface which enables the "coming together: of metrics [criteria] in three categories: Human [inhabitation]; Cultural [place]; and Infrastructural [ecosystem], into a spatial convergence." From 2008–2010, we collaborated with the 20 square mile (51.8 square kilometers), 100,000+ resident, Southwest Detroit (SWD) neighborhood on the Value Densification Community mapping project, which created the foundation for our current NZE project (Bodurow et al., 2009). We are primarily humanists and urbanists, but are also influenced by geography and landscape methodologies, such as Corner's "agency of landscape" which has helped shape our approach to vacancy in Detroit. While trained in scientific and technical fields, studio[Ci] is primarily expert in the spatial disciplines related to infrastructure and the built and natural environments (architecture, urban

planning, urban design, landscape architecture, civil engineering, environmental and mechanical engineering) and the agency each brings in addressing the grand challenges facing the globe. However, not all academics, practitioners, and students are predisposed to our TDD method, so recruitment and selection of team members are carefully curated. While we seek colleagues who are experts in their respective disciplines, more important are characteristics of intellectual curiosity, openness, and patience (as time expands to support the TDD collaborative environment and address the inevitable obstacles). As Pinson observes, "a precondition for transdisciplinarity: identifiable disciplines capable of a constructive dialogue with other domains of knowledge." (Pinson, 2004) Close and extended collaboration is required, what Despres called "mediation space and time" or Horlick-Jones and Sime called "border work" (Lawrence and Després, 2004). Klein adds: "Margaret Mead suggested that "analogic" thinkers may be more successful at handling integrative tasks than "digital" thinkers, who may be too narrow to deal with cross-cutting issues." Further, the best-suited faculty are "academic intellectuals…accountable to a wider audience, academic intellectual may have experience with concepts and problems outside academe." (Klein, 1990). This tracks studio[Ci]'s foundational values of relevance, rigor, and integrity. As Klein asserts: "there is no transdisciplinary *Esperanto*". It is "a generative form of communicative action that is context specific". (Klein, 2004). Transdisciplinarity "is simultaneously an attitude and a form of action." (Klein, 2004).

In 2010, we claimed we could make SWD neighborhood a NZE community, and then, with funding support, spent the next two years proving it could be achieved (Bodurow et al., 2012). We created a "Manifesto" based upon context, theory (Ci), and approach (Transdisciplinary Urbanism). Strongly research based, we created an emergent TDD framework, which, at the time, was more iterative in nature in order to conduct foundational research and analysis, make propositions to achieve NZE, and establish process and co-production between our team and representatives of the community.

Through our 2010–2012 effort, we observed that vacancy in SWD concentrated and arrayed itself around infrastructure and institutions, which became the basis for several specific design interventions in what we call "generative infrastructure" hybridized with nature, energy, and density. Our proposed "Energy Farms" design intervention in the Tireman Neighborhood was most favored by the community, and offered opportunities for the large scale generation of solar and geothermal energy and the engagement of many potential partners. (Bodurow, 2010) Since fall 2013, studio[Ci] has engaged in research, teaching, design, evaluation, construction, testing, and monitoring for the implementation of a prototype Net Zero Energy (NZE) structure which will be fully installed by June 2016. This evolved TDD progression is illustrated in Figure 5, with capacity (institutional, community

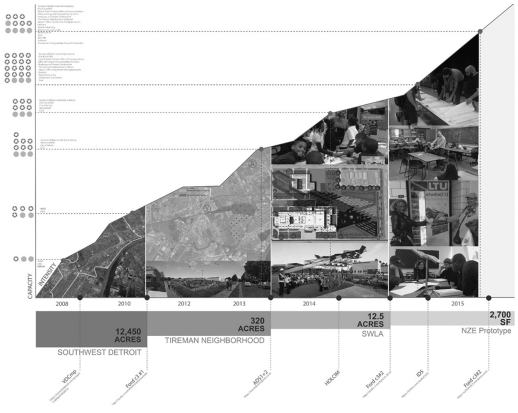


Figure 5. Method: time, capacity, intensity, geography (Bodurow et al., 2015).

and funding) on the Y axis, time and geography on the X axis, and intensity on the Z axis. The project evolved over time in its capacity (existing and emergent professional and community expertise), intensity (the form and modes of intellectual and emotional investment, creative production, and the demands of multivariate performance criteria) and geography (from city to neighborhood scale to site and built intervention. It is interesting to note that as our capacity and the intensity of our co-production increased, the geography of our intervention compressed, from 12,450 acres (5038.3 hectares) to 2,700 sf (250.8 square meters).

2.4 *Co-production and knowledge transfer*

Our team's goal was to experiment with, innovate, and hybridize NZE technologies; create and test a unique prototype structure; and work at the boundaries of our disciplines, thereby advancing them individually and collectively. Our team asked: What if students learned about NZE in elementary school? What if residents were trained and empowered to generate their own energy? What if vacancy could be generative – of energy, wealth, educational opportunities? What would this mean for the stabilization of a neighborhood, the city, their future?

The TDD method is about knowledge production, but also focused on knowledge transfer. As educators first and foremost, we have created vehicles for student engagement, both in more traditional forms and non-traditional forms, such as the development of an innovative TDD studio pedagogy, and establishment of a NZE Team Room at SWLA, allowing engagement of elementary school children in active learning around NZE (Figure 6). Learning objectives for students included gaining awareness and knowledge of transdisciplinary method in support of Net Zero Energy goals and performance metrics; acquisition of skills in the design, construction, and installation of hybridized photovoltaic and water collection systems; and direct



Figure 6. NZE Team Room at DPS/Sampson.

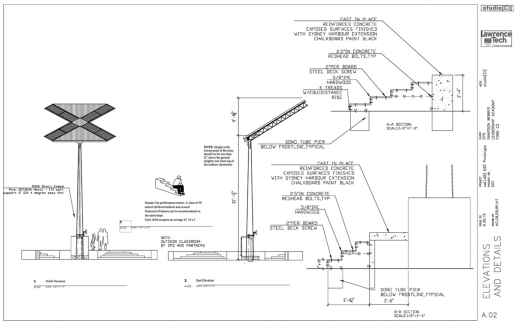


Figure 7. DD/CD set for NZE Prototype.

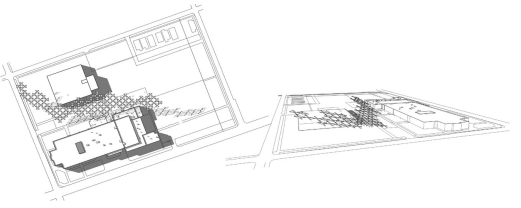


Figure 8. Array, module and canopy studies modeled on site.

experience in issues of social justice and the agency of design in addressing the grand challenges.

Co-Production is integral to our TDD progression, so we agree with "the intentional involvement of stakeholders in the definition of problems and those criteria, objectives, and resources used to analyse and resolve them." (Klein, 2015) Our transdisciplinary progression emphasizes the importance of critical thinking and altering designs to respond to dynamic conditions. We incorporate awareness, education, and training into a replicable model which allow all team members to engage in co-production.

Our TDD method encourages the integration and resolution of diverse expertise, perspectives, and values. We assemble and engage a diverse array of talented and passionate constituents. These co-producers form a team lead by faculty to realize a generative, hybridized NZE architecture and infrastructure. Complexity is assumed, and an entrepreneurial spirit and commitment to expanded time and space for interaction and integration is essential. As in all design research, risk taking, failure, patience, and persistence have equal importance to intellect, skill, and expertise. Challenges and pressures influence process and outcomes in unexpected ways.

We required that the prototype achieve aesthetic, performative and equity goals. Staying within a tight budget encouraged students to make each design iteration with care. The transdisciplinary progression emphasizes the importance of critical thinking and altering design to respond to dynamic environmental and urban conditions. Students are engaged in all aspects of the design and implementation work both on campus and in the community. Students held roles in detailed design through testing array alternatives, engaging in making; and creating details for bid and construction (Figure 7).

Architecture, Urban Design, and Engineering students engaged the project through a transdisciplinary method including curricular, co-curricular, technical, and research assistant roles and benefitted from cross college collaboration. In spring 2015, students refined a CAD Design Development/Construction Documentation (DD/CD) set and physical and digital models for the prototype. Students researched local, state and federal regulations regarding solar and water harvesting projects and interacted with the city, DPS, DFC and other partners. Students supported the bid process with local fabricators and installers and the bid set to which they contributed was the basis for our final design/structural set. Aggressive deadlines required sustained effort by the entire team, including process with DPS, the community, final design, approvals and permitting, installation, testing and evaluation.

Students advanced work on the long term vison utilizing parametric modeling to replicate the prototype array into twenty array modules, and eventually projecting the overall canopy on site (Figure 8). Students engaged project constituencies and diverse publics. In spring 2016, one Masters level student lead a weekly class of 6th graders in the design and construction of the Outdoor Classroom element, providing tutorials in 3D software and basic woodworking. Students engaged with the community and then summarized progress and created summaries for social media posts, keeping University, School, partners, funders, the general public, and the surrounding community informed. These uploads illustrate progress on implementing the prototype. ("s'CiLTUFordC3," n.d.). Using survey tools, we plan to gather data on impact to student and teacher thinking and approach. Through a prescribed monitoring protocol, we will document performance metrics and evaluate costs.

3 CONCLUSIONS

Our TDD conceptual framework of "Speculative Normativism" has evolved over eight years, served to address several grand challenges, and advanced studio[Ci]'s efforts to achieve our NZE Prototype. Our operative method has identified the "Territory of

Hybridization and Co-Production". Identifying this new territory for architectural research and practice, transformative action, and co-production has proven essential to our TDD method. We have expanded design agency, and created new roles for designers through this melding of disciplinary expertise. Any transdisciplinary method is imperfect, but we believe our mode of inquiry and transformative action is globally transferable, replicable, and scalable in resource constrained communities, and so, in our experience, the results justify the means. As important to realizing the prototype, we aspire to launch a next generation of design and engineering students who are inspired to explore Transdisciplinarity and NZE beyond their insular disciplinary boundaries in the quest for hybridized, and therefore more sustainable, design solutions.

Our NZE prototype represents a catalytic and transformative action in a much broader, long term vision for the city. Through the completion of the project and future monitoring, we intend to advance inquiry for:

- Feasibility and optimization analysis on canopy and structural systems for digital fabrication;
- Economic and financial feasibility studies for the creation of a neighborhood energy district (micro grid) cooperatively owned by residents;
- A new educational trajectory for Detroit's children and our students through exposure to NZE and transdisciplinary lesson plans;
- Work force development to train Detroit residents for jobs in the emergent renewable energy/ knowledge based economy;
- Approaches to impact the spatial inequities which entrench disparity between wealth and poverty in Detroit, moving toward a more sustainable economic model.
- Evolution of our TDD conceptual framework and method in pursuit of in order to achieve sustainability and a NZE future for cities.

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Regenerative design for achieving net-zero energy commercial buildings in different climate types

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ABSTRACT: This article discusses feasibility of achieving net-zero energy goals in retrofitting existing commercial buildings in different climate types. The objective of the research was to study how to integrate passive design strategies and energy-efficient building systems to improve building performance and reduce energy consumption of existing buildings, and to reach net zero energy goals by utilizing renewable energy sources. Based on extensive energy modeling and simulations, multiple design considerations were investigated, such as improvements to building envelope, retrofitting of HVAC and lighting systems, occupancy loads, and application of renewable energy sources for commercial buildings located in cold, mixed and hot climates. The comparative analysis of simulation results was used to determine how specific techniques lead to energy savings in different climate types and for buildings of various shapes and orientations. The research results show that it is possible to meet net-zero energy use with appropriate design manipulations and comprehensive utilization of renewable energy sources.

1 INTRODUCTION

1.1 *Background*

Net-zero energy buildings (NZEBs) contribute to reduction of energy consumption in the building sector, mitigating the environmental impacts brought by constructing and operating buildings. In the U.S., commercial and residential buildings account for approximately 40% of total energy consumption. The total end-use emissions of CO_2 from the commercial building sector was 897.9 $TgCO_2Eq$ in the U.S. in 2012, constituting 18% of the total emissions (EIA 2015). High demand for fossil fuels needs to be controlled and CO_2 emissions need to be decreased to mitigate climate change and enhance urban resiliency. To achieve this goal, one of the strategies is to reuse and effectively adapt existing buildings to improve their environmental impacts.

Retrofitting existing buildings is a viable approach for decreasing energy consumption associated with the building stock. Vast majority of commercial buildings in the U.S. (81.5%) were built before 1999, and 60% of them were built before 1979 (CEBCS 2012). This indicates that most of the existing buildings were built before the energy codes were established and extensively enforced (Laustsen 2008). Effective and reliable energy efficiency measures are able to ensure enhanced energy performance in the long run and improved occupant comfort by increasing the natural light, optimizing temperature controls, and introducing healthy building operation and maintenance systems (Tobias 2010).

Regenerative design is a design approach for existing buildings, which utilizes comprehensive sustainable, energy-efficient and resilient design methodology (Aksamija 2015). In building retrofits, regenerative design is conceived as exploration and improvement of buildings' functionality, aesthetics, human comfort, and energy performance. Different from historic preservation, regenerative design of existing buildings can be applied extensively for retrofits and adaptive reuse, allowing buildings of different types, functionalities, and sizes to be upgraded efficiently and cost-effectively.

Taking the idea of NZEB into regenerative design requires integrated passive and active design strategies, as well as renewable energy sources into existing buildings' redesign to meet the net-zero energy consumption objectives. The NZEB concept has been widely explored during the last few years as a way to achieve energy efficiency in the building sector and encourage on-site renewable energy incorporation. Considering the significant portion that commercial buildings take in the U.S. building stock and their high energy consumption level, involving NZEB methodologies into commercial retrofits will benefit the preservation of embodied energy in original construction and the reduction of operational energy.

1.2 *Literature review*

Significant research exists relating to building retrofits; however, the rate for existing buildings' upgrade continues to be low, representing only around

2.2% of existing building stock (Ma 2012). Current sustainable retrofit techniques include renovating building envelope, HVAC and lighting systems, as well as upgrading building functions, materials and building use. The challenge and barriers relating to regenerative design include existing building's size, quality and equipment (Wilkson 2012), as well as tenants and owners' acceptability, which is critical in the decision-making process for sustainable retrofit practice. Building performance is the core issue involved in the evaluation, and assessment of potential energy savings and costs must be taken into consideration. The integration of regenerative design and net-zero energy goals in retrofit projects provides challenges to practice, but offers an opportunity to embed a strengthened performance-based design approach and global energy conservation.

The fundamental objective of net-zero energy concepts is to use low-cost, locally available, nonpolluting and renewable sources to satisfy building's energy requirements. The commonly applied accounting methods are net-zero site, net-zero source, net-zero costs, and net-zero emissions (Torcellini 2006). Recent research extends the net-zero energy building methodological framework to introduce the life-cycle perspective in the energy balance, thus allowing the building's embodied energy and its components to be included in the discussion (Cellura 2014). For retrofit projects, life-cycle energy balance calculation method could be applied to acquire the true environmental influence with respect to both the consumption of energy during operation and the preservation of energy embodied in the buildings' materials, structure, and technical installations (Marszal 2011). However, the methodology to fulfill the building energy assessment and rating extension for embodied energy calculation still has uncertainties in handling the socio-economic aspects of building construction, which needs to be further explored and investigated (Hernandez 2011). In this paper, net-zero energy building is defined as a building which is able to achieve zero balance for annual energy budget with on-site renewable energy sources. Commercial office retrofit buildings were set as the study target. The study was conducted by investigating the effects of sustainable retrofit strategies on buildings' energy efficiency in different climate types and introducing renewable energy sources to meet the annual energy needs.

1.3 *Objectives*

The main goal of this research was to examine the possibility of achieving net-zero energy goals in commercial retrofit projects located in different climate types through regenerative design. The utilized research methods consisted of several aspects, including conducting multiple simulations of common commercial building prototypes under different climate conditions to test their energy use and establish baseline energy usage, and applying multiple energy saving retrofit strategies. Also, renewable energy design considerations were investigated to explore the feasibility for achieving net zero energy goals. This paper addresses these following research questions:

(1) What are the main characteristics of existing commercial buildings in the U.S.? What is the baseline energy usage for buildings located in different climates? What is the effect of shape and orientation on energy consumption?
(2) What are the appropriate strategies for improving energy efficiency for building retrofits located in different climate types? How to apply retrofit design strategies to maximize energy savings?
(3) How to make net-zero energy goal possible through adopting regenerative design method? What are the applicable renewable energy sources and how can they be used to meet net-zero goals?

The research methods included data analysis, energy consumption calculations through energy modeling and investigation of applicable renewable energy technologies. Based on the analysis of properties and characteristics of commercial buildings located in different climate zones in the U.S., energy simulations were used to investigate baseline energy usage and the effects of regenerative design methods on energy consumption. Further calculations and explorations of renewable energy sources were performed to investigate methods for achieving net-zero energy goals. The following sections describe research methods and results in detail.

2 CHARACTERIZATION OF EXISTING COMMERCIAL BUILDINGS

2.1 *Building size*

Chicago, Baltimore, and Phoenix were selected to represent three different climate zones (cold, mixed, and hot). According to the data from 2012 Commercial Building Energy Consumption Survey (CBECS), common features of commercial building within these three climate zones were determined to develop the energy models for simulations. CBECS database provides actual data about the commercial building sector in the U.S., hence allowing us to accurately analyze the building characteristics (Griffith 2008).

The survey results show that approximately 88% of total commercial buildings are less than 2,300 m^2 (25,000 ft^2), which means that most commercial buildings are medium to small size. The mean square area for all the regions in the U.S. fluctuates between 930 m^2 (10,000 ft^2) to 2,300 m^2 (25,000 ft^2) (Figure 1). The mean area per building in Chicago is 1,608 m^2 (17,300 ft^2). As the second largest seaport in middle Atlantic, Baltimore's mean area is 2,100 m^2 (22,300 ft^2). Phoenix is located in southwestern part of the U.S., and the mean area per building is about 1,400 m^2 (14,500 ft^2). Based on this data analysis, we developed prototypes and the simulation models as 1,300 m^2 (15,000 ft^2) buildings to represent the general

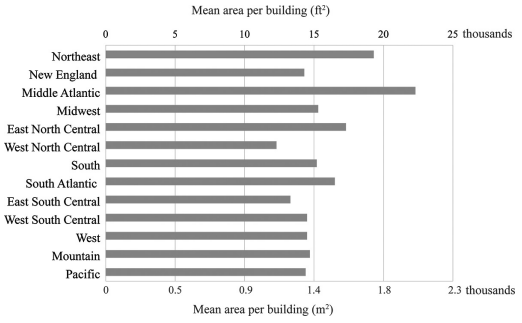


Figure 1. Mean area of commercial buildings in the U.S.

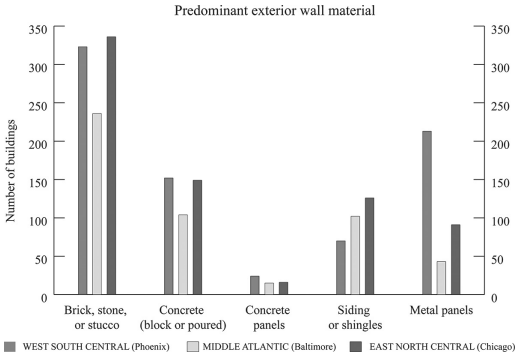


Figure 2. Predominant exterior wall materials.

condition of existing commercial building stock in the U.S. market.

2.2 *Building envelope*

To construct the energy models and set the inputs for building envelope treatment, occupancies, building systems and construction methods for existing commercial offices, CBECS data was analyzed to determine the details for each building component. For Chicago, Baltimore, and Phoenix, exterior walls for most buildings are constructed of brick, stone, or stucco, while concrete and shingle siding serves as the secondary important exterior wall material in Chicago and Baltimore. In Phoenix, metal panels and concrete are also major materials used for building envelope (Figure 2).

Roof's construction is another critical issue in determining building's energy performance. Currently, most commercial buildings located in Phoenix have metal roofing. Asphalt, fiberglass, or other shingles are the predominant roof materials in Chicago and Baltimore (Figure 3). Shallow pitch roof and flat roof are predominant roof types in West South Central, Middle Atlantic, and East North Central areas (Figure 4).

2.3 *Building systems and equipment*

Optimizing the control and efficiency of building equipment used for HVAC and lighting systems plays

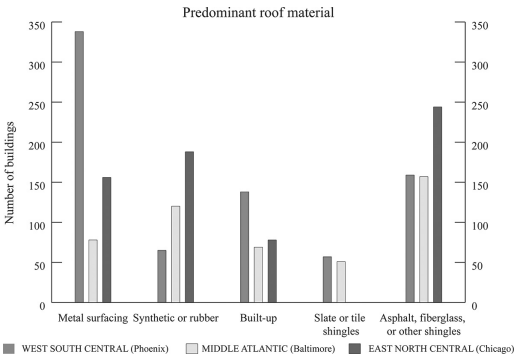


Figure 3. Predominant roofing materials.

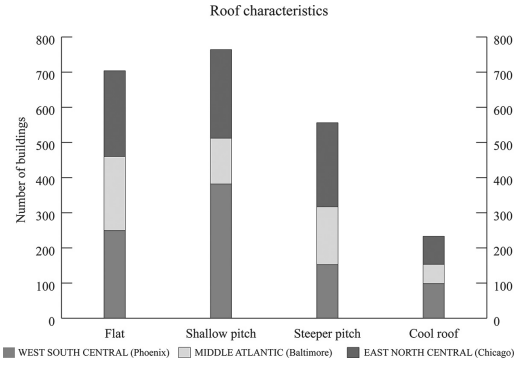


Figure 4. Roofing characteristics.

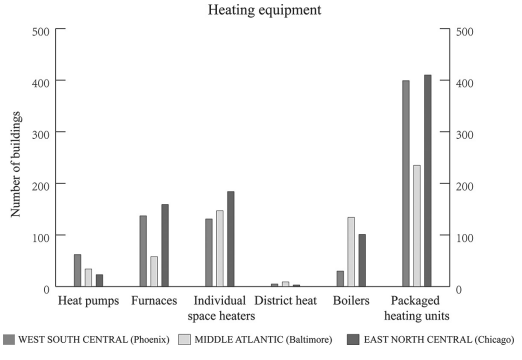


Figure 5. Heating equipment (more than one may apply).

an important role in reducing energy consumption during building operation. Packaged heating units are the most popular heating system in existing commercial buildings, based on CBECS data (Figure 5). Some other types of heating equipment, such as boilers, individual heaters, and furnaces are also widely used for heating purposes.

When it comes to the cooling equipment, packaged air conditioning units are dominant cooling systems, which are used in existing commercial properties in Chicago and Phoenix. In Baltimore, individual air conditioners are the third type of cooling equipment

extensively used in commercial offices. Furthermore, considering that lighting accounts for a large portion of commercial office's electricity's consumption, the CBECS database was analyzed to determine typical lighting equipment. According to the survey results, standard fluorescent fixtures are widely used, as well as incandescent and compact fluorescent fixtures.

3 ENERGY MODELING AND RENEWABLE ENERGY

3.1 *Simulations and energy modeling*

Energy simulation program eQuest was used in this research, where baseline models were created, as well as models representing regenerative design strategies as alternative runs. Since the building form and orientations may vary according to specific site constraints, 14 prototypes were created to represent different shapes, forms and orientations (Figure 6). For each prototype, three different models were created, representing the baseline model, and two alternative runs (low-impact and deep retrofit design options). Energy modeling was performed for all of these scenarios, and for buildings located in different climate types (Chicago, Boston and Phoenix). Therefore, 42 different energy models were developed.

The test model is described as 1,400 m^2 (15,000 ft^2) commercial office building with four stories above ground. The inputs for baseline models located in cold climate (Chicago) were selected according to the 2012 CBECS survey data for East North Central Region. The average energy use intensity (EUI) was calculated to be 398 kWh/m^2 (126 kBtu/ft^2). This high EUI suggested that most of the existing commercial office buildings in Chicago are not highly energy-efficient. The first alternative run was based on an improved model with thermally improved exterior walls, roof and windows, lower window to wall ratio for west and east facades, lower lighting power density (LPD) for functional rooms, and more energy efficient HVAC system. The results indicated that these strategies would reduce energy consumption by approximately 30% compared to baseline models. For the building envelope, adding insulation would increase the R-value of exterior walls and the roof to better control heat transfer through building envelope. For Chicago area, brick is the major exterior wall material currently used. The retrofitting measure of adding insulation to improve the R-value of existing exterior walls would have an effect on the energy efficiency and durability. Adding insulation and air/vapor barrier would increase thermal resistance of exterior walls, control moisture transport and eliminate possible thermal bridging. Building envelope upgrade also considered replacing windows, adding exterior shading and interior light shelves, contributing to energy efficiency, and improving daylight and visual comfort. Manipulation of window to wall ratio was also applied as a method to help improve the energy performance of building envelope. The model's window to wall ratio was set to 40%, in order to ensure an appropriate exterior appearance, enough access to natural light, and a well-functioning building facade system in terms of providing expected thermal performance and achieving energy efficiency. Retrofitting interior lighting fixtures to reduce lighting power density is an effective way to lower electricity consumption for lighting, and was included as one of the retrofit design strategies. Installing occupancy sensors to control interior lighting and adding daylight harvesting are also feasible measures, which were incorporated into this study. Moreover, upgrades to existing HVAC systems were included, specifically increasing the efficiency of service systems and widening zone temperature ranges for operation and set points.

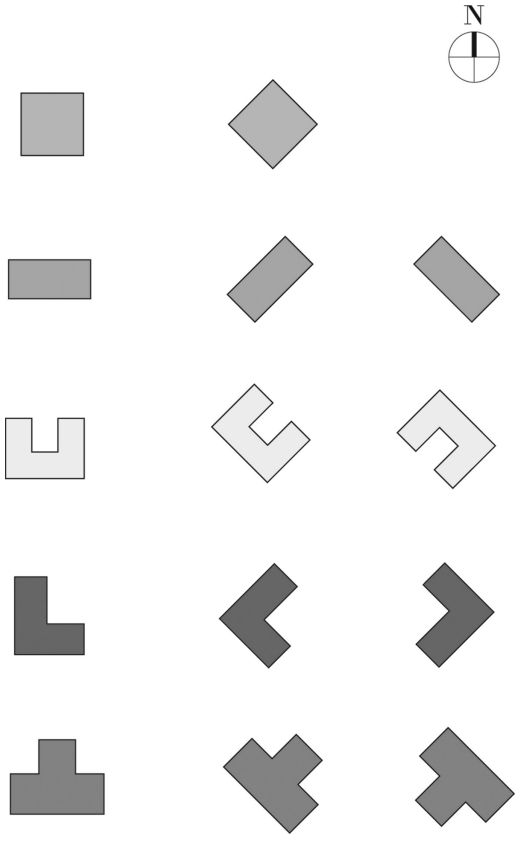


Figure 6. Building prototypes.

To achieve significantly lower end uses for heating, cooling, and ventilation, deep retrofit measurement could be taken into account, such as completely retrofitting HVAC systems. For example, radiant systems are much more energy efficient than typical VAV systems. Radiant systems also provide improved thermal comfort with lower energy consumption (Rhee 2015). The deep retrofit strategy considered retrofitting of HVAC equipment and integration of radiant systems. The modeling of radiant system in eQuest is approached by setting the system type as

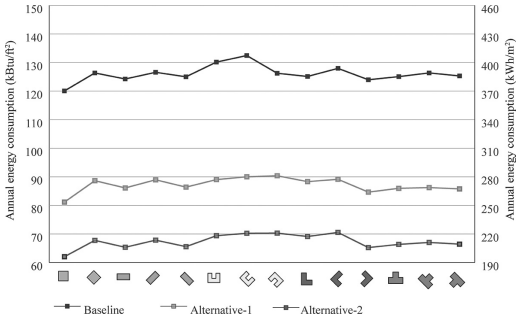


Figure 7. EUI comparison of three runs for Chicago commercial office buildings.

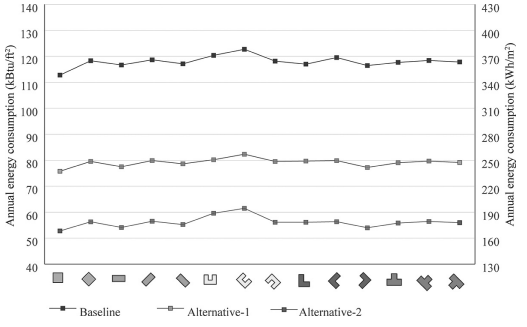


Figure 8. EUI comparison of three runs for Baltimore's commercial office buildings.

4-pipe fan coil with hot water heating. The second alternative run results were obtained after using radiant system, and they indicate almost 50% energy reductions compared to baseline run results (Figure 7).

The effects of building shape and orientation on the total energy consumption is evident in the fluctuations of EUI values. The results demonstrate that for the buildings of same size and identical systems, square shape with north-south orientation has lowest EUI, while the U-shape and T-shape buildings have higher EUI. This finding indicates that compact shape and reduced surface area benefit buildings in terms of energy performance. Also, north-south orientation for identical building shapes results in lower EUI than other orientations.

Further analysis was conducted to determine energy consumption of commercial office buildings in Baltimore and Phoenix. Baltimore has mixed climate. The results indicate that commercial buildings in this climate generally have lower EUIs than buildings in Chicago. The estimated average EUI for commercial building sector in Baltimore is approximately 370 kWh/m^2 (117 kBtu/ft^2), and deep energy retrofit could lower EUI's to 177 kWh/m^2 (56 kBtu/ft^2), shown in Figure 8. This means that 268,160 kWh (915,000 kBtu) energy could be saved for a 1400 m^2 (15,000 ft^2) commercial building on an annual basis.

The same research method was applied to study the existing commercial building stock in Phoenix.

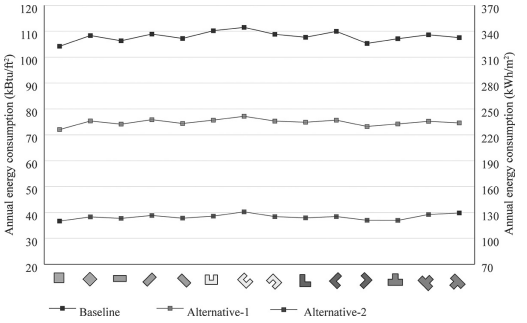


Figure 9. EUI comparison of three runs for Phoenix's commercial office buildings.

Phoenix's climate type is hot and dry, so energy demand for heating in Phoenix's commercial office buildings is not as high as for Chicago and Baltimore. Rather, cooling interior air is critical for providing comfortable thermal environment. The baseline run demonstrates that average EUI of a typical commercial office building in Phoenix is approximately 341 kWh/m^2 (108 kBtu/ft^2). Without high energy demand to maintain heating system, energy usage of commercial offices' is relatively lower compared to the computed values for Chicago and Baltimore, and mostly consist of cooling, equipment and lighting loads (Figure 9).

The energy modeling of typical existing commercial office buildings located in different climates (Chicago, Baltimore and Phoenix) and regenerative design strategies uncovered how low-impact and deep retrofit design methods would influence energy consumption. Also, energy consumption swings that are caused by building shapes and different orientations indicates that neutralizing the building envelope is a key element in energy efficient design (Hootman 2012). Improving building envelope, upgrading HVAC and lighting systems, and integrating advanced building technologies would drastically reduce energy consumption of existing buildings. Net-zero energy goals can only be achieved by lowering energy consumption as much as possible, and providing the remaining energy needs with renewable sources.

3.2 *Renewable energy sources*

Renewable energy technologies, such as photovoltaics, wind turbines, geothermal, biomass, hydropower and fuel cells can be used for buildings' energy demand. Since the monthly usage of electricity and gas was calculated through energy simulations and modeling, renewable energy sources were identified to make up the energy gap and meet net-zero goals.

The widely accepted method is to integrate high efficiency commercial photovoltaics and install on buildings' roofing system. Rooftop PV arrays enable conversion of solar power into electricity to meet the buildings' electric requirements. For commercial

retrofit projects, using grid-connected PV systems has certain benefits and drawbacks. On one hand, PV products have relatively simple configuration, so installment and maintenance are not complicated. On the other hand, the fact that most commercial buildings might have very limited space to add new components or limited roof area might reduce potential for energy generation from PVs. For a square shaped 1,400 m^2 (15,000 ft^2) commercial building in Chicago, a series of 14 PV panels, which cover 350 m^2 (3,750 ft^2) roof area, would produce approximately 70,334 kWh (240,000 kBtu) energy annually. This energy accounts for around 25% of the total energy the building needs on a yearly basis, indicating that it is difficult to achieve net-zero energy consumption with only PV system.

One alternative renewable energy source that can be considered is wind power. Building-integrated wind turbines with vertical axis are becoming more widely adopted as they can be designed as part of the building systems without occupying large area. Creative integration of wind installations is closely related to the building shape, site, wind availability and urban fabric, therefore posing challenge to existing building's retrofit (Bobrova 2015).

Hydropower system could be a possible choice for commercial buildings close to water sources. For small to medium size commercial buildings, adding site-based micro hydro system can be considered if site and location are favorable. Incentives for micro system applications are widespread, which can offset a significant part of the cost for equipment purchase and instalment (Jenkins 2013).

Fuel cell technology also has an important role in renewable energy systems. By converting the energy of chemical reaction into usable energy, fuel cells serve as renewable energy devices with battery characteristics. When it comes to implementation in the building stock, fuel cell systems could be incorporated into modular building components. The modularity potential of fuel cell lends this renewable energy source significant advantages, since flexible applications and cost-saving maintenance are possible.

To successfully achieve net-zero energy consumption, integrated design approach is required, where multiple renewable energy sources are implemented. Different from initiating a new building, retrofitting existing buildings and regenerative design have more limitations and restrictions. The orientation and the main structure of the building can hardly be modified, and the potential return on investment for new applications is critical in the decision making process. Plus, when it comes to employing renewable energy technologies, the barriers often lie in lacking local resources and installation space. For instance, hydropower systems require accessibility to on-site resources. Limited rooftop space and shading from adjacent buildings could significantly impact the usage of photovoltaic panels and their performance. Therefore, realizing net-zero energy goal in commercial retrofit projects requires the combination of passive and active design strategies, full analysis of local resources and feasibility studies, and application of multiple renewable energy systems.



Figure 10. Case study building (prior and post-retrofit).

3.3 *Case study*

In order to illustrate application of the framework and methods discussed in this paper, a case study is briefly presented to demonstrate regenerative design methods to reach net-zero energy goals for an existing commercial building. The study was conducted by authors and previously published (Aksamija 2015).

An 18,500 m^2 (200,000 ft^2) old paper mill located in Holyoke, Massachusetts was the target for the study. The climate is heating-dominated, although cooling is also needed in the warm seasons. The original building was built in 1895, and underwent several additions and retrofits over time. Currently, only 20% of the building is still used for commercial functions, and majority of the building is abandoned.

The first step in adaptive redesign was to analyze massing of the existing building, structure, and spatial organization. It was determined that parts of the building will be demolished (mainly, parts of the second and third floor), and that two additional floors will be added to accommodate new building program, which includes offices, classrooms, museum, retail space, and a restaurant (Figure 10). The middle part of the building was redesigned into a courtyard. With this retrieved courtyard, daylighting and natural ventilation were integrated as passive design techniques to reduce energy consumption. Building envelope upgrade was also achieved by improving the exterior wall insulation. Expanded polystyrene (EPS) rigid insulation panels and fiberglass batt insulation within the framing cavity were added to resist the heat flow and increase the R-value of the wall assemblies. For the top two floors, a new facade system was designed. Curtain wall system and exterior horizontal sunshades system were combined to achieve environmental optimization and energy efficiency. Biomass heating system was integrated into the building's HVAC system by combusting biomass fuels, which add to significant cost-saving, environmental, and social benefits. Since wood, agriculture residues, and crops are the most common fuels for biomass energy systems, easy accessibility to these organic matters in this region would lead to reduced delivery and storage cost. Commercial HVAC smart control system was taken into the HVAC system retrofit to facilitate intelligent integration and optimization of HVAC system components in the building.

Using simulation software eQuest to build and analyze energy model of this commercial building, it was possible to understand the energy consumption quantities, explore the energy saving potentials, and evaluate different sustainable design alternatives. The baseline simulation showed high annual energy consumption, with EUI of 379 kWh/m^2 (120 kBtu/ft^2). Deep retrofit measures incorporated control of internal loads and operating schedules, lighting, improvement in the building envelope, and retrofitting of HVAC systems. For museum, classrooms, stores and offices, different demand for interior lighting environment and occupancy schedules were taken into considerations. Lighting power density (LPD) was reduced for all spaces in the building. After applying all the possible energy saving strategies, an alternative simulation run was conducted to acquire a comparison analysis, lowering the EUI value to 164 kWh/m^2 (52 kBtu/ft^2).

According to the simulation results, it was evident that renewable energy sources are necessary to achieve net-zero energy goals. Comprehensive thinking towards energy conversion ratio, feasibility, accessibility, and cost contributed to the decision of selecting four types of renewable energy systems to work together, generating enough energy to support the operation of the building. High efficiency commercial photovoltaics were considered to be placed on the roofs. The design of PV arrays involved a series of 240 PV panels, covering 4,600 m^2 (50,000 ft^2) roof area to provide approximately 1,170,000 kWh (4,000,000 kBtu) energy annually. In addition, wind turbines were considered to be installed on top of the building to capture wind energy on site. Medium vertical axis wind turbines with 2KW generator were selected to be installed on the roof to generate about 528,000 kWh (1,800,000 kBtu) energy per year. The reasons for choosing this type of wind turbines included their high efficiency, possibility to catch wind from all directions and simplicity in mechanical configuration. Biomass and hydropower were also used in the design of renewable energy systems based on the consideration of the availability of resources. Holyoke is located in western Massachusetts area, which has rich agricultural resources, so it is cost-efficient to collect and deliver biomass materials. The last renewable energy source that was considered for the retrofit design of the building's energy system is hydropower. The location of this building was the primary reason for including hydropower. This particular building has a great potential for hydropower due to its proximity to canal and existing hydropower turbines. For this building scale, a micro hydro system is suitable for placement on the site. Combination of solar and wind energy, biomass and hydroenergy would make this retrofit building reach net-zero energy goals. Solar energy would account for 45% of the energy demand, wind energy for 20%, biomass for 12% and hydroenergy for 20%. The results show that this commercial building is able to meet net-zero energy goals after appropriate design manipulations and use of several renewable energy sources, and also illustrates methodology for regenerative design of existing buildings to meet net-zero energy goals.

4 CONCLUSION

Based on the comprehensive analysis of current commercial buildings in the U.S., their energy use and impacts of design retrofit strategies, this paper explored the possibility of taking regenerative design into commercial offices' retrofit practice to achieve net-zero energy consumption. The energy performance of existing commercial buildings needs to be improved to address energy consumption associated with buildings and address climate change. General strategies for retrofitting design include enhancement of the building envelope and optimization of the building systems. It is important to integrate high performance building envelope, advanced lighting systems, and energy efficient HVAC systems into existing commercial buildings to lower their energy consumption. Implementation of renewable energy sources to reach net-zero goals should be considered only after deep retrofit strategies are adopted to significantly lower the buildings' EUI. Importantly, net-zero energy goals typically cannot be accomplished with only one renewable energy system. Integration of multiple renewable energy systems is essential in successfully reaching net-zero energy goals. Besides the widely adopted photovoltaic systems, other renewable energy technologies must be adopted, such as fuel cells, wind turbines, hydropower, etc. However, the barriers to execute deep retrofit design still exist. Financial consideration and economic impacts are one of the most important challenges. Building owners may be reluctant to make substantial investments for the retrofit analysis, design and construction. There is a lack of research and available resources towards the cost comparison of building new and retrofitting old structures, so it is complex for most building owners to take all the potential costs into account during the decision making process. Also, insufficient knowledge of advanced sustainable design strategies, applications to retrofitting projects, as well as their benefits in the long run lead to the preference towards constructing new buildings rather than retrofitting existing buildings in some cases. It is important to improve understanding and perception of net-zero retrofits and encourage more practice to test different net-zero energy retrofit measures and verify their feasibility. Further explorations need to be made to overcome the barriers relating to commercial retrofits, identifying cost-effective and performance-based design techniques. The considerations for combining net-zero energy design strategies into commercial retrofits include the payback and investments for renewable energy systems, as well as the impacts of various design strategies on energy consumption and their costs. Net-zero design strategies are initiated by including energy saving components and advanced building systems, but their advanced functions can hardly be fully exploited if

proper management lacks in the operation. Therefore, integrated design that improves energy consumption, advanced building technologies and systems, renewable energy sources, and improved building operation are required for regenerative design of existing buildings to meet net-zero energy goals.

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Tall buildings, high expectations, towering responsibilities: Critically considering skyscrapers, urbanism and sustainability

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ABSTRACT: Skyscrapers loom large in our urban centers, defining skylines, consuming blocks and shaping social fabric (Alotaibi & Sinclair, 2015). They contain our businesses, incorporate our shopping malls and increasingly include our homes. Cities around the world engage constantly in a frantic race towards the heavens. Whose buildings will be the tallest? Where does function end and vanity begin? What contributions do these emerging edifices make to the civic realm? And, what potential do they hold for improving our quality of life? The race upwards dates back to the late 19th century when the first skyscraper was erected in Chicago, with New York City taking the lead a few years later, resulting in this typology of building dramatically evolving as time marched ahead. Until now the tall building has been considered, albeit with ample controversy and debate, a prominent symbol of a city's growth and prosperity; also representing land efficiency, economic value, corporate ambition, individual power, and great potential for more sustainable environments. The future reaches even higher while the demand for skyscrapers burgeons. However, to better meet shifting expectations, demands and responsibilities, this typology needs to be critically considered, redefined, reinterpreted and redesigned through the inter-related lenses of environmental psychology, building performance and urban planning. Moreover, there are numerous challenges confronting the tall building: issues of vertical transportation; aspects of human interaction with the building, including satisfaction of occupants' psychological and physiological needs; and attention to the urban realm, including how to better integrate the building with the city's fabric in a way that adds more value. Advanced technology in building construction and elevator systems, among others, pave the way for skyscrapers to grow taller and taller. Today's super-tall buildings are no longer single purpose skyscrapers, rather they are considered mixed-use vertical cities with many facilities and functions available to occupants & users. Structures such as the Burj Khalifa, Shanghai Tower, and Kingdom Tower, as cases in point, take the typology in unprecedented directions. Many aspects of this new breed of building need to be evaluated and explored, such as the concept of sky-streets that provide a sense Based on statistics from the Council for Tall Buildings and Urban Habitat (CTBUH, 2015), approximately 90% of future super-tall buildings will be built in these two international regions. The authors review current practices associated with tall buildings, and interpret the advanced and cutting-edge technologies realized through the development of exemplary contemporary towers. Following an assessment of a range of case study towers the researchers present a holistic approach to the design, delivery & occupation of tall buildings, bringing together different of place to the occupants and link outdoor with indoor, sky-bridges connecting towers & communities, and the inter-woven structural, regulatory, sociological, psychological, environmental, and urban ethos of such buildings. The present paper moves beyond conventional technological aspects of the tall building in order to pursue more culturally, psychologically and socially-engaged buildings. This paper addresses the present challenges and future possibilities of tall buildings by first focusing on two main geographical areas that globally dominate tall building construction: Asia and the Middle East. perspectives, and constructively considering perception, performance and place-making as central contributors to the innovation and emergence of a next generation of this remarkable architectural typology.

Keywords: Skyscrapers, Design, Planning, Place-Making, Asia, Middle East, Systems Thinking

1 INTRODUCTION

Tall building design is a complex and demanding task. There are multiple facets and factors that make this building typology unique and intricate, and thus the challenges that face designers are varied in their scope & direction. However, from the authors' view the approach used to tackle these challenges has been

proved to be narrower and more specific than it should be. There is a crucial need for integration and a holistic approach in architecture in general, and especially in tall building design. Brian R. Sinclair (2015) noted:

> "Accompanying and inter-related with fragmentation is the increasing push for narrowness and specialization. Rather than viewing and managing the world in an inclusive and holistic manner, the path today is too commonly one of the selfishness, taking care of individual before communal needs, seeking information and securing solution with a "point-of-sale" mentality, and looking almost exclusively to the short term."

The rapid development of tall buildings around the world has stressed the need to gain great clarity and understanding of the big issues facing tall buildings. There has been a preoccupation with the empirical, the measurable and the technical. The authors, however, believe that place-making, urban integration, and sustainability issues stand as neglected and essential parts of the future of tall buildings, and need careful consideration from all designers, developers and stakeholders.

1.1 *Tall building and place-making*

"Creating the sense of place is the first task of Architecture" Juhani Pallasma (2012)

The dramatic increase of populations around the world, and the migration from rural to urban areas, give reasonable justification for building tall. Tall buildings promise to achieve a greater level of density, to reduce building footprints in favour of public space, and to encourage the use of public transit – all of which will help cities to grow sustainably in the era of climate change, resource scarcity and dramatic urbanization.

From the beginning, in the late 18th century, the skyscraper as a typology was derived most notably from economic and identity factors, which led the skyscraper to generate wealth and shape a distinctive image of the city. The economic factor is related to land value, especially in the case of Chicago, in which the value of land in The Loop neighbourhood increased dramatically from $130,000 per acre in 1880 to $900,000 per acre in 1890 (Douglas, 1995). The other driving factor which was articulated in the first generation of tall buildings was the power of meaning and image-making. Rybczynski (2002) pointed out that the first generation of American skyscraper designers, especially Raymond Hood, developed a unique approach to tall building design: Nietzschean symbolism for corporate power, or architecture as advertisement. From that time onwards every step upwards was conceived as symbol of power and prestige, and cities engaged in a competitive race to have the tallest building, without which a city would lack status (Gottmann, 1966).

The two sectors that dominated the first generation of tall buildings were newspapers and insurance corporations, both seeking image and power in the city. Domosh (1988) pointed out the symbolic role of skyscrapers as a reflective image of economic paradigm changes:

> "These first tall buildings need to be understood as attempts by this new economic class to fulfill two parallel goals – to find appropriate expression for its new power and to legitimize that power by placing it within the constructs established by the more traditional elite, thereby conveying a civic as well as a commercial message."

From the beginning, the image of the skyscraper was an integral part of skyscraper design. The dilemma at present is that many designers ignore this capacity of power, and design their towers in aesthetic manners that avoid, dilute or deny cultural and social forces. In this regard, Huxtable (1984) clarified the problem that dominates the design of tall buildings: "Today architects are looking at some very big buildings in some very small ways".

The authors do not seek to classify tall buildings based on their style, but rather look to encourage ways in which tall buildings might better integrate with and reflect a more meaningful image of a city. The combination of efficiency and iconicity is a huge task for achieving the balance needed to provide a sense of place for tall buildings (Polo, 2007). For instance, Albahar Tower (Alotaibi, 2015) proves a strong example, designed in a sensitive way for its context and functioning well in numerous ways. This genuine quality is perhaps what differentiates the true image of tall buildings, over fakery, which appears in some places in Asia where the façades are ornamented aimed at uniqueness and expressionism, without any serious function (Polo, 2007). In his seminal work, Hough (1992) explained the forces that shape distinctive places and argued for the important roles of indigenous materials, basic needs, natural forces, cultural history, and changing technologies in the uniqueness of locality.

Tall buildings have become an important phenomenon in cities for many reasons; among others, they reflect specific economic activities and work as distinctive landmarks for/in a city's landscape (Gottmann, 1966). Despite the importance of the symbolic role in the built environment, and tall buildings in particular, only a few studies have sought to examine tall buildings' architecture as cultural artifacts (Rapaport, 1969, 2005; Appleyard, 1979; Harvey, 1985).

Based on question-driven inquiry rather than a problem-solving approach, the present researchers sought to examine the current situation regarding tall buildings in the developing areas of Asia and the Middle East – and especially from the perspectives of place-making, the image of a city, and identity. As well, the authors explored how those factors are embodied in the design process and reflect on the buildings' symbolism, and how the designers in both regions balance the experiential and functional needs of the occupants, developers, users and stakeholders.

1.2 *Where the towers meet the ground*

Tall buildings play a huge role in the 'living' fabric of the city – the real issue today is not about how tall buildings shape the skyline, but rather how tall buildings meet the ground and integrate with the urban realm. Tall buildings as a typology were initially and fundamentally conceived as a sky element. Thus, historically designers paid great attention to the last portion of the tower, where the tower meets the sky (i.e., where it "scrapes" the sky). On the other hand, the way the tower is developed & delineated on the ground has garnered far less attention from designers. Maybe this shortcoming is related to the visual impacts of the building's height and how people see the tower, since usually the first thing people do when they encounter something tall, is to look upward. But the city arguably benefits more from attention to the ground plan of the tower than from its interface with the heavens. An aim of the current research was to consider how best to add greater livability to the urban fabric, versus fragmenting it even further.

The way a tall building is situated in its context is integral to mediating this potent building type with the urban realm. The direct and non-direct impacts of towers on the city are huge – they can either attempt to create vivid areas at grade it or work as isolated objects that divide the city into fragmented zones that prove counter to livability aspirations. The context, relationship to transportation, permeability, microclimate or local environment, and contribution to public spaces are among the areas that need to be seriously investigated with regard to the impacts of tall buildings in/on the urban realm (Short, 2012).

Firely (2011) suggested in his study of the relationship between tall buildings and cities that it is important how these buildings are placed in the city, whether singly, in clusters, or as vertical districts. In many cases such towers are placed in ways that prevent meaningful and effective connection between activities at street level. These towers frequently operate in dehumanized and dehumanizing ways. The relationship between the inside (i.e., the tower itself) and the outside (i.e., the street level) should be treated in ways that encourage people to engage and experience, and that invite te people to use and enjoy the spaces at ground level. Regarding this point, Whyte (1980) asserted that:

> "A good integral space should not be blocked off by bland walls, it should be visible from the street; the street and its surroundings should be highly visible from it; and between the two, physically and psychologically, the connections should be easy and inviting."

The urban approach of placing the tall buildings in their context is varied: for instance the Europe approach is very different from the North American one. In Europe tall buildings are often clustered in areas out of the core of the city, which tend to be dominated by historic buildings. In cities such London we see the development of Canary Wharf and Paris the creation of La Défense. In Asia and the Middle East there are combinations of these two distinct approaches; in some cases the towers puncture the urban core based on public transit routes, such as in Tokyo, where there is no central 'downtown' for clusters of tall buildings, but where distribution depends on the infrastructure and transportation system (Polo, 2007). In the Middle East, for example in the case of Riyadh, Saudi Arabia, both approaches work together: tall buildings appear in clusters (e.g., the King Abdullah Financial District) which contain more than 66 towers with appropriate infrastructure and public transportation hubs. In contrast to this, the rest of the towers in Riyadh are distributed on the city's main roads without any due consideration to the way they are placed or to the provisions of the public transit system.

The current dilemma with tall buildings and their integration with the urban realm caused architect Moshe Safdie (2015) to raise a fundamental question that helps to frame our inquiry. In a piece entitled How to Build a Better City, Safdie questions:

> "How crowded should or can cities get? What should be driving tower design, be it residential, commercial or mixed use? Are our current planning and zoning regulations adequate in guiding this growth, in mitigating the impact of density? Or do we need new tools for a new era of mega-scale construction?"

The need for careful integration of tall buildings with the urban fabric is crucial, and the success of this integration is based on many factors such as being connected to public transportation, careful design of the podium, examining how to meet the ground plane, considering the social life of the in-between spaces that work to link the fabric of the city, and addressing the micro-climate and its direct effect on the people on the street. In the last decade there has been increasing awareness about the importance of the integration between tall buildings and urban areas, with the CTBUH recently launching an award in this category to encourage designers to pay more attention to this vital aspect of tall buildings.

1.3 *Tall and green*

Tall buildings are considered huge consumers of energy, and this reality has attracted concern from designers and developers alike. In fact the major concern is not on the general environmental performance of buildings but rather has tended to focus on one aspect: energy-saving. The present authors advocate for a much broader + more robust understanding of environmental performance versus a narrow view on energy reduction/savings. Some scholars (e.g., Goncalves, 2011) underscore the importance of real-life data to support environmental claims, and urge an examination of the validity of the figures that designers typically present to highlight savings on buildings' energy bills. The urgency here is to link together

the physical components of sustainability with cultural and social ones, and for them to inform each other (Tabb, 2013). We should work in "responsive cohesion", a term coined by Warwick Fox "to describe a state in which the various elements of a thing or process exhibit a reciprocal interaction between elements that constitute it, and the context in which it is located" (as cited in Williamson, 2003).

Thoughtful consideration of active and passive energy approaches is pivotal to create a sustainable environment, and tall buildings have a great potential to deliver this goal. Designers have many routes of action. For example, by adapting this typology of building to its particular context great strides can be realized – for example, ensuring that skyscrapers contribute to microclimates in positive ways. Sky gardens, roof gardens, elevator buffer zones, climatic-responsive façades, and solar voltaic panels are some of the principles that can be deployed in tall buildings to help to reduce energy, lessen carbon impacts, and heighten environmental responsibility.

Ken Yeang, a Malaysian ecologist and architect, is a pioneer in redefining tall buildings as a green option for future cities. He sought to adapt this type of building during a time of impending climate change, and designed early "bioclimatic skyscrapers" in the 1990s. One striking example of his integration of towers and the environment is the IBM Tower (Wood & Parker, 2013). This building was designed according to the bioclimatic approach, which relies on passive methods of generating energy, and results in a better integration with the environment. This simple system ultimately results in a pleasant and comfortable environment for its occupants (Cheung & Chau, 2005). Another watershed venture moving us towards sustainability and energy-saving is the innovative design of the Commerzbank Tower in Frankfurt [1997], by Norman Foster. This project provides a good example of the application of passive techniques to create pleasant spaces for users. The tower's 'Nine Skycourts' provide natural light and fresh air for its occupants and utilizes stack affect techniques, which help to achieve a high level of natural ventilation of 80% over the span of a year. This tower has been recognized as the first truly "Green" skyscraper (Wood & Parker, 2013).

These examples of exceptional environmental performance raise vital questions: "What is the appropriate evolution for tall building environmental performance that moves us beyond the quantitative to meaningfully consider the triple bottom line of sustainability, (i.e., technological, economic, and socio-cultural)?", and "How should the designers of tall buildings deal with the more human, softer, qualitative and experiential aspects of sustainability when building tall?"

The tendency to reduce sustainability to one of these three pillars seems to be quite prevalent in architectural practice. And the low-hanging fruit seems to inevitably be around scientific and readily measurable aspects therein. There is a strong belief in the capability of technology to solve the environment problems (Adhya, Plowright, 2015). The need, however, for a critical re-interpretation of 'sustainable' architecture, is essential. It is crucial to move beyond the empirical to also embrace the social and ecological parts of the sustainable development equation. As Adhya & Plowright state:

> "Sustainable architectural design should understand its disciplinary priorities through human well-being, integrated fitness landscapes, social development, and social hope…. This ecological approach can be catalytic in promoting sustainability as a shared 'dialogic space', where things can function in relation to others, and among various critical agencies of the society."

Sustainability is a contested terminology, with definitions posited different ways in different fields. (Guy, Farmer, 2001) sought to reinterpret sustainable architecture – they ended up classifying sustainable architecture into six logics of typology: Eco-technic, Eco-centric, Eco-aesthetic, Eco-cultural, Eco-medical, and Eco-social. This variety of typologies emphasizes the urgency of seeing sustainable architecture as a multi-scalar entity, which then compels designers to move beyond the technological sphere.

2 ANALYSES

The present research considered critical examination of two very active regions for building tall, namely Asia and the Middle East. Specific projects in these regions were examined in terms of design and development approaches as well as built outcomes (including urban integration). Learning from the consideration of cases in the regions, the researchers conceived of and crafted a conceptual framework for building tall that incorporates a much broader spectrum of facets that is propagated via the status quo (i.e., business as usual).

2.1 *Asia context*

From 1970 onward, major Asian cities transformed into remarkably globalised cities: for example Shanghai, Beijing, Hong Kong, and Tokyo. For instance, in the Chinese context, planning systems were changed from a centrally planned economy to a market economy, resulting in cities sharing the principles of neoliberal cities (Wu, 2008). Ren (2011) deliberately illustrated this phenomenon of building globalization in China by focusing on transnational architecture production, or how the governments of emerging cities in China used renowned international architects to design "branded" buildings. As stated in (5), "Chinese cities are not alone in their pursuit of prominent international architects for city branding and promotion. From Bilbao to Chicago, urban governments have competed with one another to use prestigious international architects to put their cities on the map."

However, although various architects have worked to adapt Western architecture to the Chinese culture,



Figure 1. The Shanghai World Financial Centre (courtesy Leslie E. Roberston Associates).

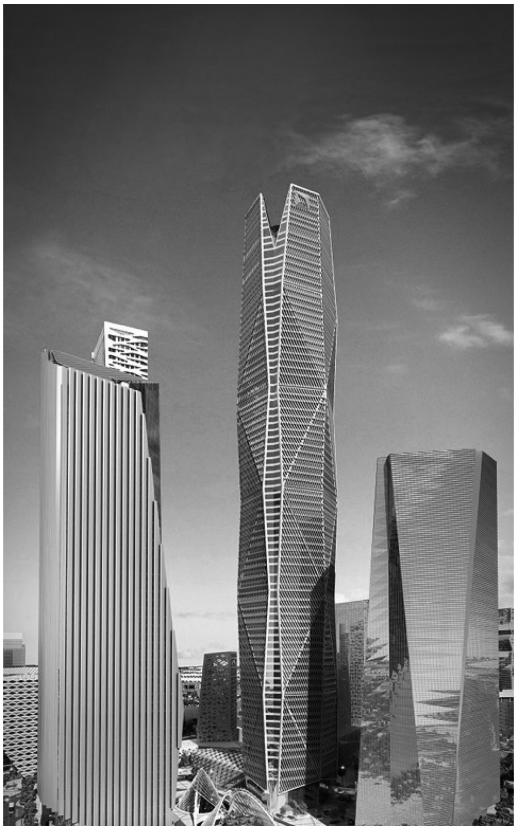


Figure 2. The Capital Authority Tower looms as the tallest building in the KAFD (courtesy HOK).

the works of Y.C. Lee stand as prominent examples for achieving better balance between the modern and the traditional. Many of his buildings were tall buildings, designed to reflect spirit of place based on his interpretations of many sources of Chinese architecture: poetry, art, and traditional architecture. Lee developed his architectural language to be inspired by local traditions. An exemplar in this regard is 'Taipei 101' – a skyscraper that deployed and successfully manifests his adaptive architectural language.

The Shanghai World Financial Centre (SWFC) stands out as a symbolic icon of Shanghai's and China's endeavours towards producing the vertical city. Rising to 492 meters, located in the Pudong District, next to Jin Mao Tower, the two towers compete in the sky to reflect the city's attitudes and ambitions. The elegant form of the SWFC results from a careful configuration of function and form. The towers' form begins with a square prism at the base with the plan tapering as it reaches heavenly.

This form expresses the ancient Chinese symbolism of heaven and earth (Wood, 2008). The bold features of the towers are the simplicity of form that symbolize the city's culture in an elegant way, and the innovative manner in which the structure was developed from a more conventional one into a novel system, thereby reducing weight by 10% and reducing materials – together making the buildings more environmentally friendly (Wood, 2008).

2.2 *Middle East context*

Emerging Arab cities have been undergoing a huge transformation, especially in changing from conventional low settlements into vertical urban centers that hold second place only to Asia concerning the total number of tall buildings constructed. Dubai launched the region's race to the sky in the early 1970s, with British architect John R. Harris (designer of the city's master plan) design of the first tall building in the region (Dubai World Trade Center). This tower was the tallest building in the Arab World from 1979 until 1999 (Alotaibi, Sinclair, 2015). In comparison Riyadh, the capital of Saudi Arabia, was conceived by the renowned planner Constantinos Doxiadis as a low-rise city. That said, the city quickly embraced the race to the sky, with the past decade seeing more than 50 towers designed and built in Riyadh. Most of these skyscrapers were placed in the new financial zone

King Abdullah Financial District (KAFD). This impressive district is a multi-phased mixed-use development, comprising 34 towers with more than 3 million square of space (O'sullivan, 2011). The master

plan for the development was designed by Henning Larsen, with directions inspired by cultural references and site geographical features – the main theme of the district was based on the passages known as "wadi" (urban elements of traditional Arabian cities) which is manifest as a rich network of interconnected alleys (Becker, 2015).

The Capital Authority Tower looms as the tallest building in the KAFD, with a height of 385 meters and comprised of 80 stories. This tower is designed in sensitive way that reacts to the intense desert climate in Saudi Arabia – this responsiveness to climatic issues is manifest in numerous sustainable features including a high-performance integrated enclosure system that incorporates solar shading, photovoltaics, façade lighting, and an innovative façade system (Soto & Al-Shihabi, 2015). The podium of the tower was conceived to provide good access for the public and to better link the towers with the urban amenities (including connecting the building to the district's notable alley system). From the current authors' perspective, urban integration is an essential aspect for successfully designing tall buildings. One compelling example for placing a tall building in ways that contributes to the city is Sowwah Square in Abu Dhabi, United Arab Emirates. Sowwah Square is mixed-used development comprising 4 towers and one low-rise office building (i.e., Stock Exchange Building). The development is located in a distinctive setting within Al Maryah Island, the four towers dramatically frame the Stock Exchange Building which is placed in the center as the heart of the project. The landscape of the area is well designed, the project is well connected to urban fabric and in strong relationship to the Gulf coast. These projects act to illustrate some of the success stories in the region.

In both the Asia and Middle Eastern context the above-noted case studies are more of an exception than the rule. The present authors underscore that the majority of towers tend to be rather disconnected from the urban fabric, tend to stand alone as sculptural objects versus community players, and focus unreasonably on technical solutions rather than holistic and integrated components of the broader city. In response the researchers engaged in an act of synthesis based on findings from the literature and the case analysis – resulting in the creation of a conceptual framework that challenges convention and aims to raise awareness (and the bar) around more complete ways of designing, developing, constructing and using tall buildings.

2.3 *The Alotaibi-sinclair framework for integrative tall building design*

In reaction to their research into and critique of conventional approaches to building tall, the authors shaped a conceptual framework intent on much greater holism and integration. The framework functions as an instrument to provoke and precipitate greater understanding of the tall building phenomenon. It is proposed as an alternative approach based on greater integration and more holistic ways of thinking. Sinclair (2015) stressed that "Integration is a vital aspect of the equation for a more sustainable environment. Our modern world is fraught with fragmentation. Communication between departments, disciplines, governments, corporations, and individuals is commonly strained and often dysfunctional. Western culture, in particular, emphasizes dualistic thinking and acting, and seeks to classify and categorize anything and everything. Increasingly, specialization of knowledge is sought and rewarded. Discrete knowledge is promoted, bounded, and protected. Silos of information and containers of knowledge are cautiously and aggressively guarded. The end result is often systems that break down, approaches that are isolated, problem-solving that is limited, and solutions that are less than effective." The present framework serves to counter such fragmentation and separation – breadth and comprehensive consideration is vital to designing tall buildings under greater pressure and facing heightened complexities.

As illustrated in Figure 3, the current situation for skyscrapers has treated these buildings as isolated sculptural objects, looming in a way to express power and prestige. End goals are primarily achieved through the implementation of technological aspects while ignoring the other essential parts of the equation. The present authors readily admit that advanced technology is inherent in the tall building typology. However, other factors such as urban, social and cultural dimensions are equally important. As mentioned previously, present architectural approaches have migrated towards narrowness and specialization – and in the instance of tall buildings, practices have focused on overly-constricted views towards some technical aspects, such as structure, envelope, and environmental systems. Furthermore the authors believe that emerging and different forces will shape the future of tall buildings, such as climate change, embrace of mixed-use models, and rapid urban growth. Also, the way that decisions on these buildings are made are highly complex, involving more input than just the designers – in fact, interdisciplinary engagement of architects, bankers, politicians, engineers, contractors and community agents, is now the norm. Thus, considering the authors' framework, tall building design must not be distilled down to fundamentally technical/technological emphases, but also must philosophically, meaningfully and operationally embrace ecology, psychology, sociology, and urbanism as equally urgent.

3 CONCLUSIONS

Tall buildings have a huge impact on the environment, playing crucial roles in creating the image of the city and offering immense potential to contribute positively to the urban fabric of our cities. A wealth of factors, including scale of construction and scope of programming, make this building typology intricate and unique. Architects assume significant responsibility to pay attention to the design process and innovate

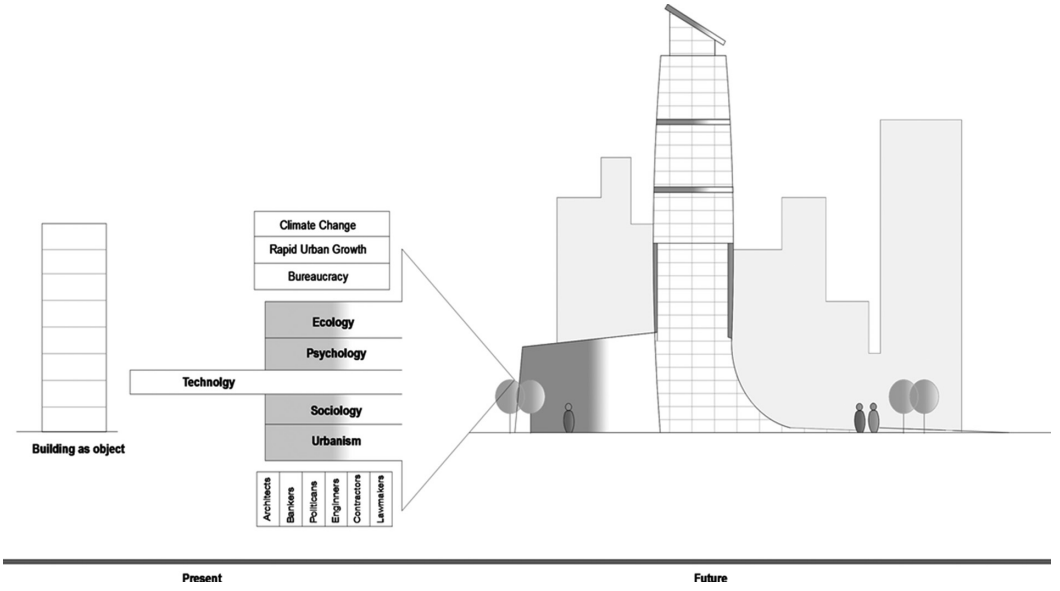


Figure 3. Alotaibi Sinclair Framework for Integrative Tall Building Design.

ways in which such projects are conceived and realized. The stakes are very high indeed. The authors stress that the approach for designing this remarkable building type is to date incomplete and lacking. Moving forward the strategies for design and development must be comprehensive, integrative, holistic and far for responsive (i.e., socially, psychologically, culturally). Examples of tall buildings in Asia and the Middle East, showcased in the present paper, illustrate movement towards higher levels of environmental performance, urban integration, and place-making. The conceptual framework presented aims to propel tall building design and development forward on a trajectory well beyond technical matters. Future studies by the researchers will continue to place emphasis on the holistic approach rather than focusing on more measurable, empirical and quantitative aspects of building tall. The surge towards even more tall buildings globally compels environmental design professionals to critically examine the role of the tall building, and in response to devise and shape the typology as significant contributors to our cities and as meaningful solutions to address our needs.

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Sustainable design and performance of architecture and landscape architecture in urban areas

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ABSTRACT: Cities are at the core of current environmental problems and, conversely, host the solutions for them. Design has a great potential to reshape cities transforming them for improved living conditions and balanced ecological systems. Among the cities' elements that contribute to sustainability are green spaces. Therefore, this paper focuses on criteria for designing and evaluating contemporary sustainable landscape located in urban areas. First, the role of urban green spaces is defined, followed by the criteria for sustainable design and performance of urban landscape architecture and architecture. Then, Washington Canal Park is evaluated as a case study, as it is a comprehensive example of contemporary urban green space with a broad approach to sustainability. The paper concludes discussing how the comprehension of landscapes designed for sustainability informs new design decisions, considering the high potential for advancing further with possibilities of integrating buildings and landscapes for multi-layered performance.

1 INTRODUCTION

Cities are the everyday environment for the majority of the global population (Haase et al. 2014). More than half of the world's population is living in urban areas (United Nations 2014). Cities are continuously growing in terms of geographical area, number of buildings, and population (Pozo Gil 2013). This growth of cities and population is increasing the demand and impact on natural resources and energy, and, thereafter, the challenges for ensuring human welfare and for preventing the increasing loss of soil, habitats, resources, and biodiversity (Haase et al. 2014; Gómez-Baggethun et al. 2013).

The endless environmental damages hitting our planet are consequences to our way of living that have been sacrificing our lives and health and, also, of all other species, while exhausting the ecosystem capacity to support human impact (Ryn et al. 2007). Cities are at the core of current environmental problems and, conversely, host the solutions for them (Griffith & Berdague 2006; Haase et al. 2013; Gómez-Baggethun et al. 2013).

Among the cities' elements that contribute to sustainability are green spaces. Since the nineteenth century the importance of green spaces in cities and towns is recognized; at that time, they were a special contribution to escape from air pollution (Swanwick et al. 2003). After the 1990s, both the quality and the quantity of green spaces became relevant as a consequence to the significant growth of the cities and the transition of the world to an urban one (Swanwick et al. 2003; Lee & Maheswaran 2011).

Therefore, green spaces play a fundamental role in cities for a more sustainable urban environment as they may provide social, economic and environmental benefits (Ignatieva et al. 2011). The effort of having urban green spaces providing multiple benefits is in consonance with contemporary high demand for multifunctional landscapes (Lovell & Taylor 2013).

In this context, design has a great potential to re-shape cities transforming them for improved living conditions and balanced ecological systems. Therefore, most projects claim for sustainable solutions, aiming for net zero carbon, water and energy, more biodiversity, and quality of life. Though, assessment of the built project is necessary to measure how successful the design solution is and to inform new solutions. Evidence and measures related to sustainable performance are imperatives, as evidence-based design is a powerful means to justify and prove the benefits of sustainability (Hamilton & Watkins 2009).

For this study, first, the role of urban green spaces as multifunctional landscapes is defined. Then, a collection, analysis, and comparison of criteria for sustainable landscape architecture is presented, considering design and performance. The criteria for sustainable design are drawn from evaluation platforms, in particular: Leadership in Energy and Environmental Design (LEED) and Sustainable Sites Initiative



Figure 1. View of Washington Canal Park (Olin 2016).

(SITES) Rating Systems; whereas the criteria for assessing sustainable performance are drawn from Landscape Performance Series (LPS).

Second, a case study is applied to Washington Canal Park. Built on a brownfield, Canal Park is a comprehensive and informative example of contemporary urban green space with a broad approach to sustainability (Figure 1). It received the AIA|DC Chapter Design Award 2013; it is certified both by LEED and SITES, and, also, assessed, in terms of its performance, through LPS. Thus, the project's claims toward sustainability and its performance after construction are compared. The data gathered from this case study is interpreted, interrelated and evaluated. Existing interrelations between design and performance for sustainability are defined and discussed.

Through these research steps, recommendations for evidence-based designs are extracted which bridge science and design, discourse and practice, while improving the means for sustainable design in a practical and reasonable approach. This provides designers with solutions for sustainable design that are informed by monitoring and assessment of projects in operation.

The paper concludes with discussing how the comprehension of landscapes designed for sustainability informs new design decisions in the field of sustainability, which in a broader scale contributes with the paradigm shift towards an evidence-based environmentally friendly designed world.

2 URBAN GREEN SPACES AS MULTIFUNCTIONAL LANDSCAPES

Landscape architecture deals with balancing the built and natural environments through a multidisciplinary approach ranging between science, design and art (ASLA 2016). Urban green spaces are among the tasks of landscape architects and architects, as they include not only parks, street trees, urban agriculture, residential lawns, but, also, green roofs and walls (Kabisch & Haase 2014).

Green spaces are a major component of cities with a huge significance in enhancing the urban environment and the quality of life in cities (Ignatieva et al. 2011). Indeed, the contemporary agenda for urban areas is related to social inclusion, health, sustainability, and urban renewal (Swanwick et al. 2003). Therefore, urban green spaces have a positive impact and contribution.

Urban green spaces provide great benefits such as social, health, economic, and environmental benefits. The health benefits of green spaces are related to outdoor exercises, stress reduction and relaxation, and primary contact with biodiversity and natural environment (Swanwick et al. 2003). Some of the social benefits of green spaces are environmental education, child development, social inclusion and interaction (Swanwick et al. 2003). The environmental benefits include: preservation and enhancement of the biodiversity, fresh air availability, noise reduction, climate extremes mitigation, sustainable urban drainage systems, carbon dioxide absorption, and opportunity for applying and demonstrating sustainable management principles and practices (Swanwick et al. 2003). Finally, urban green spaces bring economic benefits, including direct employment, revenue generation, valorization of property prices, and business and tourist attraction (Swanwick et al. 2003).

A landscape supporting multiple benefits is considered a multifunctional landscape. Multifunctional landscapes may be understood as supporting both the diversity of human needs and ecosystem functions (Canfield & Bo 2014). Therefore, multifunctional landscapes may deliver as many ecosystem services as possible. Ecosystem services are defined as components of nature, directly enjoyed, consumed, or used to yield human well-being (Boyd & Banzhaf 2007). They are the product of ecological processes and functions that support life as a result of the interaction of living and non-living elements (Miller & Spoolman 2009; Myers 2013).

The four categories of ecosystem services are: (1) *provisioning services*, which provide food, water, timber, and fiber; (2) *regulating services*, which regulate climate, floods, diseases, wastes, and water quality; (3) *cultural services*, which include recreation provision, aesthetic, and spiritual benefits; and, (4) *supporting services*, which include soil formation, photosynthesis, and nutrient cycling (Millennium Ecosystem Assessment 2005).

In this sense, multifunctional landscapes should provide global and local climate regulation; air and water cleansing; water supply retention; erosion and sediment control; hazard mitigation; pollination; habitat functions; waste decomposition and treatment; human health and well-being; food and renewable non-food products, and; cultural benefits (SITES 2014).

The concept of ecosystems services provision is in many ways embedded in the concept of sustainability. Currently, one established practice of ensuring sustainable practices in design projects is the adoption of rating systems. Therefore, follows the criteria for sustainable design and performance of urban landscape architecture and architecture.

3 CRITERIA FOR SUSTAINABLE DESIGN AND PERFORMANCE OF URBAN LANDSCAPE ARCHITECTURE AND ARCHITECTURE

3.1 *LEED v4 for building design and construction*

LEED is a rating system for project certification toward green buildings and communities in terms of design, construction, maintenance and operation. It is the green building certification program that is most recognized and used across the world. For the purpose of this work, LEED v4 (version 4) for Building Design and Construction (BD+C) and New Construction (NC) is considered. It is important to mention that Canal Park was LEED BD+C: NC v3 2009 certified. However, comparisons between the two versions were made which showed that there are not substantial differences for our analysis purpose.

In LEED, each subject being evaluated has some requirements and credits. After attending all the requirements, and depending on the amount of credits scored, a project may be certified, when it achieves from 40 to 49 points; it may be classified as LEED Silver, meaning that it scored from 50 to 59 points; LEED Gold, from 60 to 79 points; and, LEED Platinum, if scoring from 80 to 110 points.

Besides supporting an integrative design process, LEED v4 for BD+C: NC is related to design decisions about location and transportation; sustainable sites; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality; innovation; and, regional priority.

Evaluating a project for its location and transportation means valuing sensitive land protection; sites with development constraints; density and diverse uses; access to quality transit; bicycle facilities; reduced parking footprint; and, green vehicles. In terms of sites sustainability, construction activity pollution prevention is required, while credits are related to site assessment; site development considering habitat protection or restoration; open space; rainwater management; heat island reduction; and, light pollution reduction (USGBC 2015).

In relation to water efficiency, a LEED certified building must have outdoor and indoor water use reduction, and building-level water metering, while credits include, again, water reduction, cooling tower water use, and water metering. About energy and atmosphere, it is required that a project presents a fundamental commissioning and verification, minimum level performance, building-level energy metering, and fundamental refrigerant management. Besides, there are credits for enhanced commissioning, optimized energy performance, advanced energy metering, demand response, renewable energy production, enhanced refrigerant management, and green power and carbon offsets (USGBC 2015).

Materials and resources are approached toward sustainable design by requiring storage and collection of recyclables, and construction and demolition waste management planning. In addition, credits are scored by considering building life-cycle impact reduction; building product disclosure and optimization, in terms of environmental product declarations, sourcing of raw materials, and material ingredients; and, construction and demolition waste management (USGBC 2015).

For indoor environmental quality, minimum in-door air quality performance and environmental tobacco smoke control are required. Credits are related to enhanced indoor air quality strategies, low-emitting materials, construction indoor air quality management plan, indoor air quality assessment, thermal comfort, interior lighting, daylight, quality views, and acoustic performance. Finally, extra credits may be scored when projects demonstrate any innovation, regional priority, and a LEED Accredited Professional (USGBC 2015).

In the LEED v4 for BD+C: NC, from the total of 110 possible points, most possible points are related to energy, which represents 30% of total. Second most ranked subjects are location and transportation, and indoor environmental quality, which are worthy 14.5% of total points each (Table 1).

Table 1. Criteria topics of LEED v4 for BD+C: NC.

Topics	Requirements	Points	Points (%)
Integrative Process	0	1	10
Location and Transportation	0	16	14.5
Sustainable Sites	1	10	9.1
Water Efficiency	3	11	10
Energy and Atmosphere	4	33	30
Materials and Resources	2	13	11.8
Indoor Environ. Quality	2	16	14.5
Innovation	0	6	5.5
Regional Priority	0	4	3.6
Total		110	100

3.2 *Sustainable SITES initiative*

SITES is a comprehensive rating system for sustainable landscapes. It is similar to LEED, indeed the U.S. Green Building Council, LEED's developer, is a supporter and stakeholder of SITES. In addition, SITES supports and encourages projects that have buildings to apply simultaneously for LEED.

SITES' Guiding Principles for sustainable landscape design advocate for protecting existing ecosystem services on site and its surroundings; applying the precautionary principle to avoid irreversible damages; designing with nature and culture; using a decision-making hierarchy of preservation, conservation, and regeneration; providing regenerative systems as intergenerational equity; supporting a living process; using a systems thinking approach; using a collaborative and ethical approach; maintaining integrity in leadership and research; and, fostering environmental stewardship (SITES 2014). By incorporating these principles

to design, SITES values the creation of regenerative systems embedded with resiliency; provision of future resource supply and climate change mitigation; market transformation; and, enhancement of human well-being and communities (SITES 2014).

For SITES certification, projects are assessed similarly to LEED in terms of requirements and credits. The subjects considered are site context; pre-design assessment and planning; site design and water; soil and vegetation; materials selection; human health and well-being; construction; operations and maintenance; education and performance monitoring; and, innovative design solutions or exemplary performance (SITES 2014).

For site context, it is required limiting development on farmland; protecting floodplain functions; conserving aquatic ecosystems and habitats for threatened and endangered species. Points are scored if redeveloping degraded sites; locating projects within existing developed areas; and, connecting to multi-modal transit networks (SITES 2014). Pre-design assessment and planning requires using an integrative design process; conducting a pre-design site assessment; and, designating Vegetation Soil and Protection Zones. Credits are scored by en-gaging users and stakeholders (SITES 2014).

For site design and water, it is required management precipitation on site and reduction of water use for landscape irrigation. In addition, there are credits for management of precipitation beyond baseline, outdoor water use reduction, functional storm water features designed as amenities, and aquatic ecosystems restoration (SITES 2014). Sustainability in site design in relation to soil and vegetation requires the creation and communication of a soil management plan; the control and management of invasive plants; and, the appropriate use of plants. More sustainable solutions lead to scored points, such as conserving healthy soils; appropriate and special status vegetation; and, not only conserving, but also using and restoring native plants and their communities; optimizing biomass; reducing urban heat island effects; using vegetation to minimize building energy use; and, reducing the risk of catastrophic wildfire (SITES 2014).

For human health and well-being, there is no requirement for a sustainable site design, but several possibilities of credit scoring. Among them are the protection and maintenance of cultural and historic places; provision of optimum site accessibility; safe-ty and wayfinding; promotion of equitable site use; mental restoration, physical activity, and social connection support; on-site food production; light pollution reduction; fuel efficient and multi-modal transportation encouragement; minimization of exposure to environmental tobacco smoke; and, local economy support (SITES 2014). In terms of construction, it is required communication and verified sustainable construction practices; controlling and retaining of construction pollutants; and, restoration of soils disturbed during construction. Additionally, a project scores points if restoring soils disturbed by previous development; diverting construction and demolition materials, and, reusable vegetation, rocks, and soil, from disposal; and, by protecting air quality during construction (SITES 2014).

Table 2. Criteria topics of SITES v2.

Topics	Requirements	Points	Points (%)
Site Context	4	13	6.5
Assessment + Planning	3	3	1.5
Water	2	23	11.5
Soil + Vegetation	3	40	20
Materials Selection	1	41	20.5
Human Health	0	30	15
Construction	3	17	8.5
Operations + Maintenance	2	22	11
Education + Monitoring	0	11	5.5
Innovation (Bonus)	0	9	4.5
Total	18	200	100

The requirements for operations and maintenance are planning for sustainable site maintenance and provision for storage and collection of recyclables. Then, points are scored if considering organic matter recycling; minimization of pesticide and fertilizer use; reduction of outdoor energy consumption; use of renewable sources for landscape electricity needs; and, protection of air quality during landscape maintenance (SITES 2014). Education and performance monitoring are not required. Their criteria are: promotion of sustainability awareness and education; development and communication of a case study; and, planning for monitoring and reporting site performance (SITES 2014). In conclusion, SITES rating system offers a possibility of scoring bonus points in case of innovation and exemplary performance (SITES 2014).

The two most scored subjects in SITES are related to soil, vegetation, and materials selection in site design, that all together represent approximately 40% of total possible points. And the subjects that have more requirements are site context, assessment and planning, soil and vegetation, and construction (Table 2).

3.3 *Landscape performance series*

The Landscape Architecture Foundation through two programs, being Landscape Performance Series (LPS) and Case Study Investigation, is playing an important role on research about landscape performance of built projects. These programs are based on case studies of high-performing multifunctional landscapes. They focus on landscape quantitative and qualitative data and the health of its ecosystems, people, and economies.

Landscape performance is defined as a measure of effectiveness with which landscape solutions fulfill their intended purpose and contribute to sustainability. Evaluating the performance of built projects may

contribute to improve the quality of designed and planned landscape toward sustainability. Landscape performance measures aim to inform design decisions and knowledge, public policy, to reduce investor risk, and to improve return on investment (LAF 2016).

LPS provide resources about sustainable land-scape performance through case study briefs, facts library, metric tools, and theme collections. Through these means, they are contributing to enhancing sustainable landscape design and to disseminate sustainable landscape value.

There is no rating system in LPS. For measuring landscape performance benefits, LPS offers a set of measurement tools which are related to one or more benefits. These tools are online calculators that may be comprehensive when able to measure several benefits, or very specific (LAF 2016). The benefits from landscape performance may be estimated during design process or when actual measurements of built projects are not available. The evaluated benefits are land; water; habitat; carbon, energy and air quality; materials and waste; social; and, economic (LAF 2016).

The benefits related to water are: stormwater management, water conservation, water quality, flood protection, and water body/groundwater recharge. Habitat benefits measure populations and species richness. Land benefits consider soil creation, preservation, and restoration. Benefits related to carbon, energy and air quality measure energy use, air quality, temperature and urban heat island, carbon sequestration and avoidance. Reused and recycled materials together with other strategies for waste reduction are other valued benefits for landscape performance (LAF 2016).

Considering the concepts from these three systems for enhancing sustainable practices, Washington Canal Park will be the following object of study.

4 WASHINGTON CANAL PARK

Washington Canal Park is a model of contemporary sustainable urban park located in Washington DC designed and built from 2009 to 2012. It stretches over three linear blocks, summing 3 acres from approximately 1,000 feet long and 100 feet wide. It is a former brownfield, that served as a parking lot for school buses, transformed into a vital and sustainable urban environment.

The park is named after Washington Canal that ran in that area back in the 1800's. Three pavilions were designed also as a site historical reference to floating barges that were a common feature of the old canal (AIA DC 2013). The pavilions host a café and dining area with 65-seat, a stage, and a storage room. Olin Studio designed the park while Studios Architecture designed its buildings.

Canal Park offers a very diverse programming besides the restaurant and the stage. It has an interactive fountain with programmable jets in the summer, ice rink in the winter, lawn and gravel areas, sculptures, an interactive light cube where art work and other things are displayed, and social and cultural events (Canal Park 2016).

The park's major environmental aspect is to collect and manage storm water from the site and its surroundings while satisfying most of the park's water needs. It has a rain garden that works as a storm water collection basin filtering and directs the water to an underground storage tank. It was also designed to collect storm water from the roofs of adjacent buildings. Cisterns hold up to 80,000 gallons of runoff. With this system, recycled storm water is reused for majority of park's irrigation, toilets, fountains and making ice demands (Figure 2).

In addition, it has 28 geothermal wells that contribute to reducing the park's demand on energy, together with the use of energy efficient lighting (Olin 2016). The park's buildings were built with harvested wood; they also have green roofs, natural ventilation through operable screen panels, and they may rely on reused water for the toilets (AIA DC 2013). The park presents a strong educational component for sustainability. Also, it became a social reference in the neighborhood where people take their pets for a walk, office workers have lunch, families attend for playing with water or ice features.

Washington Canal Park is an endeavor of public-private collaboration that enhanced the value of existing and future real state development in its surroundings. The fact that the park is close to a metro station makes it accessible to other people from the city and allows the use of public transportation contributing for traffic, air pollution, and fossil fuel consumption reduction. It is important to mention that the park offers electric car charging stations, which contributes to make this technology publicly accessible.

Washington Canal Park was awarded two certifications, being LEED and SITES. After construction, its performance has been measured and the results for that are presented in the LPS. Considering these facts, Washington Canal Park is assessed through the lens of those evaluation systems.

4.1 *Canal Park, LEED, SITES and LPS*

Canal Park was certified as LEED Gold (LEED for New Construction and Major Renovations v2009) on 2014. It achieved 65 points of 110 points which means 59% of possible points. In this system, the project scored all points possible for water efficiency and innovation; and, 24 of 26 points possible for sustainable sites. It also scored high in terms of indoor environmental quality, 11 of 15 possible points. It received almost one-third of total points for energy and atmosphere, and approximately one-fourth of total possible points for material and resources. Finally, it did not score anything in regional priority and integrative process (USGBC 2014).

The park also received SITES Three-Star Level Pilot Certification. It scored 164 points of 250 possible

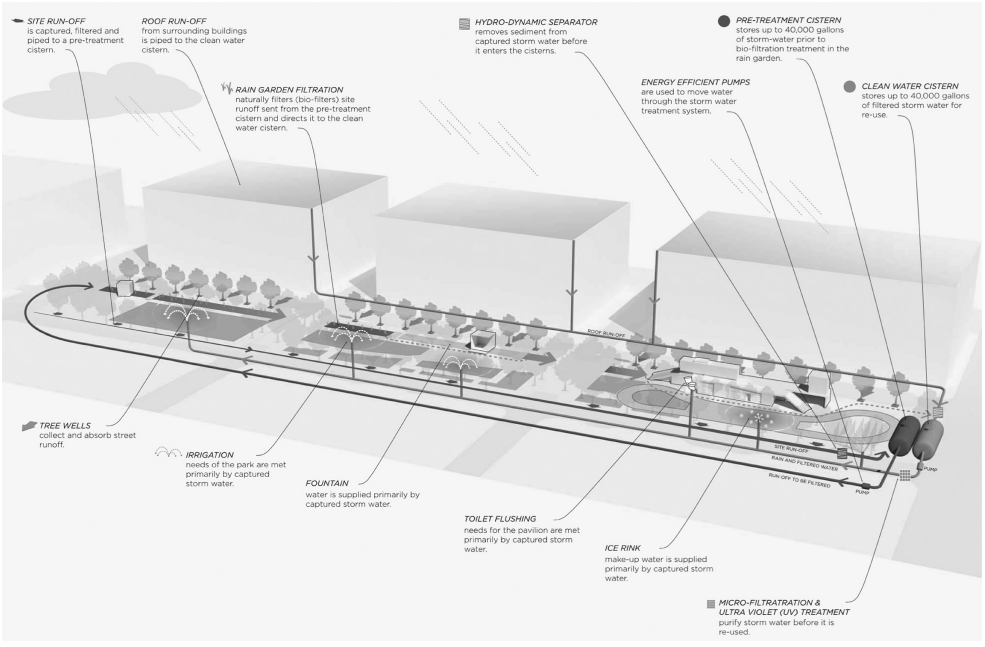


Figure 2. Stormwater management system (Olin 2016).

points, which means approximately 66%. Therefore, it is SITES certified in a close percentage range as it did in LEED.

In SITES, the park scored the total points for site selection, assessment and planning, and monitoring and innovation. For human-health and well-being, it scored 27 of 32 possible points. However, it only scored 25% for materials selection; and approximately half of possible points for site design and water, site design and soil and vegetation, construction, and operations and maintenance (SITES 2013).

LPS highlights Canal Park's many sustainable performance benefits. Being the environmental benefits mostly related to the high efficiency of the stormwater management system, as it captures and treats 95% of average annual runoff from the site and neighboring streets with perspectives for collecting and treating also the storm water from surrounding buildings roofs. Consequently, 88% of potable water is saved with stormwater reuse, which may reach 100% as stormwater from surrounding buildings roof are collected. In addition to environmental benefits, there is an energy consumption reduced by 12.6% with the use geothermal energy for heating and cooling of the large pavilion that hosts the restaurant and with efficient light fixtures throughout the park. Finally, 100% of residual concrete, brick, block, and asphalt from construction was recycled, which contributed to greenhouse gas emissions reduction (Salazar et al. 2015).

Social benefits of the park are reflected by the high number of visitors with an average of 58 visitors daily and 28,000 visitors for one-year long. Also, the park is perceived as well-designed by most of its visitors, while providing inviting spaces for social interaction. Further more, the park contributes to safety perception on site and neighborhood, and to 18% decrease of vehicular speed in the street sections that cross the park (Salazar et al. 2015).

Economic performance benefits sum up 43 jobs provision for low-income people and members of the local community; the generation of 100% of the funds needed for park's operation through the events, ice skating rink revenues, and rentals; and, increased property values in 1% more than the rest of the city during the same period of time. While contributing to the growth and development of the neighborhood, the park is also contributing to the generation of more tax revenue and jobs. In addition, by reducing potable water consumption, water cost is saved. On the other hand, the use of certified wood increased the cost of the project in relation of conventional wood. However, in a macro scale it contributed to savings with broader sustainable benefits (Salazar et al. 2015).

5 DISCUSSION

5.1 *About LEED and SITES*

Comparing SITES and LEED, it is observed that the emphasis on energy is considerably higher in the latter. Energy efficiency is mentioned four times in different topics in SITES, but the system does not have a specific topic dedicated to energy, neither any requirement for energy efficiency. Although it is known that energy consumption is not as critical as water consumption in green spaces, it should be highly considered as a great collaboration for the surrounding buildings through

energy production, for example. About water, both systems consider it with approximately same weight in the total of possible scoring. In terms of materials, SITES awards two times more percentage points than LEED.

In addition, while LEED values sustainable sites with several possible points related to this topic, SITES does not consider sustainable building construction on-site for scoring. Making it part of the formal SITES rating system would definitely make a difference for valuing and considering all the built elements of a site toward sustainability.

Both systems consider the importance of multimodal transportation, but only LEED awards points to parking footprint reduction. This is intriguing as parking lots are a critical element against good and sustainable urban landscape architecture. LEED does not have any educational component, nor consideration for on-site food production, while SITES does. There should be a greater incentive for educational purpose in buildings. As people tend to spend more time in buildings than in open spaces, the former could offer a potential approach for increasing the perception and enhancing the behavior for sustainability.

On the other hand, SITES does not mention acoustic performance, as LEED does. Acoustic performance could be considered in both rating systems, while LEED may continue evaluating it for indoor environmental quality, SITES could consider it for noise reduction in urban open spaces.

5.2 *About canal park*

LPS highlights many of Canal Park's ecosystem benefits. However, it does not mention anything about heat island reduction, or any relation with climate mitigation, besides storm events. Adding to that, biodiversity or habitat issues are not mentioned either. Even being a small park, it provides green spaces, which certainly have some contribution to both climate mitigation and habitat provision. Canal Park was assessed according to the criteria proposed by LPS, which are based on the ecosystem services. However, most data related to the park's performance are directly linked to the project and documentation from LEED and SITES within their boundaries and requirements. In this sense, LPS should make it clear how comprehensive or specific is each case study they present in relation to the broad approach and criteria for ecosystem services that they propose.

Despite limitations of methods and application of the post-occupancy evaluation conducted by Olin and Capitol Riverfront BID, it has a positive aspect for the project after construction, especially because it demonstrates the sensibility about the importance of monitoring performance. Olin's research was part of the requirements from SITES, however the methods for monitoring social performance could be enhanced for a more comprehensive understanding of the social mechanisms and more conclusive results.

Some issues about the park's performance are related to systems that are not working as designed and predicted, such as water reuse for toilet flushing. The appearance of the reused water in the toilets did not satisfy the users. Even with explanation about the sustainable system and its safety, public dissatisfaction conduced the park's manager to switch the toilets for city water use. In this sense, there is a relevant need to overcome the cultural barrier for water reuse in toilets. In addition, the collection of stormwater from adjacent buildings' roofs was not implemented. Some buildings have been redeveloped after the park's construction and they were not connected to the park's system as proposed by the park's project.

6 CONCLUSION

There is a high potential for advancing further with possibilities of integrating building and landscape for efficient and comprehensive environmental performance, such as exemplified in the Canal Park proposed system for stormwater collection from adjacent buildings' roofs.

Canal Park definitely has more benefits then the ones presented by LPS. Probably because of time limitations for conducting the performance research, not all benefits were able to be explored and measured. Also, it should be taken into consideration that the impact and benefits of an urban green space goes beyond its site, as it is one element of a bigger interrelated ecosystem. Canal Park is a small urban park, but if considered as part of a green network other benefits could be highlighted from its performance.

While acknowledging cities' dynamics and constant changing and adaptation, for urban sustainability, it is necessary to have regular monitoring of projects that should be responding to changes without losing their sustainable characteristics. Therefore, urban spaces design for sustainability is about accepting adaptation, through flexibility of systems and program, without losing sustainable performance, or better, enhancing performance.

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An autopsy of an environmental tragedy: 1995 Chicago heat wave

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ABSTRACT: In July 1995, a heat wave struck the City of Chicago causing 739 heat-related deaths in few days. This paper provides a comprehensive analysis of the outdoor and indoor environmental conditions that occurred in July of 1995. We selected three sites in which two residents have perished which represent different architectural and urban conditions. Site climate data were synthesized using microclimate simulation. The generated climate data is then used to estimate the internal conditions. Estimated interior conditions have shown a two-day time lag between the outdoor and indoor peak heat stress. This research established that heat-related fatalities are likely to occur in extreme heat episodes if the air-conditioning fails and the residents were frail, unable, or unwilling to spend the nights elsewhere. The results also demonstrated that trees and vegetation may reduce the impact of Urban Heat Island (UHI), but will not negate the extraordinary conditions created by a heat wave.

1 INTRODUCTION

1.1 *Chicago heat wave 1995*

In July 1995, a heat wave struck the City of Chicago causing 739 heat-related deaths in eight days. According to the Bulletin of the American Meteorological Society (Kunkel et al. 1996), a brief but intense meteorological incident occurred in the Midwestern United States. By July 13th, the air temperature peaked at 41°C (106°F). In the next five days (11th–15th), the temperature kept rising. A weak cool front slowly began to provide relief the Midwest from the 15th–17th (Kunkel et al. 1996). Due to the high demand for electricity, the city suffered from widespread power disruptions (Klinenberg 2002). These power outages that left over 49,000 citizens without air-conditioning (Thomas 2015) had devastating consequences on the health and safety of the most citizens of Chicago.

Starting with three victims on the 13th, the numbers climbed the next two days quickly to 181 (Whitman et al. 1997; Semenza et al. 1996). The death toll resulting from direct heat-related causes between the 14th to the 20th amounted to 485 residents of Chicago. Finally, after the event ended and the epidemiologist compiled their statistics, over 739 excess deaths were counted. During this brief period, there were 1072 (11%) more hospital admissions than average and 838 (35%) more than expected among patients aged 65 years and older (Semenza et al. 1996).

1.2 *Heat stress*

The Cook County Medical Examiner Office (CCMEO) defines heat-related death as one that occurs with "no history of trauma or evidence of fatal injury."

Table 1. Demographics of the Victims*.

Age	Non-Hispanic White	Non-Hispanic Black	Total
<55	27	42	73
55–64	19	44	69
65–74	62	62	125
75–84	87	63	176
>84	47	45	258
Total	242	256	514

*Data expressed in excess deaths which accounts for morality figures above observed in July 1995. Source: (Whitman et al. 1997).

The definition requires that the measured body temperature was 40.6°C (105°F) or higher before or immediately after death (Whitman et al. 1997). Significant to this study, the CCMEO suggestion that there should be evidence that the environmental conditions at the death scene reached 37.8°C (100°F) or more (Whitman et al. 1997). Since the majority of these deaths happened indoors, the estimation of air temperature could be used to verify the CCMEO stipulation.

Table 1 shows that the majority of the victims were elderly males, who lived alone (Klinenberg 2002; Whitman et al. 1997). A study conducted in Epidemiology Program Office and the National Center for Environmental Health using multivariate analysis showed that more than 50% of the deaths could have been prevented if the victims had a working air-condition system (Semenza et al. 1996). Other risk factors include bed confinement, ambulatory restriction, and lack of companionship (professional or familial). The study showed that individuals with

pre-existing medical conditions accounted for a significant percentage of the deaths (Semenza et al. 1996). For a heat-wave episode to cause this level of mortality, evidence showed that a series of environmental and societal conditions have to prevail. In fact, sociologists attribute the large number of victims to urbanization, poverty, overwhelmed city emergency infrastructure, and safety (Sheridan & Dolney 2003; Dolney & Sheridan 2006; Ebi et al. 2006).

A number of comprehensive studies have linked morbidity during heat waves to heat stress index (Hartz et al. 2012; Kaiser et al. 2007). Heat stress index is a two-parameter environmental index that estimates an equivalent temperature by combining the effects of dry bulb temperature and relative humidity (Belding & Hatch 1955). However, thermal comfort is a complex physio-psychological phenomenon that necessitates the inclusion of multiple environmental parameters such as; dry bulb temperature, relative humidity, ambient mean radiant temperature, air and movement with human metabolic rate and clothing insulation (Fanger 1970). It is defined as "condition of mind that expresses satisfaction with the thermal environment" (ISO 2005). Thermal sensation and thermal comfort are related phenomena. On a scale of −3 cold, −2, cool, −1 slightly cool, 0 neutral, 1 slightly warm, 2 warm, 3 hot, values of 2 and 3 represent heat sensation levels that may cause heat stress. Fanger identified three parameters to achieve thermal comfort; heat balance, sweat rate, and mean skin temperature (Fanger 1970). Deviation from the full achievement of these parameters causes discomfort (Epstein & Moran 2006). Sensitive populations – elderly and those with preexisting vascular diseases – tend to be more likely to be affected by local thermal discomfort. A study conducted in the school of Medicine, University College London found that the elderly demonstrated poor judgment of ambient temperature and consequently were unable to control the temperature. These studies demonstrate a clear connection between the indoor environmental conditions and the elderly as a group vulnerable to heat stress. The body of vulnerable persons responds to high thermal stress conditions by increasing their heart rates, increasing body temperature, thus stressing their respiratory function beyond its capacity to adapt.

Individuals exposed to thermally stressful conditions may have their health severely affected and may lead to death. Upon stress, the thermoregulatory system that distributes heat throughout the human body fails to accommodate the need for the competing organs including the blood flow to the skin. (Parsons 2003). With sweating, the human body loses sodium and potassium (Niosh 2013). If this condition persists, the sweat glands will begin to swallow if the air is humid (Niosh 2013). Prolonged exposure to this leads to a decrease in sweating which consequently causes the skin temperature to rise. In turn, the core body temperature rises rapidly (Parsons 2003; Patz et al. 2000). At 38°C–39°C (100.4°F–102.2°F), the individual exposed may collapse, at 40°C (105.8F) core temperature, heat stroke will likely occur (Abderrezak & P. 2002). Men over 40 years old represent over 50% of fatal heat stroke cases and 25% of the non-fatal cases (Niosh 2013).

1.3 *Research questions*

Despite the rich body of research work connecting heat waves and morality, it became evident to the authors that the impact of individual structures and urban conditions remain largely unstudied. Based on extensive review of the literature, the research team developed the following research questions:

a) Was the temperature at the building sites where individuals died differently from those measured at the airport due to the Urban Heat Island?
b) Was building type, height, or urban morphology significant factors affecting the outdoor environments adjacent to where the victims lived and died?
c) Did the individual building design affect the indoor environmental conditions conducive to heat stress?

The intent of this study is to estimate through computational methods and simulation the indoor environmental conditions prevailing during the heat wave. The resultant data will be used to gauge the potential human stress caused by these circumstances.

2 RESEARCH DESIGN

2.1 *Climatic data*

Historical climatic data measured at O'Hare Airport were collected from NOAA's website. The data were measured on an hourly basis but a few hours were missing. The researchers used fourth order polynomial curve-fit routines to construct complete hourly data sets (dry bulb temperature, relative humidity, wind speed and direction, and cloud cover).

2.2 *Sites selections*

Three sites were selected in the city of Chicago to represent three morphological conditions; dense urban, less dense urban, and suburban. The other criterion for site selection was that at least two victims died at the same address. This data was collected from the Chicago Deadly 1995 Heat Wave: an Oral History website (Thomas 2015).

Site #1 is located in a northeastern area of Chicago. It is a brick four-story building with multi-family residential units. The area is fully covered with concrete pavement, asphalt roads and parking lots (Figure 1). The only vegetation on the site in 1995 were mature deciduous trees on the streets and alleyways. The trees create deeply shaded areas near and at the back of the residence of concern. Due to privacy issues the research team cannot identify the specific buildings



Figure 1. High-density Urban Site #1. Source: Google Earth.



Figure 2. Low-density Urban Site #2. Source: Google Earth.

or the residents who perished in it. The two individuals who died in this neighborhood died on the 18th of July.

Site #2 is located in a neighborhood on the Southside of Chicago (Figure 2). The majority of the deaths in this neighborhood occurred on July 15th–17th. The apartment building is located on a broad right of way containing a four lane street and two one-way streets. Approximately 50% of the site surface is covered with structures, 35% with dirt and vegetation, and 15% with asphalt and concrete. Most of the other structures are also four-story apartment buildings except a church and two residential towers at the Southeast corner of the site. One tower is 50 meters high, and the other is 72 meters (236 ft.) high. Site #2 is representative of lower income, residential neighborhoods that are a mix of medium and high-density apartments in a fairly open urban setting. Vegetation (Trees and green lawns) are sparse but provide comprehensive coverage of the buildings in the general area.

Site #3 represents an impoverished low-density neighborhood with suburban-like single-family pattern (Figure 3). The site is covered with grass (front and backyard) and some street trees. Additionally, some mature trees are located near the house under investigation. The lot is surrounded by neighboring houses and is located on the main road with a secondary road located behind it. The unit studied is about five meters high (15 ft) and represents a typical residence in this neighborhood. Deaths occurred at the site on July 14th.

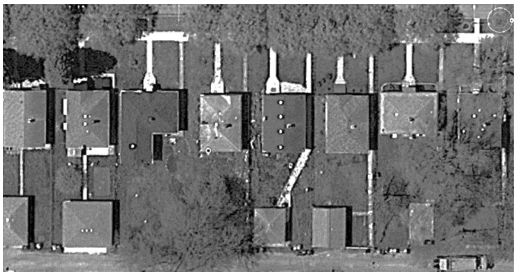


Figure 3. Suburban Site #3. Source: Google Earth.

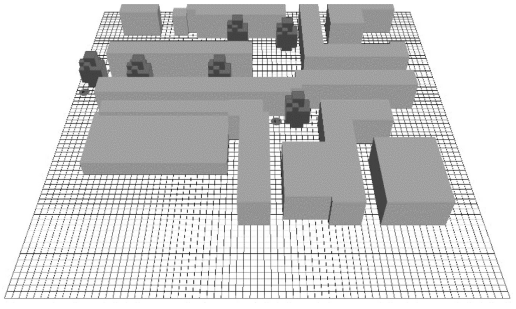


Figure 4. Envi-Met Model for Site #1 (Example).

2.3 *Preparing models for microclimatic simulation*

Three-dimensional models were constructed in Envi-Met. Building dimensional data were collected using Google SketchUp Pro. Envi-Met is a non-hydrostatic microclimate modeling system that is used to simulate surface-plant-building interaction in urban spaces. It uses a simple one-dimensional radiative transfer model with vegetation model (Bruse & Fleer 1998; Huttner et al. 2008). The program uses a uniform mesh with a maximum of 250 × 250 × 30 cells.

2.4 *Microclimatic modeling*

The research team used historical weather data for the period of July 10th–20th in the simulation of the three sites. The data was collected from O'Hare Airport using NOAA website. Data for each day were entered, and the program ran for 24–48 hours per day and configuration. Each of the models used a 100 × 100 × 40 cell models. The resulting outdoor conditions were then compared to the airport data (Figure 5).

The comparison of the resulting environmental data showed that a relatively small variance existed between the airport and the other sites. However, site-specific physical conditions such as overshadowing of a neighboring building, vegetation, and wind obstructions created unique and distinguishable microclimatic conditions for each site.

The research team replaced the three calculated hourly meteorological data (Dry Bulb Temperature, Relative Humidity, and Wind speed) by Envi-Met at

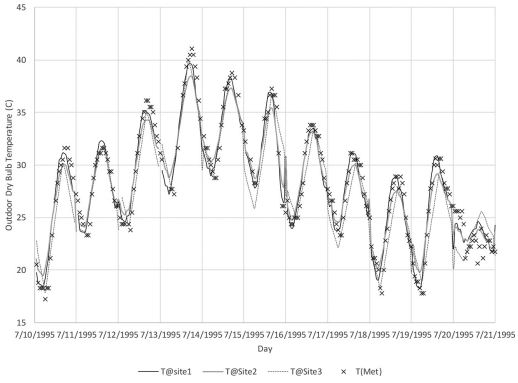


Figure 5. Dry bulb temperature calculated for the three sites at 1.0–1.8 m show variation from the airport readings.

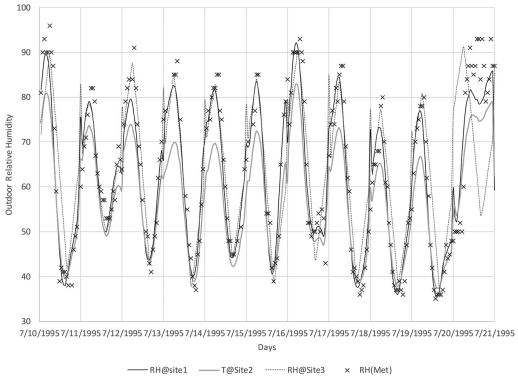


Figure 6. Comparison between the calculated Relative Humidity and the historical data at O'Hare Airport.

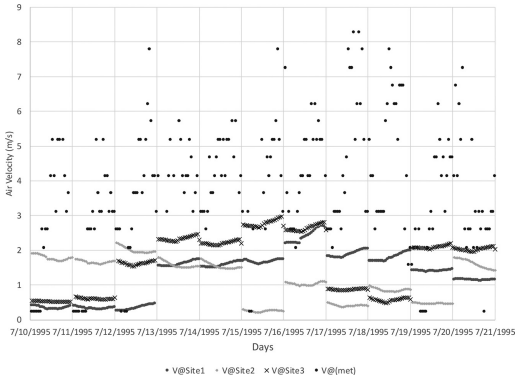


Figure 7. Air velocity at the airport is much higher than those calculated at the three sites. Site #1 had the lowest street level air velocities where Site #3 had the highest.

the three sites for the period of July 10th–20th in place of the climate data available for energy simulation programs. The modified climate files were used in the simulation of the indoor conditions.

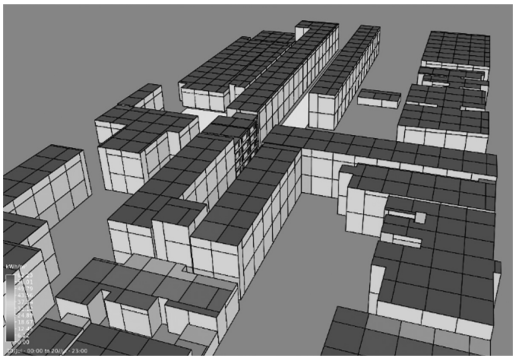


Figure 8. The least amount of solar intensities incident on the roof and wall areas were calculated for the apartment on site #1.

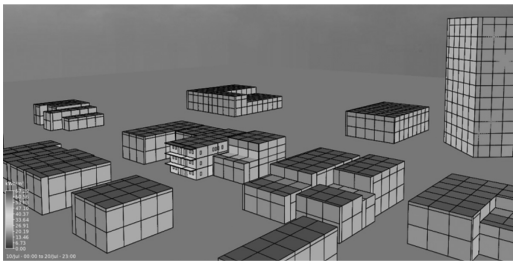


Figure 9. The average density Site #2 showed high roof surface incident solar radiation intensities while wall surfaces were exposed to average solar intensities.

2.5 *Indoor condition modeling*

Integrated Environmental Solution (IES) program Virtual Environment (VE) was used to simulate the indoor conditions for the buildings in the three sites. Before running the energy simulation, we ran the Solar Shading Calculations Module to estimate the shading coefficients for the month of July. This data was passed to the Apache Simulation Module.

3 ANALYSIS

This section will focus on the analysis of the outdoor and indoor conditions as well as the estimation of the thermophysiological responses of the occupants during the period from the 10th to the 20th of July 1995.

3.1 *Conditions at the three sites*

The three sites represent different environmental and urban morphological conditions. They also differ in the nature of the ground cover surrounding the buildings of concern. Site #1 had the highest percentage of concrete and asphalt finishes while sites #2 & #3 we had green lawns and trees.

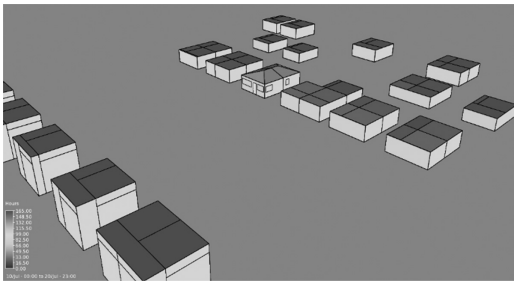


Figure 10. Together with Site #2 the roof surfaces in site #3 received the highest intensity of solar insolation per square meter.

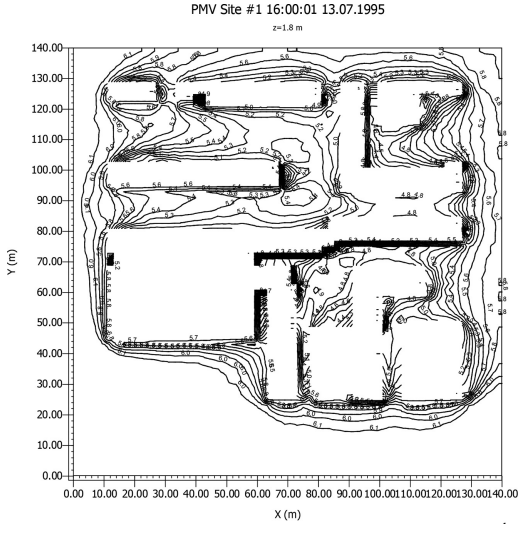


Figure 11. Site #1 Outdoor PMV distribution for July 13th at 4:00p.

3.2 *Comparing the three sites*

This comparison will use the thermophysiological response to include the four environmental parameters and assumes a 65-year-old individual clothed at 0.53 CLO and an estimated work metabolism of 80 W calculated from an average walking speed of 1.2 m/s amounting to a total personal metabolic rate of 154 Watts.

The thermophysiological response metric used in this paper is the PMV. PMV index (Fanger 1970) is one of the most popular biometeorological thermal indices for a broad cross-section of people (Mayer & Höppe 1987; Staiger et al. 2012; Johansson et al. 2014). Point 2 and above on the scale represent a thermal sensation level hot and higher.

Despite the difference in the distribution pattern of the calculated PMV for July 13th at 4:00p, the range of the obtained values remained constant (4.5–6.0) except for Site #1 where the PMV value is lowered to 3.8 between the deep street canyons (Figure 11–Figure 13). The outcome of Site #1 is validated by comparing the calculated PMV value to the measured

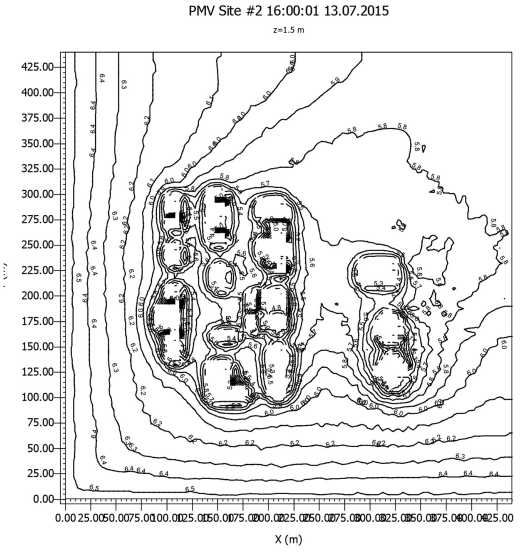


Figure 12. Site #2 Outdoor PMV distribution for July 13th at 4:00p.

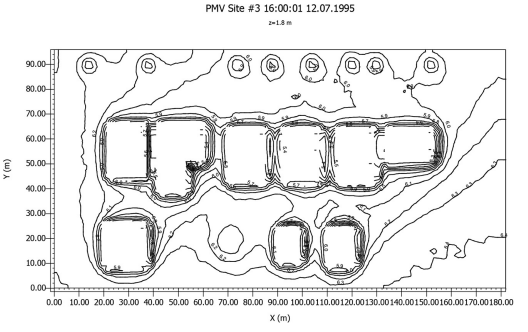


Figure 13. Site #3 Outdoor PMV distribution for July 13th at 4:00p.

and documented data in a research project conducted at the Department of Biometeorology and Applied Meteorology, University of Munich (Mayer & Höppe 1987).

Figure 14 show that the PMV values for the three sites far exceeded the acceptability range. In fact, PMV persisted after the peak temperature on the 13th (Figure 5). It should be noted that despite the extreme heat stress experienced by the residents, the evenings remained tolerable. Images documenting the event showed that many residents slept outdoors in parks and open spaces (Figure 15).

3.3 *Comparing the three interior conditions*

Energy simulation of the interior spaces at the three sites showed a significant variation of environmental conditions indoors. Based on accounts of the events, the majority of the residential units where unconditioned, due to either power outages or the lack of air-conditioning units in the apartments. Other reason

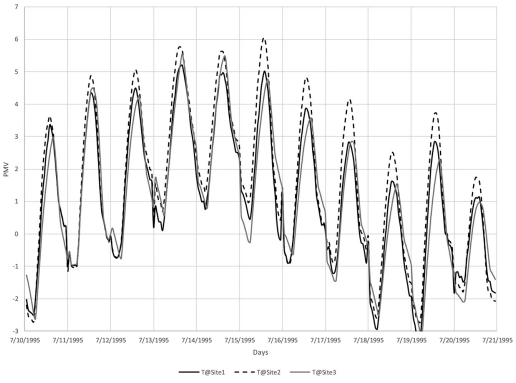


Figure 14. Predicted Mean Vote (PMV) for the three sites outdoor conditions.

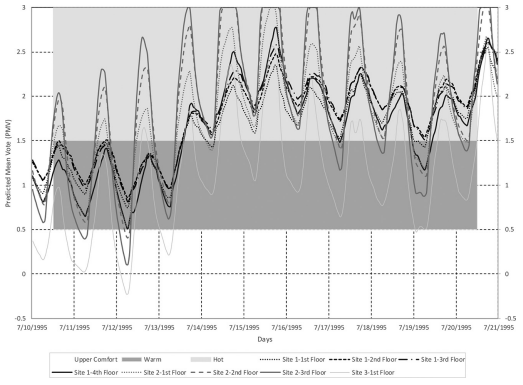


Figure 16. Predicted Mean Vote (PMV) calculated for indoor conditions in all sites and levels.



Figure 15. Sleeping in public parks. Source: https://www.emaze.com/@ALLIZFQR/Chicago-Heat-Wave-1995?autoplay.

included the unwillingness of residents to open their windows for fear of burglary and personal safety. As a result, the indoor simulation was conducted with no ventilation and no air-conditioning.

The resulting indoor air temperatures were highest at Site #2 on the third (top) floor. This floor was exposed to the highest incident solar radiation intensity. Generally, site #2 experienced the highest temperatures. The indoor peak temperature on the top floor reached 40–50°C (104–122°F) in the period between the 12th to the 20th. Heat stress experienced by the residents was extremely high resulting in their deaths on the 15th and 17th. The single residence in Site #3 experienced the highest fluctuation of diurnal temperatures. Despite being the coolest structure, residents were exposed to temperatures over 40°C (104°F) from the 12th to the 18th. Heat-related deaths in the residence occurred on the 14th. Residents on the fourth floor of the apartments in Site #1 were exposed to temperatures close to those in the Site #3. However, because of the relatively high thermal mass and shadows cast by the surrounding buildings the diurnal temperature fluctuations were minimal. As a result, the occupants were exposed to an elevated indoor temperature exceeding 38°C (100.4°F) from the 13th to the 20th. The deaths that occurred in this building on the 18th clearly indicated that the residents suffered for three days, elevated levels of thermal stress without relief. Since the occupants were elderly and opted not to open their windows or leave the apartments to sleep on the street, they likely suffered a long and painful death.

Predicted indoor PMV values (Figure 16) show that the thermal sensation and consequently levels of thermal stress varied between the three sites. While occupants in site #2 experienced the longest period of thermal stress (11th–20th), stress levels of residents in site #3 exceeded acceptability from the 12th to the 20th. Site #1 began to exceed acceptability by the 12th but only continued until the 18th.

4 CONCLUSIONS & DISCUSSION

Even though heat waves are rare meteorological events (Kaiser et al. 2007), valuable lessons are learned by studying them carefully. This research project showed that there is strong evidence that links heat-related deaths to indoor environmental conditions.

Figure 17 proves that the peak and the pattern observed in excess death matched the peak and the pattern of the indoor PMV levels. This was true in all three of the sites.

It should be noted however that the number of excess deaths could be drastically reduced we respond in the following manner;

a. Properly ventilating the residences may have provided relief at night. Especially when many died because of the heat buildup indoors.
b. It is important to understand that the most significant losses occurred days after the peak heat intensity. This time, lag can be attributed to building capacity to retain heat longer than the air. Knowing that could have given the authorities the time to respond.
c. While shading using trees and overshadowing cast by neighboring building reduced solar radiation, air

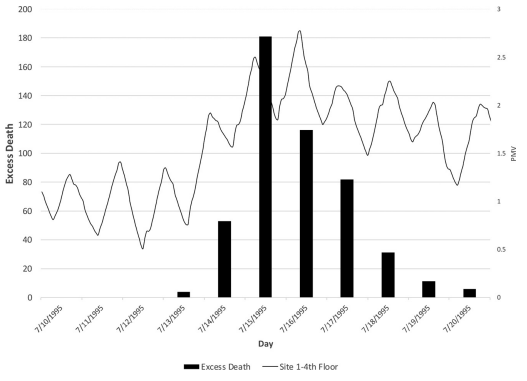


Figure 17. Comparing Heat Related-deaths to calculated indoor PMV. Source: (Whitman et al. 1997).

movement was also significantly reduced thus negatively affecting the residents' thermoregulatory system.

d. Large mature tree canopies provided shade but also reduced air movement in the alleyways and increased the relative humidity above ambient levels.
e. Vulnerable groups in potentially unventilated top floors should be identified and forcibly removed from their residents when predicted weather conditions have the profile experienced in the July 1995 event.
f. Urban heat Island that prevailed at the city during the summer season created the ideal environment for the retention of the heat after the peak and extended to the next few days. That condition was identified as the footprint of the "killer urban heat wave."
g. It is necessary to develop climate scenarios to deal with climatic and weather uncertainty (Goodess et al. 2007).

5 LIMITATIONS OF THE STUDY

The study provided the research team with an insight to the thermal conditions that prevailed in a short but intense point of time in the City of Chicago. However, it should be noted that the causes for mortality due to heatwaves in urban areas is a complex problem and could not be completely explained by estimating the environmental conditions that prevailed indoors or outdoors at the time. Due to the scope of the paper, the authors did not expand upon commonly used Heat Stress indices beyond the thermal comfort metric (PMV).

6 FUTURE RESEARCH

This effort is an on-going project and the outcomes presented in this paper are only a small fraction of the scope of the full project. We are currently working on the following issues.

a. Use of thermal stress indices to relate the biometeorological data to the physiological responses described in the introduction
b. Investigate passive and active ventilation strategies that may reduce the probability of overheating of indoor spaces during extreme heat episodes
c. Test retrofit strategies to reduce overheating of exterior and interior environments
d. Develop an indepth understanding between the Urban Heat Islan and the extension of extreme heat conditions beyond the peak meteorogical temperature
e. Study the impact of climate change on the frequency and intensity of extreme heat episodes

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The people's park: A study of the relationship between design and conviviality in Superkilen

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ABSTRACT: Scholars have traditionally focused on the ecological function of urban parks. Lately though, ecology is playing a secondary role, as demonstrated by many newly awarded parks. The 'people's park' typology, with a strong emphasis on design and program, is seen as a potential everyday space that can promote social wellbeing. This research aims to find out what about design makes the 'people's park' a convivial place. We conducted a pilot study at Superkilen, a 'people's park' in Copenhagen, testing for markers of conviviality. Observations show it is a robustly convivial environment. To test how design can influence the level of conviviality in the people's park we developed a checklist based on scores. The findings at Superkilen show that there are correlations between a park's level of conviviality and the scores obtained. This methodology will be tested in other parks – successful and non-successful – in order to make it generalizable. The significance of the research lies in the development of this methodology or checklist that can serve both in the design phase as well as on the diagnosis to assess the design problems of underperforming parks.

1 THE PEOPLE'S PARK TYPOLOGY – *WHAT?*

Landscapes have hosted social activities and interactions in the 'public' for a very long time. From the private garden at Octavius Quartio House (3rd century BCE) or the hortus conclusus at St. Gall Monastery (9th Century CE) to one of the first public parks, Prince's Park in London (1842). Conviviality as a quality of a landscape being friendly, lively and enjoyable, evolves from being a private phenomenon of an elite, to gradually becoming more public and inclusionary for every citizen. Contemporary urban parks, though, seem to be reflecting a reverse tendency (Zukin 1996).

The concept of urban park as we understand it nowadays, has its origins in the early 19th century, during the Industrial Revolution, when planners recognized their benefits and positive effects (Rogers 2001). Urban parks have since then been highlighted especially for their ecological functions, as well as their experiential and cultural effects (Czerniak 2007). Lately though, the ecological function seems to be secondary, as many new internationally awarded urban landscapes show. Clemens Steenbergen (1993) talks about the development of the city park as a landscape architectural model. One of the turning points he mentions is the appearance of what he calls 'The people's park': "until then the landscape architectural form could be reduced to its origins in nature. The people's park [. . .] became a recreational machine. Instead of nature, the program became the source of unity." (Steenbergen 1993, 122). It is interesting to note that Elizabeth Barlow Rogers (2001) refers to the Victorian Garden also as the "people's park", but in a slightly different sense than Steenbergen does. She was describing the turning point of 19th Century England, when the first public parks were designed, with the provision of land "for the Recreation of the inhabitants" and using "public funds for parkland acquisition and development to pay back this cost with the proceeds from the sale of the adjacent building lots." (Barlow Rogers, 2001, 323). She refers to this phenomenon as "the democratization of landscape design."

Adrian Geuze questions whether urban parks should exist as 'natural' spaces at all. In his essay "Moving Beyond Darwin" he claims: "Green has become a kind of habit. And it has also become a cliché of its own [. . .] there is absolutely no need for parks anymore, because all the 19th century problems have been solved and a new type of city has been created." (Geuze 1993, 38–39). This research will look at this last typology of park, the people's park, highly designed and programmed and not necessarily green in the traditional sense.

We often associate green in cities with health (Le Corbusier 1933). This research, though, is interested also in those aspects that transcend the merely green component of a park, and that talk about the quality of social interaction and integration (conviviality) it can promote. The World Health Organization states "health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." (The World Health Organization Constitution, 1946). This research wants to strengthen this notion of "social well-being" as directly linked to health, and as something that shouldn't be extraordinary (i.e. on holidays or weekends) but ordinary, it should be part of our day to day routine. In the Ottawa Charter, the World Health Organization specified that: "health is created and lived by people within



Figure 1. The 'settlement health map'. Barton & Grant, 2006.

the settings of their everyday life; where they learn, work, play, and love. " (WHO Ottawa Charter, 1986). This must be remembered when designing the public realm and parks are especially important for a high quality of life in cities (Jellicoe 1975). If we look at 'The Settlement Health Map' (Barton and Grant 2006) in figure 1, we can appreciate the determinants of health and well being in our neighborhoods. Our research on the design of urban landscapes falls under the categories of 'activities' and 'built environment', but like this health map explains, it can directly affect 'local economy', 'community', 'lifestyle' and thus 'people'.

2 DIVERSIFYING POPULATION – *WHY?*

The people's park is a particular instance of urban landscapes. In this new family of urban landscapes that puts a larger emphasis on design and program than on ecology, social well being seems to play an important role and is seen as a pertinent aspect to study. Thus, finding out what aspects of design make people feel welcomed and integrated become essential aspects of this research. An important challenge of the people's park typology is to make people feel like at home (i.e. an extension of their living room) and at the same time to promote a tolerant and respectful attitude towards strangers. It's important to look for design solutions that allow inclusive participation by individuals and groups. This becomes an even more important question in demographically, culturally, economically and/or ethnically diverse contexts.

Conviviality is understood in our research not only in a scientific context, but also as an ordinary phenomenon to achieve in our everyday spaces. This is a timely issue, particularly in Europe, which has for a number of years been struggling to accept a diversifying population and even more timely as the current crisis in the Middle East drives refugees to European cities. Today's refugees' movements might have tremendous implications in urban public places and the people's park typology is one of the places where we are going to see this especially play out. European countries had been fairly homogenous and in recent years have been confronting issues of diversity. How design influences the level of conviviality in a people's park becomes an especially critical question in todays diversifying context. Copenhagen is a good example of a diversifying European city, making Superkilen, the park this paper focuses on, an appropriate site for our research.

3 THE STUDY OF CONVIVIALITY THROUGH DESIGN – *HOW?*

In our previous work we have defined conviviality, through a literature review on its synonymous concepts 'sociability' and 'liveliness.' We define convivial landscapes as "physical places that are flexible, changing and adaptable, which are a result of processes and outcomes based in equity, integrity and democracy, and that contain urban uses and solutions that correspond to resident's needs and desires" (Beltran & Simon 2015).

Our current study posits a direct relationship between certain design features in urban landscapes and the conviviality level these promote among its users. If we examine the literature on what makes people interact with each other in public places, we find many factors. We found three inherent design qualities: 'accessible' – as opposed to restricted–; 'inclusive' – as opposed to exclusive–; and 'multi-functional' – as opposed to single-functional; as especially relevant for the study of conviviality in the people's park typology.

3.1 *Main requirements for conviviality*

The three factors for conviviality are used as a measure of how convivial an urban landscape is. They cannot be understood as separate entities, but as part of a sequence or continuum, like figure 2 shows. The three factors are represented in a graph, along the x-axis. Each factor is sub-divided into various design features (see 3.2. for details), which are each given a score. Each score is added vertically, in the y-axis. Instead of placing each score independently, as you move right, each score adds up to the immediate previous one (the one on the left). The reason for this is that you can easily read the overall score for accessibility (x), inclusiveness (y) and multi-functionality (z), as well as the final conviviality score ($x + y + z$) at the right hand side of the graph. You can also eventually compare very easily the graph results on conviviality for various parks.

The most primitive or first factor, 'accessibility', is a necessary condition for people to be in the park in the first place, and therefore a necessary condition for conviviality to even be possible. If an urban landscape

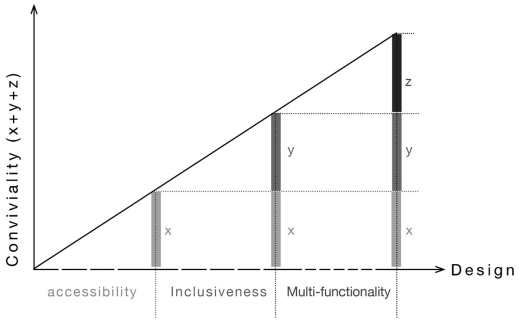


Figure 2. Conceptual graph on the sequence for conviviality in relation to design.

is accessible, it means people, everybody in general, *can* physically access it; it doesn't mean that they will. The next level in the sequence, 'inclusiveness', speaks of the psychological effect a design might have on people, making them feel welcome and comfortable in it. Therefore, once people have the possibility of access, if on top of that they feel attached to that place they will *want* to be there. Lastly, if we look at the third level in the sequence, 'multi-functionality', we talk about people actually interacting in and with that urban landscape, using it and manipulating it.

3.2 *Data: What design features to look for*

The three factors (accessibility, inclusiveness, and multi-functionality) that we think are relevant for peoples' conviviality level have been examined to determine what data to collect. This is reflected in a checklist of design features to study in a people's park (table 1). Many of these design features are recurrent themes in any urban analysis. The novelty of our proposal is to study them together and as directly linked to convivial behavior.

To evaluate accessibility of an urban landscape we must collect data on the following design features: physical boundaries, connectivity and walkability. An urban landscape with very open boundaries will be more accessible than one with very closed margins or fences or with restricted entry times.

In order to evaluate inclusiveness we must collect data on the symbols used, the aesthetic qualities, the type of furniture and the lightning features. All of these might determine whether someone feels welcome or confortable in a place or not. For example, offensive or sectarian symbols might repel certain population sectors and poor lightning might decrease activity or social interaction.

Lastly, to evaluate multi-functionality, the data collected will focus on: number and simultaneity of activities, presence of thematic areas, changes in surface material and variety in vegetation. A larger variety of thematic areas or activities means more opportunities for different people to interact, to get to know each other, and therefore a better chance for conviviality to flourish.

Table 1. Design features for each factor for conviviality and score system.

Design feature	**0 score**	**1 score**	**2 score**
ACCESSIBILITY			
Physical Boundaries	Closed	Semi-permeable	Opened
Connectivity	Poor	Acceptable	Well-connected
Walkability	Low	Acceptable	High
INCLUSIVENESS			
Symbols	Offensive	Neutral	Welcoming
Aesthetic	Sectarian	Anonymous	Inclusive
Furniture	Individual	Collective	Mixed
Lighting	Deficient	Sufficient	Good
M-FUNCTIONALITY			
Number of Activities	None	One or two	Multiple
Simultaneity of Activities	None	Scarce	Preeminent
Thematic Areas	None	One or two	Multiple
Surface Material	1	2	More than 2
Vegetation	homogenous	2 varieties	Varied: according to different uses

Like table 1 shows, each design feature has three distinguishing degrees, from worse to best. These are meant to translate the data collected through the checklist onto a graph of conviviality vs. design (like the one in figure 2). If the park under examination scores the lowest on a given design feature, no points will be awarded in that particular category. If it scores intermediate, 1 point will be awarded and if scores highest, then 2 points will be awarded.

4 SUPERKILEN PARK – *Where?*

This paper focuses on one specific case study, Superkilen park in Copenhagen (Denmark), because 'Superkilen' was found to be especially relevant in the study of conviviality in a diverse urban setting and poses an interesting scenario for studying the affect of design on conviviality. Since its inception, Superkilen's performance has been widely debated for its implications in relation to the increasing expectations of public investments, new modes of participation, collaboration and conflicts (Steiner, 2012). The park was built as a result of a public and private partnership, and represents the challenges and possibilities of a shared yet heterogeneous space, with an emphasis on participatory practices and social integration goals.

The whole City of Copenhagen is developing under a common strategy based on "more urban life for all, more people to walk more, and more people to stay longer." (Steiner 2012, 9). Superkilen is part of a greater urban development project for Nørrebro, an ethnically and socially mixed neighborhood in Copenhagen, with very different ideas on social co-existence. The Project was launched six

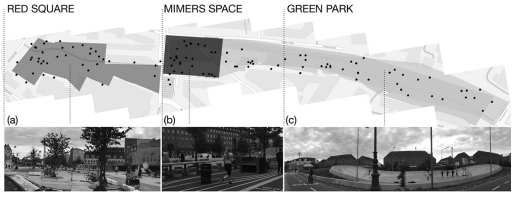


Figure 3. The three conceptual areas in Superkilen (source: the authors).

months after the Mohammed cartoon crisis and people in Denmark were coping with the ambiguities of being tolerant. The city of Copenhagen and Realdania, an association created to invest in creating quality of life in the built environment (www.politiken.dk), launched the partnership project on urban development in Mimersgade in Nørrebro, with a budget of 100 million Danish crowns – 13.4 million euro – for three projects (Nørrebrohallen, Mimer park and Superkilen).

4.1 *Inception*

The following consultant team was responsible for Superkilen's design: BIG (Danish architects), Topotek 1 (German landscape architects), Superflex (Danish artist group), Lemming & Eriksson (Danish consulting engineers) and Help communication (Danish communications consultants). They all worked together with the City of Copenhagen and the local residents. The park has been awarded various international design prizes, such as the 2013 AIA Honor Award in the Regional & Urban Design category by the American Institute of Architects, the mention for Design of the Year by the Design Museum in London as well as for the European Union Prize for Contemporary Architecture. The interest for this research, though, doesn't stem from how it is valued in the design community, but from the effects design might have on residents' and users' ways of interacting with each other, and on their level of conviviality.

The point of departure for the designers was the fact that public spaces are overloaded with conflicting expectations and the commission's brief implicitly asked the designers to deal with the issue of migration in the neighborhood and to ameliorate the situation through the park's design. The official website of Denmark, advertises it as one of the most ethnically diverse and socially challenged neighborhoods in the Danish capital (www.denmark.dk). The design concept organizes the park into three zones, each with its own identifying color (red, black, green), and each containing plantings and artifacts characteristic of the different cultures and countries represented in Nørrebro's population.

The 'Red Square' was conceived as an urban extension of *Nørrebrohallen's*, a cultural and sports center for the neighborhood, inner life. It is composed of various areas for cultural activities and sports and a larger central space, meant as an opportunity given to the community to meet while exercising and/or playing (figure 3a). The red coating extends beyond the limits of the park, into limiting streets and into *Nørrebrohallen*. Furthermore, the adjacent buildings are incorporated into the project visually by painting them the same red as the ground, which appears to fold up creating a three dimensional space. The most prominent example, at the Nørrebrogade boundary of the park creates a sloping curve conceived as sitting area (figure 4). Most of the surface in the red square is built with multifunctional rubber coating, making suitable for activities such as ball games, parades, or as an ice rink in winter, etc. Near *Nørrebrohallen* temporary stands are placed often, to accommodate activities such as open-air cinema and theater or sporting events. On the square's east side there is outdoor seating from the cafe at *Nørrebrohallen's* main entrance. At the north end of the square, areas for playing basketball are fitted into the parking lot.

'Mimers space' (the black area) is conceived as Superkilen's heart. This is designed for locals to meet around the Moroccan fountains, gather under the Japanese cherry trees, or sit on the Turkish bench. There are permanent tables, benches, and barbecue areas that serve as a kind of urban living room, where people cook, eat, read or play chess (figure 5). At the North end of the black square the designers located an elevated south-facing seating area, a hill overlooking the square that serves as a playground (figure 3b).

The green area, the 'Green Park', is conceived as a more traditional park, with paths around rolling hills. It is conceived as a green landscape and playground where families with children can gather for picnics, sunbathing and seating in the grass, as well as accommodating hockey tournaments or badminton matches. The consultant team designed multifunctional spaces, such as a multifunctional hockey and basketball court (figure 3c).

4.2 *Operation and maintenance*

There are two entities responsible for the management of Superkilen. The first one, Copenhagen Municipality's Renovation of Parks & Nature Department, is responsible for operation and maintenance. Because Superkilen was established with the aim to create a framework for a more active life in the neighborhood, a board was established before the park was built, once the winning project was selected, to supervise its realization. Nowadays it operates under the name *Kile* board. This board is the second entity responsible for the management of Superkilen. It is composed of local representatives and acts as a generator and coordinator of activities, events, and happenings in the area. Its main goal is filling Superkilen with activities for the benefit of citizens in the neighborhood, creating synergies with other activities in the city, supporting networks, and collecting experiences concerning the locals. *Kile* also draws from local resources and knowledge to generate feedback on possible future uses for Superkilen.

The Mimersgade Partnership for the neighborhood allocated 1,050,000 DKK (150,000 EUR) for *Kile* during a period of 3 years after Superkilen was built. Kile submits an annual accounting to the secretariat of Nørrebro Local Committee and manages applications to support activities four times a year. The activities and events in Superkilen have public access and are selected according to certain criteria, such as level of visibility, sustainability and health and integration and mutual cultural understanding. This last criterion is key for our research. Not only was Superkilen created under participatory processes broadly representing the multi-ethnic community, but also once in operation, the park took on the mission to provide activities and events involving many different players and citizens, across age and ethnic backgrounds.

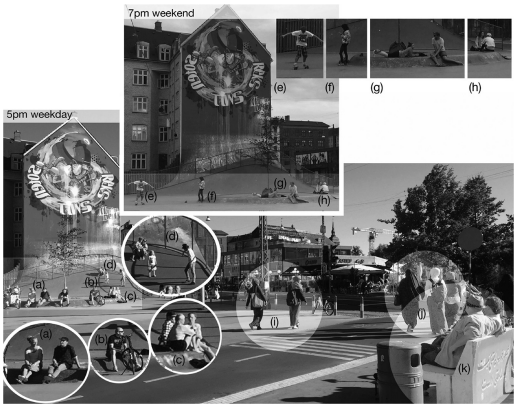


Figure 4. Red Square at different times and days. August 16 7 pm (top) / Aug 18, 5 pm (bottom). Source: photographs taken by paper authors.

5 METHODOLOGY, ANALYSIS & RESULTS

The research methodology has two steps. First we observed and coded park-goers behaviors, in order to identify markers for conviviality. From our analysis of the results we created a checklist of the most prevalent indicators. Next, we ran a study using the checklist. We selected for our study Superkilen, a people's park that was explicitly designed to be a convivial place and was perceived to be convivial by designers, politicians and locals (this was described in section 4). We conducted a pilot study on Superkilen, as the first of a series of studies of parks that make up our larger investigation. We went there and observed users' behavior. We then coded convivial behaviors through photographs (figures 4 and 5). Last, we ran the checklist to measure and diagnose convivial behaviors in Superkilen. Below we summarize the two-step analysis undertaken.



Figure 5. Mimersgade Space (Aug 18, 2 pm). Source: photographs taken by paper authors.

5.1 *Observing and coding conviviality*

The pilot study takes place during August 2015, a very vital time of the year for outdoor activities in Denmark due to climate, holidays, etc. We visited the park for one entire week, Monday through Saturday, three times per day: in the morning, afternoon and evening. Figures 4 and 5 show some of the settings at different days and times. Like the images show, we coded photographs in order to identify convivial behaviors among users and reveal an overall convivial environment in Superkilen.

When we coded the images we identified the following markers for conviviality:

- People doing different activities: chatting (figure 4d), sunbathing (figure 5c), texting (figure 4m), playing (figure 4a), skating (figure 5e), looking (figure 5b), laying down (figure 5g), reading (figure 4g), walking (figure 4k), drinking (figure 5a), among others.
- Varieties in age (figures 4a, 4c, 4d, 4h, 5d, 5k), or race (figures 4b, 4c, 4d, 4e, 4h, 4k, 5i)
- Variety in group size: one (figure 5b), two (figure 5a), three (figure 5c), group (figure 4b)
- Physical comfort (people sitting down)
- Psychological comfort: strangers of different ethnic origin facing at each other (figure 4j), people lying down in public (figure 5g), people sitting very near strangers (figure 4h), among other signs.

The more all of these are intermingled, the more convivial the place. Since conviviality is not an already established phenomenon, we selected these particular markers to identify convivial behavior.

5.2 *Measuring conviviality*

Having confirmed visually that Superkilen was a convivial environment, we ran the checklist, in order to measure conviviality and therefore diagnose the park. The score results can be seen in figure 6. All but one of the design features scored maximum (2 points), meaning that they strongly support conviviality. The exception was 'vegetation', since only two main varieties of plants were found that accommodate to cultural variances in the park's users (1 point).

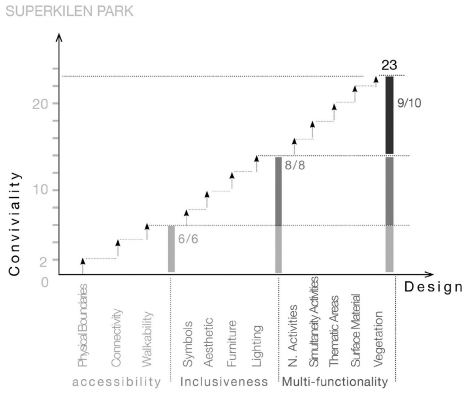


Figure 6. Conviviality vs design graph representing Conviviality scores in Superkilen.

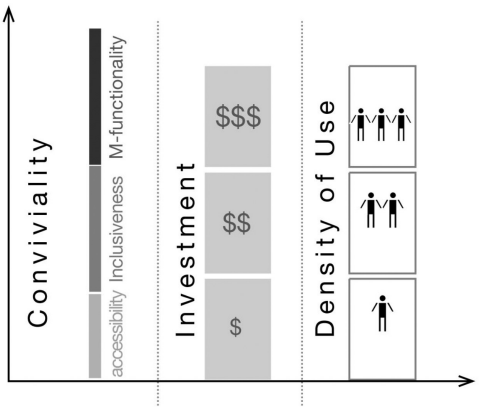


Figure 7. Conceptual graph to compare conviviality levels (accessibility + inclusiveness + multi-functionality), investment and density of use (number of people/size of park).

6 CONCLUSIONS

We selected Superkilen Park, intended from its inception as a place to unify a diverse neighborhood, as a case study for piloting our methodology for diagnosing conviviality in the people's park. We went there to see if we could observe the behavioral results of the designers' decisions. What we observed was a robustly convivial environment, reflected in the coded images. When we measured conviviality according to the checklist, we found correlations between observed conviviality and the scores.

Superkilen has proven to be a good example of a convivial 'people's park', providing a reference measurement for comparison with other parks. In future research we will test this checklist in additional people's parks, including examples anecdotally considered successful and unsuccessful, in order to validate the methodology.

The significance of the research lies in the development of the checklist, potentially useful both in the design process and in post-occupancy evaluation. Designers facing the commission of a new park can use the checklist as a tool. It can also be used to diagnose existing underperforming parks. It can serve as an important tool for diverse communities in the design and evaluation of everyday urban public spaces that foster conviviality.

Since a people's park usually requires a large investment of money, it will also be relevant to compare the conviviality levels obtained in a post-occupancy evaluation with the money directly invested in the design of the park and the density of people ultimately using it. A very straightforward comparison (see figure 7) between the conviviality score, the investment made and the density of use might tell us whether the park is efficient, whether it was a good investment, whether conviviality happens no matter the investment made or whether the three variables have no connection whatsoever. This graph can be used to compare parks of different geographical location or economic/social/political context, to extract useful findings.

This research contributes a small but useful tool, particularly relevant today as communities confront the problems of rapid diversification. As formerly homogeneous neighborhoods take in a more diverse population, it is important to create spaces that welcome diversity and promote tolerant and respectful social interactions. The people's park, designed for conviviality, is a powerful force for building a sustainable social fabric.

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Evidence-based design of outdoor learning spaces in winter: Behavioral mapping in a 'Forest School'

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ABSTRACT: Outdoor learning spaces can be used to support child development where children engage with natural elements as an integral part of their school experience. This naturally facilitates cognitive play: a grouping of behaviors that facilitate cognitive development. The problem is that outdoor learning is particularly challenging in winter due to cold weather. This compromises opportunities for children to benefit from outdoor learning for a large part of the school year in cold climates. Previous studies, using behavioral mapping, have pointed to the role that design elements play in child development; although these studies were conducted in warm weather. Our solution is to map child behaviors in schools where outdoor play is encouraged during winter, to illustrate the role that design elements play in winter outdoor learning, and to enable us to highlight challenges of winter outdoor learning that may be addressed through design interventions. We observed three schools which are dedicated to outdoor learning, during winter in a cold climate, using behavioral mapping, focused observations and photo documentation. Our analysis confirms that outdoor winter environments support cognitive play, and we discuss design interventions that can mitigate challenges faced by schools dedicated to outdoor learning in winter.

1 INTRODUCTION

Numerous studies indicate the benefits for children of playing outdoors in natural settings (Fjørtoft & Sageie 2000, Ozdemir, Corakci, Özdemir, Çorakçi, Ozdemir, Corakci, Özdemir, & Çorakçi 2010). Outdoor play may counteract the public health implications of increasing childhood obesity (Ebbeling, Pawlak, & Ludwig 2002) and concerns that children are suffering from nature deficit disorder, caused by the lack of connection to natural environments (Louv 2008). Changes in outdoor physical activity have been related to season and weather, with reductions in activity particularly evident for children who attend indoor schools during winter months (Tucker & Gilliland 2007). This study investigates the design features of 'Forest Schools' in a cold climate to better understand how design elements can support outdoor play in learning environments during winter. The intention is that the study can be used by designers of schools incorporating outdoor classrooms, and to support child learning in outdoor settings during winter months.

1.1 *Forest School approach*

The Forest School approach, developed in Denmark and Britain over the last twenty years is a response to a perceived nature deficit in early-childhood education (Maynard 2007). More recently these schools are opening in large centers across Canada (Andrachuk, Edgar, Eperjesi, Filler, Groves, Kaknevicius, Lahtinen, Molyneux, Morcom, Petrini, Piersol, Power, & Young 2014). These schools offer programs which engage children in outdoor play in natural settings. Three schools that adopt the Forest School approach operate in both rural and suburban settings in Calgary, Canada, and enable outdoor play throughout the winter. This study looks at these schools to examine how design features support outdoor play in winter, and identify opportunities for new design elements that may further facilitate the objectives of the school.

The Forest School pedagogical approach has been described as social constructivist (O'Brien 2009) in that it enables learning through examination and engagement with the natural environment, and requires students to construct their understanding of curriculum through experience; interacting independently and with one another. The school uses hands-on experiences in a natural woodland setting to build confidence and self-esteem in children. The school's approach enables children to prioritize learning through guided play, rather than instructor-centered activities. In the schools observed, there is no

delineation between "play time" and "learning time", instead the children follow a flexible pattern of activities through the day that is outlined by the teacher, where play and learning occur in tandem.

This study utilizes focused observations using a *fly on-the-wall* approach (Moggridge & Atkinson 2007), behavioral mapping (Moore & Cosco 2010) and photo documentation. The focused observations were used as a qualitative approach to design-research, where a researcher with a design background (architectural design) observed the school activities without interfering.

1.2 *Behavioral mapping and cognitive play*

Behavioral mapping was incorporated as a quantitative method to observe and record the play behaviors of the students in relation to environmental features at the school. The method records cognitive play behaviors as a means to evaluate design features. The United Nations Convention on the Rights of the Child states that all children have the right to play (article 31). Play is important not only for developing physical abilities, or letting off steam (Ozdemir, & Corakci 2010) but is critical for developmental learning (Herrington & Brussoni 2015). Cognitive play is a grouping of play behaviors that allow children to engage with an environment and learn through their interactions with it (Malone & Tranter 2003). The current study uses Rubin's play observation scale to identify five cognitive play behaviors: functional, constructive, dramatic, explorative and games-with-rules (Rubin 2001).

Behavioral mapping has been used as a method for evaluating children's outdoor play areas, and is suggested as a research method that would be useful for designers to gather information about a design project (Moore & Cosco 2010, Ozdemir, & Corakci 2010, Cosco 2006, Herrington & Brussoni 2015, Zamani & Moore 2013). In their study of manufactured elements in preschool settings Zamani and Moore (2008) use behavioral mapping to identify design recommendations to incorporate features that afford cognitive behaviors. In this research mapping is used to evaluate outdoor classroom elements at three Forest School locations, in order to identify opportunities where design interventions would further benefit the objectives of the school.

1.3 *Affordance theory*

Gibson's affordance theory presents the environment in terms of features which afford possibilities for numerous types of actions (Gibson 1979). The theory describes the relationship between an environmental feature and human perception and use. The use or function of an object is dependent on the qualities of the object itself as well as the abilities, perceptions and desires of the human. Environmental features provide opportunities for human engagement – such as a tree with low branches which affords climbing. Affordance theory is usefuline valuating children's outdoor play spaces because it enables a researcher to evaluate certain elements of a design by the behaviors that it affords (Cosco, Moore, & Islam 2010).

Table 1. Environmental Features Categories. Shows groupings of the environmental features that were used in this study.

Environmental Setting	Examples
Bushes	Bushy branches
	Shrubs
	Berry bushes
Loose Parts	Buckets
	Shovels
	Hammocks
	Sleds
	Dinosaur toys
	Mud Kitchen
Forest	Deciduous
	Coniferous trees
	(Trees that create a canopy)
Open	Open Landscape
	Natural Grassland
	Prairies
Snow	Ice Sculptures
	Snow Sculptures
Building	Heritage Park Barn
	Community Hall
	School Classroom
Chair	Furniture
Table	Picnic Tables
	Indoor tables

Affordance theory has been expanded upon by Heft who developed a framework for evaluating environments. Through analysis of multiple behavioral studies of children he designed a preliminary taxonomy of environmental features (Heft 1988). Heft argues that understanding the affordances of an environment is more useful for evaluating a design than simply stating the form of an object. In other words, when designing a play space for children it is more useful to understand a tree as something that is "climb-able", or "hide-behind-able", than it is to say it is a tree. Heft's taxonomy has been used and customized for various environments, and has been applied in the context of interviews (Korpela, Kyttä, & Hartig 2002) and behavioral mapping (Zamani & Moore 2013).

2 ANALYSIS

2.1 *The Schools*

The research was conducted in Calgary, Canada at three schools which incorporate a Forest School approach. There are three locations for the schools. Two are located just south of the city in a rural area, these both utilize a public park near a lake (the Lake Site). One of these utilizes the community hall amenity as a classroom (Preschool 1) and the other has use of a classroom at a private school in the area (Nature

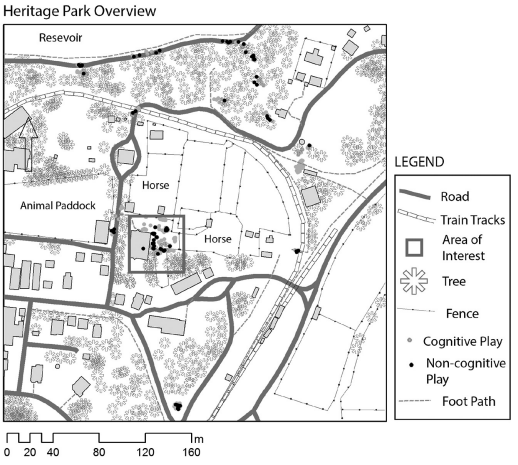


Figure 1. Overview map of Heritage Park showing distance travelled by Preschool 2. Map shows the different locations visited by students and the extent of travel across the site.

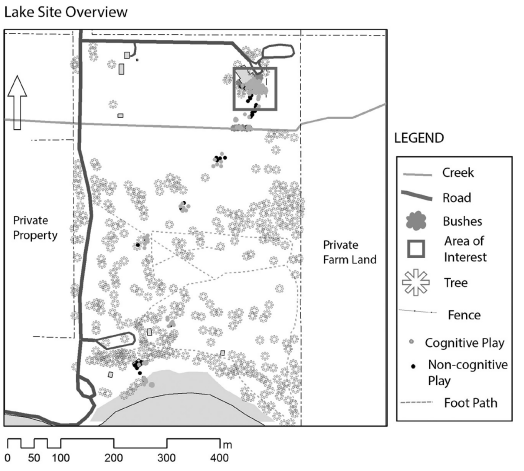


Figure 2. Overview map of the Lake Site, showing distance travelled by Nature Kindergarten and Preschool 1. Map shows extent of excursions travelled by students and the diversity of the landscapes visited. Lake Site is larger than Heritage Park with fewer man-made features.

Kindergarten). The third school is located within the city limits (Preschool 2). It has temporary use of a city-owned cultural amenity called "Heritage Park" for the winter months.

Preschool 1 and 2 provide programs for preschool children age 3–4 from 9:30 am–2:30 pm. Children attend the school for either 1 or 2 days a week. The objective of the school is to encourage outdoor learning, but the school also utilizes indoor classrooms. The Lake Site is a rural prairie landscape with many small patches of trees, some scrub and bushes, a creek and one more densely forested area. Preschool 2 is located in a cultural park, which uses heritage buildings and Park elements, to create a historical museum amenity. The park is not open to the public in winter months and Preschool 2 has access to all outdoor, unfenced parts of the site as well as a building for a classroom. Heritage Park has a large forested area, walkways and open spaces that are used by the school.

The Nature Kindergarten is a kindergarten for children aged 5–6 focused around the objectives of the Forest School. It utilizes the Lake Site, as well as a classroom in a nearby private school. Students attend the school for either a 2 day or a 3 day program. Both the 2 day and the three day spend one day a week almost entirely outdoors, where they are dropped off at the lake edge by their parents and throughout the day they traverse the property to the community hall, and return back to the lake for afternoon pick-up (see Fig. 2).

These schools were selected as a subject for the study because of their inherent interest in engaging children in long periods of outdoor play, even in winter. Even though the schools have heated classroom facilities and spend more time indoors on very cold days, there is a desire to engage children outdoors as much as possible. The three sites are complimentary in that they offer a range of environments within the same climate to support the study outcomes. The study was conducted in January which is, on average, the coldest month of the year in the Calgary region. The study was conducted over two weeks enabling observations to occur with multiple groups of children on the three sites. In total 56 children were observed over eight days.

2.2 *Climate*

The temperature of the days the study was taken ranged from −6 degrees to 9 degrees Celsius. (Environment Canada 2016). There was fresh snow on the ground which changed in consistency and malleability over the course of the study due to night freezing and varying temperatures during the days. Despite a tendency for Calgary to experience Chinooks (unusually warm weather from mountain wind) it is typical for much of the ground to be covered in snow in January. Calgary averages 54.2 days of snowfall a year and for at least 84 days per year (one quarter of the year)it is expected there will be at least 1 cm of snow on the ground.

2.3 *Methods*

The purpose of this study is to evaluate current design features of three Forest Schools, using evidence-based observations, in order to support the school's winter curriculum, and identify opportunities for design improvements. We examine the following research question: Which existing design elements are currently being used to support the Forest School objective of learning through outdoor play? The play behaviors were recorded using Rubin's play observation scale (Rubin 2001) which was slightly adjusted for this study. Behaviors recorded include the five cognitive behaviors described by Rubin as well as the non-cognitive play behaviors recommended in Rubin's

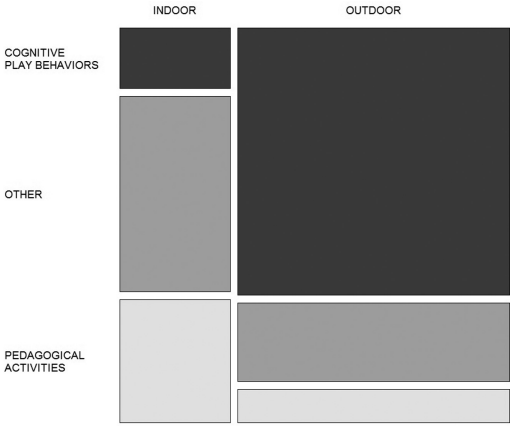


Figure 3. Chart indicating indoor and outdoor play. Area of each rectangle represents the percentage of total time observed displaying a behavior in an environment, demonstrating that outdoors afforded more cognitive play behaviors than indoors, and pedagogical activities were mostly observed indoors.

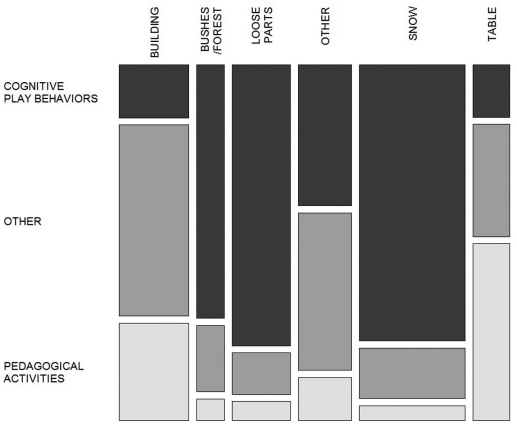


Figure 4. Chart indicating environments and afforded behaviors. Area of each rectangle represents the percentage of total time observed displaying a behavior in an environment, demonstrating that snow afforded the most cognitive behaviors, followed by loose-parts.

method. These include: transitional, onlooker, uncodable, hovering, rough and tumble, aggression, peer conversation, and unoccupied. Three additional activities were also included, these were: eating, instruction and curriculum activities.

The observations were conducted during three days with Preschool 1, two days with the Nature Kindergarten and three days with Preschool 2. *Fly-on-the wall* observations started near the beginning of the school day between 9:30–10:00 am and the close of the day at 2:00–2:30 pm. The observer participated in all class outings and activities while present at the site. The observer, through note-taking and observations looked to identify ways that current design features support the objectives of the school, as well as opportunities where new design features would be of benefit.

The behavioral mapping was conducted at the same time. The observer recorded observations at five minute intervals for one hour in the morning and one hour in the afternoon (between 10:00 am–11:00 am and 1:00 pm–2:00 pm). At every observation each student was observed for 10–15 seconds, their play behavior and environmental feature was recorded with pencil in a record sheet, as well as a location marker on paper maps of the site. Location markers were transferred to GIS software after the study was complete. Between 6–10 children were recorded each day. In total there were 1633 unique spatial and temporal observations collected for 56 children.

The behavior mapping times were carefully selected in conversation with the teachers at the school because they were the most likely times to observe children in active play and learning. Due to the approach taken by the school there is no set "recess time" or set "class time". The two pedagogical activities that were added were "instruction" and "curriculum activities". Instruction was coded as one-on-one instruction from a teacher as well as group instruction.

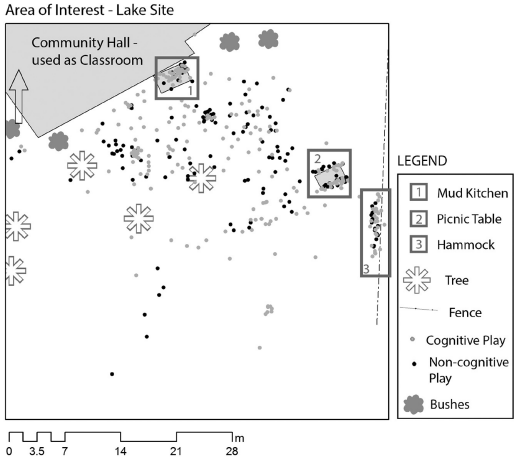


Figure 5. Close up of the Lake Site showing cognitive behaviors at the hammock, picnic table and the mud kitchen, identifying spatial and temporal associations with key design elements.

Curriculum activities included projects or activities provided by the teachers, which were at times optional and at other times conducted as a group activity. A grouping of environmental features was developed specifically for this study (see Table 1). The environmental feature groupings were based on previous studies (Zamani & Moore 2013, Heft 1988, Cosco 2006) and adapted to the available features at the site. GIS locations were recorded and analyzed based on proximity to an environmental feature and the behavior recorded at that site.

Photographs of the overall site, the indoor classrooms and the individual environmental features were taken as a record of the various elements, and as a reference for comparison (not included here). The

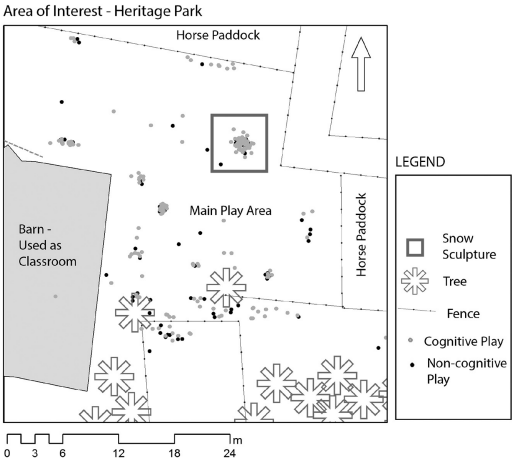


Figure 6. Close up of Heritage Park showing concentration of cognitive behaviors at the 'snow sculpture', a structure built out of snow, by the students, that afforded the most cognitive play behaviors in this environment.

photographs are used to visually describe the characteristics of the available features. Consent for the observations was obtained through emails that were sent out to parents and teachers explaining the intent of the research. Signed consent forms were collected at the school locations. Research was approved through the University of Calgary Conjoint Faculties Ethics Research Board.

2.4 *Results*

Chi-squared test of independence was conducted on behavioral and environmental data. Results reject the hypothesis that there is independence between environments and behaviors ($p < 0.01$, $df = 24$), indicating that there is an association between these elements. The environmental feature that afforded the most cognitive play behaviors was snow, with functional and constructive behaviors being observed the most. This agrees with other studies which cited "natural loose" elements as affording mostly constructive behaviors (Zamani & Moore 2013). The unique features of snow is that is can provide for a wide range of activities, due to its malleability and constructability. Snow was observed being used create structures (constructive play) which were later used to afford functional play (climbing), and dramatic play (playing house) (see Fig. 6). Some challenges with snow were observed during *fly-on-the-wall* observations. Snow is cold and if children lose their mittens or are not dressed appropriately they may want to go inside. When snow melts it is wet, which can cause children to be uncomfortable if their snow clothing is not also waterproof. Snow consistency and maleability changes due to temperature, which meant it could not be depended on for specific activities. In addition snow does not afford fast running or wheeled toys. Despite this, snow afforded the most cognitive behaviors (see Table 2) with functional, constructive and dramatic being the most observed. In addition, the children interacted with snow for the majority of the time spent outdoors (see Fig. 4).

Loose-parts were second in affording cognitive play behaviors (see Fig. 4 and Table 2). It was observed that loose-parts work in combination with snow to provide an environment which affords cognitive play. Common loose-parts were shovels and buckets which were used in constructive and functional play. Hammocks were hung from an existing fence and afforded functional play. The loose-parts element that afforded the most dramatic play was the mud kitchen (Fig. 5). Instruction was observed in all environments, but curriculum activities were most common at a table (see Table 2).

The non-cognitive behavior most observed was transitional time, mostly related to children getting dressed to go outside. The regular routine involves coming indoors to go to the bathroom and eat lunch or snack both at the beginning of the day and in the middle of the day. This results in at least two times a day when children spend time dressing and undressing for the weather. The ability to get oneself dressed in snow gear is a part of the learning process and children are encouraged to get themselves ready. Some children are able to get read in a shorter amount of time, but for safety reasons they wait for their peers or for a teacher to accompany them outside. Travel on the site was observed in all three schools.

Travel in this study refers to an excursion where preparation was required, and the class would travel on foot, as a group, to new environmental landscapes on their site. Travel is far enough from the main classroom that students could not pop-in and out if needed. As seen on the overall maps of the two sites (see Fig. 1 and 2), the students did not remain in the outdoor area near the classroom. 36% of the observed time was spent more than 40 m from the main classroom (see Fig. 7 and 8). It was observed that a 40 m radius from the main classroom indicated the distance that play would occur without travel. Travel across the site was either used to support the pedagogy, or requested by the students as a way to visit their favorite spots. Both the Heritage Park site and the Lake Site have forested areas which required travel to visit. There were days when the students requested to visit the forest but they were unable to go because there was not enough time to walk there and back. Previous research has shown that a variety of landscape features is important in developing child play environments (Fjørtoft & Sageie 2000), and it is felt by the researchers that travel is an important feature of the school's approach to outdoor learning.

Games with rules was the cognitive play behavior that was least observed (see Table 2). This may be due to the age of the children, as well as the lack of available traditional game-type elements such as balls or sports equipment. This may also have been a result of the snow-covered ground. Exploratory was the second lowest observed cognitive play behavior. Exploratory was observed mostly in the forest and in the open. These behaviors were observed including exploring a

Table 2. Percentage of total observed behaviors and environments, indicating the relative observed prevalence of behaviors within each environment category.

Behavior	Building	Loose-parts	Other	Snow	Table
Constructive	0.6	2.3	0.8	7.3	2.0
Dramatic	1.4	3.9	1.7	3.8	0.4
Exploratory	0.6	1.5	5.1	1.0	0.2
Functional	0.5	5.9	4.0	12.3	0.7
Games	0.0	0.0	0.4	0.0	0.0
Instructional	4.4	0.4	1.3	1.2	0.2
Curriculum Activity	1.3	0.6	1.1	0.1	5.2
Transitional	7.1	0.4	2.6	0.9	0.2
Other	4.0	1.6	5.9	3.6	3.2

new part of the forest, looking at tracks, looking for something or making new discoveries in the snow or ice due to changes in temperature.

Cognitive play behaviors, as a percentage of time spent in outdoor and indoor spaces, were higher outdoors (see Fig. 3). Chi-squared test of independence was conducted to determine the association between indoor and outdoor environments and observed behaviors. Test results indicate that indoor and outdoor environments are not independent from the observed behaviors, and are therefore associated with each other ($p < 0.01$, $df = 16$). Reasons for this may have been that much of the indoor time was spent in transition (putting coats on) or pedagogical activities. It is unclear whether the reasons for this difference is due to the space being more suitable for structured learning, or whether structured activities are needed indoors to keep the children engaged. Further study is required to explain the reasons for these differences.

2.5 *Discussion*

Outdoor play in natural settings for children in winter landscapes affords a variety of beneficial cognitive play behaviors. Snow, being present only in winter affords beneficial play and in combination with the appropriate loose-parts, winter landscapes can afford all play behaviors for children. This concept is supported both by previous studies which demonstrate the role of natural loose elements and manufactured loose elements, as well as previous Forest School and outdoor play space evaluations (Herrington & Brussoni 2015, Fjørtoft & Sageie 2000, O'Brien 2009, Zamani & Moore 2013, Cosco 2006).

The overall design implications are thus related to enabling children to engage with outdoor natural elements for longer periods of time. This includes being able to travel further distances on the site, and be able to stay there for longer periods of time without returning to the indoor classroom. Elements that are currently used that support playing outside longer were loose-parts, particularly buckets, shovels, hammocks

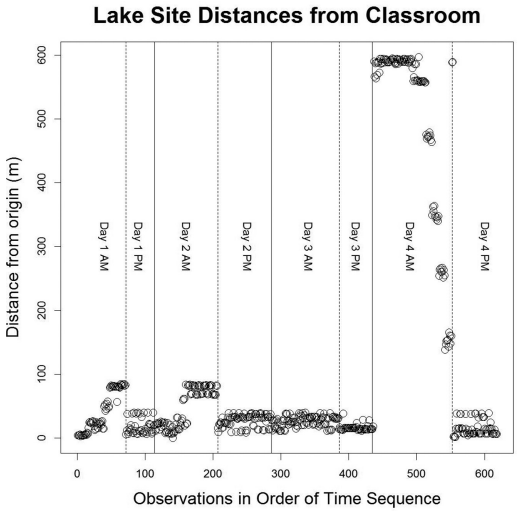


Figure 7. Distances traveled by students at the Lake Site, indicating students raveled up to 600 m from the classroom on Day 4 and 90 m from the classroom on Days 1 and 2.

and sleds. Shelters provided at the Lake Site enable students to eat outdoors which reduces the transition time involved in changing into snow clothes. Design elements that would support staying outside longer could include a deck or intermediate outdoor space between the classroom and outdoors where students could eat, participate in curriculum activities and have shelter from snow and rain without removing snow clothes. Outdoor storage to keep school supplies from weather damage and would allow access from outdoors would also support extended outdoor time. Access to washrooms from outdoors without full removal of snow clothes would lower transitional times. Elements that support curriculum activities outdoors could include seating that is off the ground, and table top surfaces that are flat and sturdy enough to support paint jars and other containers without tipping.

Design features that currently support the students traveling a distance from the buildings include sleds and teacher's backpacks; which carry tools, dry mittens, teacher's supplies, safety equipment, art clipboards and pencils. Features on the site which function as partial shelter are lean-to and tipi-like shelters that have been constructed in previous weeks. Opportunities for design to support students traveling farther from their main classroom include pre-built stations, or portable sled-like elements that would include a place to go to the bathroom, shelter, a chance to warm up or dry off, opportunity to sleep/nap off the ground, seating, storage or tools or equipment, a table surface and mud kitchen elements.

The researchers felt that behavioral mapping was a useful method for collecting quantitative data about the activities of children at the Forest School. The maps provide a visual representation of the daily activities, and information about the distance children traveled. The coding sheet provided adequate data to support

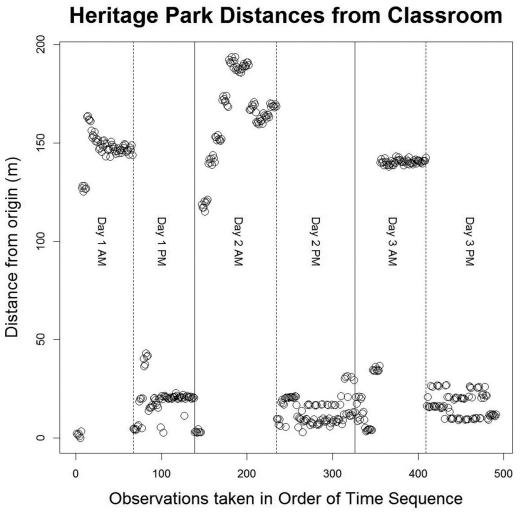


Figure 8. Distances traveled by students at Heritage Park, showing students traveled as far as 198 m from the classroom Day 2 and traveled, at least 145 m from their classroom each other day.

design decisions and statistical analysis, although the researchers felt that the behavioral mapping results were not sufficient to generate new design recommendations without additional observation methods. This is because the mapping results do not indicate the reasons for behaviors, or the role that teachers or pedagogy play in student dynamics. In addition, mapping can only evaluate a current design, but cannot generate new ideas, particularly innovative solutions that have no existing examples to test. It is the opinion of the researchers that observational research should be conducted by designers themselves in order to understand the complexities and subtleties that are difficult to portray in study results. Without being present during the research, it can be challenging for a designer to translate numeric data in a way that gives a holistic picture of design problems or points to innovative solutions. In addition, if a designer is a part of the research process they can help identify research questions that are useful for design, as well as analysis methods that will pin point relevant findings.

2.6 *Limitations of the study*

Limitations of the study include the difficulty in separating free play from pedagogical activities. For this reason it is difficult to determine if environmental feature affordances were the cause of a behavior or if it was influence from a program or teacher. Mapping of the spaces was challenging due to the size of the sites. The role that snow and winter elements play in the study are difficult to compare without a summer baseline study. Despite these limitations it is felt that the study was able to record the activities of the children and demonstrate the ways that the environment supported the objectives of the school. Even though the size of the site made mapping challenging, the resulting graphics were helpful in describing the movement of the students on the site and associated behaviors. Despite not having a previous study conducted in summer to use as a baseline, previous studies conducted through qualitative research and behavioral mapping of children's play areas can function as a comparison.

3 CONCLUSION

Through an observational study of three Forest Schools, this study evaluates two outdoor learning spaces in winter. Educators at these schools have been resourceful in using suburban and rural locations for the program, often repurposing various structures and facilities to serve their needs. Design elements, particularly snow, loose-parts and a natural site with a variety of landscapes, have been successful in meeting the objectives of the school and in engaging learning outdoors in winter. Overall the students were observed engaging in cognitive play behaviours for the majority of their time spent outdoors. Design recommendations revolve around developing built areas around the building, indoor spaces that reduce transition times and pre-built stations on the site to further facilitate child engagement with natural elements.

The study results support the conclusions of previous studies conducted in warmer weather: that outdoor natural play environments afford cognitive play behaviors. Snow was the environmental feature that afforded the most cognitive play behaviors, which indicates that snowy winter environments can support cognitive play and learning. Loose-parts, such as shovels, buckets, hammocks and a mud kitchen, afforded the second most cognitive play behaviors. Games with rules, was the least observed cognitive behavior, suggesting that the available environmental features do not afford these activities. Design interventions that enable outdoor learning in winter will provide opportunities for cognitive play. It is recommended that design solutions be developed that reduce transition time. It is also recommended that design interventions that support children's travel on the site be considered. Behavioral mapping was considered by the researchers as a useful method for evidence based design when used in conjunction with other observational methods.

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Re-naturalization of post-war housing estates in Poland. The value of residential green space

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ABSTRACT: The authors raise an issue of creation common spaces in the post-war multifamily housing areas in Poland, and how does those common spaces affects on life quality of inhabitants. The subject of studies covers three housing estates in Warsaw, Cracow and Lublin, created between 1940s, 1950s, 1960s in the context of the present trends of transformation and preservation of their spatial, natural and architectural values The article will both present examples of well-functioning, common green areas in multifamily housing complex and also will indicate what are main problems associated with badly solved or lack of common green spaces . Presented residential settlements has derived from the idea of the 'garden city" by Ebenezer Howard. This idea has determined the shape and space quality of those settlements, makes them still attractive places for living.

1 HISTORICAL BACKGROUND OF HOUSE SETTLEMENTS IN POLAND

1.1 *Polish house estates before World War 2*

In 1898, in the publication of the book *"Tomorrow: A Peaceful Path to Real Reform",* Englishman Sir Ebenezer Howard presented a model of a radially-concentric garden city, as a response to the crisis in the second half of the nineteenth century. According to Howard's concept, the Garden City would create favorable living conditions in health and harmony for the entire community, combining the advantages of living in the countryside and in the city (Howard 1902). This idea became the drive for the development of new urban concepts and a solution to social problems. It was implemented for the first time in 1903, in the housing estate of Letchworth, near London, designed by Raymond Unwin and Barry Parker (*Conversation* . . . 2013). Although the housing estate designed in a suburban village failed to fulfill its role in its entirety, the founding ideas of Howard were adopted in various urban planning solutions worldwide. Howard's urban planning concept was in its heyday in Western Europe in the pre-war period, mainly in England. Also in Poland, these concepts were propagated by architects and urban planners designing interwar housing estates in Poland. An example would be the village of Ząbki near Warsaw (designed by Tadeusz Tołwiński) (Tołwiński, 1963), or the Garden City of Młociny near Warsaw (designed by I. Miśkiewicz). According to Professor Tadeusz Tołwiński (1887–1951), one of the most important factors in the urban and architectural creation were natural conditions, among them green spaces, as the basis for good urban planning – from health to aesthetics (Toeplitz 1937). Polish pre-war garden cities were located mostly on forested land, in good natural conditions. More often than whole cities, under the influence of Howard's concept, garden housing estates were implemented in such a manner to form residential facilities for the rapidly growing urban centers (*Creating* . . . 2013). The latest European trends in the design of urban housing estates were already known and used.

In 1932, the Polish Association of Housing Reform (PTRM) was founded. It has popularized the achievements of the new, worldwide, urban planning. In many publications on the development of residential areas, engineer-gardeners drew ways of shaping public green areas, allotments and other green spaces. Solutions of housing estates, where houses were located in a common park, with no private gardens, were presented. This was reflected in the design of newly established housing estates, as a coherent "well-functioning organism" (Przesmycka & Przesmycka, 2005). Both in professional journals and in daily newspapers, the importance of creating harmonious housing estate gardens was emphasized, taking into account their functionality. Garden began to be treated as a continuation of the apartment (Lynch, 1960). The creation of lawns, planting beds of perennials, such as plantings of roses were recommended. At the same time, it pointed to the need to design recreational spaces for the elderly and children's playgrounds, in conjunction with the use of plants that closed these spaces (Gehl, 1971). It was pointed out to the importance of hedges that do not create optical barriers for the observation of green bushes and colours of flowers planted in gardens. The costs of setting up residential gardens were estimated at 5–8% of the building price, which proves attaching great importance to the proper management of the buildings' surroundings. Even then, uniform fencing and flexibility in terms of planting by the inhabitants of their land was proposed.

It was suggested to plant trees according to a uniform plan, which gave the impression of more space.

1.2 *Housing estates in Poland after World War 2*

In the post-war period, Poland was under the influence of the Soviet Union, which translated into a change of the political system, elimination of private property, nationalization of industry and large landed property.

War damage, changing the country's borders, industry development, all resulted in the migration of rural population to urban areas. This necessitated an unprecedented pace of building housing estates. For the purpose of the developing industry, numerous large housing complexes were erected, most frequently occupying the formerly nationalized agricultural lands located on the outskirts of cities. This gave the opportunity to implement the whole residential neighborhoods, often for several or even tens of thousands of residents. Simplified and typified residential buildings originally based on Soviet patterns were positioned in attractive locations, not sparing the area, which allowed for the creation of large housing estates earmarked for playgrounds, recreation and design of green spaces. Fortunately, many contemporary designers were architects educated before the war, who were able to introduce Howard's concepts in the design of large public housing complexes for 30, 40 or 50 thousand residents (Skibniewska 1979). These housing estates were created mostly in the way of architectural competitions until the 1980s.

1.3 *Housing estates in Poland after transformation*

After 1989, Polish political changes began a new era in the urbanization. The ideas of state or cooperative housing estates or housing estates built for employees of industrial plants failed. Political changes also resulted in the transformation of the spatial structure of housing estates erected in the communist period. A change in the legislation allowed for the privatization of individual buildings, and hence the separation of the public space that belonged to them. This resulted in the possibility of compacting the building arrangement at the expense of green areas.

Currently, especially in large cities, the participation of local communities in efforts to shape the neighborhood spaces is increasing. Residents are beginning to appreciate the value of green spaces. The aging population begins to take its own initiative: revitalization of residential spaces (Przesmycka & Przesmycka 2011). Of course, this is being done with varying degrees of success, but it signifies the importance of the social factor in taking the initiative to improve the quality of residential spaces. Both formerly planted high greenery, small ponds, playgrounds no longer meet today's standards, and they need attention. Sometimes residents take the initiative in their own hands – most often in the immediate vicinity of their place of residence. There are many grassroots initiatives that prove the formation of bonds in the local communities that initiate the processes of restoring natural functions and giving them new spatial forms. Of course, these processes do not follow the same pattern in all housing estates. Often it is the city authorities and the administration of estates who decide on what is going to be changed or retained.

Housing estates selected for the analysis of transformations are representative of the different periods of the formation of the urban planning assumptions for housing estates. Post-war housing estates are represented by means of the example of Nowa Huta, currently a residential district of Cracow at Lenin Steelworks (1948). The Sady Żoliborskie housing estate presents an example of design with preservation of natural space, which was found in the cases of implementation of Polish housing estates in the 1960s and 1970s. The third example are the Juliusz Słowacki housing estates in Lublin, designed by Oskar Hansen, where a large role was played by the use of natural conditions (configuration of the terrain and the existing greenery). All housing estates are linked by the problem of "aging" of the residents and inadequacy of public and semi-public spaces to the changing needs of the users. The zoning and segregation of transportation designed at that time allowed collision-free vehicle and pedestrian traffic, but it does not meet many of today's requirements.

2 AIM AND METHODOLOGY OF THE STUDY

The subject of studies covers three housing estates in Warsaw, Cracow and Lublin, created between 1940s, 1950s, 1960s in the context of the present trends of transformation and preservation of their spatial, natural and architectural values. These housing estates are characterized by reference to the concept of garden cities by E. Howard. The authors examine the condition of the ongoing activities in order to maintain their natural and urban planning values and determine the possibility of carrying out the effective re-naturalization processes in the Polish legal and economic conditions. Research is carried out against the background of the historical perspective of the implementation of housing estates in Poland as integral parts of the garden city concepts. They refer to the European implementation of the restoration and creation of a garden city by means of the example of Letchworth Garden City.

3 NOWA HUTA SETTLEMENT, CRACOW

Nowa Huta was founded originally as a satellite town near Cracow. The city was to provide social facilities for the steelworks. Currently, it is a Cracow district.

Nowa Huta and its subsequent housing estates were erected over the period of several decades, representing urban planning and architectural assumptions typical of the period of socialist realism until the late modernism. Over the years, the nature of development,



Figure 1. Nowa Huta, An aerial view from the south, along the main N-S compositional axis. Source: Wikimedia .org https://upload.wikimedia.org/wikipedia/commons/2/2e/Nowa_Huta_jako_idealne_socjalistyczne_miasto.jpg.



Figure 2. Nowa Huta main promenade (rows of trees, little architecture). Author: E. Przesmycka, 2016.



Figure 3. Nowa Huta, green, common space between block of flats. Author: E. Przesmycka, 2016.

its intensity and quality of new buildings has changed.

Work on the Nowa Huta design began immediately after the war, in 1948. There were different design groups working on urban plan of Nowa Huta, but the main part of this settlement has designed Tadeusz Ptaszycki with his team. Apart from the obvious attention to recreational and green areas at the planning stage, the city of Nowa Huta primarily formed part of Howard's concept thanks to its urban grid with clearly separated green center, extensive residential complexes, with broad thoroughfares in the form of alleys with planted trees (Fig. 1). Designed green areas of the housing estate combined the elements of the town's historical stylistics (rows of trees) with the ideas of the interwar functionalism (Fig. 2) (Dobrzycki, 1955). The first part of the housing estate was located nearest the plant – Lenin steelworks; this was carried out strictly according to the first, classicising design. The estates were characterized by an intimate scale and a traditional form, modeled on pre-war residential areas. It was dominated by a small residential building pattern for several families in an environment of the designed, diverse vegetation. The favorite tree species were Italian poplars, and beds of roses were planted along the main avenue (Kosiński, 2011).

After 1990, like most of housing estates of that period, Nowa Huta lapsed in lethargy for several years. Lack of management concept, the impoverishment of residents – former employees of the decaying steelworks, were additional factors that contributed to the degradation of the residential space. Over the next several years, the situation faced by Nowa Huta and similar housing estates from 1950s have changed. Nowa Huta began to be perceived as an example of an attractive urban concept. Its attractiveness lies in the presence of green spaces and public spaces between blocks of flats (Fig. 3) (*Lokalny Program* . . . 2008). Also, the aesthetics of the socialist realism architecture is now regarded positively. This change in the public perception of housing estates from the 1950s meant that it is easier to obtain funding for the on-going revitalization. The breakthrough came with Poland's accession to the EU and the opportunity to acquire EU funds, which helped start work on improving the standards of the utility spaces, as well as individual residential buildings. Currently, numerous revitalization projects are being implemented, from improvement of public transport to the recovery of the social infrastructure.

4 SADY ŻOLIBORSKIE HOUSING ESTATE, WARSAW

The housing estate of Sady Żoliborskie in Warsaw is an example of the estate created at the end of the 1950s – i.e. after some easing of the communist regime in Poland.

The housing estate was created in the years 1958–1973 and was very modern. It is characterized by an open form, and it was freely composed – designed for the comfort of living. One of the objectives was the separation of the pedestrian from vehicle communication. Public transport was routed out to the outskirts of the housing estate. The challenge for the designer was

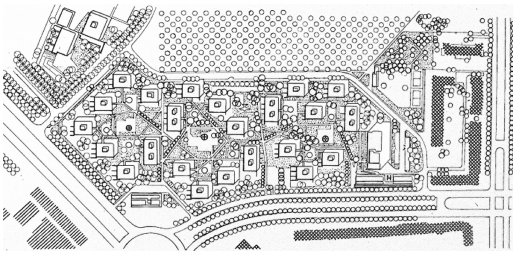


Figure 4. Sady Żoliborskie housing esate, urban plan. Source: H. Skibniewska 1974. *Rodzina a mieszkanie,* PAN, Warszawa.



Figure 5. Sady Żoliborskie housing estate, Warsaw, source: powojennymodernizm.com.

to preserve the tree stand existing on land intended for the construction of the housing estate, and integrating it in the space of residential buildings. Residential houses were designed as three- and four-story buildings, in a clearly rhythmic, spatial layout, split by wide alleys. Orchards, which were on the plot allocated for the construction of the housing estate, constituted the core of its urban planning. The author of the project integrated the line of new residential houses so as to avoid interference in the existing tree stand, and the felling of trees was the last resort (Fig. 4).

'If in the housing estate we are to erect a house and plant a tree at the same time, a resident is forced to wait for the tree twenty-five to thirty years. I know I must preserve everything that grows, because it allows me to quickly create a genuine environment.' (Skibniewska, 1974)

Today Sady Żoliborskie is a place where one can find the concept of the garden city, and residents identify with it. Well communicated with the Warsaw city center, it provides tranquility, green and interesting architecture that is embedded in the greenery. Several years ago, the whole complex underwent a thorough thermo-modernization. The value of the apartments in this neighborhood is high compared to the prices of the apartments in other neighborhoods of the same period and demonstrating similar utility values. This is an example of how the property value is affected by the quality of the urban assumption and natural values of the space, in which residential buildings are located (Fig. 5).

5 JULIUSZ SŁOWACKI HOUSING ESTATE, LUBLIN

In the first years after World War 2, the housing situation of Lublin was very unfavorable. Housing shortage caused by the ravages of war was further compounded by the investment neglect of the interwar period. Post-war Lublin ranked one of the highest cities in Poland in terms of residents per room. In the face of continuous population growth and the increasing housing shortage, the city authorities were interested in an inexpensive and intensive housing construction. The response to this unfavorable housing situation of the city was in the form of housing co-operatives (Przesmycka, 2009). One of the first such cooperatives in post-war Poland was established in Lublin. The new residential district of Lublin formed in so-called Rury Jezuickie. The land allocated for the construction of residential buildings managed by the Lublin Housing Cooperative (Lubelska Spółdzielnia Mieszkaniowa – LSM) occupied approx. 360 ha. Seven housing estates were created there. The first housing estate, erected in 1958 was the Adam Mickiewicz housing estate, while the next one was the Juliusz Słowacki housing estate. The first housing estates were characterized by exceptional care for green spaces. Small, three- and four-storey blocks were distributed quite freely on a hilly terrain. In the 1970s, the housing estate occupied 42 ha, of which 20 hectares were allocated for green areas, giving approx. 38 sq. m of green areas per resident. Importantly, the Adam Mickiewicz housing estate and the entire LSM district, when compared to the latter housing estates, were characterized by the favourable proportion of green areas in relation to the land for other purposes (Przesmycka & Sosnowska 2010). The Juliusz Słowacki housing estate was one of the most interesting urban planning and architectural assumptions created in the 1960s in Poland (Fig. 6). In that period, urban planning and architectural design were subordinated to the "top-down" defined standards and guidelines. These standards limited the size of apartments and housing space per resident, which was to ensure the greatest number of apartments in the building. As a result, buildings and apartments referred to as "typical" were made in the prefabricated and industrialized technologies. The housing estate was to be more densely built-up, cover a smaller area and serve more people. The authors of the housing estate design were Zofia and Oskar Hansen. They implemented it according to Oskar Hansen's original concept of "The Open Form". The designers wanted to make future residents design a layout of walls in their homes and determine the layout of windows and balconies – which in those days was a remarkable extravagance (Hansen 1965). The buildings were formed in such a way that they formed part of the natural, hilly terrain (Fig. 7). An important element of landscaping the public greenery was

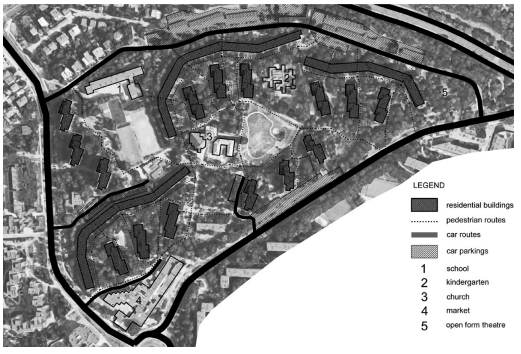


Figure 6. Juliusz Słowacki housing estate. Urban plan. Author: Z. Napieralska.



Figure 7. Juliusz Słowacki housing estate. Author: E. Przesmycka, 2016.

an open-form theater located in the highest part of the housing estate – a square having a sculpturally shaped form. Today, this part of the housing estate is devastated and not used.

In 1966, Hansen developed the Linear Continuous System (LSC) theory, which assumed a band division of the space into zones with different functions and a departure from the traditional division between the center and the periphery. Again, this concept has been applied in the design of the Juliusz Słowacki housing estate, where residential zones are separated by service areas and green areas (Fig. 8). The project assumed that in every place, the residential zone had a different relationship with green and service zones, but it was equal in terms of distance and ease of access (Hansen 1970).

The Open Form concept by Oskar Hansen and the concept of the Garden City are the examples of harmonious design of residential buildings and the natural environment in order to ensure a high quality of life. The Open Form concept assumed an additional opportunity to shape public space by each resident and the breakdown of the artist's supremacy in the design process – according to Hansen, the role of the designer was rather to be a guide (Hansen 2005). He believed that there was no such thing as a "typical person" for a "typical house", despite the ubiquitous typification in the architecture of the socialist era.

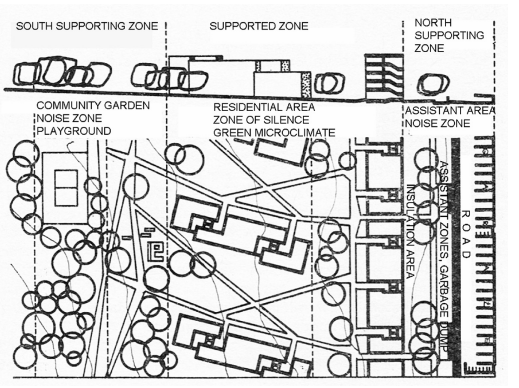


Figure 8. Plan presents the Linear Continous System at Juliusz Słowacki housing estate. Source: T. Szafer, 1972.

6 HOUSING ESTATES IN THE 1970S AND 1980S IN POLAND

The 1970s and 1980s were the peak period for industrialization and intensification of development in the housing sector in the countries of the Eastern bloc. Housing estates implemented in that period lacked a well thought-urban composition, and were characterized by high density of flats with a relatively free layout of buildings, which is not conducive to the formation of social spaces. Extremely little attention was paid to creating residential interiors. Residents gradually ceased to identify with such "dormitory towns" that were distant from the city center, while housing estate administrators paid no attention to the natural values of the settlements. It is hard to find in them traces of Howard's concepts, despite there were plenty of open spaces in housing estates of that period.

A common problem of the most of the housing estates created in the second half of the twentieth century in Poland is the lack of ongoing activities to prevent "the aging of buildings and residential spaces". Paradoxically, the absence of any corrective actions saved the original assumptions of greenery and landscaping elements in most of the housing estates. Today, they are a valuable evidence of the era and in many cases they begin to be perceived as elements of spatial identity of the housing estates.

7 CONCLUSIONS

Currently, we are observing a trend that is very important for the quality of life in post-war housing estates era of the People's Republic of Poland; this trend involved transformation and modernization of the neighborhood spaces (Przesmycka & Sosnowska 2012). The surfaces of sidewalks and roadways are being replaced and the necessary landscaping elements are being added, but these are often temporary measures, showing no traces of conscious design and respecting the existing urban planning concept. At this point, the question arises whether these housing



Figure 9. Letchworth Garden City, Great Britain. Author: E. Przesmycka, 2013.

estates may be saved by a comprehensive revitalization process, with particular emphasis on green areas?

In most of these housing estates, a sense of identification with the place of residence increases as a result of revitalization activities, the most important element of which is the re-naturalization.

In the housing estates of the second half of the twentieth century, greenery has reached the stage, where most of the tree species are in their maximum habits. Trees and shrubs require proper maintenance or replacement. Some forms of greenery (e.g. the so-called rockeries) are no longer fashionable. Over the years, the soil in the city undergoes irreversible sterilization and contamination, which causes dying out of valuable species (shrubs). Random plants planted by the residents often disturb the old landscape assumptions.

Functional and aesthetic arrangements of the greenery are conducive to strengthening neighborly bonds (Beatley, 2000). This is also linked to a sense of security in the area, improvement of natural environment values. Residents who get engaged in activities to improve the quality of their housing environment, identify with this space and feel more and more responsible for it.

The analysis of the presented housing estates demonstrates the need for the re-naturalization of green areas as part of the integrated revitalization processes. These processes have already begun in many cities; however, often they are not adequately managed. The problem is attempts to use the free space for dense arrangement of the buildings or allocating to missing parking spaces. The proper conduct of the revitalization process is conducted with the participation of the local community, which does not relieve the city authorities from responsibility for the natural environment in housing estates (Farr, 2008). Because of the large percentage of natural ecosystems in the urban structures, greenery should be particularly protected and cared for. The revitalization of Letchworth Garden City (Fig. 9) suggests that this is possible and demonstrates the positive effects of coordinated actions to improve the quality of historic housing estates and garden cities.

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Industrial ruins. A re-cycling approach in researches for dismissed areas

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ABSTRACT: Ruins are one of the configurations through which architecture reveals its multitemporal dimension in a renaturalization process of the contemporary city. A specific character related to that question is readable in brownfield sites, in which is possible to highlight morphological interactions between ruins and buildings in sites involved in regeneration projects. In some research experiences these dismissed areas represent a possible network for testing settlement patterns more suitable for their regeneration and useful to get a more intense dialogue between different stakeholders. Among the possible elements oriented to the definition of such settlement patterns are: sequence of regeneration cycles through energy infrastructures in a multitemporal dimension; the link of these areas to network of networks formed by water infrastructure, roads and railways reinterpreted as new ecological corridors; legal and management subjects, planning tools at urban and regional scale, methods for mapping on a regional, urban and building scale.

1 INTRODUCTION

1.1 *A re-cycling approach*

In this text we will try to understand how a re-cycling approach could be seen as more radical than the re-using one in regeneration processes applied to brownfield sites, through the reference to the multitemporal dimension of ruin, at architectural scale, and to the role of waste landscapes or drosscapes, at territorial scale, in order to define more flexible aesthetic and design strategies.

2 MULTITEMPORAL DIMENSIONS OF RUINS

2.1 *Ruins and constructions*

Ruins are one of the most interesting configurations through which architecture reveals its multitemporal dimension.

Ruins are represented by figures through which it is possible to explore the hidden form, where it reveals not only the ways of its construction, but also the terms of its possible transformation.

In architectural history and theory – for example through the work of Baldassarre Peruzzi, John Soane, August Perre, Louis I. Kahn, Francesco Colonna, Georg Simmel – it is possible to read, in its theories and practices, traces of this fertile relationship between ruins and transformation.

A similar principle is applied, after the Renaissance, from those architects directly involved in archaeological research or interested in it (Tafuri 1980): as for example Giovanbattista Piranesi, Fischer von Erlach, Julien David Leroy, Antoine Desgodetz, Léon Dufourny, Bernard de Montfaucon, Pierre-Adrien Pâris, Giuseppe Valadier, Karl Haller von Hallerstein, Robert Cockerell, John Soane, Luigi Canina, Thomas Leverton Donaldson, Leo von Klenze, August Caristie, Jakob Ignaz Hittorf (Pousin 1993).

Many of these architects describe ancient monuments through representations – sections, prospective sections, elevations in different combinations –, which not only reproduce what you can see of those ruined spaces, but also what is not seen, i.e. the formal and tectonic principles that constitute its architectural space (Pinon 1993).

The theme of ruin has origins dating back at least to Francesco Petrarca, although the representation that opens the aesthetics of ruin (Borsi 1995) is the "destructo et deserto tempio" (Mortier 1974; Vercelloni 1990) described in 1499 by Francesco Colonna in his *Hypnerotomachia Poliphili* (Colonna 1980).

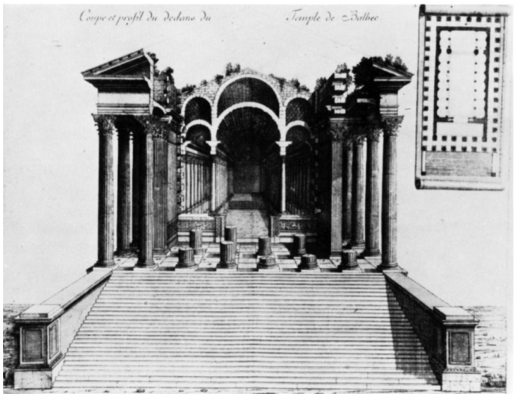


Figure 1. J. Marot, Representation of Bacco's temple in Baalbek, 1680.

Beyond the italian origin, it is in France that the theme of ruins is spreading thanks to Joachim Du Bellay and his work *Les Antiquitez de Rome*, written between 1553 and 1557 (Mortier 1974).

In philosophy, is Georg Simmel that more keenly has treated this issue, defining the ruin, in one of his texts (Simmel 1911), as the phenomenon by which the balance between nature and spirit in architecture is shattered, giving rise to a "new form which, considered from the point of view of nature, is absolutely significant, intelligible, autonomous".

When a building changes his state, and it loses its functional character remaining only a shadow of its form – the new form defined by Simmel, i.e. the ruin –, at that moment is possible to reveal the dichotomy in architecture, which like any system contains order and disorder, construction and deconstruction. Architecture seems to bring in itself the cause of its own degradation and transformation: it is a complex phenomenon, which while resulting in a unit, maintains different levels of complexity and contradictions that may lead to its decay or transformation.

The study of complexities and contradictions in architecture led in the second half of the twentieth century, for example through researches developed by Robert Venturi, to a significant mutation of linguistic references, of the transformation objectives, of the relations between architecture, city and history (Venturi 1966).

The fragment, the unfinished and the complex program reveal different scalar relations in the city, as well as the ruin lets understand some hidden architectural elements. The ruin tends to reveal architecture's configurative structure, i.e. the possible and dynamic relationship between form and content in a multi-temporal dimension.

On the other hand, the use of industrial ruins is quite similar to the recycling practices of greek-roman monuments, which characterized the paleo-christian architecture from V-VIth century A.D. until the so called "protoumanesimo".

As highlighted by several authors (Choay 1992) ancient monuments were primarily subject to two opposite practices: on the one hand the overall reuse, linked to more or less radical modifications; the o-ther, the fragmentation or the despoiling of component parts (columns, ornaments, decorations) later reinserted in new buildings.

Similar practices have characterized the spoliation cases of abandoned industrial complex where existing machines and facilities for production cycles are dismantled and reused in other industrial areas, sometimes thousands of kilometers away, leaving mute ruins on the abandoned site, buildings unable to communicate their origin.

Or even cases in which it is designed and built a reuse of spaces and areas, with new configurations of spaces, new senses and signs.

3 POST-INDUSTRIAL RUINS

3.1 *Ruins and constructions*

It is important to carefully evaluate the potential that the same relation between ruins and constructions reveals in some research experiences in which theories and methods of architectural design can play an important, if not decisive, role.

An obligatory reference is due to researches dedicated to the relationship between archeology and contemporary design, in which interesting expe-riences have been developed by several research groups.

A specific character is readable in research experiences related to the redevelopment of brownfield sites, in which relationships between different disciplinary apparatus – for example, industrial archeology, architectural design, urban regeneration, economic evaluation – highlight morphological interactions between ruins and constructions in sites involved in regeneration projects.

In particular, the field of remediation and redevelopment of contaminated sites, even though not succeeding to take off, in Italy represents a strategic area of great economic and environmental opportunities: 58 sites of national interest for approximately 7000 sq km, representing approximately 2.3% of the national surface, set the framework for testing of settlement models strategically more suitable for regeneration of brownfields, in relation to the specific characteristic of each site.

The current post-industrial phase has seen the relocation, decommissioning and abandonment of areas



Figure 2. Fertilizer's deposit, Agrimont site, Porto Marghera, Venezia (photograph by Angelo Desole).



Figure 3. Sugar refinery's site Delta Po, Porto Tolle, Rovigo (photograph by Angelo Desole).

considered strategic from urban, infrastructural and economic points of view. In this sense, brownfield sites are key elements for urban renewal of entire areas, considering their infrastructure, technology, energy, social and economic characteristics.

Some researches (Bottarelli, Pogutz & Tencati 2005) shows that in the sites of national interest with inherent potentialities the remediation costs represent only a few percentage points in the overall economic budget. So that clean-up costs do not constitute the decisive factor in the productive chain of "remediation and reuse" of contaminated sites, but are the same potentialities of the site which eventually lead to the regeneration. Industrial reclaimed buildings are reduced to modern ruins, leaving only read the skeleton of its original structures, often with the loss of secondary devices: infills, coatings, applications and other material characteristics.

Furthermore reclamation processes, often driven by survey models unable to describe three-dimensional complexity of these industrial sites, inexorably erase the rich complex of infrastructure – roads, railway lines, bridges, cantilever roofs, walkways, conveyors, cranes, water and cooling towers, chimneys, silos – which historically represent the intrinsic reasons of the historical settlement, and in the meantime can be considered as future potential of urban renewal of these areas.

3.2 *Settlement patterns*

In some research experiences developed in our university, these dismissed areas represent a possible network for testing interesting settlement patterns more suitable for their regeneration, in relation to specific characteristics of the site.

Among the possible elements that contribute to the definition of such settlement patterns are: the location of these brownfield sites in an urban context characterized by soil contamination and the possibility to define sequence of regeneration cycles of the same areas through energy infrastructures (i.e. geothermal energy, photovoltaic) in a multitemporal dimension; the link of these areas to "network of networks" formed by water infrastructure, roads and railways, that could be reinterpreted as new ecological and slow mobility corridors in the lanscape; legal and management subjects, planning tools at urban and regional scale, methods for mapping on a regional, urban and building scale, useful to get a more intense dialogue between different stakeholders.

The following paragraphs will describe some experiences of research and teaching activities developed in our universities on these issues.

3.3 *Tools for feasibility studies: ASM*

In the contemporary design of an housing complex the definition of the functional programme (Blanchard 2002) is developed by interdisciplinary groups and has an important part in new residential districts inside existing urban settlements. Often these are hybrid areas, where are visible infrastructural intersections or abandoned precincts of dismissed industrial areas, that become residual ones, then transformed in secondary landscapes (Clément 2004).

In such cases the process of designing the program can enable, through comparison of different scenarios or urban regeneration strategies, to previously define the objectives of regeneration process, to evaluate comparatively the criteria identified to achieve them and to share with other stakeholders different stages of decision-making (Massarente 2012).

As a result of such actions, designing the program can developed in most cases through the tools of feasibility study, which is the platform through which you can: develop dialogue and confrontation between different stakeholders; foster communication of ongoing activities to local communities; define the overall framework of (technical, environmental, economic, financial, procedural) feasibility of interventions; draw up a detailed articulation of the functional program of activities provided through a preliminary design document; identify possible funding opportunities for the design and implementation of interventions; develop the subsequent design levels.

This project was developed since 2010 to 2011 during a research activity, that lead to the definition of a feasibility study on urban rearrangement of an area in Rovigo, a town between Ferrara and Venezia, that was previously a gasometer plant for gas production and lighting, in the second half of XIXth century. Nowadays the same area is the head office of a public company (ASM) that has the management of a

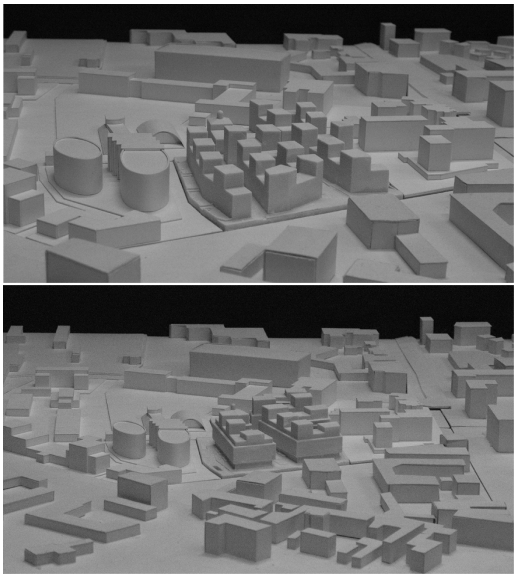


Figure 4-5. Models of two different alternative visions "borgo" and "community" (below), ASM former gasometer area.

series of public territorial services, such as energy distribution, renewable energies, waste treatments, last honours services.

During these research activities were deepened two different alternative visions ("borgo" and "community") which represent two possible urban scenarios for the same area, with different composition criteria for housing, compatible activities (such as co-working, retail trade, coffe-shops) and local services for housing district (health district, meeting places for young people and associations).

The concept of "borgo" vision is based on a sequence of spaces which intertwine the characteristics of square, street and park, becoming an organizing principle of the settlement through urban spaces that expand and shrink, linking public, semi-public and private spaces, and meanwhile trying to connect to existing permeability in the surrounding blocks.

The concept of "community" vision is based on a composition of clusters forming relations between public, semi-public and private spaces with fragments of pre-existing industrial buildings.

These composition criteria, like the profile of possible new clients and dwellings' dimensions, were developed through analysis and samples of direct and indirect sources of local real estate market.

Unfortunately the research project, after its conclusion, was not used by ASM for subsequent decision acts. Contingencies of the real estate market, company policies and administrative constraints in dealing with the municipal administration did not allow, among other factors, to move towards an urban regeneration process.

Nevertheless we believe that this research experience, for tools, methodologies and outcomes, can be a useful reference methodological framework for urban regeneration of areas in which the collaborative relationship between proprietary companies, municipalities and university research centers can be developed with tangible results (Massarente & Verde, in press).





Figure 6-7. Ground floor plan and urban section of vision "community" and (below) perspective of one court, ASM area.

3.4 *Research and didactic interactions: Alc.Este*

Through the experience of the Workshop *Regeneration of productive areas. The case of former distille-ries Alc.Este in Ferrara* it was intended to offer students of the Final Synthesis Studios of the degree course in Architectural Design, University of Ferrara, an educational experience centered on a well-documented case study involved in recent urban redevelopment programs.

Since 2012–13, these Studios are the place where students prepare dissertation through a first phase working on a theme characterizing the Studio, by which students are led to choose the topic of the dissertation, and a second phase of individual study and development.

Each of the 5 Studios are consisting of a characterizing subject (Architectural Design, Architectural Restoration, Architectural Technology, Urbanism, Landscape Architecture), and teaching modules also of other disciplines, aimed at guaranteeing the interdisciplinary nature of each Studio.

The themes of the 5 Studios are related to main research areas to which are referred the professors' and lecturers' teaching activities: Regeneration of abandoned industrial areas, Restoration of Twentieth century architecture, Technological design for architecture, Public spaces and sustainable development, Landscape architecture and infrastructures.

This relationship between training for dissertation and departmental research may trigger virtuous circuits between teaching and research: either through didactic verification of research methodologies (i.e. feasibility studies' tools) tested in applied researches, both through carrying out researches for study cases already discussed, on an experimental basis, during dissertations.

Ferrara School has a steady network with the architectural profession and these virtuous circuits, triggered by this new articulation of Final Synthesis Studios, tend to integrate graduates' professional careers towards the various forms of architectural profession with possible collaborations in research activities by best motivated students, also by attending PhD courses.

The articulation of these Studios also tends to foster various possibilities for postgraduate training, such as master for professional level and postgraduate schools, with which centres and research laboratories have long collaborated, in coordination with professional associations.

This Workshop was attended by students of Master's Degree MPI in *Conservation, management and enhancement of industrial Heritage*, promoted by University of Ferrara in partnership with other Italian universities, and by students of Erasmus Mundus TPTI *Techniques, Patrimoine, Territoires de l'Industrie. Histoire, Valorisation, Didactique*, in collaboration with Université Paris 1 Panthéon-Sorbonne (France), University of Evora (Portugal), University of Padua (Italy).

Following some introductory lessons dedicated to the case study, carried out in the first semester and at the opening of the Workshop (April 2015), students were asked to produce, in few days, a concept related to possible regeneration strategies for the area of the former distillery, to translate into 4 different scenarios of transformation, even through phases, using documents available and methodologies applied during the Workshop.

These strategies and scenarios proposed by students were discussed with Workshop's professors and researchers and were subsequently compared by synthetic multicriterial analysis, which will be briefly described in a short publication in their assumptions, purposes and processing mode.

With this educational experience is intended make interact the students with one of the most complex issues in the processes of regeneration of brownfield sites, that is the definition of the program and its complex relationship with processes of planning, urban regeneration policies and logics of economic enhancement.

Meanwhile it was decided to interlace these educational activities with the experiences of post-graduate training more advanced today in Italy on this subject, trying to refine some results, inevitably limited by time



Figure 8. Buildings and infrastructures, Alc.Este area.



Figure 9. Buildings and infrastrutctures, former distillery Alc.Este area.



Figure 10. Alba cement industry site, Porto Torres, Sassari (photograph by Angelo Desole).

and nature of teaching carried out in the Workshop, through the work of students of the Master MPI.

This educational experience has determined the basis on which were developed some further investigation: at level of a degree thesis in progress, both through a project work by two students of Master MPI, both through the analysis in progress of case study developed as part of a doctoral research in the frame of IDAUP International PhD Architecture and Urban Planning.

3.5 *Regeneration's cycles: RE_loaded buildings*

A recent experience is linked to the presentation of the research project *RE_loaded buildings. innovative technologies for the regeneration of the building stock in abandoned areas*, as part of the financing program POR FESR 2014-2020, axis 1 *Research and Innovation*, action 1.2.2 *Support to the realization of complex projects of research and development activities on a few thematic areas of importance and the application of functional technological solutions to the realization of the strategy S3*, promoted by EU European regional development Fund and Region Emilia Romagna.

The economic crisis of the real estate market in Italy during recent years leaves us a complex scenario, characterized by an increasing availability of brownfield sites, abandoned beyond the threshold time of transformation.

These abandoned areas offer themselves as a basically no more reproducible resource, assimilated to a new state of nature to be exploited, which requires an investment of creativity without precedent.

To face this condition, in this research program it was proposed to use these areas as urban laboratories inside which to test new methods and techniques for urban regeneration, bringing corporate identities and productive cultures, widely disseminated in the city through multiplicity of research and manufacturing centers.

Through the promotion of innovative practices and subsequent development of an overall production chain of regeneration, it is intended to exploit the available and unused real estate asset as business incubator for training of new specialized job profiles in recycling culture of existing urban complexes.

For this purpose this research project aims to promote a strong integration of knowledge, able to cover different prerequisites of regeneration process: remediation of contaminated areas, recycling waste materials, monitoring and seismic safety of structures, energy retrofit of buildings, temporary uses of interior spaces, development of digital meeting platform that fosters the matching of supply and demand for redevelopment and urban regeneration initiatives.

This project intends to develop a coordinated system of specific building sites, allowing the experimentation of processes and products, then promoting an immediate enhancement of the areas through valorisations actions and use, even temporarily, of brownfield sites and its buildings.

The project is divided into 4 working areas that are translated into development objectives: Technical solutions for diagnostics of brownfield sites; Technologies for safety and energy efficiency of built environment; Technological systems for reactivation of spaces; Information systems for planning, design and management of brownfield sites.

In particular, in working area 4 the general objective is the development of data management tools for analysis and design of brownfields, through implementation of geographic information systems and design tools in order to make accessible to different stakeholders data related to diagnostic tests, innovative technologies and phases of temporary use of areas and buildings, through a strong interaction with activities carried out in working areas 1, 2 and 3.

So in this working area, it is expected the development of territorial data management tools from application of innovative technologies (soil reclamation, recycling of inert materials from excavation, waste water treatment, solar and geothermal energy) as part of regeneration cycles of brownfields, as well as informations generated by application of innovative technologies (seismic safety, energy retrofit, acoustic comfort, building systems) as part of redevelopment phases of abandoned areas and buildings.

4 CONCLUSIONS

These research experiences show us that the re-cycling approach could be seen (McDonough & Braungart 2013) as more radical than the previous re-using one, because of its two intrinsic possible processes. The first one is the "up-cycle process", i.e. the valorisation of an object or a site towards a form of higher life through a new creative use and very simple interventions. On the contrary, the second one, called "down-cycle process", foresees a reduction of the original functions of the site, proposing a re-use of its individual components as raw or semi-finished materials for other purposes and in different contexts.

In any case, re-cycling attitude implies the ability to sight, in discarded objects, new potentialities, which



Figure 11. Perspective of one pedestrian space of vision "borgo", ASM area.



Figure 12. Ground floor plan and urban section of vision "borgo", ASM area.

are very different from the original functions for which they have been originally conceived.

Considering industrial dismissed areas as "waste landscapes" or "drosscapes" (Berger 2006) accepting "waste/dross" as a natural part of urban process, could represent a new field of research, in which ruins could be considered as part of the configurative tools of the project.

In fact, according to Alan Berger, "the natural process of the city is not unlike that of living orga-nisms, whose hard parts originated in the expelling and/or managing of waste . . . . Cities are not static objects, but active arenas marked by continuous energy flows and transformations of which landscapes and buildings and other hard parts are not permanent structures but transitional manifestations.

Like a biological organism, the urbanized landscape is an open system, whose planned complexity always entails unplanned dross in accord with the dictates of thermodynamics . . . The challenge for designers is thus not to achieve drossless urbanization but to integrate inevitable dross into more flexible aesthetic and design strategies".

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The ripple effect: How saving Yamuna river will save Delhi

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ABSTRACT: Yamuna is dying. One of the holiest rivers of the Hindus that charmed the Mughals to build the Taj Mahal along its banks is reduced to a pale, sickly drain. The paths along the riverfront, which were once the centre of a thriving river culture, have disappeared without a trace. Yamuna has become a cautionary tale of rapid unchecked urbanisation.

In 1912, when Herbert Baker and Edwin Lutyens won the commission to build a new capital for the British Empire's jewel, India, their aim was to create a garden city of 400,000, "with room for endless expansion". That number has now swelled to a staggering 16 million. In the 22 km it flows through Delhi, the river Yamuna dies from a million cuts. For instance, Delhi generates 36 million tonne of sewage, and 50% of it flows untreated into the river. The 22-km stretch of the river through the city — two per cent of its total length — contributes 80% of its pollution load. Delhi is damaged by the going paradigms of the river Yamuna. Since 1993, successive governments have spent over 250 million Euros in 3 phases to revive the river, with little to show for it. Amidst this failure how can we future-proof the desecrated city of Delhi through strategies of spatial and urban planning?

This research-work seeks to find salvation for Yamuna through Green Urbanism, a conceptual model for zero-emission and zero-waste urban design, which arose in the 1990s, seeking to re-engineer existing ci-ties and regenerate the post-industrial city centre. This study concludes that a design that crosses theory to take into account, political, social and economic realities, will help in creating a feasible natural and urban landscape in Delhi. With this new strategy, the future city of Delhi forms a new urban structure where the urban-rural morphology and nature overlap. The study develops a strategy by interpreting the results of various research methods like DPSIR, SWOT, Place-diagram and Stakeholder-analysis for a realistic outcome.

This regeneration strategy for Yamuna is based on a case study of Rhine which flows through Germany. Rhine, which has a catchment area of 200000 km^2 where 58 million people live, was once labeled as the 'Open Sewer in Europe'. A sustainable plan, has transformed the fortunes of Rhine, which received the European River Prize in 2013. A study which brings together sustainable practices and ideas from both professionals and stakeholders is a perfect way to understand the complexity of huge scale urban projects. The outcome of such a study will guide us to a green and sustainable future.

1 INTRODUCTION

To achieve maximum results in the shortest time, I have planned a strategy in an area where Yamuna is effected the worst, i.e. Delhi. Delhi, with a population higher than 22 million, is the world's second most populous and the largest city in India. A mere 2% of Yamuna's total length runs through Delhi and dies along its way. The current population of this rapidly growing city is more than 16,753,235 and has grown more than 10 times over the last hundred years.[1] This makes Delhi one of the fastest growing cities in the world. This has lead to several problems and utter mismanagement which has lead to the severe environmental pollution.

1.1 *Current state of Yamuna*

In the year 1909, Yamuna was distinguishable as "clear blue" as compared to the silt-laden yellow of the Ganga. In 1970–80s Yamuna was regarded as the life line of Delhi. The first 375 kms stretch of Yamuna from Yamunotri to Delhi is of reasonably good quality water, after which the discharge of waste water from 18 drains renders the river severely polluted after Wazirabad in Delhi.[4] Today, Yamuna has become one of the most polluted and toxic rivers in the world.[5] Whatever the state may be, Yamuna is a source of life for millions. Today, the water from the river is abstracted for various purposes. Major part of the water i.e. 94% is used for irrigation, 4% of the water is used for domestic purposes and 2% for industrial usage.[6]

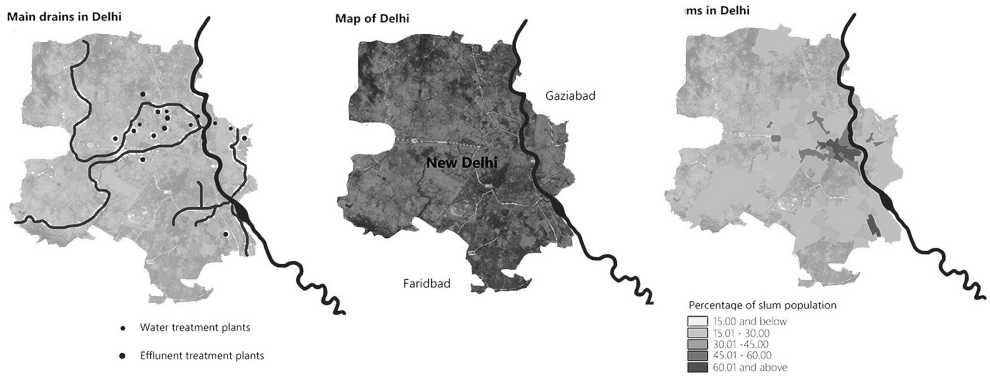


Figure 1. Co-relation – Yamuna River and Slums in Delhi.

Stakeholders	Role of stakeholder	Gain and benefit
People *Slum dwellers and the waste picker community*	Separate waste and wastewater Collect waste from Yamuna	Sell waste for money at canteen bio plant Get low priced meals from canteen & get purified water for reuse Make sustainable homes
Private sector *Comapnies, NGOs, organisations*	Built canteens which run of bio-gas Built STPs with bio plants to produce energy from sludge Buy waste from slum dwellers	Raw material for running the plant from Yamuna Future investment secured
Public sector *Central government, DJB, muncipality*	Create *"Community washing units"*, on-site *"Water treatment plants"* *Designate job titles to waste pickers* *Share responsibility with private companies*	Target of "Clean Yamuna" achieved sooner Work load shared, costs will be reduced The new government will win trust and goodwill of the citizens, make stronger

Figure 2. SWOT Analysis of the curent situation in Delhi: *This explains the How, Who and Why in the two processes. Who all are key Stakeholders, How can they bring a change, how are they related and lastly, Why would it be profitable for them, their city and the enviornment they live in.*

1.2 *How to plan the future of Yamuna*

Apart from the existing government plans and projects which have not shown good results, what I propose is a common solution for the holisistic problem at hand. A SWOT analysis in Figure 2, helps understand what could be part of the next steps in saving Yamuna. This analysis further decided how to proceed with the

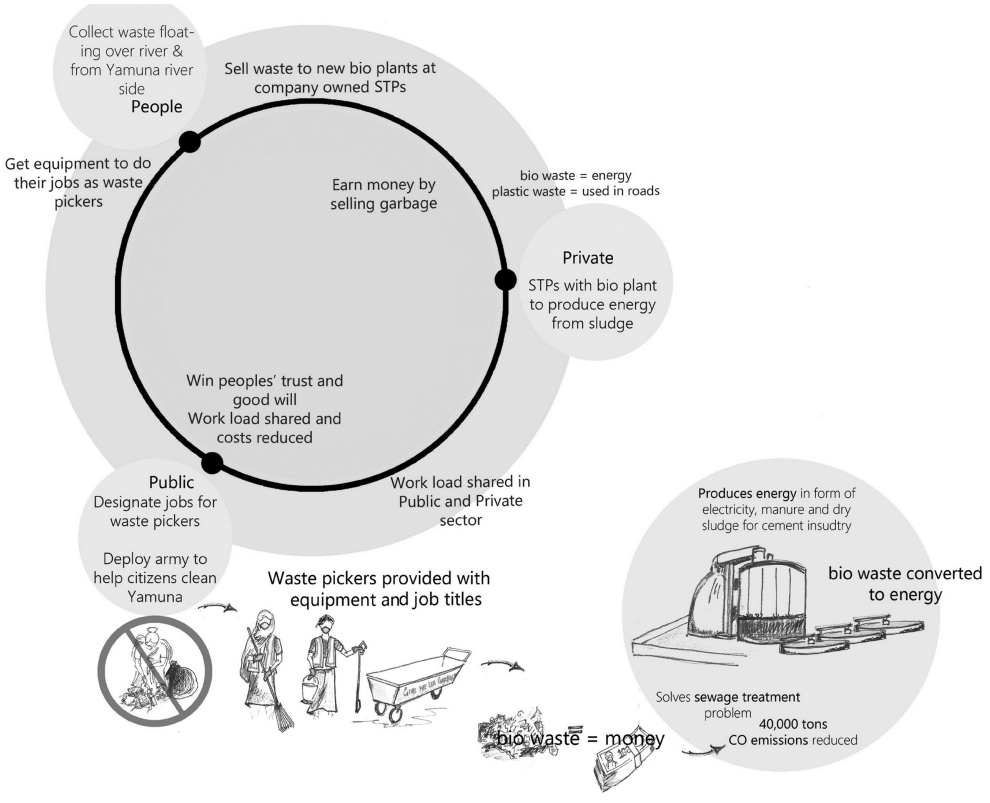


Figure 3. Active Cleaning Process. *Source: https://www.mannheim.de/node/22107*, *https://www.mannheim.de/node/22108 "The rise of the smart city". The New Economy. Retrieved*

strategy proposed to revive the dying river. 52% of the total population living in slums, pollute the Yamuna and if even half of this problem is tackled, it would bring great relief to Yamuna. In my strategy, I propose to take the help of the slum dwellers to clear Yamuna of a majority of its pollution by involving them in the cleaning process.

1.3 *Strategy*

This project concerns Slums around Yamuna and develops these blighted areas. It is crucial to understand the need of slum dwellers, their relation to the urban-natural habitat around them and recognize the problems associated with its existence.

A 'Slum Rehabilitation project' or 'River Revitalization projects' are not just planning or design projects but it is a social response that requires the coordinated effort of the NGOs, Private investors, Citizens, Slum Dwellers and most importantly the Governing Authorities.

But why would everyone work to develop slums unless they understand how it effects the society, economy and environment?

The answer is only if one can profit from saving the Slums and cleaning Yamuna will one work for it! A Stakeholder analysis below will explain Who, Why, How can be a part of Delhi Slum rehabilitation & Yamuna revival project.

All Urban problems in Delhi directly or indirectly relate to the Slums in Delhi and the common solution for this is also a vast change in urban and natural landscape. This can be accomplished. Explained in two phases: Active and Passive Process of cleaning Yamuna and Slum Rehabilitation in Delhi.

2 ACTIVE PHASE

The Active process demonstrates the relation between Yamuna and the Slums. Once this is accomplished all contributors would effortlessly work together in a cleaning and rehabilitation process in Delhi. In this way by empowering the people and specially slum dwellers with the help from the public sector, many social and environmental problems find a common solution.

Thankfully though, citizens of Delhi like some spiritual groups, youth groups, children and students are now taking initiative to clean the river and take part in events to clean the Yamuna. This is a brilliant start of a publicly driven cleaning process and at the same time this can be guided better.

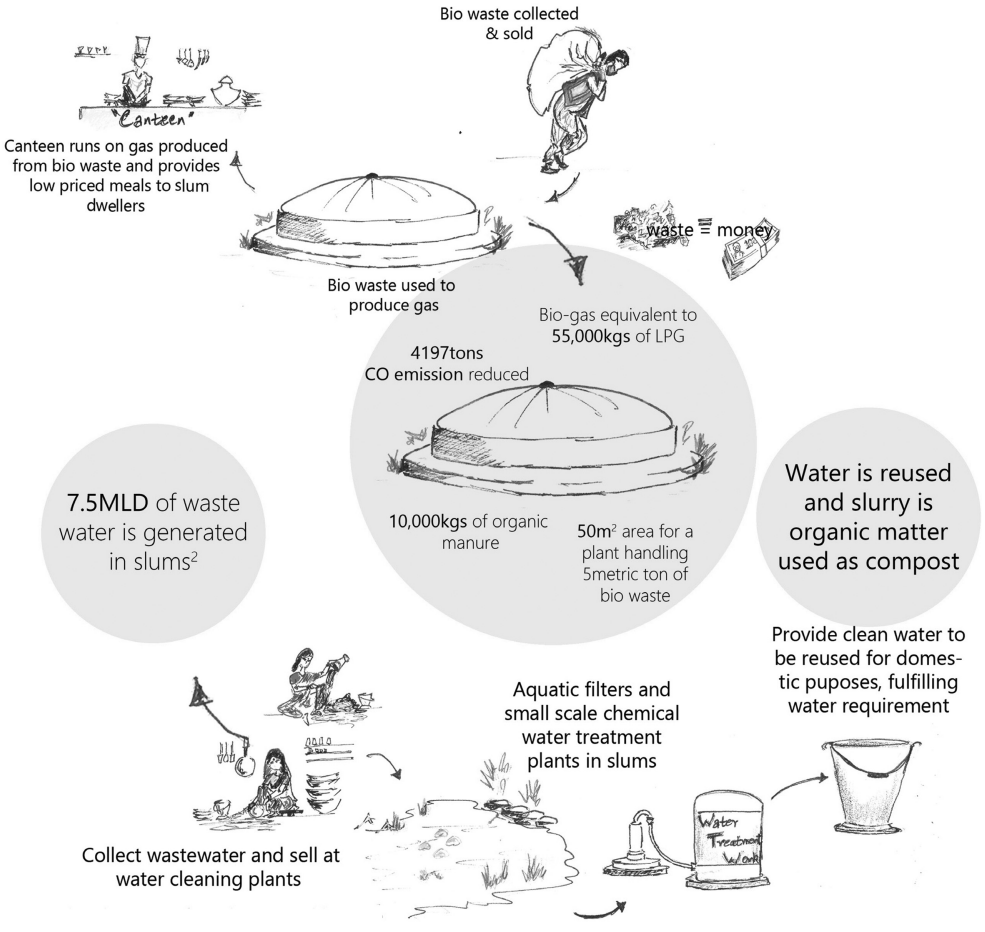


Figure 4. Passive Cleaning Process. *Source: http://www.no-burn.org/waste-pickers-run-biogas-plants-in-mumbai-india-on-the-road-to-zero-waste-blog*

Channelizing this in the right direction and empowering the people with the help from the public sector, a cleaner Yamuna can be achieved.

In this strategy, I again used the 3P's sequence as in the previous phase. The role of each part involved is explained graphically in Figure 3.

2.1 *Passive phase*

The Passive process manages the waste water and bio garbage produced in slums and at the same time providing the slum dwellers with services like clean water, washing area for clothes or utensils and a canteen which offers low priced meals to the slum inhabitants.

This will not only be effective in cleaning Yamuna but a sustainable process as the slum inhabitants can collect and sell bio waste in "Bioplant+Canteen" like in Mumbai. An organized approach with the support of the government will motivate the waste pickers in the slums to collect the waste from Yamuna where on one hand they could sell for a good price. Where don the other the government gets Yamuna cleaned effectively, the slums develop in a sustainable way. It is calculated that the slum in Delhi generates approximately 450,000 kgs of bio waste a day.

3 INTRODUCING A CHANGE

Changing the face of the Yamuna, providing slums with services and creating new infrastructure will take considerable time and resources. This change will not be overnight. A pictorial description of the infrastructure required for this change depicts the magnitude of development required.

3.1 *Scenario method*

A visual explanation of how the Slums, Yamuna and the urban life around Yamuna can be developed is explained in visuals using a Scenario Method.

Current Situation: Here all the urban complexities in Delhi are depicted in context to the Slums, metropolitan region Delhi and the Yamuna. Due to the

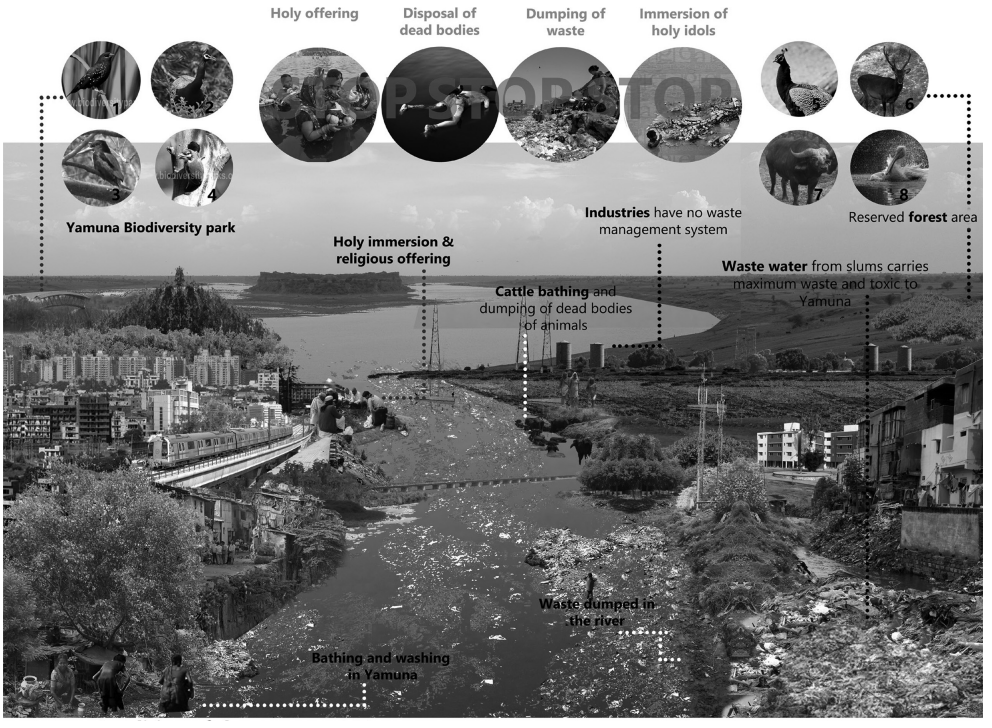


Figure 5. Scenario 1. Current State of Yamuna. If no changes are made the condition will worsen and create hazardous problems in Delhi.

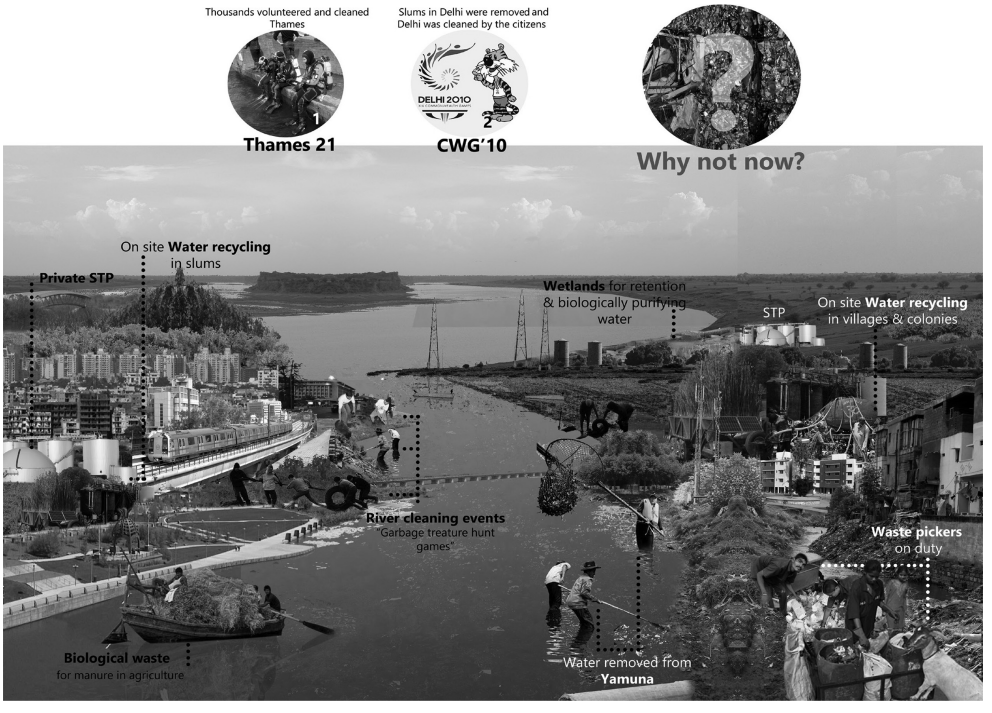
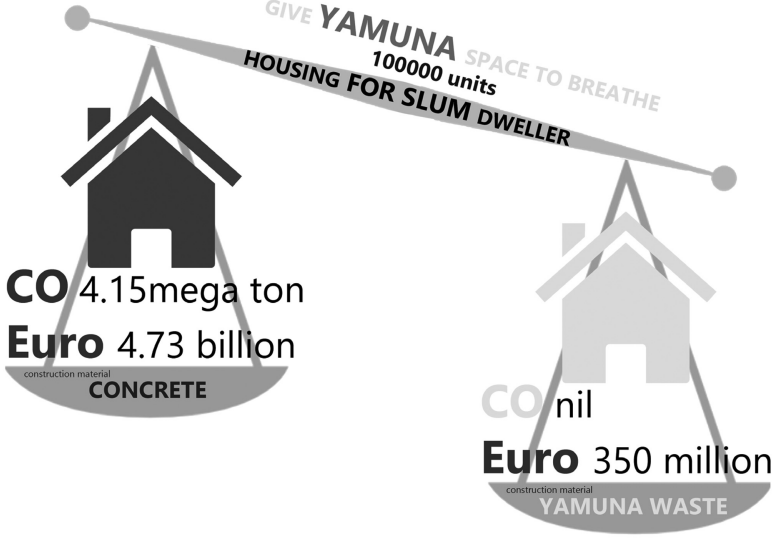


Figure 6. Scenario 2. A united effort. People have to work as one to bring a whole new life into Yamuna.



Figure 7. Scenario 3. A Possible Future.



Creating homes from PLASTIC and RUBBER waste collected from **YAMUNA** solves the problem of waste and pollutans floating over the river and provides **SUSTAINABLE** and **LOW COST HOMES** for the people living in the slums which are built right next to Yamuna. **WASTE** generated in future can be used to make homes for the rest of the people living below poverty line and without proper shelter.

Figure 8. Sustainability of the Strategy. *Source: https://sustainability.water.ca.gov/documents/18/3406693/Estimation+of+CO2+emissions+from+Constructing+Apartments+in+Korea.pdf*

inhumane conditions in which the people live in slums, they are forced to use the river water for the necessary daily work and release the pollutants in the river at the same time. To their misfortune, they do not have an option to think otherwise.

Change in future: For a better future for Yamuna and Delhi, people need to unite together to bring a change. It was seen at the time of the Asian "Common Wealth Games" in 2010, Delhi citizens gathered to clean the streets. Slums were moved for which 200,000 people were given compensation and more than 200 truckloads of garbage was removed from roads. Once Delhi realizes the role of Slums in the city, change will occur.

Yamunalive: With the advanced technological solution and further improvements in these developments, garbage and waste is going to be the resource used to make many interesting inventions.

4 SUSTAINABILITY OF THE STRATEGY

Any kind of human activity produces waste and 'Waste' will be the inevitable outcome in any future. With the rate of growth in Delhi, the generation of bio waste, domestic garbage and sewage will increase in future. Like today, the waste management issue will be a problem if a concrete solution is not developed. This strategy converts the waste polluting Yamuna into energy and sustainable housings. This will be a never ending process as the waste production will neither decrease nor stop.[13]

With this process, massive amounts of CO emissions will be reduced and unlimited resource for energy will be produced. The calculations of these figures for relatively smaller numbers compared to the whole population of Delhi are below.

To revive the Yamuna, one of the major challenges is to move the slums built immediately next to the river and shift them farther away in outskirts or open unusable cheap land. As proposed, with the Active cleaning process the slums can be rehabilitated and sustainable homes can be made from the rubber tyres, plastic bottles and aluminium cans recovered from the waste.[14]

For 100,000 units, the calculated comparison between regular construction and sustainable construction processes is given in Figure 8. The new housing will include on-site water recycling plants and canteens with renewable and sustainable energy like explained in the Passive cleaning process. This will give the river natural space to breathe and the pollution load will be reduced by creating green corridors along Yamuna.

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Bartram's bringing boating back: Reviving Philadelphia's Schuylkill River

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ABSTRACT: Bartram's Garden is 45 acres of parkland settled by America's first botanist John Bartram in 1728. The garden is located to the southwest of Philadelphia along the west bank of the lower Schuylkill River. To the south at Point Breeze is the location of the largest oil refinery on the East Coast. Although the quality of the river's water has been compromised due to industrial production, there are numerous efforts underway to breathe life back into the river. Bartram's Garden is restoring its freshwater tidal wetland area, cultivating mussels to support the river ecosystem, and is the first to bring public boating recreation back to the river. To follow is a sketch of the history of the Schuylkill River and Bartram's Garden to provide a context for understanding the significance of the Public Boating Program at Bartram's Garden and the work of university, high school and vocational students to help make this vision a reality.

1 INTRODUCTION

In 1683, the surveyor Thomas Holme drafted "A Portraiture of the City of Philadelphia" for William Penn (Fig. 1). Marked by four green public spaces near the corners and punctuated with land for its city hall at the center, the city was laid out spanning the breadth of a peninsula in Pennsylvania bounded by the Delaware River to the east and the Schuylkill River to the west (Fig. 2). The Delaware River became the city's conduit to Europe with its large ships for international trade and the lower Schuylkill River became the locus for industrial production.

In 1728, the third-generation Pennsylvania Quaker John Bartram purchased 102 acres to the south of the city alongside the Schuylkill River from Swedish settlers. A man with a passion for scientific inquiry, Bartram systematically began collecting seeds and plant specimens resulting in the most varied collection of North American plants in the world. He established a trans-Atlantic hub of plant exploration through his exchanges with London merchant Peter Collinson. By 1765, Bartram was so internationally recognized that he was appointed the "Royal Botanist" by King George III. Under the care of three generations of Bartrams, his international plant trade and nursery business survived him and continued to thrive along the Schuylkill River until 1850.

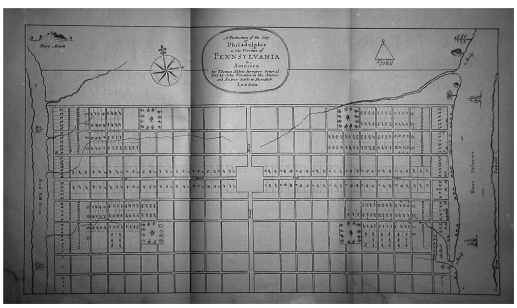


Figure 1. 1683 Thomas Holme, "A Portraiture of the City of Philadelphia" (Historic Maps of Pennsylvania).

A delicate ecosystem named "hidden river" by the Dutch, the east bank of the Schuylkill River was where the city began construction on the Fairmount Waterworks in 1812, the source of the city's drinking water until 1909. A beautiful, picturesque assemblage of buildings modeled after the temples of ancient Greece (Fig. 3), the waterworks pumped water from the river up a hill to a 3 million gallon earthen reservoir that held the city's water. By 1854, downstream at Point Breeze two industries were thriving: the Atlantic Refining Company which shipped nearly one-half of the world's illuminating fluid and the Point Breeze Gas Works which was then considered the largest in the world. By 1891, 35% of all petroleum exported from the U.S. was shipped from this location in Philadelphia. This same year, the City of Philadelphia took possession of the estate to preserve Bartram's Garden and by 1893 the John Bartram Association was created by his descendants. Today, the site is managed by the Association in cooperation with Philadelphia Parks and Recreation.

The water quality of the lower Schuylkill River has been adversely affected over time by numerous industries including sewage treatment facilities near the mouth of the Schuylkill River, scrap metal and waste recycling businesses, and refuse from slaughterhouses. By the end of the 20th century, the delicate ecosystem of this hidden river had become severely compromised. The 21st century has brought a new

vision for the renaturalization of the Schuylkill River resulting in a number of strategies for creating a more healthful water resource for the city, most notably Philadelphia's *Greenworks* program, the *Green Cities, Clean Waters* effort spearheaded by the Philadelphia Water Department, and *The Tidal Schuylkill River Master Plan*.

One of the more prominent projects to activate the river is the Schuylkill River Trail, a multi-use trail in Southeastern Pennsylvania with a projected length of almost 130 miles when complete. This trail will culminate (or begin) at Bartram's Garden to the south near the mouth of the river. Efforts to breathe life back into the river are underway. While the water is not yet drinkable, Bartram's Garden is restoring its wetland area, cultivating mussels to support the river ecosystem, and is the first to bring public boating recreation back to the river. To follow is a sketch of the history of the Schuylkill River and Bartram's Garden to provide a context for understanding the significance of the Public Boating Program at Bartram's Garden.

2 AMERICA'S FIRST BOTANICAL GARDEN

When John Bartram (1699–1777) bought his garden in 1728 in the rural township of Kingsessing, in Philadelphia County, it was located on an idyllic 102 acres along the Schuylkill River. It was the perfect location to establish a North American botanic collection: it faced toward the southeast, was sheltered by low hills to the north and south, and was fortunate to have a great variety of soils (Fry 2004). Located along the boundary between two geographic regions, the coastal plain and piedmont, this was an ideal location for Bartram's botanical garden. The mid-Atlantic climate of Philadelphia was moderate and plants from both the north and the south could survive outdoors (Fry 2008). Approximately four miles from the heart of Philadelphia, Bartram's garden could be reached by crossing the Schuylkill River at Gray's Ferry and traveling through a peaceful countryside down Woodland Avenue and past gracious estates on the way to Darby (Fig. 2).

In September of the following year, John Bartram married his second wife Ann Mendenhall (1703?–1789) after his first wife had unfortunately died two years earlier leaving him with one son. They had nine children, eight surviving to adulthood. They and three generations of their descendants lived in the stone house they built in 1731, which still survives today at the garden (Fry 2004).

Although John Bartram's garden began as a personal garden, it grew to a botanical inventory of native and exotic plants he collected throughout America's eastern seaboard and exchanged with others from abroad. Raised a Quaker in nearby Darby, he was trained to view scientific inquiry as a means of revealing the guiding principle of God in nature (Fry 2010). His trips into the wilds of America were botanical expeditions that in and of themselves served as a school of



Figure 2. 1752 N. Scull and G. Heap, "A Map of Philadelphia and Parts Adjacent" (Historic Maps of Pennsylvania).

botany. He and his family understood North American plants and plant communities from direct observation of the natural environment and by cultivating plants in their garden (Fry 2004).

By 1733, Bartram began corresponding with a fellow Quaker in London, Peter Collinson (1694–1768), a cloth merchant and novice botanist and gardener. Collinson connected Bartram with a disparate group of British gardeners, nurserymen, botanists, scientific collectors, aristocrats, and the owners of some of the most famous gardens of the eighteenth century—Bartram then had new sources for exotic plants to import to his garden and conversely had buyers for his North American plants and seeds (Fry 2004, 2008). This was the beginning of a lucrative business with Europeans who were willing to pay significant sums for rare and valuable North American plants (Fry 2010). By 1765, Collinson lobbied King George III to recognize Bartram for his devotion to botany and natural science. He was rewarded with a royal stipend of £50 per year for the rest of his life and the unofficial title of King's Botanist for North America (Fry 2004).

By the middle of the eighteenth century, Bartram's Garden had the biggest variety of North American plants in the world. Neither publicly funded nor officially recognized, it functioned as a national botanical garden during his lifetime and through to the 1840's. By the middle of the nineteenth century, though, North American plants had become widely cultivated in

Europe and America and were no longer rare or interesting to the horticultural world. Bartram's plants and seeds were now part of the gardening mainstream and could be cultivated in Europe without importing his seeds from America. Ultimately, the Bartram family plant and seed business was dependent upon an elite group of customers who no longer needed their product.

By 1850, Bartram's descendants were forced to sell the house and garden. A railroad industrialist, Andrew M. Eastwick (1811–1879), bought the estate and preserved the historic garden as a private park. Thomas Meehan (1826–1901) tended the garden and ultimately was responsible for leading the movement in Philadelphia to preserve the site as a public park (Fry 2010). In 1891, the City took possession of the estate to preserve Bartram's Garden and by 1893 the John Bartram Association was created by his descendants. In 1892, the editor of *The Horticulturist* John Jay Smith reflected on its significance, "From this garden dates horticulture in America. It should be carefully preserved forever" (Fry 2008).

3 THE SCHUYLKILL RIVER WATERSHED

3.1 *The schuylkill watershed ecosystem*

Bartram's Garden is located within the Schuylkill River watershed. A watershed is the area drained by a river or a river system. A watershed functions as an interconnected system, or *watershed ecosystem*, which includes an intricate network of small headwaters streams and the agriculture, forest, plant, and aquatic communities it serves. The watershed is the irreplaceable source of water for groundwater and the water people drink (TCF 2002).

The largest tributary in the Delaware River Basin, the Schuylkill watershed covers about 1,916 square miles, or over 1.2million acres. The river originates to the northwest at Tuscarora Springs in Schuylkill County and travels approximately 130 miles toward the southeast to its mouth at the Delaware River in Philadelphia. The Schuylkill River drainage network falls into four natural physiographic regions or "provinces" with different geologic, topographic, hydrologic, soil and climatic conditions, which in turn has influenced land use and economic development patterns within the watershed. Bartram's Garden is located within the Atlantic Coastal Plain Province, which is at the southern tip in the City of Philadelphia extending into New Jersey. One of the region's most important groundwater sources is contained in this province (TCF 2002).

Critical elements of a watershed ecosystem are streamside areas and wetlands. Healthy wetlands prevent flooding, sedimentation, habitat degradation and invasive non-native plant species. Almost like a water sponge, the wetland stabilizes the shoreline and prevents erosion. Other benefits are the special habitats they provide for wildlife, some of which can be globally endangered species (TCF 2002).

3.2 *Schuylkill river trail and greening the river*

Although only complete in sections, a multi-use recreational trail follows portions of the entire 130-mile length of the Schuylkill River. There are currently over 60 miles of finished trail for significant lengths along the east bank of the river. Starting at the northern limits, there's a scenic seven-mile stretch from Auburn to Hamburg in Schuylkill County that near Port Clinton intersects with the Appalachian Trail, the national scenic trail that extends from Maine to Georgia. While the Hamburg to Reading section has not yet been built, cyclists can follow a signed on-road route for about 20 miles between the two cities. From Reading, the trail continues another 20 miles to Pottstown where the trail breaks off again and is picked up in Parkerford to connect with a 30-mile stretch to Philadelphia (SRT). At South Street in Philadelphia, there are plans for the Trail to cross the river to the west bank and continue on to Bartram's Garden, which will serve as the southern gateway to the Schuylkill River Trail (MGA).

The Schuylkill River serves as the central spine for Fairmount Park, the largest landscaped city park in the United States. Its name derives from the "Faire Mount" shown at the northwest corner of William Penn's plan of 1682 (Fig. 1). In 1855, the city council passed a resolution to open the land formally to the public as Fairmount Park. In late 1858, the Committee on Public Property invited "Plans for the Improvement of Fair Mount Park". The goal was to combine newly acquired upriver estates, along with other parcels, comprising about 130 acres all together, into a unified park based on New York's Central Park designed by Frederic Law Olmsted and Calvert Vaux. In 1859, the firm of James Clark Sidney (ca. 1819–81) and Andrew Adams (ca. 1800–60) won a public competition for the design of Fairmount Park. Later in 1866, the city invited Olmsted to make a study for the park, which later became a formal proposal for the completion of the park in January 1871. However, in the end the project went to a young German architect, Hermann J. Schwarzmann (1846–91), the park engineer on staff who had been responsible for the ongoing work of park maintenance (Lewis 2006).

Opening in 2000 to the south of Fairmount Park, the Schuylkill Banks recreation area connects the Fairmount Water Works with Locust Street (KSK 2012). That same year, the nonprofit Schuylkill River Development Corporation (SRDC) began a master plan to extend Fairmount Park south through the City to create a new Schuylkill River Park to help mitigate the predominately industrial corridor of the lower Schuylkill River. The goal is to improve public access, promote tourism on the river, reclaim industrial sites for green public space, and acquire land to create greenways that can connect to adjacent residential neighborhoods (TCF 2002).

3.3 *Industrialization of the Tidal Schuylkill River*

The Tidal Schuylkill River is the eight-mile portion of the river and both its land banks located below the

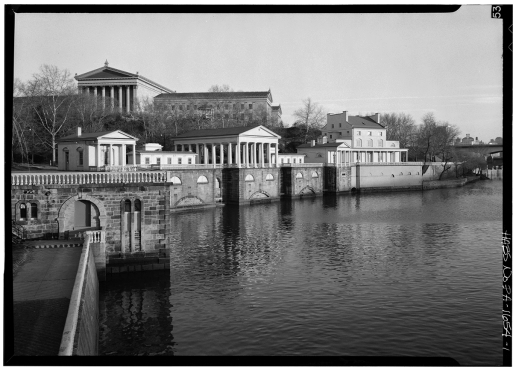


Figure 3. General view from the water with the Philadelphia Museum of Art in the background – Fairmount Waterworks, Aquarium Drive, Philadelphia, Philadelphia County, PA (Library of Congress Prints and Photographs Division Washington, D.C. 20540 USA http://hdl.loc.gov/loc.pnp/pp.print).

Fairmount Dam going south to the confluence of the Schuylkill with the Delaware River. Construction on the Fairmount Water Works began in 1812. The dam was constructed in 1822 to provide higher levels of water for pumping at the water works; to the north of the dam was the source of the City's drinking water and remains so today. The dam also stilled the waters, which encouraged waterborne shipping to come up the river as far as the dam, as well as use of the river for recreation. Surprisingly, the tidal flux of the river is over eight feet daily. Water was pumped from the Schuylkill up the hill to a 3 million gallon earthen reservoir to hold the city's water. By 1909, the quality of the river's water to the south of the dam was no longer suitable for drinking and the bathing establishments along its eastern shore had been driven out of business by the unabated pollution of the river (EDAW 2003). This mound later became the earthen platform for the Philadelphia Art Museum, constructed 1919–1928 (Fig. 3).

From Holme's "Portraiture" of Philadelphia (Fig. 1), it would appear that the City spanned from river to river. While this was William Penn's grand vision, actual settlement was predominately along the western bank of the Delaware River. The area west of Broad Street from the future City Hall (1871–1901) was sparsely settled well into the 19th century. The Delaware River became the location for shipping, the river lined with piers and wharves, many of which are still there today and some of which have been repurposed for parks, housing, and retail. Located at the western "back door" to the City, the hidden Tidal Schuylkill River became the locus for industrial production, especially oil refining.

Early in the 19th century, the Philadelphia Gas Company was located on the east bank of the Schuylkill at the foot of Market Street, several blocks south of the dam. By1836, it was purchased by the City and became consolidated as the Philadelphia Gas Works; its first significant commission was to provide illuminating fuel for the forty-six natural gas street lights along Second Street between Vine and South Streets near the Delaware River wharves. An even larger city-owned gas company was to be located at Point Breeze mid-century, remaining active for a little over a century (Cotter 1992). Soon thereafter, the Atlantic Petroleum Storage Company (now ARCO) established wharves at Point Breeze in 1861 (Fig. 4). Thirty years later, nearly half of the world's illuminating oil was exported from the Atlantic refinery at Point Breeze, which was 35% of all petroleum exported from the U.S. (Weigley 1982). Later in 1903, the Philadelphia Electric Company (PECO) established Generating Station A-1, the first large-scale, centralized power plant in the Philadelphia region near Grays Ferry along the eastern bank of the Schuylkill. Additional generators were added over the years and the area remained in operation by PECO in some capacity or another to generate energy until the end of 2012.

The oil refining business continued to expand in the Tidal Schuylkill River. Just south of Point Breeze at Girard Point, Gulf Oil built its first terminal in 1920. Together, both refineries were processing 69,000 barrels of oil per day by World War II. Sunoco purchased both the Point Breeze and Girard Point refineries, which the company consolidated into one refinery in 1994. Today, Philadelphia Energy Solutions (PES) owns the refining complex, which it operates as two separate domestic refineries with a combined processing rate of 335,000 barrels per day (14 million U.S. gallons) of crude oil. It is the largest oil refining complex on the U.S. Eastern seaboard (PES 2016, Quivik 2015).

Although the Schuylkill River north of the dam at the Fairmount Waterworks is still the source of drinking water for 1.5 million people, 56% of people surveyed believe that their local stream or river is not safe to swim in and 82% never or rarely use the Schuylkill River and its tributaries for recreational purposes (TCF 2002).

4 RECREATING THE HIDDEN RIVER

4.1 *Philadelphia's efforts to green the rivers*

It is not surprising that by 1909 the Fairmount Water Works had ceased to supply the City with its drinking water. The water was so well known to be hazardous that in 1892 the New York Times reported three Philadelphia boaters who set off a fire with the "thoughtless act" of tossing a match into the Schuylkill, which ignited the "thin scum of oil from the adjacent oil works." In 1896, a negligence suit had been brought against the Atlantic Petroleum Storage Company by an exporter whose ship caught fire at Point Breeze. A gas works engineer testified that floating oil "would be all over the river, and sometimes it would be close in along the wharf, according to which way the wind was blowing." Another gas works employee testified that the ground was mostly "clinker and debris" and that "oil will come through it just like a sponge" (Dougherty 2013). Industry blocked attempts to clean up the river until the 1940s when the Schuylkill

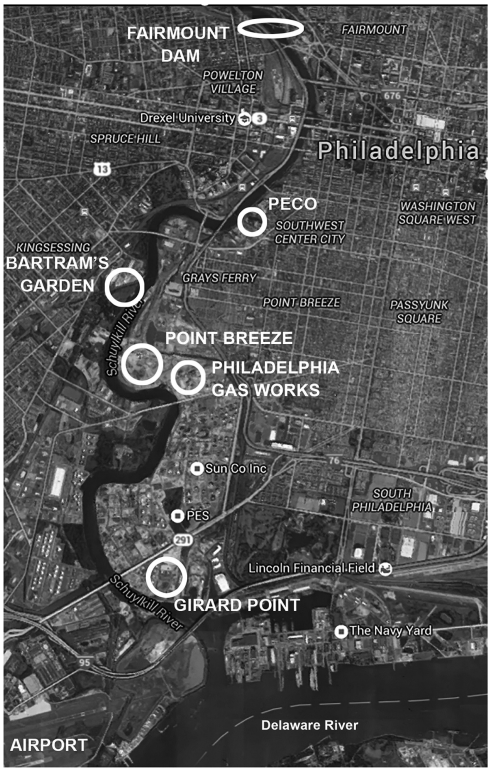


Figure 4. Bartram's Garden location with respect to the oil refineries in Philadelphia (map by google earth with locations identified by author).

River Project, a joint state-federal clean-up effort, was created. The river's water quality was improved with EPA's introduction of the Clean Water Act in the 1970s.

While much had transpired since then, the EPA levied a $1.25 million fine against the Sun Oil Company in 1994 for its violation of the Clean Water Act at its Schuylkill refinery. Sun Oil's fines allegedly resulted from discharging ammonia, nitrogen, chromium and other chemicals into the Schuylkill River. Unified under the name "South/Southwest Philadelphia Environmental Endowment," sixteen groups from neighboring communities discovered that the law allowed for a portion of the fine to go to a community-based Supplemental Environmental Project (SEP). The "Endowment" met with representatives from the Academy of Natural Sciences and Bartram's Garden to devise a SEP remediation plan (Pontarelli 1995). Their solution was to create a 1.5 acre freshwater tidal wetland on the river at the southwest corner of Bartram's Garden, which historically had been the location of a pond near the shoreline (Mueller 1996). It took 18 months for the legal issues to be resolved and another year to get the project going due to the proposed wetlands proximity to a local ball field, Native American archaeological artifacts discovered at the site, and the requirement to test for soil contamination (Howard 1996).

The Philadelphia Airport is located near the mouth of the Schuylkill River where it meets the Delaware River. In 2012, the airport proposed to extend one taxiway to connect with another, which would include the filling and loss of 1.49 acres of emergent non-tidal wetland habitat. As compensation for the wetland loss the airport proposed a wetland enhancement project to expand the tidal wetlands at Bartram's Garden. The proposed plan would include re-grading and excavation to develop a 2.33 acre tidal wetland complex with 1.54 acres of open water and emergent tidal wetland, 0.24 acres of scrub/shrub wetland habitat, 0.23 acres of forested/shrub wetland habitat, and 0.33 acres of upland buffer habitat (US Army Corps of Engineers 2012). The proposal was well-received by Bartram's because the 1997 wetlands were never dedicated as a permanent wetland nor did the wetland include the proper plants to prevent invasive species from overtaking the grounds. Additionally, no funds were set aside for long term monitoring or to purchase and install the plant species needed to anchor the wetland. The rebuilt wetlands were designed to be fully tidal and to accommodate the 8-foot tidal differences, which could make the wetland an ideal spawning ground for larger fish like bass (Hahn 2013). The wetlands underwent a number of design alterations to add the nearly one-acre addition due to the discovery of the 17,233 artifacts that spanned the time periods of Late Archaic through Late Woodland (as long ago as 3000 BCE), and the late seventeenth-century to modern times (Harris 2013).

The freshwater tidal wetlands restoration project at Bartram's Garden is a tangible example of the efforts the City of Philadelphia has expended to make the city a more sustainable urban environment. Inaugurated in 2009 and updated annually since then, *Greenworks Philadelphia* has fourteen targets directed at reducing energy consumption, reducing greenhouse gases, improving air quality, diverting solid waste from landfills, and managing stormwater, among others. A companion document is the *Green City, Clean Waters* program developed by the Philadelphia Water Department. PWD's strategy is to utilize green stormwater infrastructure to help mitigate the effects of Philadelphia's combined sewer overflows that drain to the Delaware and Schuylkill Rivers. Philadelphia's strategy to green its waterways is supported by groups such as the Partnership for the Delaware Estuary, which is a nonprofit organization dedicated to protecting and enhancing the Delaware Estuary, where fresh water from the Delaware River mixes with salt water from the Atlantic Ocean. They and Drexel University's Academy of Natural Sciences have been actively involved with the Bartram's Garden wetland restoration. Their programs support and provide guidelines for freshwater tidal wetlands and freshwater mussel recovery, among others.

4.2 *Freshwater tidal wetlands*

Freshwater tidal wetlands are critically important for both the urban ecosystem and human health. The

Delaware Estuary has the largest freshwater tidal prism of any estuary in the world. Because of the broad salinity gradient from the Atlantic Ocean to the upper reaches of the Delaware and Schuylkill Rivers, it allows for nationally rare freshwater tidal wetlands in the upper estuary. The ecological and economic benefits of a freshwater tidal wetland are multiple: flood protection; nursery, forage and nesting habitats for fish and wildlife; water quality improvement; and carbon and nutrient sequestration (Kreeger 2011). The wetland at Bartram's is significant as an urban ecosystem because in addition to its ability to improve water quality, it could potentially provide habitat for diverse animal species unable to live elsewhere in the city.

4.3 *Mussels restoration*

Mussels are bivalves, which are the best taxonomic group to target for integrating an ecosystem-based approach to conserving, managing, and restoring aquatic resources. In order for mussels to survive, they require a healthy population of suitable fish hosts as well as decent water and habitat quality. Freshwater mussels can live to be 80- to 100-years old and most species do not begin reproducing until 8- to 10-years old. In contrast to other bivalve species, freshwater mussels need a fish host to complete their reproductive cycle: a female with developed larvae propels her baby mussels, or glochidia, into a fish's mouth where they attach to the gills or sometimes the fins. This enables the mussel population to disperse upstream where the larvae could not go on their own. The glochidia remain attached to the fish for approximately 2–3 weeks until they release in a new upstream location. Therefore the life and health of a mussel species is directly dependent on their fish hosts, who can be adversely affected by dams, water quality and habitat degradation (PDE 2012).

Freshwater mussels are critical bioindicators that directly reflect the health of an aquatic system and are one of the best tools for bioassessment of both specific contaminants in the water as well as the overall ecology of a waterway. Since they are large filter feeders, they must process large amounts of water and particles across their soft tissues, which results in greater exposure to contaminants. Because mussels filter copious amounts of water and they do not swim around, their presence in a waterway indicates healthy water. Healthy and abundant freshwater mussel beds provide a multitude of ecological services and are a dominant functional component in aquatic food webs: they stabilize bottom habitats and enrich sediments for other fauna, add habitat complexity and increase water quality (PDE 2012).

A few mussels have been found near Bartram's Garden, which indicates the water quality is likely to be sufficient. One of the goals of the John Bartram Association (JBA) Strategic Plan is to "serve as a model for environmentally responsible practices, work in partnership for revitalization of the Schuylkill Riverfront, and work with the City to … make Philadelphia a vibrant urban green city." One strategy to achieve this goal is to "develop restoration and maintenance plans for Bartram's tidal wetlands" (JBA 2013). JBA has expressed interest to PDE in hosting a mussels production hatchery. Juvenile mussels would be propagated at the hatchery and would be used to reseed streams and rivers in the Delaware watershed where there were once diverse and abundant mussels, but no are longer. A mussels hatchery would also contribute to the habitat restoration and water filtering capability of Bartram's newly restored wetland.

5 RENATURALIZING WITH RECREATION

5.1 *Bartram's urban garden*

Once reached via a country road from Philadelphia on the way to Darby, today Historic Bartram's Garden is hidden from the public, reached circuitously via paved concrete roads marked by trolley rails that snake through a bleak post-industrial complex of buildings that often are in disrepair. On the other hand, Bartram's beautiful garden can also be reached directly via the recently completed Bartram's Mile which connects this historic landscape to the verdant recreational Schuylkill River Trail and the south Philadelphia community.

Cognizant of the unfortunate public perception of the river as a polluted waterway, Bartram's Garden has taken on the challenge of transforming this negative view to a vision of a vibrant urban oasis for recreation for the whole community. In addition to the Bartram's Mile gateway project, their Action Plan includes safeguarding and improving the Garden's environment, enhancing recreational activities, establishing the on-site working farm and orchard as a destination for the urban farming community, developing restoration and maintenance plans for the tidal wetlands—essentially establishing Bartram's as a world-class cultural, heritage and urban green space destination with nutrition and environmental education programs that emphasize awareness and stewardship (JBA 2013). Part of this vision includes activating the waterway—really activating the waterway by putting people on it in boats.

5.2 *NYC boathouses*

Inspiration for recreational boating at Bartram's has come from the numerous successful boathouses the staff has visited in the vicinity of New York City. Apparent from the boathouse mission and activity descriptions to follow is a concern for the environment as an integral part of recreational boating.

The *Yonkers Paddling & Rowing Club*, Inc. is a not-for-profit membership organization whose purposes are to encourage rowing and paddling sports as well as to educate and inform the public about the environment of the Hudson River and the importance of its protection for present and future generations.

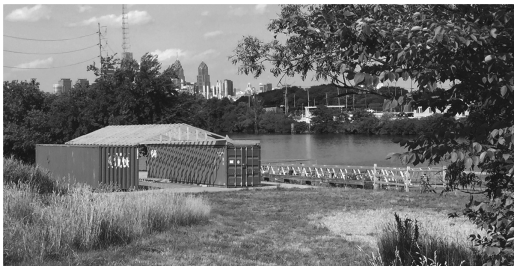


Figure 5. Bartram's Garden Community Boathouse with city skyline in the background (photo by author).

Two of the goals for the *Village Community Boathouse at Pier 40* are: 1) to improve the park's Estuarine Sanctuary through public education, research and habitat enhancement and 2) to provide free or low-cost recreational opportunities for New York City residents.

The *North Brooklyn Boat Club* (NBBC) offers environmental education workshops on site in their "container classroom", regular water testing, as well as small workshops on wooden boat building, restoration and repair. NBBC has two main educational programs, an on-land component and an on water version to better involve citizens with a number of ecological issues facing urban waterways.

Long Island City Community Boathouse is playing a critical part in revitalizing Long Island City by reconnecting residents and local business people with their estuary through its paddling programs and raising awareness about estuary ecology.

In addition to its continuing public boating and youth programs, the *Brooklyn Bridge Park Boathouse* supports appropriate local advocacy initiatives aimed at improving public access and water quality in the harbors and rivers of New York City. They advocate for the reclassification of "designated use" waterways to "primary contact", because human-powered boating exposes people to the same risks of unclean water as swimming. They test the water every Thursday at the popular launch sites for human-powered boaters and publish the results on the Water Trail Association website on Friday. The goal is to provide a reliable database that harbor boaters can use to predict water quality at their preferred launch site.

5.3 *Bartram's bringing boating back*

Inspired by the boating programs in New York City, Bartram's inaugurated their River Program to bring water-based activities to Southwest Philadelphia. Their Community Boathouse opened on June 14, 2015 to the fifth annual RiverFest and second annual Tidal Schuylkill River Boat Parade, a community event that included a floating ice cream parlor, a floating brass band, and a choreographed dance performance on paddle boards. Featuring the garden's history, a Rhododendron Flotilla reenacted Bartram's trip home from Berks County with the first example of the *Rhododendron arborescens*, discovered near the headwaters of the Schuylkill River.

The Community Boathouse (Fig. 5) was the product of a year-long collaboration with Drexel University through their Engineering Partnerships In Community Service (EPICS) program. Staff at Bartram's Garden worked directly with a team of architectural engineering students for their Senior Design project, which included designs for a boardwalk and overlook for the newly restored wetlands, a living shoreline, pier and promenade along the riverfront, the community boathouse, and a floating dock that could accommodate the 8-foot daily tidal flux. These college students worked on site with high school students from a Philadelphia Charter School, The Workshop School, to build the Floating Dock they had designed. The Community Boathouse was designed by the team who detailed a roof truss system over a 20-foot span between two shipping containers and a green roof with rainwater collection system. The shipping containers were donated by a Drexel alum and the roof system was built by the Challenge Program, a vocational school located in Delaware. The shipping containers are used for boat storage and the 20-foot span provides shaded outdoor space for Philadelphia Waterborne, an experiential, project-based educational program for middle- and high-school students that utilizes boat building, maritime history, and environmental education as a way to engage students and enhance student educational outcomes. In total, the Community Boathouse and Floating Dock were the products of educational programming at all levels that used project-based learning as the key educational principle.

6 CONCLUSION

North American settlers were unaware of the gift they had been given when they stumbled upon the pristine, hidden Schuylkill River. Characteristic of human settlement, the river and adjacent land were used to accommodate growth and expansion of the city named after its founder, William Penn. In retrospect, post-industrial societies are recognizing the value that will be lost due to the growth and expansion of cities without consideration of the natural environment. Philadelphia is renaturalizing its city through a number of strategies including wetlands and mussels restoration, green stormwater infrastructure, and bringing recreation back to the river.

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Learning from ancient Anatolia: Strategies of naturalization in metropolitan Istanbul

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ABSTRACT: The negotiation between the natural and built environment in urban design is one of the more vital aspects facing the practice today. The process of assessing this relationship is facilitated by state-of-the-art simulation tools which enable designers to study the ambient qualities of space and associated multivariate effects such as static rays, fluid flows and thermal gradients. These toolsets pave the way toward alternative strategies in urban naturalization, ones that consider the natural and the constructed as part of a shared ecology in lieu of being diametrically opposed. This paper examines the nature of this exchange in high-density urban situations where adequate access to daylight, fresh air, and view sheds are limited due to over-development. The focus of this research resides in Turkey where historical examples dating back three millennia serve as strong examples for cities today where high-density development has undermined the quality of life for metropolitan inhabitants. This paper reviews outcomes from a cross-disciplinary student workshop, funded by the James Marsden Fitch Foundation, carried out over a nine week period in western Turkey. With the use of computer simulation programs, ancient housing typologies including Ephesus, Priene and Pergama are analytically unpacked and played back in the form of design exercises set in Istanbul. During the research period, simulation tools enable the team to disclose design strategies from ancient settlements and test the reintegration of those strategies within new models of collective development.

1 INTRODUCTION

Urban naturalization, as an established practice, largely focuses on returning the city to a more natural condition through the use of vegetal means native to the region (Urban Naturalization in Canada, 2001). While this approach certainly improves the quality of urban life for all inhabitants, its emphasis lies largely in the benefits provided by the presence of landscape elements, foregoing in-depth examination into how natural states operate to systemically forge the disposition of urban space itself. Understandably, the sublimation of urban development into the dynamics of its natural setting is less pervasive in design because traditional means used to study the characteristics of an urban condition tend to be symptomatically stationary. And yet, in contemporary urban design practice, there is much excitement surrounding new performance modeling and simulation platforms that facilitate the observation of various energy states that constitute a natural environment, especially when used to test design alternatives within its shared domain (Reed and Lister, 2014). These tools pave the way to unprecedented areas of investigation, advancing the very concept of naturalization in urban design through experimental processes that examine the operative principles particular to the natural world. Furthermore, these new processes offer a response to urban theorists who in recent decades have called for interdependence between the natural environment and human intervention in the form of a shared ecological system (Botkin, 1990).

This digitally augmented ecological approach to urban naturalization examines the behavior of renewable resources such as solar and wind inputs through observable models that highlight characteristic climatic factors and the role of design strategies in modulating these fields. With the disclosure of environmental knowledge provided by such an alternative workflow, we are drawn to speculate whether such knowledge is present within classical examples of urbanism. Prior to the invention of active building systems, early populations seemingly achieved atmospheric zoning by putting basic building attributes to task, finely attuning building assemblages to ever-changing environmental factors to provide comfort for inhabitants. Based upon this premise; can analysis of these early forms of urbanism in places like Asia Minor provide insight into how access to natural resources was provided in antiquity? If so, what relevance does this knowledge from ancient sites have in contemporary urban planning? How can this knowledge be used in developing new models of multi-tenant living within the same region at least three millennia later? In this paper, these questions are posed with regard to cases of urbanization that exhibit both

concentrated population groups and the need for adequate access to native resources. The motivation of this research is two-fold; to identify strategies of naturalization and climatization present in urban antiquity and to examine how these strategies offer insight in places like Istanbul where unprecedented growth and subsequent construction patterns have left these resources depleted and its citizens marginalized.

Using simulation operations such as computational fluid dynamics and backward ray tracing enables designers to model systems of climate behavior and intervene within these domains to survey the impact of human influence on these given states (Marsh and Khan, 2011). In modeling the complexity of the physical world using simulation platforms, designers are able to develop new forms of literacy about how the natural world operates around us and how effective our planning strategies are in maintaining these relationships and subsequently improving our quality of life within constructed situations. The potential of this approach translates to improved quality of life for building occupants and accommodated densities dictated by extreme economic demand without forsaking natural resources essential to the ecological dynamics of place. Furthermore, in light of our ongoing climate crisis; simulation tools can help reduce emission of greenhouse gasses and shape a holistic built environment that is more connected to energy resources thus improving comfort levels for occupants as a complete ecological system (Hensen, 2004).

This paper looks at recent research conducted in Turkey where simulation programs are used to disclose design strategies developed by early populations in Asia Minor and test the reintegration of these findings to identify new collective living strategies in rapidly developing metropolitan Istanbul. As simulation platforms generate observable output states, they facilitate assessment of viable high-occupancy housing alternatives against established project goals and objectives. These goals not only include parameters for density targeting occupant concentrations but also standards of performance that comprise of access to uniform daylighting, distribution of fresh air and maintenance of view sheds. The paper reports on how these simulation tools offer new ways to conceptualize space within high-density urban developments by establishing the atmospheric qualities of both individual and shared space from the inside-out in lieu of developing high-rise communities from the outside-in. Outcomes from the research of ancient settlements in Asia Minor are presented which focus on the advancement of spatial organizations that toe the line between interior and exterior; individual and collective; and natural in comparison to constructed. The assimilation of these strategies within new models of collective living are tracked to assess the relevance of these spatial agglomerations in today's urban society as they generate variable atmospheric zones which invite inhabitants to use space collectively and migrate daily activities based upon the ambient disposition of each zone.

2 CASE STUDIES

2.1 *Ancient anatolian settlements*

Strong examples of early urban planning are plentiful along the Aegean coastline in western Turkey, also known as ancient Asia Minor. Sites such as Priene, an Ionian settlement dating back to the 4th century BC, better known for its Hippodamian grid planning; Ephesus, an ancient Greek city dating back to the 10th century BC, best known for its housing complexes terracing from prominent urban promenades; and Pergamon, also an ancient Greek city dating back to the 4th century BC whose citadel is perched atop a prominent promontory all provide early examples of urban planning where space is organized around constraints dictated by both climate and the need for solid defenses from invading factions. The compact composition of living units and the intensified development densities in these settlements adhere to their sloped terrains, creating terraced patterns that establish unique models of collective living, generating spatial gradients from more to least enclosed. In each case, these transitions from public to private zones establish a rich inventory of space types that serve to inflect the daily and seasonal variations of climate along the Aegean coastline (Frank et al, 2014). Furthermore, because these settlements were situated between Greece and Persia they were home to some of the most intense battles in ancient time, giving rise to sophisticated systems of fortification and the need to maximize space developed within the citadel (Nossov, 2009). The spatial disposition within these settlements make them ideal models for passive climatization within high-density complexes as each space type engages the native region in a unique manner. The benefit of this knowledge offers is clear, a concerted language of spatial organization and subsequent strategies of passive climatization that provide insight for contemporary development within the region.

2.2 *Case study methodology*

The methodology associated with this case study analysis advances in a systematic manner with the final output disclosing how ancient design strategies are used to temper varying ambient states present within the extensive environment. Portions of residential complexes within the three aforementioned cities are analyzed using simulation platforms to reveal these signatures of climatic modulation. This process involves three primary steps; modeling, simulation and comparative analysis across key timeframes. In the initial step of the process, each of the residential complexes are digitally modeled using Rhinoceros, a NURBS based 3-D modeling platform developed by McNeel, to create polygonal meshes from archeological reconstruction data. These polygonal mesh models are imported into simulation domains where they are exposed to numerous environmental factors at critical timeframes including the equinox and solstice periods

in the annual cycle. Using regressed climate data from the region, the environmental factors accounted for in the analysis include daylighting, solar radiation, single source view sheds and ventilation. Diva for Rhino, developed at the GSD at Harvard University, uses the Radiance backward ray tracing engine to conduct daylighting and solar radiation studies in the analysis workflow. The isovist component in McNeel's algorithmic modeling plug-in, Grasshopper for Rhino, is used to analyze view sheds from single source points. Simulation CFD, distributed by Autodesk®, is a computational fluid dynamics simulation platform used to survey the be havior of air velocity, path and pressure in the case study analysis. In the third step, initial output from the simulation analysis is compared to ascertain how design strategies such as spatial organization, degree of enclosure and orientation account for changes indicative in the temperate Turkish climate with cool-wet winters and hot-dry summers to provide levels of interior comfort that approximate contemporary standards.

2.3 *Case study outcomes*

Upon completion of the initial round of case study analysis, three signature traits were evident in the ancient settlements studied; thin unit blocks, permeable building masses and mass-void juxtapositions within building complexes. Using the methodology described above, output states from simulation platforms demonstrate degrees of climatization whereby interior comfort is provided through the sole use of naturally renewable sources, namely the climatic context in concert with basic elements of the material enclosure. As evidenced below, this ability to simulate first-principles relationships within ancient settlements provides unprecedented insight into how early populations organized space in concert with climatic constraints, especially where space was at a premium within systems of fortification.

Thin unit blocks are typically one to two rooms wide and elongated in the east-west direction to maximize exposure to solar and wind resources. At Priene, housing units were two rooms wide with the southernmost rooms acting as intermediary space types that work off of central courts, offering varying degrees of light penetration into the enclosed area of the living unit and reflective surfaces that redirect ample daylight into all areas of the plan. The thinness of the plan and loose definition of the southern-most spaces provide daylight uniformity at a rate of 0.54, above the recommended value of 0.4; daylight levels within interior rooms of 300-3,000 lux, within the recommended range of 108–5,400 lux; and daily insolation values of 2 kWh/m^2 on interior surfaces during the winter (Figure 1).

Permeability includes the design of apertures and open spaces within a defined building block which harvest natural resources like wind and daylight while also framing views out to the immediate context. At Pergamon, permeability is achieved through colonnaded

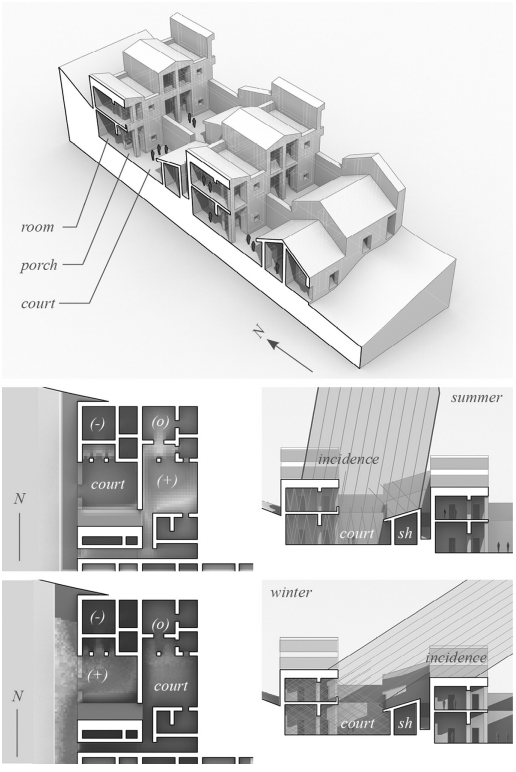


Figure 1. Above: Reconstruction of Priene Insular Row House after Hoepfner. Below (clockwise from upper left): daylighting analysis of the first level, summer solar raytracing, winter solar raytracing and daily insolation analysis of the first level.

arcades, open antechambers and aligned apertures within the peristyle housing blocks. These strategies produce ventilation rates of 1.26 m/s on the interior, just below the maximum allowable air velocity rate of 1.5 m/s; a range of daylight levels situated within the comfort range from 500 to 3,000 lux; and framed visual connections out to the hinter-land from 96% of the occupied floor area (Figure 2).

Mass-void juxtapositions stem from the terracing of housing blocks along inclined terrain. This type of spatial organization places open space below grade and sets loosely enclosed volumes above the ground. At Ephesus, the mass-void juxtaposition happens through the deep two-story courtyard that provides light and air access to subterranean spaces while allowing air and heat to stratify from lower to upper levels of the complex. This approach creates two distinct zones within the compound, an upper zone where light and air velocity levels are more variable at 2,700 lux and 0.3 m/s respectively. In the lower zone there is a much tighter light and velocity range at 1,400 lux and 0.1 m/s (Figure 3).

All three examples provide evidence that historical structures, as reconstructed by those in the field

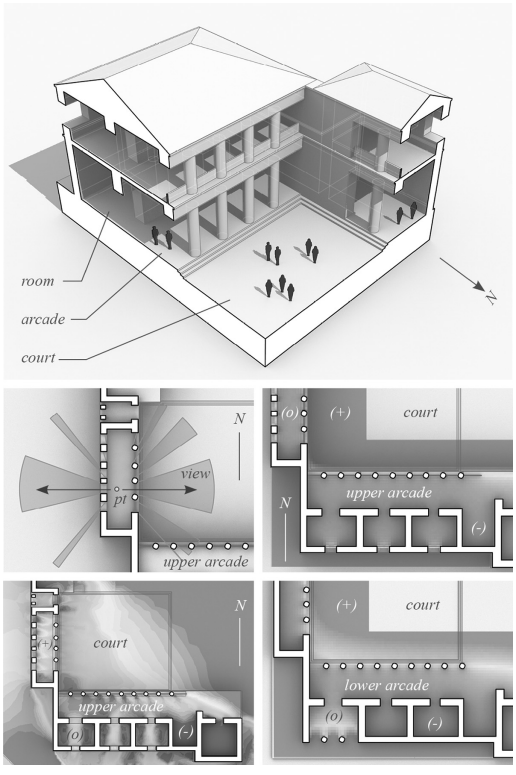


Figure 2. Above: Reconstruction of Pergamon, Group V Complex after Radt. Below (clockwise from upper left): isovist analysis of the upper level, upper level daylighting analysis, lower level daylighting analysis and upper level air velocities.

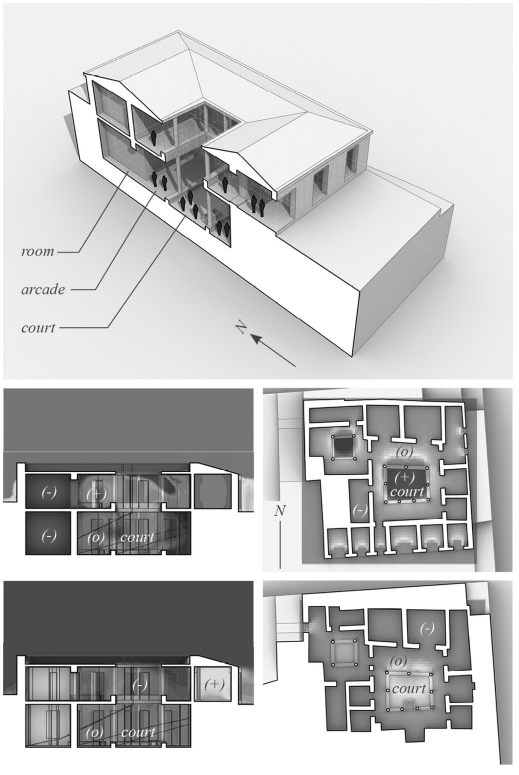


Figure 3. Above: Reconstruction of Ephesus, Terrace 2, Dwelling Unit 2 after Osterreichisches. Below (clockwise from upper left): air velocities in section, upper level daylighting analysis, lower level daylighting analysis and temperature in section.

of archeology, offer insight into how spatial organization, degree of enclosure and orientation contrib- ute to passive climatization. As noted in formative architectural treatise, early populations put material enclosures to task in order to step down climatic extremes so to provide some level of interior comfort for occupants (Pollio, 1960). Expanded knowledge of these strategies opens the door for reuse, in contemporary terms, within metropolitan high-density development where access to view, fresh air and natural light are paramount. In the following section, the research examines the relevance of these strategies when incorporated into models of high-rise construction rapidly taking place in Istanbul.

3 CONTEMPORARY DEVELOPMENT

3.1 *Modern-day Istanbul*

With a population growth rate at 3.45%, Istanbul is the fastest growing city of any nation in the Organization for Economic Co-operation and Development (OECD) and is on pace to reach 24 million inhabitants by 2023 according to the World Population Review (WPR, 2015). Growing pains have ripped through the city where over-building, green space eradication and poorly climatized high-rise structures have resulted in marginalized inhabitants and violent protests. Furthermore, at the time of the research, the warmest month on earth was reported by the National Oceanic Atmospheric Administration, providing further evidence that climate change is an existential threat that requires reassessment of our design and construction processes (NOAA, 2015). In light of these challenges, new development strategies are desperately needed that offer equitable yet equally responsible access to renewable resources for use in rapidly expanding metropolitan areas such as Istanbul.

As highlighted in the previous section, alternative methods of planning embedded within historical settlements in ancient Asia Minor prioritize naturalization and access to renewable resources within concentrated building complexes. Drawing insight from how early populations organized densely populated space in concert with naturally renewable resources is a worthwhile endeavor in light of the design challenges present in metropolitan Istanbul. These insights are specifically relevant if the knowledge extracted from these early examples of urbanism

serve as the basis for experimentation, encompassing new models of naturalization within high-density development.

3.2 *Workshop methodology*

A cross-disciplinary student workshop, carried out over a nine week period in western Turkey, investigates patterns of spatial configuration, atmospheric differentiation and performance within concentrated population densities in Istanbul. In lieu of working solely with a Euclidean definition of space, the workshop advances our understanding of space as comprised of dynamic social and environmental zones. The act of spatial organization in this exercise evolves from the strict regulation of absolute space to the modeling of layers, superimpositions and transformations of phenomena that permeate the built environment. This process is facilitated by the aforementioned performance modeling tools that allow workshop participants to measure the inextricable relationships that exist between systems of spatial enclosure and the fluid state material energies which pervade them. The working methodology during the workshop period parallels the one defined in the case study section above with exception to the feedback loops which openly test a range of spatial configurations and support new lines of inquiry within the process of experimentation. This design process foregrounds the potential of new toolsets for non-linear testing, systematically evaluating design alternatives against established workshop goals and objectives. These goals include parameters for density targeting occupant concentrations of 28 square meters per person where the median floor area of a unit is divided by the household as an indicator of adequacy in the context of overcrowding. Additionally, performance parameters are considered that include abundant access to uniform daylighting with a minimum of 250 lux over 90% of a floor plate; maximized distribution of fresh air to interior spaces with natural ventilation rates ranging from 0.8–1.5 m/s; and maintenance of view sheds to outdoor areas for a minimum of 90% of occupied spaces. These performance metrics parallel those adopted by the building industry which recommend daylight illuminance levels between 108–5,400 lux with a uniformity ratio of at least 0.4 when measuring the minimal daylight level over the weighted illuminance average; interior ventilation rates between 0.2–1.5 m/s; and direct lines of sight to outdoor areas for 75% of regularly occupied floor areas.

Aside from inhabitants that populate a metropolitan area, the physical identity of a city is largely derived by factors that include material, vegetation, terrain, and climate. While all of these factors are influential in defining the specific identity of Istanbul, this research solely focuses upon its characteristics of climate. Istanbul is classified in the Köppen system as temperate with hot and dry summer seasons. This climatic region resides 41 degrees north of the equator and 28 degrees

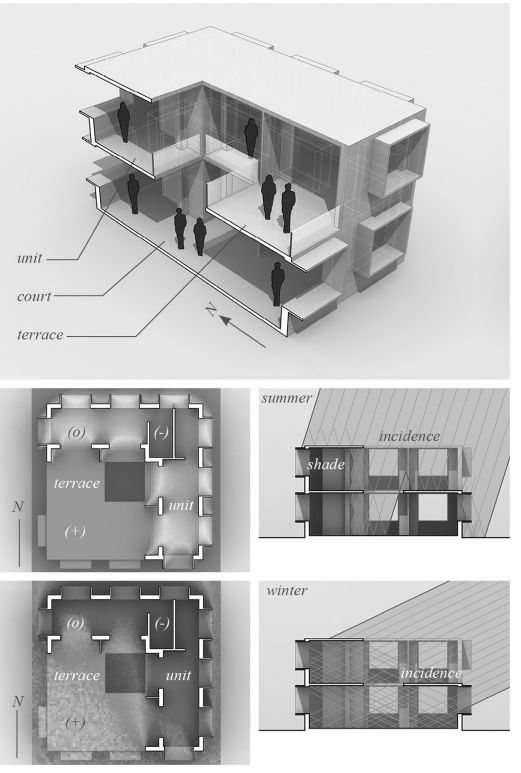


Figure 4. Above: Collective living model with thinness after Sanjaya. Below (clockwise from upper left): daylighting analysis of upper level, summer solar raytracing, winter solar raytracing and daily insolation analysis of upper level.

east of the prime meridian. Significant seasonal variation is present with daytime high-temperature averages in the winter at 7°C and in the summer at 28°C. Prevailing winds in the region generally come out of the north with year-round average speeds ranging from 4–6 m/s with peak velocities in the summer situated at 15 m/s. Additionally, from winter to summer solstice, the sun's elevation angle in the city shifts from 25–75° when measured at noon. The oblique relationship between solar inputs from the south and wind inputs from the north offer unique opportunities in passive climatization from summer to winter within Istanbul's temperate climate.

3.3 *Workshop outcomes*

Outcomes from the workshop demonstrate the cogency of spatial dispositions extracted from ancient structures in developing new models of collective living. Participants reintegrating the aforementioned design strategies including thinness, permeability and mass-void juxtaposition achieved direct connections with the immediate environment, heightened levels of comfort for building occupants and reduced reliance on high grade energy sources for building performance. With the use of simulation platforms, this

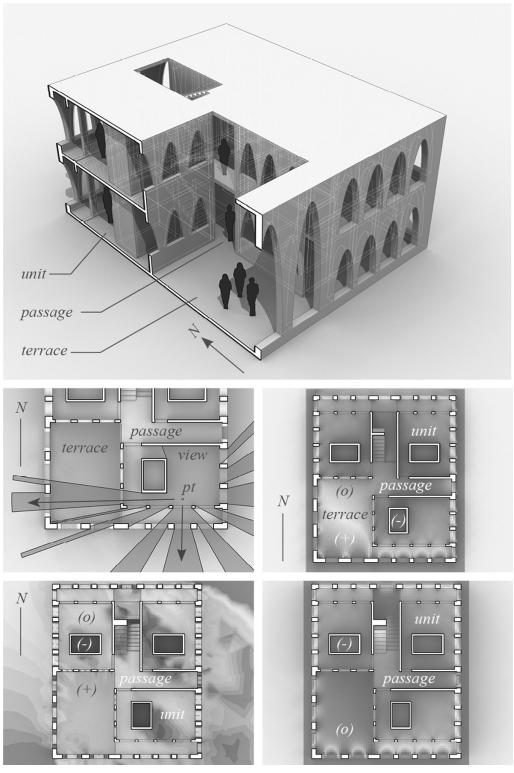


Figure 5. Above: Collective living model with permeability after McDonough. Below (clockwise from upper left): isovist analysis of the upper level, upper level daylighting analysis, lower level daylighting analysis and upper level air velocities.

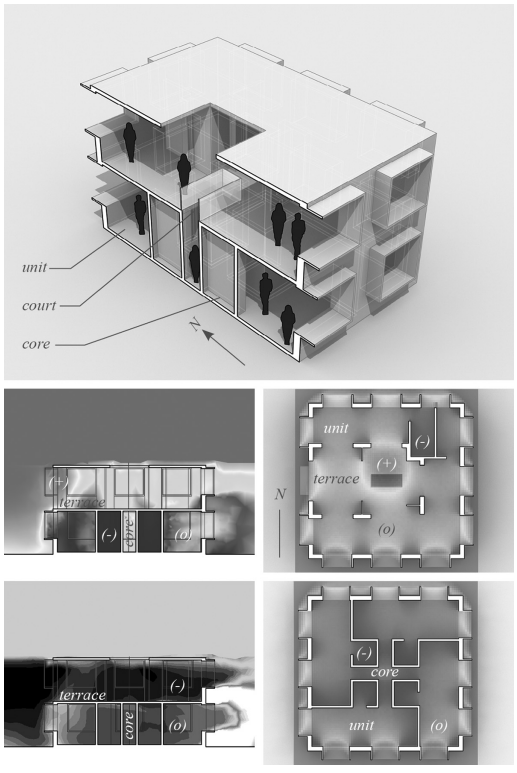


Figure 6. Above: Collective living model with mass-void juxtaposition after Sanjaya. Below (clockwise from upper left): air velocities in section, upper level daylighting analysis, lower level daylighting analysis and temperature in section.

research trajectory re-conceptualizes spatial typologies in urban settings by considering their ambient composition as comprised of an array of natural states. Using simulation domains, participants model natural forces pervading an urban condition and heuristically test alternative spatial dispositions, observing the dynamic interactions present within this shared domain. Through this process, participants track the relative strengths of design alternatives against the well-established metrics of passive building performance, outlined above, in context of constraints dictated by local climate.

Thin unit footprints are proposed in the workshop through the use of centralized spaces and concentrated living areas around the perimeter of a building block. Narrow unit plans and intermediary zones outfit with light shelves along the edges of each unit channel light into the central parts of the living area. The concentration of enclosed private functions along the perimeter with common amenity space central to the residential block provide occupant concentrations of 27 square meters per person. The resultant daylight levels along the central spine of the unit interior reach 925 lux at a minimum while the uniformity of light distribution in the space resides at 0.69 across the interior living area, both superior results against standard performance metrics for illuminance. Additionally, view sheds to the exterior are also provided to 99% of the private and common amenity areas of the complex (Figure 4).

Permeability is projected in the workshop with the introduction of air gaps between enclosed private living areas. These gaps, exposed to the fluid environment serve as common amenity areas, open circulation chases and unit access corridors. These tightly defined passages, set between loosely distributed enclosed private living units and intermixed amenity areas, offer occupant concentrations of 24 square meters per person. With circulation and amenity gaps doubling as ventilation ways, air velocity rates in each living area reside within the recommended range, between 0.5–1 m/s with 5 m/s prevailing winds out of the north. Distributing enclosed living units around the perimeter of each block while maximizing the openness of spaces between offers ample access to light and opportunities to view the surrounding context. Daylight levels central to each living area reside at 1000 lux on average while views to surrounding areas are provided to 96% of the unit floor area which are exemplary against comfort recommendations (Figure 5).

Mass-void juxtapositions are advanced in the workshop with gradually defined spatial zones whose configuration changes from loose to tight. Enclosed service areas, centrally located on certain levels, serve

to insulate living areas around the perimeter while on other levels, a narrow central court maximizes exposure of the enclosed living areas to the natural environment. Due to the shared access to the central court space and the additional area provided by enclosed service zones, occupant concentrations reside at 24 square meters per person. Due to the buoyancy of hot air, upper zones of the juxtaposed configuration need to exhaust hot air through ventilation provisions. With added exposure to the prevailing winds within these upper zones, hot air stratifying can be exhausted with strong ventilation rates of 1.5 m/s when exposed to the 5 m/s prevailing wind out of the northwest. Furthermore, superb daylight levels ranging from 1333 lux to 2000 lux are provided in each of these spatial zones through self-shading and orientation that offers adequate daylight distribution in order to maximize visual comfort for all interior activities (Figure 6).

4 CONCLUSIONS

The research presented here aims to provide an alternative workflow in the design of multi-tenant living models within densely populated metropolitan areas. Looking at ancient case studies as a source of insight, these models focus upon ecological relationships between the natural and constructed elements of a city to assimilate the building into the interworking of the local climate. The process highlighted in this paper opens the door to widespread use of strategies borrowed from antiquity and advances clustered living trajectories that measure the potential of renewable resources in providing comfort for inhabitants while sourcing in a manner that doesn't denigrate the natural ecology. Through the creation of observable simulation models, this research contributes to the future of our changing society by making the climatic conditions less constraining and more invigorating in urban design. As demonstrated in the analysis above, leveraging natural resources toward the betterment of the built environment offers added comfort and connection whereby spatial definition ceases to separate or isolate one from their surroundings but uses simulation models to extend, intensify or proliferate the characteristics of the natural world. Results from both the case study analysis and the collective living workshop produce atmospheric dispositions that reside well within established ranges for adequate interior comfort, offering a quality of life and healthy living situation for all population groups.

Up to this point, the research has explored three principal goals: offering new workflows within the design process that place natural and constructed elements within a shared domain, accommodating the need for population agglomerations in cities and offering improved access to natural resources for all urban inhabitants. While continued assessment of the successes and failures across this array of objectives is needed, the focus of this paper has been to deploy a new mechanism for analysis and design while measuring initial outcomes for relevance and potential impact on society. The expectation moving forward is to advance the research by transitioning from small abbreviated models of collective living to total developments where multiple scales of design are required that include specific unit parameters and tight site constraints. Next steps include the integration of evolutionary solvers within future workflows, continued examination of ancient case studies across the Anatolian region and corresponding workshops that examine high-rise housing complexes within Istanbul where density has resulted in over-development and subsequent tension among its population.

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A city for the eyes of the future – children's visions of the city

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ABSTRACT: This article addresses the conceptualization of urban areas and intends to approach the delineation of possible ideals for future urban development. It focuses on the idea of the renaturalization of the city understood as a process of making it more human-friendly in opposition to the many known factors that dehumanize urban space today. We depart from the assumption that architectural design is always a projection into the future and that children as citizens of the future should somehow be heard in such a process. Children's vision of urban space emerges from the analysis of 59 collective drawings representing idealized cities executed by about 800 young teenagers and are based on their experiences of living in urban areas. Quantitative data from the analysis of these visual documents allowed us to draw pertinent conclusions to the problem addressed and can now contribute to future urban planning.

1 INTRODUCTION

This article is an attempt to sketch a pertinent answer to the questions the organizers of this congress launched concerning the new ways in which urban areas are being conceptualized today. As they have put it, "urban and rural conditions overlap. Built areas merge with landscape and nature. How can research reconceptualize the urban condition? What will the city of the future look like? What was the presence of Nature in the urban fabric of the past?" We are looking for research that focuses on this transformation process (. . .) and points to possible ideals for future urban development" (Costa et al. 2016).

We address here the conceptualization of the urban areas and intend to approach the delineation of possible ideals for future urban development. In fact, dehumanization of the urban is something that we are being confronted with and it seems to result from the devaluation and neglect of the biological condition of humanity affecting all life forms in Earth. In a sociological viewpoint Lidskog (2001) asks "why do people (. . .) ignore some scientifically based recommendations (e.g. the random issue in dwellings) but totally accept others (e.g. Greenpeace's claim that Shell's plan to sink the oil platform Brent Spar in the North Sea would have ecologically detrimental consequences)?" Renaturalization of the city as a form of urban regeneration is an emergent concern among urban planners who are making efforts to transform the urban fabric focusing on expanding existing natural elements and even creating not only to just add a green area to urban settlements but giving natural elements the core role of structuring and organizing urban reconstruction.

To shed light on these issues from the perspective of the citizen we set up a visual research aiming to understand their urban aspirations. Although that is always a difficult task, it is also a particularly interesting viewpoint to put ourselves in, if we can succeed in gathering reliable information.

Departing from the assumption that architectural design is always a projection into the future we think that children, as citizens of the future, could serve as the perfect interlocutors in the much needed dialogue between the urban planning sphere and citizens. In fact, if the city will be theirs we shouldn't be indifferent to children's existence and find ways to take their visions into account as we responsibly devise our legacy to the next generations. It can similarly be argued that children are already full-fledged citizens and potentially the first victims of urban dehumanizing conditions and that is reason enough to take their city understandings and eventual urban aspirations into account.

Measures designed to overcome dehumanization of urban space specifically concerning children's well being is not new. Measures are being developed and implemented trough initiatives like UNICEF Child Friendly launched in 1996. This organization is growingly acting on the resolution passed during the second United Nations Conference on Human Settlements (Habitat II) which declared that "the wellbeing of children was the ultimate indicator of a healthy habitat, a democratic society and good governance" (Scott, 2011). They advocate listening to children's needs towards the built environment once it "has a significant impact on children and young people's development, their quality of life and their experience and enjoyment of the world. Schools, houses, shops, walkways, railways, parks, recreational and community centers are all part of our built environment" (Scott, 2011).

Expecting to collect data that allows a fresh look on these issues in a pertinent way to the problem addressed, we set up a detailed analysis on a series



Figure 1. Children drawing first drafts at workshop, 2013.

of group drawings made by children representing invented cities. The set of drawings was produced by 786 children aged between 11 and 13 years old that attended one of the 59 editions of the one-day workshop "Uma cidade para os teus olhos" (A city for your eyes) promoted by Universidade do Porto at Faculdade de Arquitectura as part of the much broader program for children "Universidade Júnior" (Junior University) in July 2013, July 2014 and July 2015. The workshop design was created by Professor Raquel Pelayo who is also responsible for its implementation. All authors of this article have worked directly with the children at the workshops and the assumptions deduced from the analysis of the drawings are also consistent with the informal observations made of the youngsters overall performance and what they externalized during the workshops.

Drawing is a process that captures not only conscious deliberate thinking but also unconscious and more profound subjectivities. That is the reason why it is one of the most important art forms and also quite appropriate as means of inquiring children.

The focus of the analysis is on the quantification of urban equipments that children elected to feature on their collaboratively idealized cities, but we realized that other focuses can be implemented in future research once these drawings are quite rich and have several layers of information that go beyond urban equipments. Since 2014 audio recordings of children's oral presentations of the individual first drafts have been done (about 500) within the workshop activities and those documents can be used in future further research, namely to compare the results of this visual inquiry with oral data.

2 VISUAL DATA ANALYSIS

Fifty nine large line drawings made with thick marker pen on newspaper of approximately 113×69 cm (44.5×27 in) executed collectively, in groups of fourteen young teenagers each, representing the city idealized by each group, are the visual documents analyzed in this investigation. We searched for traces of the children's vision of urban space in order to find out what they value in an urban area and the relative importance that they attribute to each of the urban equipments that they have chosen to include in their invented ideal cities.

We depart from the assumption that in what concerns children's drawing each drawn item is meaningful for its author. In this case each item stands for a piece of urban equipment that one of the children's deliberately desired to see in the city. This was not done by chance; they developed personal objective and subjective criteria to meet the workshop challenge i.e. drawing "their desirable city", "the best city ever", "something that would work" and that "they would be proud of".

At the workshops, the groups of 14 children were introduced to the knowledge world of architecture and urbanism, had the opportunity to develop graphic and visual skills, were sensitize for a responsible/active citizenship and reflected upon urbanism from their experiences of living in urban areas. All of that is reflected in their final collective drawings of the group "desirable city".

Note that before the execution of the collective drawing each child has created an individual drawing of the city with graphite pencil on A3 paper as can be seen in Figure 1. Only after completing that task the child has been asked to choose from his or her drawing the most important item(s) and draw them in the collective city in order to create with the co-workers the "ultimate city". These last drawings are the ones we analyzed. The execution of these final drawings has been filmed as part of the workshop. All these videos are available online at: https://www.youtube.com/channel/UCCPyZ3CyXk6n6hTUCXhqtkA and include all the audio recordings mentioned earlier (in portuguese).

The first question to be raised is if the visual documents analyzed are a viable and credible source to inform a theoretical approach to children's vision on urbanism. An example of one of the drawings analyzed can be seen in Figure 2. That depends on how true, coherent and comprehensive the raw quantitative data appears to be. And that is the case for all three conditions because we can confirm children's typical tastes from resultant data, like their preference for ice cream shops and fast-food restaurants – the only ones that appeared - or a relative strong presence of videogames shops. Also regarding entertainment children's preference for circus or funfairs are clear. On the other hand, we can see the presence of all basic life supporters on this planet, like water, light, plants and some animals. Sun and animals were items not considered in the analysis undertaken but almost all cities have a sun in the sky and birds/dogs also appear – as well as a dinosaur!

The portrait the numbers give us on children's vision is not an oversimplified version of the city's complexity, neither is devoid of logical and pragmatic thinking given that many areas and concerns appear, including the most important life maintenance activities, like feeding, health care, security, administration and even honoring the dead. Other main vital areas for surviving within society are present, like transports,

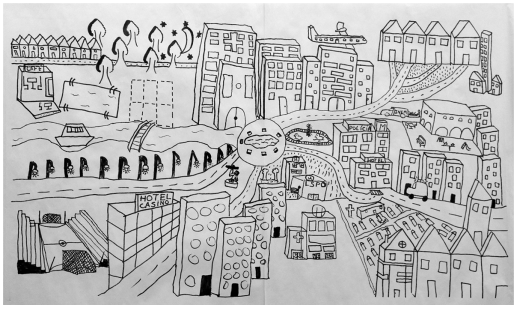


Figure 2. Children's collective final drawing of an imagined city. 2015. Raw data from conducted research.

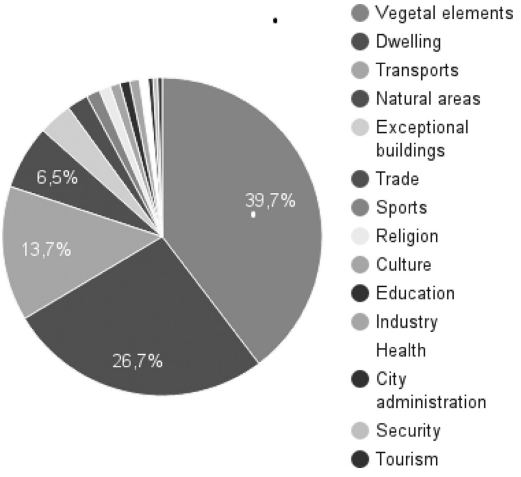


Figure 3. Percentage of urban equipment categories found. Data from conducted research.

schooling, diverse areas of business, entertainment and even cultural, identity and spiritual needs, as we will see. A last word to say that even children's humor, freedom and imagination are all reflected in these drawings for example when visiting UFOs overfly the city and suck-in a peaceful citizen or when a terrible fire ignites somewhere in the city presenting a security risk. We found a total of 3072 items corresponding to components of the 59 collaboratively imagined cities. Natural elements like the sun, the moon, clouds and animals were not taken into account and only the vegetal world has been considered to account for the presence of the natural world. This category is distinct of natural areas which consists in organized natural settings like a riverfront or a garden despite containing eventually some of the green elements that appear in natural areas. The percentages of urban equipment categories we found is represented in Figure 3 chart.

The main categories found are natural elements (1219), which include mainly trees and some flowers and grass. The second more present component is dwelling (821) divided in houses (516) some of them organized in housing estates and apartment buildings (305).

Transport equipments (421) are the last major category found, superior to 10 % of the total items. It includes roads (228), vehicles, like cars, buses, aircraft, helicopters, trains, ships or boats (93) bridges (38), traffic circles (27), railroads (10) and other equipment including airports and parking areas amongst other (25).

These data are surprising in what concerns the presence of nature in these cities. Data points very clearly to the importance children give to their need for nature to be present in their daily life since it not only has the larger amount of all, but also is everywhere and represents almost half the items absorbing 39.7% of all considered items.

Dwelling is an expected frequent feature and is 26.7% of total items. Population rates give us an idea of the size of the city. Once we have a housing value well below 50% of all features one can interpret that children prefer cities that are not giant urban agglomerates, highly populated. Following this preference for a certain equilibrium in the size of the desirable city one can add there is also a preference for one-family houses instead of big vertical buildings to live in. Despite that transportation is a big concern for children, not only in what concerns the circulation within the city, mainly by car – considering the 254 roads and traffic circles that are more than half the sum of all transport items – but also in terms of having connections to go anywhere, given the significant presence of long course transports by air, rail and water, although not by car once there are no highways.

These cities have shown to be quite complex as we proceeded to a more detailed analysis of the remaining 19.9% that splits into twelve different kinds of equipment that includes the following categories in order of higher presence: Natural areas (200), Exceptional buildings (105), Trade (66), Sports (42), Religion (35), Culture (32), Education (30), Health (30), Industry (30), City administration (15), Security (15) and Tourism (14). A chart representing these categories per quantity is at Figure 4.

Once again natural settings lead in number reinforcing the vital importance of it for children's well-being. Natural areas found are very diverse and include backyards (51), parks (38), riverside (31), waterfronts (30–17 lakes and 13 beaches) and adjoining the city there are frequently mountains (29) and forests (21). Water in diverse forms is always expressively present in the drawings. Its number more than triples the number of drawn cities.

Exceptional buildings are a category of constructions with no clear use that stands up for their architectural and symbolical value. It is of two sorts, contemporary buildings (41) and heritage buildings (64), 44 of those are medieval castles and/or fortifications. It's presence in the drawings almost doubles the number of cities. Amongst these historical value items we found quite similar versions of two Eiffel towers, a Palace of Westminster with the Big Ben tower, and even a TajMahal or a White House, but most of

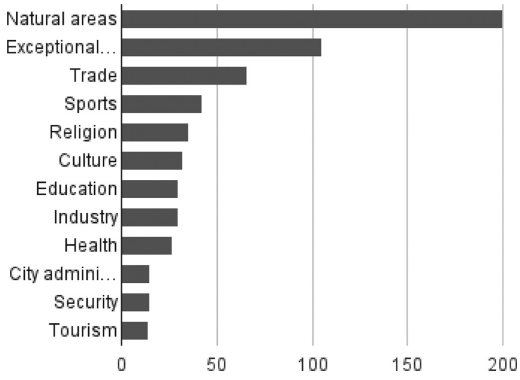


Figure 4. Other urban equipment categories per quantity. Data from conducted research.

these are invented in a blurred classical architectural style. These constructions might have been conceived as museums, offices, headquarters of various sorts, hotels or dwelling buildings but they stand in the city as expression of its cultural high level and historical value, as well as signaling the city's economical power. This leads us to conclude that for these children art as social identity vehicle imbued of cultural value is above all other more utilitarian life aspects present in the drawn cities. Even if those aspects carry survival value like food, health or security.

Trade is the next more frequent group of features. Its presence is similar, but superior to the number of drawn cities analyzed. Trade equipments include shopping centers (6), clothes shops, groceries (15), videogames, music and book shops (7), restaurants (9), bars and ice cream shops and a street food seller (19), banks (4) and post offices (3). Shops and services are usually grouped together in a street or certain area of the city. There is a preference for street shops and services (60) rather than shopping centers (6).

Sports is represented mainly by football fields and stadiums (19) followed by swimming pools (15) and other sport equipments for tennis, basketball, equitation, bowling and a multisport complex (8). What seems significant here is that all these equipments are in open air, favoring nature contact. The number of urban sport equipments is just below the number of city collective drawings.

Religion is the next most present concern in the children's cities. We found mainly churches and chapels (25) but also cemeteries (9) often side by side the churches. They appear in any place within the city. The number of religious constructions is about half the number of drawings meaning that half the cities have it. Also with a similar number we find Culture, Education, Health and Industry.

Culture aggregates open air funfairs (14) circuses (12) and buildings like theatres, music halls or museums (7). Almost as numerous as cultural equipments we found 30 schools, two of them universities and an astronomy research center. Health care is another area that has a fair presence in these cities once about half the cities have it. There are 27 hospitals and 3 pharmacies. The last type found in half the cities analyzed is Industry, which is composed mainly by factories (21) and includes not only two nuclear power plants, a wind turbine and a waste treatment center but also preindustrial equipments like windmills (6) and some other few features connected to agriculture (3).

City administration, Security and Tourism are present but are less frequent, appearing in only about a quarter of the drawings. The need for city management is represented through 15 central town hall buildings. Tourism is also seen as something important in a city. There are 14 hotels – one of them for dogs. Some of those are extravagant buildings, have many stars, swimming pools or a heliport at the top.

Security is the last type of equipment found in the children's drawn cities. There are six police stations and two police teams in action (8), some prisons (3) and four firefighter teams in action but we failed to distinguish their fire station buildings. We interpret that the importance given to security is expressed trough appearing as an ongoing activity rather than by urban equipment quantity.

3 CONCLUSIONS

The study conducted on children's drawings representing cities allowed us to access relevant information about children's space appropriation and aspirations, confirming the use of drawing as a powerful instrument of inquiry as attempted previously in other studies concerning territory (Lynch, K. 1960) and more recently Guerra (2014).

Main findings of this study concern the natural versus constructed balance, the population density and the symbolic value of art and architecture confirming previous conclusions from other studies on children connection to nature and adding identity issue as something that is worthy of further research.

There is no space for doubt in the data collected that the most important children aspiration stemming from the visual documents is for a strong nature presence in their lives and environment. The expressiveness of numbers points out this issue as being a precondition for human life once it is far above any other possible concern, confirming the biological need for more nature-friendly cities. As Lynch (1977, 57) put it "The hunger for trees is outspoken and seemingly universal". These results express the importance of developing policies towards the renaturalization of urban areas. It confirms Lynch (1977) oral collected data from children interviews when participants were asked to imagine the best place to live in, stated frequently trees, and as beautiful places, gardens and parks. It is also in line with other concomitant conclusions of the first explorative studies on how children used and experienced local places beside Lynch seminal work, like Hart (1979) and Moore (1986) researches that uncovered, for the first time, the high value of nature to children. This conclusion

is also supported by more recent studies, so comprehensively reviewed by Chawla (2015), that point to physical and psychological health benefits of nature contact.

Another important finding not unrelated to the previous is the city size in terms of population density per urban area. This is a concern that is shown by a smaller number of dwellings than expected (i.e. matching common cities' reality) associated with the preference for horizontal housing and followed by a frequent but bland presence of the road network, where no highways appear.

The final most relevant finding is not something that concerns physical survival. It expresses the primacy of spiritual and psychological human dimensions over materialistic needs. It is about the importance of art forms for a community. The number of exceptional buildings in the children's cities exceeds all other minor areas of urban equipments (i.e. Trade, Sports, Religion, Culture, Education, Health, Industry, City administration, Security, Tourism). In the analyzed set of drawings children ascribed vital importance to art's power to unite humans in a shared common identity. Be it trough celebrating present life – using new forms of beauty – or by celebrating our ancestry by preserving the past's precious heritage. In fact, the ability to empathize is at the core of every human conglomerate since prehistoric times and even though there are no previous studies pointing to this conclusion it is not alien to Sobel (2002) concept of "affective geography" coined upon Cobb (1959, 540) theory that states that "What a child wanted to do most of all was to make a world in which to find a place to discover a self".

Children's vision on the city points to these three ideals for future urban development concerning nature presence, city size and art and it would be interesting to compare children and adults vision on future cities in future studies.

Children say that without its totems (and what they stand for) or devoid of grow control the city will decay and that without its green shadows and flows of water the city will certainly die. As we all are responsible citizens and active members of communities around this planet we should all listen to our children and take in consideration their vision to see what we can do to leave behind a better and happier world.

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A bio-socio integrative approach for future development of waterbodies in Alexandria

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ABSTRACT: Urban areas in many cases irreversibly disrupt and fragment the landscape by imposing built structures and hardscapes, along with damaging human activities. This research is concerned with water bodies as natural elements in urban areas. Water has always been a fundamental attraction for city development. However, nowadays the integrated water-city relationship has weakened. In many cases the public are not engaged with waterfronts, and urban functioning is at odds with the preservation of the natural resource, resulting in neglect and mistreatment. Such is the case in Lake Mariout, Alexandria, Egypt.

The research addresses the fragmented approach to dealing with the Lake and the lack of consensus around its future. It realizes the potential of this natural element and the opportunities afforded by adopting a bio-socio integrative approach, with the aim to repair stressed and disfigured ecosystems while facilitating human development. Various stakeholders and interest groups were surveyed to gauge their views towards future developments and the Lake in order to form a consensual vision. The paper concludes with recommendations for city-nature synergy based on the quadrant of nature, population, built environment and governance.

1 URBAN – NATURE RELATIONSHIP

1.1 *Urban – nature synergy*

The relationship between human agglomerations and nature is one of disruption and stress. Cities are inhabited by a variety of flora and fauna and have become central nodes in the commodification of nature (Swyngedouw & Cook 2014). Urban areas vary in size and their relationship with the natural environment. The discourse on sustainable urban form often advocates urban compactness and criticizes sprawl, referring to earlier attempts of bringing nature closer to the city such as Ebenezer Howard's Garden city. Both Le Corbusier and Frank Lloyd Wright built on the work of Ebenezer Howard. Le Corbusier adopted a centrist vision aimed at increasing open space and improving circulation by increasing urban densities through high rise tower blocks, yet advocating segregation of functions. Wright's 'Broadacres' vision adopted a decentrist vision, considering the opportunities presented by the car and electricity, loosening the city boundaries and allowing densified spread into the countryside. He advocated aesthetically controlled and planned decentralised urban developments but did not anticipate the consequential unplanned sprawl (Vreeker, 2009). Both visions led to current urban patterns of dense mono-development in the city core and dispersed development on the fringe. Concepts, theories and practices such as the compact city, growth management, multifunctional land use, smart growth, new urbanism and transit-oriented design have evolved in response to the dissatisfaction with resultant urban patterns (Vreeker 2009, Ancell & Thompson-Fawcett 2008, Lau et al. 2005, Hall 1998). Recently, 'unsustainability' has risen to the fore in political and public consciousness, with emphasis drawn on the repercussions of urbanizing nature beyond the city and on re-viewing nature as harmonious and desirable (Swyngedouw & Cook 2014, Samiei 2013, Kaika 2005). But how can urban areas be an extension to our natural environment and how can we reach a balanced relationship?

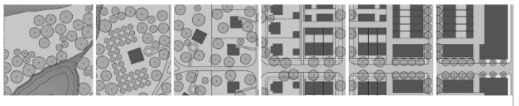


Figure 1. Urban Transect (Duany et al., 2014).

In order to conceptualize the relationship between urban areas and nature, the relative existence of nature in relation to the hierarchical urban spread is to be established. Two approaches are addressed. First, the 'transect' approach (Talen, 2002; Duany et al. 2014) which views the environment as a continuum ranging from rural to urban, aiming to preserve the integrity of both. This approach is useful in solidifying a logical progression from rural to urban with an underlying imperative that urban elements should strengthen rather than stress the immersive environment.

Six zones are specified: natural, rural, sub-urban, general, urban center and urban core (Duany et al. 2014). It is a rather linear conceptualization and does

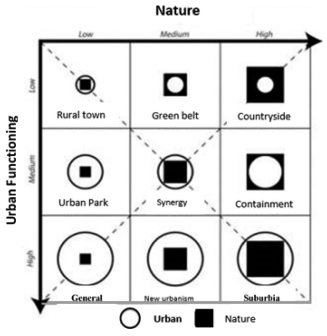


Figure 2. Urban – Nature synergy (adapted from Ducruet, 2007 and Duany et al., 2014).

not highlight issues of dependency. Second, a matrix developed by Ducruet (2007) explains the successive stages of port-city inter-relationship, subsequent spatial separation and the dependency and dominance of one over the other. He describes the relationship in terms of centrality and intermediary, where if an entity is central it holds value in and of itself, whereas if it is of an intermediary status, it is exploited and serves others. Duany et al. emphasize a spatial hierarchy, helpful to discern scale and size whereas Ducruet conceptualizes the inter-relationship between entities, valuable to discern exploitative versus synergistic associations.

Figure 2 shows a developed matrix building on both approaches to conceptualize the urban-nature relationship. Horizontally, nature increases in its dominance over the urban area, whereas vertically, urban functioning rather than density shows the pressure on nature. The diagonal running from the upper left to the lower right shows the hierarchical descent of centrality to intermediacy where nature is exploited in the context of suburbia. The diagonal running lower left to the upper right shows the opposite where the countryside is of value in and of itself and the urban areas develop independently of nature, risking patronage of natural resources. The synergy occurs in the middle where a state of equilibrium and balance can be conceptualized in terms of maintaining the integrity of both nature and the urban areas. This concept is led forward in the next section, informing the approach proposed in the paper.

1.2 *Fragmentation of city and nature*

Cities have long been viewed as disruptive to nature, a place where nature ends and intensive urban functioning begins (see the General city in Fig. 2), an imposition of built structures and hardscapes, not to mention human activities that put immense pressure on the natural environment and the ecosystem (Swyngedouw & Cook 2014, Samiei 2012, Heinonen & Junnila 2011, Yeang 2009, Grimm et al. 2008). Before the industrial revolution, cities were relatively small, few, had controlled population and their impact on the natural world was limited, in other words they were bio regionally embedded (Samiei, 2013). Following, the modernist view depicted the city as a mechanical object (Jones & Wingfield 2010), a view rejected later by many, giving rise to movements such as Metabolism, Landscape Urbanism, Urban Ecology and Eco master planning (Samiei 2013, Jones & Wingfield 2010, Yeang 2009, Yeang 2008, Svane et al. 2006, Kurokawa 1992, Anastasakis unpublished). Metabolism describes the city as a living organism, an evolving system made of parts, each having its function and the integration of the parts creates a whole (Kurokawa 1992). Landscape urbanism calls for closing boundaries between architecture and landscape, where flowing landscape-like building forms closely synchronize with their surroundings (Muller 2007). Urban ecology is an emerging interdisciplinary field that aims to understand how human and ecological processes can coexist in human-dominated systems. Urban ecosystems are perceived as diverse, hosting human activities that sustain human life forms, (infrastructure; roads, dams and buildings) and a biological inventory (plants, wildlife, water systems, food systems and microbes) (Samiei 2013). Eco masterplanning contrasts with conventional masterplanning in that it strives for a seamless and benign integration of the human built environment with the natural environment, retaining the ecosystems' integrity, connectivity and functioning.

These movements focus on the relationship between the city and nature with a focus on the built and natural environment. The human aspect is regarded in so far as it imposes infrastructure and hardscapes to satisfy human activities. More recently, it has been pointed out that the social aspects have perhaps been overlooked, calling for environmental justice, social ecology and equality (Swyngedouw & Cook 2014). Advocates encourage mapping the social activities that take place in the city and the ecological cycles at work in the urban environment (Jones & Wingfield, 2010). Hinging on resilience theory, the inter relationship between people and their environment is highlighted, stating that humans and nature are strongly coupled and co-evolving, and should therefore be conceived of as one 'social ecological' system (Holling cited in Montenegro 2010).

The literature has pointed to the fragmentation of ecosystems caused by mass urbanization which has disrupted natural systems and created unhealthy settlements. As a result, urban dwellers have become increasingly disconnected from nature, oblivious to the concepts of a healthy ecosystem, considering landscape an ornamental feature and superficial embellishment. Moreover, we face a new found uncertainty regarding social and economic pressures in light of widespread global economic instability and climate change which manifest themselves locally, more so in developing countries with the absence of effective mechanisms to deal with the various systems in urban areas.

Bio-integration and social ecology are key concepts to transform the relationship between urban areas and nature. It is by no means an easy task, particularly in developing countries with fragmented institutional structures. Coordinated action will be required for

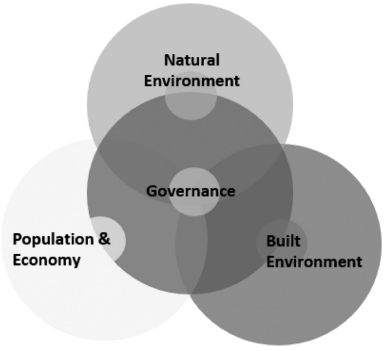


Figure 3. Key dimensions for a bio-socio integrative approach.

such a transformation to occur (Grant 2012). Figure 3 draws on the four key points outlined in the literature. It emphasizes the bio-integration of the Built and Natural Environment, the importance of coupling the natural with the human activities (socio-economic) and the imperativeness of coordination via a governance system to effect transformation. The approach is used to analyze the case study, develop a vision for the area and propose means of effecting this transformation.

2 LAKE MARIOUT CASE STUDY

2.1 *The natural environment*

Lake Mariout is one of the waterbodies in Alexandria city and borders it to the south. The Lake, once the most productive fisheries resource of the four major Egyptian brackish water lakes, in a couple of decades became the least productive (from 11,000 tons in 1976 to 6,378 tons in 2004), receiving primary treated sewage, industrial effluents and agricultural drainage water. The Lake is considered the boundary of the city where urban and rural meet, where agricultural land from the Nile delta form its south banks. The Lake area shrunk from 252 km^2 in 1889 to 71.4 km^2 in 1995 to 60.7 km^2 in 2009.

The Lake has relatively saline soil. Flora covers more than 60%, in the form of reed and water hyacinth, growing exponentially due to organic pollutants, affecting the fisheries. It is historically home to migratory birds, however, loss of habitat and hunting habits have reduced numbers significantly. The ecosystem of the Lake has severely suffered from unplanned human activities affecting its morphological and ecological characteristics. Land desiccation occurs systemically for: city development, heavy industries, agricultural reclamation and informal settlements (14.5 km^2). Motorways and canals led to the division of the Lake to four basins (Fig. 3) with no connections or waterflows, significantly changing the composition of each basin.

There are five informal settlements in the vicinity of the lake, one of which is directly on the shore. Questionnaires were distributed to their inhabitants as

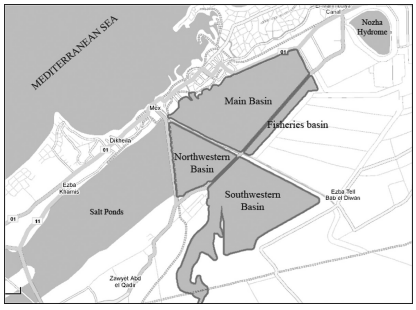


Figure 4. Division of Lake Mariout to four basins.

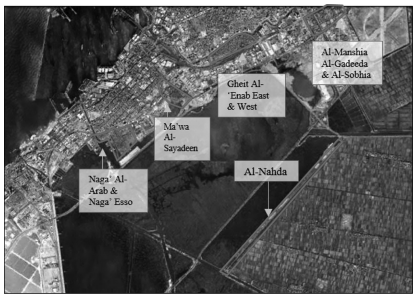


Figure 5. Informal settlements around the main basin.

part of the research (this will be explained further in the next section). 46.6% of the inhabitants prefer lake purification. Reasons varied between its natural existence and preserving the fishermen source of income, Investors use the extreme pollution as an argument for the entire filling of the water body. It is estimated that an economic loss of 5.6–8.5% of the city's GDP is attributed to the environmental degradation of the Lake between health costs, loss of tourism and recreation opportunities and loss of fisheries and wetland (CEDARE 2009). Several projects were initiated in cooperation with the Environmental Affairs Agency to address the pollution problem, however, none were implemented due to administrative reasons (explained in sec. 2.4) managerial and financial reasons. If the Lake, as an important Natural asset, is to be bio-integrated, it should seize to be seen as a backyard and its ecology preserved and harmonized with human activities. It currently has an intermediary status in the dependency relationship, where it only serves as an exploitative asset.

2.2 *Population and economy*

130 questionnaires were distributed to local residents of the area using a simple random sampling method. Five residential quarters were identified spanning three administrative districts.

The importance of the Lake to the respondents, personal attributes affecting their relationship with the Lake, their inclinations towards types of developments, were some of the main interest points. Almost 50% of the population age between 15–45 years and

those above 45 are about 23% (CEDARE 2009). To give an indication of the density, 107,476 people live in the informal settlement at the top left. Average family size is 4–5 members and illiteracy is 25%. The population are composed of fishermen, farmers and poor informal settlers where the latter forms the majority. The percentage of the workforce working in the informal sector is 30%, manufacturing industries 20%, 18% in the trade and equipment maintenance sectors, 12% in the construction sector, 10% in transport and storage, and only 10% of the total number of workforce work in fishing and agriculture (El-Refai 2009). This clearly shows that there are nearly no economic activities related to the Lake. In a neo-liberal market and according to ecological modernization, economic development is unquestionably prioritized and socio-ecological justice is neglected or receives limited consideration (Swyngedouw & Cook 2014, Baker 2007, Keil 2007, Portney 2003). Unless economic opportunities are linked with the Lake, in light of ecological modernization, the Lake might well be filled in and distributed as land plots. Also, those bearing the immediate burden of pollution are the settlers exposed to health hazards and the fishermen whose livelihoods are threatened.

The state of equilibrium and bio-socio integration is farfetched, tending towards the 'general city' (Figure 2), where the natural element has no value to the urban dwellers and is engulfed by urban functioning. This is emphasized in responses where, 51% consider the Lake unimportant to them (93% in one of the informal settlements), 35% are not ambitious about their area and only 38.4% acknowledge living in its vicinity. The Lake needs to be integral to dwellers' everyday activities and opportunities must arise to also attract the wider population of the city, affording society diversified opportunities for economic development, public enjoyment, and civic identity.

2.3 *The built environment (land-use, transportation & infrastructure*

Most of the urbanization is located to the north and west of the Lake. The estimated vacant land is about 5.68 km^2 accounting for 11%, residential uses occupy 8%, industry 18%, services 11% and vegetation 33%. Wetlands, commercial, religious and others occupy 19% (Fig. 5). Of the residential units, those 25–50 m from the shore of the Lake, are slum-like units and the price of land is third of its value compared to land on the roadways. This is obviously the opposite of what should be expected on a water body and confirms that the Lake is hardly seen as a natural asset. Heavy industries dominate the industrial sector accounting for 64% whereas light industries are 23% dominating the urban area to the north and north-west. None of the land uses are related or relevant to the Lake except for fishing. There are no recreational or tourism activities and the residential stock is limited. Land use can be an influential factor in achieving bio-integration where heavy polluting activities, poor housing stock

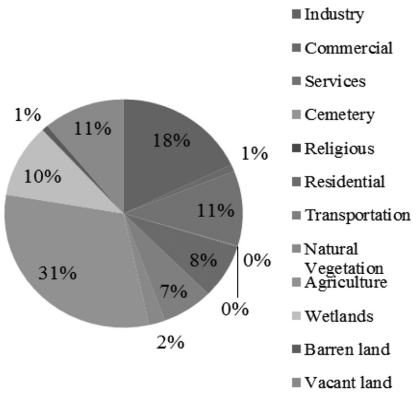


Figure 6. Land uses of the study area.

and limited civic amenities are at odds with urban ecology principles.

The transportation in the study area is one of the main factors that affect the equilibrium of the Lake ecosystem as the transportation network of roads, bridges and drainage routes were constructed in the middle of the Lake dividing it into basins with no openings for the passage of water. This isolated each basin, preventing ecological linkages, affecting its biodiversity and the way it deals with pollutants. The roads range from regional, national to local routes accounting for about 7% of the study area. These roads mostly surround the area rather than penetrate it, causing difficulties and immobility to the residents. Considering that most of the residential stock is informal, the infrastructure network is limited due to the illegality of land. The sanitation network only reaches 69% of households.

The analysis of the built environment reveals an inappropriate distribution of land uses in relation to the Lake, inconsideration of the lake ecosystem in laying the transportation routes and the severe shortage in services and facilities, all amounting to a disruptive urban area in dire need of a transformative approach.

2.4 *Governance*

The governance of Lake Mariout is at the heart of the problem. The Lake is surrounded by 6 administrative districts and managed by 7 national and local authorities, not to mention the secondary stakeholders and interest groups (see Table 1). On the national level, the Ministry of Agriculture owns the Lake, responsible for fish production, the Ministry of Irrigation manages the constancy of water level, the Ministry of Environment is responsible for environmental quality control and the Ministry of Interior enforces the Law and protects the lake from illegal activities and infringements. On the local level, the Governorate is responsible for planning and creating investment opportunities. An authority implements sewage plants, and finally industrial enterprises are ratified by the Investment Commission (Abdel Galil & Al-Din, 2013). Each

Table 1. Primary & Secondary stakeholders (Al-Din 2011, CEDARE 2009).

Primary stakeholders	Secondary stakeholders & interest groups
Alexandria Governorate	Syndicate of Fishermen and fishermen
Ministry of Housing, Utilities, and Urban Communities	Donors working in the same area (mainly World Bank, GEF and EPAP II)
Alexandria Company for Sanitary Drainage (National Organization for Potable Water & Sanitary Drainage)	Developers and Contractors (representation could be assigned to Alexandria Businessmen Association)
Ministry of Agriculture – The General Authority for Fish Resources Development	Ministry of Transportation
Ministry of Industry and Foreign Trade (and Federation of Egyptian Industries & Industry Modernization Program)	Ministry of Investment
Ministry of Petroleum – General Petroleum Organization	Waste Management Contractor (main & sub-contractors & informal labour)
Ministry of Environment – Environmental Affairs Agency (EEAA)	National NGO's (leading: Friends of the Environment, Pioneers of the Environment, and Fishermen Association)
Ministry of Interior – Water Bodies and Environment Police	Research Community in Alexandria (University of Alexandria, National Institute for Ocean Sciences)
Ministry of Health	Professional bodies
Ministry of Tourism	International bodies (World bank, UN)
Alexandria Local Council	Local community around the lake
	Alexandria populace
	Media and others

authority has its sectoral information which is not communicated to other authorities, besides the lack of an integrated management and monitoring plan for the Lake. The level of participation of the secondary stakeholders is minimal (CEDARE 2009).

The interviews conducted with government officials, professional bodies, investors, NGOs as well as the informal interviews with local residents of the lake vicinity (at the study area boundary), revealed varying opinions of the value of the Lake and the synergistic relationship between the development of the area and the natural resource. Rather than having a consensus on the value of the lake, they all agreed that it is in urgent need of purification, either because it can affect future investment prospect or for the livelihoods of the fishermen. NGOs and residents cited affordable ways to do so. However in terms of development, pressing socio-economic needs clearly shape the argument and affiliation with the lake. Bio-integration was only referred to by planning professionals, housing investors and Environmental NGOs. Residents were inclined to maintain the status quo of land desiccation and slum areas with better amenities yet no affiliation to the lake. Only the fishermen suggested changing the Lake's status as a natural reserve. The interviewees seemed unclear on who can effect these changes; for officials realize the limitations of their jurisdiction, NGOs and interest groups realize their limited role in decision making and residents go about their everyday lives depending on their social networks, as the majority are in illegal tenure.

3 BIO-SOCIO INTEGRATIVE VISION

A bio-socio integrative vision is one that considers the natural resources in the area as the foundation for human development based on a co-existing relationship where the contact with a biodiverse world is essential to stimulate the development of emotional, cognitive, and social potential and its lack results in a loss of real ecological knowledge and emotional attachment to nature. This knowledge and attachment can result in living within the limits and ecology of the natural area and informing a compatible type and form of human and built impositions. The role of governance is in fostering the integration and forging mutual relationships with the diverse stakeholders, maintaining environmental justice in order to bring about the transformation to a synergistic relationship.

In order to realize this vision in planning terms, objectives have been drawn for each of the key dimensions laid in Figure 3. Proposed projects for the area are given a priority tag and the responsibility for action is outlined (see tables 2, 3 & 4).

3.1 *The natural environment objective*

Achieving an ecological equilibrium and urban-nature synergy, avoiding human violation whether pollution or land encroachment (see Table 2).

3.2 *Population and economy objective*

Achieving balanced socio-economic structures based on environmental justice and consensual agreements (see Table 3).

3.3 *The built environment objective*

Achieving integration between the built environment and nature by allowing compatible and water-dependent landuses closer to the lake shore and relocating/mitigating harmful landuses. Also striving for environmental and social justice, accounting for social needs (see Table 4).

Table 2. Natural Environment Objective and projects.

Objective: Environmental equilibrium for lake Mariout ecosystem

Sector	Goals	Proposed Projects	Classification	Responsibility	Priority
Lake pollution	Purifying the lake water from the sources of pollution the heavy industries	– Secondary wastewater treatment plants – for the eastern and western plants – Building internal treatment plants for	Service	National Organization for Potable Water & Sanitary Drainage/EAA	High
		– Rework on opening tunnels under the international road and the Alexandria Cairo highway for the water passages	Service	Ministry of Housing and Reconstruction	High
		– The Integrated Management Project (IMP) – The Global Environment Facility project (GEF)	Service	The EAA	Medium
Lake encroachment	Preventing more land encroachments on the lake; through the immediate development on the existing shoreline	– Construction of the future development infrastructure – Promenade, directly on the lake shore	Service/local development	Ministry of Urban Planning/Alexandria Governorate	High
		– Parks and Green Spaces, adjacent to the lake shore	Service/local development	Ministry of Urban Planning/Alexandria Governorate	Medium

Table 3. Population and Economy Objective and projects.

Objective: Upgrading the socioeconomic conditions

Sector	Goals	Proposed Projects	Classification	Responsibility	Priority
Investment	Creating a fertile base of investment in the area	A catalyst project; could include water sports club, fishing clubs, or hotel and healthcare centre	Investment	Investors	High
Slum settlements & facilities	Socially accepted reallocation of the slum inhabitants, while sustaining their existing crafts.	Reallocation of the slum settlements in the same locations	Procedural	Alexandria Governorate/ investors	High
		– Economic housing; required by 30% of the slum inhabitants. (should be with equivalent existing households areas for each family)			
		– Retail complex includes most of the existing crafts and informal activities (craftsmen shops)	Investment	Ministry of Urban Planning/Alexandria Governorate *or* Investors	High
Fishing	Upgrading the socioeconomic conditions of the fishermen and increasing their existence.	– Demolishing the existing fishermen communities and establishing new ones, directly adjacent to the fishing activities	Procedural/ local development	Alexandria Governorate/ Ministry of Urban Planning	High
		– Fish market Transforming the lake, after purifying, into a "natural reserve" (as suggested by one of the interviewees)	Procedural	Ministry of Agriculture/ EAA	Medium

3.4 *Governance objective*

Establishing an Integrated Management Agency for Lake Mariout responsible for coordinating efforts and forging mutual relationships with diverse stakeholders. Decision making in a participatory process is its main responsibility.

The bio-socio integrative vision departs from the rationality and zoning of modernism separating the artificial and the natural environment which in many cases led to the exclusion of nature. It also departs from the purity and immobility of utopian approaches. Bio-socio integration starts from the notion of dependency and synergy developed in section 1.2. It aims for an equilibrium between the built, nature and humans, achieving a synergy in *function* and *size* of the urban area and nature (Fig. 1). The objectives deliver the vision, laying ground for action with seed projects aiming to repair stressed and disfigured ecosystems while facilitating human development.

4 CONCLUSION

The bio-socio integrative approach strives for a seamless and benign co-existence of the human built environment, the natural environment and social activities. The aim is ecologically and socially driven to

Table 4. Built Environment Objective and projects.

Objective: Integration with the natural environment and strive for environmental justice

Sector	Goals	Proposed Projects	Classification	Responsibility	Priority
Polices	Founding governmental guarantees and incentives for future investors	– Detailed, updated, registered land use plan – use of incentives ex. Impact fees, betterment or community infrastructure levy – Firm implementation of the existing land use laws, with increased penalties	Procedural	Ministry of urban planning/ Alexandria Governorate/ Ministry of Interior	High
Existing land uses	Mitigation of land uses that could not be relocated, integration of existing stock with the environment, and relocation.	– Establishing a buffer zone between the future development and the heavy industries	Service	Alexandria Governorate/ Ministry of Urban Planning	High
		– Relocation of the light industries to Borg Al-Arab industrial zone	Procedural/ Investment	Alexandria Governorate/ Investors	Medium
		– Rehabilitation of the old warehouses & encouraging bio-socio integrated projects	Investment	Investors	Medium
Development & Facilities	Establishing future land uses that meets the needs of the local inhabitants, the nature of the area, and economic development	– Water-dependent uses with high integration with water, including fish markets and restaurants, boat yards	Investment	Investors	Medium
		– Water-related uses with medium integration with water, including low density housing, youth centres	Investment	Investors	Low
		– General hospital required by 49% of the area inhabitants. Primary & preparatory schools. Police stations	Service/ Investment	Ministry of Urban Planning/ Ministry of Interior	High
Transportation	Enhancing and adopting the existing transportation network	– Increasing the capacity and quality of the existing transportation network and increasing accessibility	Service/ Investment/ Procedural	Ministry of Housing and Reconstruction	High
Infrastructure	Improving and enhancing the existing infrastructure system, to serve all the available potentials, including the tourism activities	Construction of a motorway connecting the study area with Borg Al-Arab industrial zone and upgrade of the railway (St no 218)	Service	Ministry of Housing and Reconstruction	High
		Increasing the capacity and quality of the existing sewerage and water systems. Roads should allow permeability though basins	Service	National Organization for Potable Water & Sanitary Drainage	High
		Designing a network of roads forming a tourism path to the historical sites in Lake Mariout area (including Wadi Mariout)	Service	Ministry of Housing and Reconstruction/Ministry of Urban Planning	Low

conserve and enhance existing ecosystems and foster a healthy relationship with urban functioning. The result is an urban-nature synergy aspiring for a state of equilibrium. The proposed approach departs from conventional planning and practices which inherently separate the built and the natural. It also departs from ecological modernization which commodifies nature, reducing impacts to tradable carbon units, and in so prioritizes economic development managed through technological fixes and organizational change, downplaying socio-ecological issues.

The case study shows how the current land uses have systematically disrupted and fragmented the landscape by imposing industries, informal settlements and regional highways not to mention dumping primary treated sewage, all destructive to the ecosystem of the Lake. Moreover, a fragmented management has resulted in further deterioration and loss of any interest in the Lake as an opportunity for enjoyment, investment and improved livelihoods. Instead of having a special value for the city, the shore rather than seen as a waterfront is considered as a backyard.

The relationship should be built on the premise of centrality rather than intermediary; the resources are not there to be merely exploited, rather a synergy should be formed. A synergistic relationship promises the development of emotional, cognitive, and social potential whilst maintaining the integrity of the ecosystem. To realize the synergy, a bio-socio integrative approach is presented building on four dimensions 'nature, population, built environment' and 'governance' where the latter fosters the integration between the former three dimensions and forges mutual relationships with the diverse stakeholders. The paper presents a useful conceptualization of the urban – nature relationship and further presents an approach building on the concept. Application on the case study showed how the approach can be taken forward through prioritized projects targeting each sector.

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Bottom-up initiatives and urban acupuncture



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Urban acupuncture as a tool for today's re-naturalization of the city: The non-constructible parcels of municipal Beirut through the case study of Saifi district

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ABSTRACT: This paper builds on a review of approaches towards the concept of appropriation of urban space and leftover spaces in particular. Focusing on re-naturalization as a specific mode of space transformation, it examines the specificities of leftover spaces and the role they could play in relation to urban strategies for municipal Beirut. The current Lebanese urban legislation acknowledges a certain number of parcels as non-constructible; integrating these parcels within the existing urban fabric and implementing a strategy that will allow flexible and innovative space management, would require a process of identification, innovative urban tools, revised legal mechanisms as well private and public actor's involvement. Throughout this paper, building upon the collection and the analysis of non-constructible parcels' data within the study districts of municipal Beirut, a re-naturalization process in the form of urban acupuncture will be proposed and recommendations for eventual urban strategies, urban operations, tools and programs will be developed.

1 INTRODUCTION

1.1 *The context*

As cities struggle to adapt to the changes in society, culture, technology and the economy, new types of urbanism intriguingly manifest themselves as necessary tools for its re-naturalization. Today's understanding of re-naturalization has shifted from the traditional focus on squares, parks and pavements to a broader concept that recognizes the value of less formal leftover spaces and the daily interactions that occur in them. It is through this manifestation and the emergence of a more dynamic, flexible or adaptive urbanism, that the city could become more responsive to new needs, demands and the preferences of its users.

1.2 *The problematic*

Within the context of a growing urbanization on a territory that can no longer accommodate such growth, and the lack in open and public spaces to respond to users' needs, municipal Beirut finds within its realm an urban resource that can no longer be ignored. This paper is an inquiry into the role of leftover space and more specifically non-constructible parcels, regarding their values and potentialities for the re-naturalization of the city, based on their contribution to the public realm. At present, municipal Beirut holds within its urban fabric a high number of residual or leftover spaces that are labeled as non-constructible and the potential of these unexploited urban land resources, resulting mainly of gaps in the laws and regulation system as well as a political and social laissez-faire by the authorities, is yet to be explored.

This paper builds on a review of approaches towards the concept of appropriation of urban space and leftover spaces in particular, focusing on re-naturalization as a specific mode of space transformation. By examining the specificities of leftover spaces, their activation components and the role they could play in relation to urban strategies for small and dense cities such as municipal Beirut, this paper will attempt to examine the impact of these urban transformations on the cities' urban fabric and the sustainable revitalization this form of urban acupuncture might have on society.

Throughout this paper, non-constructible parcels within municipal Beirut, and more specifically the Saifi district, will be identified and analyzed. This paper will show how preliminary results, using GIS and extensive fieldwork, will go through a filtering process in order to achieve final results unveiling the existence of a network of parcels ready to play a role in the city's re-naturalization. Concerns regarding the implementation and urban proposals will be discussed in relation to urban strategies, legal operations, tools and re-naturalization programs. In conclusion, a summary of the findings and recommendations will be presented as part of a long term general tactical strategy for the appropriation and transformation of space.

2 LEFT OVER SPACES AND URBAN ACUPUNCTURE

2.1 *Left over spaces*

Since the 1980's, literature on the subject of leftover and residual spaces can be viewed as a reflection of the evolution of contemporary society in European and American cities. Authors such as Trancik (1986), Bauman (2001) and Koolhas (2002), in their quest to mitigate the shortcomings of modernism's planning, referred to the concept of residual spaces as an undesirable urban situation leading to urban incoherence and emptiness, others throughout their architectural works such as Winterbottom (2000), Knapfel (2001) and Atelier Bow Wow (2002) began to acknowledge their presence as a driving force in the urban fabric and described it in their work.

The publications of Thompson (2002), Studio Urban Catalyst (2003), Wikstrom (2005), Haydn and Temel (2006), Philipp Oswalt, Philipp Misselwitz and Laus Overmeyer (2007) and the more recent works of Sheridan (2008), Hou (2010) and Colomb (2012) did not only describe this urban situation but also acknowledged them as opportunities and proposed solutions and programs while assuming the efficiency and potential of these residual spaces in the city. Put aside their divergent stands on residual spaces, these authors, amongst many others, share a common goal and that is their wills to integrate residual spaces in the urban fabric.

The evolution of the meaning of the term leftover or residual space coincides with changes in each city's economic, social, political and urban situation, and along with those changes, different land uses are associated with the interpretation of these spaces. There were two distinguished approaches to residual spaces within the urban fabric; one that acknowledged these spaces as problematic and undesirable and the other that saw in these situations an opportunity to develop temporary use programs leading eventually to the re-naturalization of the city. Both approaches shared a common concern and that is the integration of these spaces within the urban fabric.

2.2 *Re-naturalization as urban acupuncture and the concept of interim spaces*

In any given urban fabric where strategic punctual interventions are needed to shortcut economic, social, political or legal obstacles, creating new energy and helping desired scenario to be consolidated, assigning a temporary use program to a vacant or underused land with no immediate development demand, the creation of interim spaces could be triggered. This concept of urban acupuncture, just as in the medical approach, will trigger positive chain-reactions, helping cure and enhance the whole system. Lerner (Lerner, 2014), explains that a healthy city must follow a sustained, long-term preventive care process that depends on a good relationship between urban planners, designers and the city itself in the same way as medicine depends on a good relationship between doctor and patient. He maintains that good urban acupuncture is about drawing people out to the streets and creating meeting places, helping the city become a catalyst of interventions between people. In that sense, re-naturalization of the city not only functions on a spatial level, it also acts as a catalyst for those interim spaces to become platforms for citizen participation hence providing an experimental opportunity for an urban platform for democratic action and human expression (Haydn & Temel, 2006). Moreover, Thompson's Loose-fit spaces (Thompson, 2002) implies a re-design of these spaces in order to integrate the urban fabric with unfixed rules of integration that could be defined by the users' need and may change accordingly.

In order to activate those spaces and furthermore implement a given temporary use programs, there are a number of components that need to co-exist. The following section will review these components as well as the drivers and the mechanisms that generate the emergence of interim spaces.

2.3 *The activation components*

2.3.1 *Drivers and pinpricks*

Strategies for city re-naturalization through urban acupuncture and the activation of leftover spaces require the co-existence of certain activation components and pinpricks. Driven by the spatial, social, economical and cultural context, specific small scale interventions mainly aim at enhancing city life. In order to better grasp the various user dependent strategies behind the activation of interim spaces, Bishop and Williams (2012) emphasize that other than uncertainty, there are numerous drivers and conditions for temporary urbanism such as vacancy, the revolution in the workspace, the intensity in the use of space and new technologies.

The existence of biophilic patterns such as visual connection to nature, non-rhythmic sensory stimuli, biomorphic forms and refuge are identified in various projects; Paley Park (Zion, 1967) and the High Line in New York (NYC Parks, 2013), Meanwhile London (Killing Architects, 2008), PlaNYC and Calgary Pop-Up Places (Pfeifer, 2013) have developed and implemented user dependent strategies (urban pinpricks) with spatial arrangements that show a strong correlation between those identified biophilic patterns and increased physical and mental user's well-being. Some have a more ambitious program, are larger in scale and require more effort in terms of funding, collaboration and authorities' involvements; others are easier to implement.

2.3.2 *The legal mechanisms*

On the other hand, and in order to complete the development of strategies for this urban acupuncture implementation, regulatory and legislative mechanisms not currently responding to users' needs, should be adapted, backed up by adequate tools and enthusiastic actors. Increasingly incorporating city

re-naturalization through leftover spaces into official planning processes as phases of development is a good start (Lehtovuori & Ruoppila, 2012). It was exemplified as a part of a long term vision for regeneration in the NDSM project in Amsterdam, where policies were adjusted to developing needs. Another recent project to fall under the same tactical strategy would be the High Line Project in New York and the Meanwhile London Project (Lehtovuori & Ruoppila, 2012). Whether long or short-term strategies were envisioned; resources were or were not available; leaders were local authorities or intermediary agents; or developments were user driven pushing for collaboration or centralized, they all shared a bottom-up strategy starting with the understanding of user's needs and the acknowledgment of the potential of leftover spaces.

Speeding up permits, innovative agreements and contracts, short-term leases and adaptive rental policies, freeing up vacant public space, providing benefits for private owners who support such implementations as well as corporate funding, self-funding and sponsorship all backed up with a positive political will, could provide a favorable context to allocating innovative programs and spaces leading eventually to a better re-naturalization of the city.

2.3.3 *The actors*

Any approach to everyday urbanism involves the collaboration of various entities; from public and private owners, endowments, developers, municipality and local public authorities, all the way to users, NGO's and activists. Different and innovative approaches such as participation, public and private sector collaboration, public-private sector partnership are few amongst new methods in city planning to meet the needs of the community and provide its users a better quality of life.

Mapping the potential of unused and leftover spaces have been a very active operation in cities such as Oslo (Soldeberg, 2011) and Sweden (Wikström, 2005), where many projects have focused on identifying the potential of leftover spaces such as underdeveloped lots, inactive public spaces and abandoned buildings. Municipal Beirut holds within its realm an urban resource that can no longer be ignored as well. The following sections will introduce the study area of municipal Beirut identifying and analyzing leftover space in the form of non-constructible parcels.

3 MUNICIPAL BEIRUT: AN URBAN RESOURCE

The introduction of the 1973 decree n°5550 divides municipal Beirut into 10 different districts (Figure 1) imposing along the way certain restrictions regarding the constructability status of certain parcels. Municipal Beirut is managed by a law-decree n° 118 adopted in 1977, and modified in 1997. The first article of this law-decree states that the municipality is a local administration that manages within the limits of its territory the attributes that are given to it by law. It is financially autonomous and has the power to self-manage its local interests. Two authorities are directly involved in the urban planning regulations: The Higher Council on Urban planning (HCU) and the Directorate General on Urbanism (DGU). Indirectly involved in the urban planning process is the Council for Redevelopment and Reconstruction (CDR) who's mission, back in 1977 when it was created, was to prepare a reconstruction plan for Lebanon.



Figure 1. Municipal Beirut cadastral districts and zoning map.

3.1 *Non-constructible parcels*

The major master plans Beirut was subject to throughout its history, such as the Danger Brothers Scheme in 1932 and the Ecochard scheme in 1943 and 1964 (Verdeil, 2005) combined with an outdated laws and regulations system that manages urban operations, have enriched the urban fabric of Municipal Beirut with a non negligible number of non-constructible parcels. They are leftover spaces found in the shape of small vacant or built spaces in between buildings or around corners (Figure 2). Their sizes do not exceed 250 m^2 depending on the zone they belong to and they can have various land uses such as parking lots for neighboring buildings, vacant plots, dumpsters, brown land, right of ways or other. Some of them are illegally built and as for the un-built ones, they are rapidly being consolidated with larger adjacent plots by developers who are seeking more space for their projects.

3.1.1 *The current legislation*

Since 1954, with the introduction of Article 5 of the decree n° 6285/54, Lebanon's Construction's Law has acknowledged and defined non-constructible surfaces as: (a) a residue of an old road after a new alignment and (b) a result of land consolidation or left-over after planning (El-Achkar E., 1998). Moreover, Article 5 modified by decree n° 5550/73, does not allow construction on narrow parts of parcels for three main reasons (El-Achkar E, 1998): (a) for the intent of visual clearance on street corners and intersections, (b) to



Figure 2. Picture of non-constructible parcel (Plot 634) in between two buildings serving as a junkyard.

Table 1. Minimal dimensions and areas for a parcel to be constructible according to zoning as per Article 2 of the decree n° 5550/73.

Zones	Area m^2	Façade m	Depth m
Zone 1	100	9	7
Zone 2	100	9	7
Zone 3	120	10	8
Zone 4	150	10	8
Zone 5	250	12	14
Zone 6	200	12	8
Zone 7	100	9	7

manage parcel densification and (c) to avoid transferring its odd forms into the volumetric of the buildings (Table 1).

Zones 8 and 10 are subject to special decrees while Zone 9 is a non aedificandi zone and hence do not contain any non-constructible parcels within their urban fabric.

3.1.2 *Methodology*

Since no data regarding non-constructible parcels was available, maps had to be redrawn in order to identify and highlight this type of information. The use of Geographic Informational System Software (GIS) proved to be adequate for this type of query, since it provides a layering system coupled with a geographic referencing system that allows maps from different sources to be stored, manipulated, analyzed and managed. Different attributes were given to non-constructible parcels in order to achieve a clear classification and to isolate the urban characteristics and allow for future comparative analysis. These attributes are: district name, number of parcel, zoning area, nature of use, constructability status, proximity factor and land consolidation potential of each parcel. In order to validate and archive the mapping results some fieldwork was done including photographical survey, updating existing maps, and fact sheets for each parcel. However, as a limitation to this study, few areas classified as military were



Figure 3. Municipal Beirut cadastral districts and zoning map showing non-constructible parcels preliminary distribution.

inaccessible and complete parcel ownership data was difficult to achieve.

3.2 *Preliminary results for districts*

A preliminary count of un-filtered non-constructible parcels and their distribution is shown in Figure 3.

The total number of non-constructible parcels within the boundaries of municipal Beirut is 6039. Zones 3 and 4 hold within their realm the highest number of non-constructible parcels, respectively 2016 and 2008, while zone 7 holds the lowest number with 115. Zone 2 holds 534, zone 6 holds 892 and finally zone 5 holds 474 parcels. However, the raw data at this stage is not yet complete since it doesn't take into account that some of these parcels cannot be exploited as a support for the re-naturalization of the city. It will be called the exploitability factor.

3.2.1 *Exploitability factor*

It was explained earlier (see section 3.1) that non-constructible parcels can have different sizes (not exceeding 250 m2) and can hold different functions. They can also be built; in that case it is most likely that these buildings are illegal (since no construction permit can be given to these parcels), or they can be un-built. Fieldwork have shown that built and un-built parcels have different urban situations as described in Table 2.

This exploitability factor relies on the potential of these parcels to host programs related to the re-naturalization of the city. The rationale behind it is that if an illegal building is badly preserved or abandoned, it could be easier for the municipality to demolish it and give the parcels back its non-constructability status or simply refurbish it. On the other hand, a well preserved building with inhabitants could be more problematic since it requires expropriation and settlements. Vacant plots are easier to manage whether they are publicly or privately owned. In the first case the municipality can be free to use the parcel the way she wishes, while in the second case, a settlement would have to be

Table 2. Different urban situations for non-constructible parcels within municipal Beirut and their exploitability factor.

Urban situation	Built	Unbuilt	Exploitable
Well preserved	x		
Badly preserved	x		x
Light structure	x		x
Consolidated	x		
Built before the law*	x		
Junkyard		x	x
Green space		x	x
Sidewalk		x	x
Right of way		x	
Private use		x	x

* Article 2 of the decree n° 5550/73.

Table 3. Count for exploitable and non-exploitable non-constructible parcels by districts within municipal Beirut.

Districts	Total* n°	Exploitable n°	Exploitable %**	Non-exploitable n°
Mdawar	1140	38	(23%)	130
Rmeil	1725	84	(26%)	238
Achrafieh	3221	615	(50%)	612
Saifi	423	77	(61%)	50
Zokak El Blat	559	151	(71%)	60
Bachoura	809	118	(65%)	62
Mazraa	4928	303	(24%)	951
Moussaytbeh	4387	127	(26%)	362
Ras Beirut	2583	70	(22%)	247
Minet El Hosn	537	18	(67%)	9
Ain El Mreysseh	620	35	(73%)	13

*The total represents all parcels in a given district.
**From the total of non-constructible parcels.

reached with the owner in order to allow his parcel to be used and integrated within the city's re-naturalization network.

The total number of non-constructible parcels ready to integrate the re-naturalization network is 1656 (Table 3) and has a total area of 300,000 m^2. As a comparative scale, this total area is similar to the largest park existing in Beirut, the Pine Forest, located south of the Mazraa district on the periphery of municipal Beirut. Within the realm of a dense city like Beirut, injecting a new life to these parcels could radically change the users' perception on green spaces and open public spaces. By bringing closer to users a flexible and adaptable space, where people can meet, gather and socialize, or simply use according to their needs, Beirut municipality could embrace the concept of re-naturalization through urban acupuncture.

In order to validate the previous encouraging results, it was necessary to further push those findings on a selected district in order to eventually apply one or more urban strategies to meet the objectives of this study.

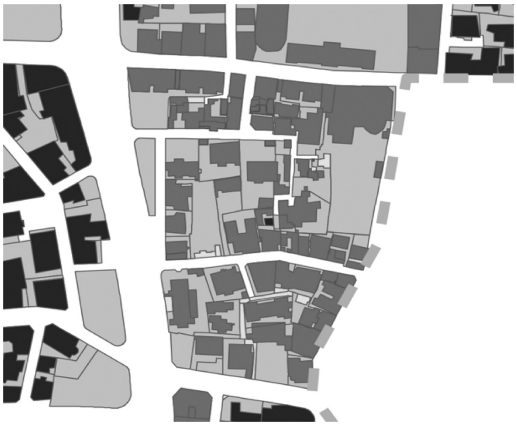


Figure 4. Examples of non-constructible parcels in Saifi district.

4 ANALYSIS OF CASE STUDY: SAIFI DISTRICT

In order to test these results as fairly as possible, it was important to select a district that would be, to a certain extent, representative of the other districts. It was also important that the selected district would have a good number of non-constructible parcels with a high rate of exploitability. Since these parcels would eventually be part of a larger network, it would be interesting that the selected district would be located close to the city center and with some proximity and connection to other districts.

4.1 *The case study area*

Saifi district fits well within the conditions stated above (Figure 4). It has an urban fabric that is quite representative of the other districts. It is situated on the southern edge of the city center and just east of Damascus road, a major axis in the urban fabric of Beirut. It holds within its realm a decent number of non-constructible parcels (77) with a high rate of exploitability (61%). Saifi district is a relatively small district with only 423 parcels in total, which makes it, for the purpose of this paper, a good case study.

4.2 *Identification*

Part of zone 2, this district's non-constructible parcels are guided by the minimal areas and dimensions listed in Table 1. The total area for the 77 non-constructible parcels adds up to 3976 m^2 or 1.5% of the district's total footprint of the built area. Should non-constructible parcels integrate the urban fabric and become interim spaces, accessibility will be an important parameter to study. Moreover, their integration and future use will depend greatly on the spatial, socio-economical and cultural context in which they belong.

Spatially, three types of situations were identified: parcels adjacent to a major road (37%), parcels

adjacent to a secondary road (48%), and parcels that were isolated inside blocks with no connection whatsoever to a road network (15%). While the better connected parcels could play an important role in exposing the network to the public, less exposed parcels could inject life into dense urban blocks in need of some breathing space. The average size of a non-constructible parcel in Saifi district is 44.7 m^2. However, further study of the Saifi district allowed the identification of a category of non-constructible spaces not identified as entities and part of constructible parcels that are acknowledged by the regulations. This urban situation could be added to the already existing reservoir of identified non-constructible parcels and could play an important role in the city.

Beirut is a city haunted by sectarian divide, and Saifi district is no exception to that. However, re-naturalization strategies have proven to have enough social commitments to overcome these divides pushing users and authorities forward to implement, promote and backup innovative urban policies in order to create a better quality of life.

4.3 *Land use*

For a better understanding of the nature of these non-constructible parcels it was necessary to analyze few urban parameters such as the status of the built, the nature of use and the types of occupancy (Table 4). Through fieldwork and data collection, it was identified that the number of vacant parcels is much higher than the illegally built. In a situation where built parcels are more demanding in terms of cost, i.e. rehabilitation and renovation, dealing with residents, and legalizing permit status, it is more cost effective to deal with un-built parcels, should their status allow it because not all un-built parcels are vacant land (see Table 5). Data also shows that the total area of vacant non-constructible parcels accounts for 37.2% of the total number of parcels and 26.4% of the total footprint of the parcels (42 parcels accounting for 1980 m^2). Even though right of ways makes 22% of the total footprint, implementing re-naturalization programs or features can be more delicate for accessibility reasons. There are very few vacant non-constructible parcels being used as gardens and that depicts a major problem in the existing urban fabric, as people have very few spaces in which they could turn to for green areas. Some of these existing parcels are playgrounds and others are just random and unorganized green spaces that need maintenance.

As specified earlier, not all vacant land are actually the same. Fieldwork shows that vacant land is used in some of the cases for: parking spaces, installing neighborhood generators, gardens, junkyards, building entrances and brown land.

On the basis of these findings, Saifi district, might as well be a very fertile ground for the implementation of innovative urban strategies focused on the city's re-naturalization. However, there are many concerns to be raised.

Table 4. Land use and types of occupancy for non-constructible parcels within Saifi district.

Occupancy	n°	m^2
Commercial	2	122
Right of way	10	640
Residential	30	1695
Vacant land	32	1640
Other*	3	134

*These are residual parcels that are part of a new road network.

Table 5. Land use and types of occupancy for non-constructible parcels labeled as vacant land within Saifi district.

Vacant Land	n°	m^2
Parking	7	778
Generators	1	301
Gardens	1	56
Junkyards	1	61
Entrances	2	92
Brown land	20	352

4.4 *The concerns*

Currently, the city under the authority of its municipality, has no vision regarding the implementation of these types of strategies. Apart from the inexistent urban strategy, non-constructible parcels are yet to be acknowledged as potential urban resource. Moreover, developments within the districts, and specifically in Saifi, are still promoter oriented rather than user oriented and no resources or funding are even remotely available to develop such endeavor, rather they still rely heavily on classical and traditional urban tools such as land consolidation and re-parceling. Bureaucratic slowdown and costly permits, as well as a case by case study by the municipality of proposed strategies (even on publicly owned land) are large obstacles for any future developments of such nature.

4.5 *Proposed urban strategies and recommendations*

Spatially, non-constructible parcels are a great opportunity to create usable outdoor spaces, integrating biophilic patterns that contribute to the overall positive health effects on the space. Views of vegetation and greenery such as trees and bushes, sound of splashing water from a waterfall loud enough to drown street noise and neighboring conversations, movable urban furniture for user appropriation of space, dynamic and diffuse light from tree shading and canopies, elevation from sidewalk and limited visual access to street are small interventions that could change the way a user views the space, enhancing it for better appropriation. Small neighborhood parks or loose-fit spaces, open air markets and cultural installations, or simply outdoor spaces that celebrate these biophilic patterns, would

emerge responding to local needs, promoting subculture diversities, hence drawing out people to the streets and creating meeting spaces, ultimately becoming a social catalyst for the city.

Strategic punctual interventions require municipality interference on publicly owned parcels, as well as owner's cooperation on privately owned land. In regards to the tactical urban strategy proposed, those interventions have to be part of a long-term vision to enhance the quality of life for the users in Beirut. Although the municipality should be leading this process and carefully following it up, informal actors should play a key role in the decision-making process and the implementation process. A collaboration of all actors within the framework of this strategy would push the implementation process forward and help its application.

First, the municipality needs to create a unit within its premises, in order to investigate and shortlist the potential non-constructible parcels. In the case where land is publicly owned, the Municipality would grant a permit for the organizer in order to use its vacant lot. The current procedures have limitations and new ones will need to be implemented. The created cell would be in charge of these procedures and would be run by experts in the field of design, events, economics, technology and other city related issues. Permits should be delivered rapidly, and decisions need to be taken on a local level, hence bypassing the municipal authority as it is the case today.

In the case of privately owned parcels, the municipality needs to interfere as well. Owners have to be contacted and notified that their unused property should be made available for a certain period of time. Of course incentives need to be given to owners who support the implementation of these programs, such as tax cuts or other. For the municipality and the owners, it is a win-win situation, since the municipality improves neighborhoods in disrepair by freeing up needed public space, and owners see their property being managed and taken care of. By issuing land procurement contracts, as it was done in Leipzig (Heck & Will, 2007), the municipality promotes private activities by prospecting and using privately owned sites for temporary use programs. Short-term leases and adaptive rental contracts could be negotiated with owners should the duration of the project require so. Moreover, by creating private public partnerships with landowners, the municipality could encourage owners to invest in temporary programs by freeing up their land.

It is clear that the potential of these parcels would not only exist in the entity of each but also in their connection to each other, creating a network of green itineraries and pathways throughout the neighborhood, district, and eventually the city.

5 CONCLUSION

The review of leftover spaces and temporary uses in North American and European cities, has shown that the concept of residual spaces has shifted from being referred to as an undesirable urban situation to being acknowledged as a driving force in the urban fabric and, moreover, as an opportunity for the implementation of re-naturalization programs. In defining the activation components for these interim spaces and highlighting the spatial, socio-economical and cultural contexts it was clear re-naturalization could, through urban acupuncture, become a tool for space transformation, hence serve as a catalyst for the city regeneration. Innovative urban strategies around the world, using mechanisms and tools led by local authorities, owners or other informal actors, share one common thread and that is the user-oriented tactics.

Through different regulatory reforms and tools such as land procurement contracts and authorization agreements, cities managed to reclaim the potential of residual spaces by collaborating with private owners and giving them incentives to encourage temporary use implementation on their property. Municipalities and local authorities have appointed special committees for following up on the process, and by short-listing potential sites, and proposing new programs, they were able to gain the confidence of the owners and implement successful projects.

It was shown that municipal Beirut holds within its realm an urban resource too precious to be ignored. In the context of urban growth and the continuous lack in open and public spaces, non-constructible parcels within municipal Beirut appear as an adequate support for the implementation of re-naturalization programs.

Through data collection and fieldwork, an updated database of the existing non-constructible parcels within municipal Beirut was generated. At first, a preliminary mapping of municipal Beirut parcels, according to their respective district's zoning and constructability limitations, has identified 6039 non-constructible parcels. According to the exploitability factor, it was shown that some of these parcels were not fit to host re-naturalization programs based on their nature of use and status. It was safe to assume that vacant parcels and illegal buildings in decay were better manageable in order to host any future program and easier to be integrated to the re-naturalization network.

The study has shown that after filtering undesirable parcels, the total number of non-constructible parcels added up to 1656 totaling an area of approximately 300,000 m^2, a non-negligible number when compared to the scale of the city. This where the concept of urban acupuncture begins to draw all its meaning. However, it was necessary to validate these results on a district's scale, in order to understand the distribution of these parcels amongst the districts. The case study of Saifi provided a deeper understanding of the nature of these parcels, as well as their distribution and scale. It was found that 1.5% of the district's built footprint or 3976 m2 of land was identified and ready to be integrated within the network. Moreover, vacant land account for 37.2% of the total number of parcels, which is an encouraging value for future implementation.

However, this study showed that were some concerns regarding the non-existent vision of the municipality which reflects on the weak legislative support for this type of operations, and the bureaucratic slowdown for permits delivery. More concerns were raised regarding the promoter oriented rather then user oriented strategies, its complete disregard for this urban resource within its realm and the lack of funding.

On the basis of these revelations, it was proposed that urban strategies dedicated for the city re-naturalization through non-constructible parcels should be of a tactical nature, consistent, focused on the implementation process, where uses are applied as part of a long-term vision for the regeneration of the city with adequate resources to back it up. Spatial arrangements integrating biophilic patterns such as the presence of water and greenery, the use of material connected to nature, elements of safety and some privacy, will increase physical and mental well-being of its users. By adjusting its current policy, involving public and private actors, investing in cells within the municipality to manage those resources and projects, Beirut municipality should strive to meet developing user's needs and push towards the re-naturalization of the city.

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Neighborhood regeneration and vulnerable youth engagement through micro-level gardening interventions

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ABSTRACT: Can local, micro-level design and cultivation of shared, urban spaces foster stronger intra-sectorial and inter-community links and elevate youth participation levels towards the improvement of the quality of social life of neighborhoods? This paper provides an affirmative answer through the examination of a participatory action research applied in a vulnerable neighborhood in the City of Toronto. This article begins by briefly discussing the context as well as the methodology. Then, it proceeds by presenting the research process and framework, community involvement and participatory design. Finally, it concludes by reporting on the results, thus far, of this project.

1 INTRODUCTION

Alongside numerous large cities around the world at various scales (e.g., Birmingham and its riots, Paris and the "banlieue" unrest, etc.), Toronto has also recently been shocked by cases of indiscriminate youth-related violence in underserved communities.

Studies have found that these vulnerable neighborhoods are characterized by higher levels of youth unemployment and crime, as well as lower levels of family and community integration that together can increase the likelihood of depression and violent behavior. Another factor that impacts communities is health equity. Besides access to jobs and health facilities, residents also need safe recreation spaces to feel less isolated and to have opportunities to interact. Often the remedies discussed involve large-scale, infrastructure-related transformations, which are costly, structure- rather than individual-centered and have a long-term (often unrealized) time horizon. This paper suggests an alternative strategy of targeted micro-level urban interventions, by way of designing and creating participatory gardens in selected locations of a neighborhood with higher levels of youth unemployment, social inequities, and crime. It focuses on the case of the Flemingdon Park in Toronto and the ongoing urban regeneration project that a team of designers, community workers, neighborhood leaders and engaged youth initiated in 2013.

The renaturalization of cities can take different forms—from the development of large scale parks like the Bois de Boulogne and the Parc de Vincennes in Paris which were considered lungs for the city of the 19th century—to planted avenues and planned urban green spaces like those designed and implemented under Alphan who improved the quality of public spaces in the French capital. These strategies contributed to the beautification of Paris and adopted a planned top-down approach.

Recently, we have witnessed an increase in citizens taking action to turn their neighborhoods into more inclusive spaces and attempt to regain access to areas overtaken by vehicular circulation. An interesting exhibition and book that displayed such initiatives was *Actions, What Can You Do with the City* curated by the Canadian Centre for Architecture (Borasi & Zardini 2008). At the local scale, the Flemingdon Urban Fair Committee has been raising awareness about the importance of green spaces in the neighborhood, has been looking for alternatives to activate them, and has been advocating for a community-based farmers market.

This paper focuses on a pilot project that uses a participatory action research approach to engage youth in envisioning and contributing to the renaturalization of parts of their neighborhood by way of gardening. It builds on earlier studies like *Paysage Solidaire* undertaken in vulnerable neighborhoods in Montreal (Farah

& Bhatt 2013) initiated by pioneers like V. Bhatt and other members of the Minimum Cost Housing Group of McGill University.

2 PARTICIPATORY ACTION RESEARCH (PAR)

Studies from a variety of fields have been using the PAR methodology. According to Baum et al. "Participatory action research seeks to understand and improve the world by changing it. At its heart is collective, self-reflective inquiry that researchers and participants undertake, so they can understand and improve upon the practices in which they participate and the situations in which they find themselves (2006 adapted from Minkler 2003 and Wallerstein and Grinch 1999)." (Baum et al. 2006).

When undertaking participatory action research in communities, the researcher helps set a framework and enable participants to contribute to addressing an issue or to a visioning session. Hence, as noted by Gumucio-Dagron (2001), the researcher plays more of a facilitator's role rather than a guide. Overall, the PAR methodology is well suited to engage communities, which is why it is becoming increasingly popular with urban planning, urban design and landscape projects (Deming et al. 2011).

3 FLEMINGDON PARK: A CASE STUDY

3.1 *Background of flemingdon park*

Flemingdon Park is a vulnerable neighborhood, with 30% of its population considered low-income – a high number compared to the City of Toronto's overall average of 19% in 2011 (City of Toronto, Neighbourhood Demographic Estimates, 2014) and the fifth highest unemployment rate (15.3%) out of the 140 neighbourhoods of the city (Centre for Research in Inner City Health, 2014). Since 2014, Flemingdon Park was included in the City of Toronto's *Neighborhood Improvement Areas* (31 neighborhoods have received this designation), and prior to 2014, it was considered a *Priority Neighborhood* (City of Toronto, NIA Profiles).

With regard to its physical layout, Flemingdon Park is niched between two ravines systems (on the West, South and East) and a main road to the North (Eglinton Avenue), hence disconnecting it from the rest of Toronto's urban fabric. Moreover, it is further subdivided due to the passing of the Don Valley Parkway (a major highway running North/South) as well as by the presence of an unbuilt strip that hosts the Hydro Corridor (an infrastructure comprising of elevated electricity transmission poles).

The question we asked was how to engage youth in this socially and geographically underserved location to envision improved pedestrian links-with increased activity as well as natural surveillance of public spaces-between selected community hubs, while also growing food.

3.2 *The research and iterative design process*

In 2015, the design process in Flemingdon Park included the following activities:

1. Meeting with the design team, Youth Outreach Workers and Public Health staff members from the City of Toronto as well as potential partners to discuss the research scope,
2. Creating an inventory of potential sites that could be used to renaturalize the neighborhood and site visits to select a number of eligible sites (shown in figure 1),
3. Collecting data related to the physical environment of the neighborhood (property plans, maps, building heights) through field work and geospatial data,
4. Analyzing the data and preparing visual materials (maps to share information about the site and facilitate the participatory process, as well as selection of urban agriculture (UA) case studies to enrich participants' understanding and illustrate the variety of possibilities),
5. Beginning to meet youth for:
   - Discussions regarding their needs, challenges they faced and their aspirations associated to the neighborhood in general and to specific sites,
   - Broadening their understanding of UA and generating ideas regarding possible implementations on the sites,
6. Engaging and including youth in the participatory design process through design charrettes,
7. Summarizing participants' ideas, elaborating their visions, visualizing the design,
8. Presenting to the community through data visualization, incorporating their feedback and further discussing ways to improve the proposal,
9. Revising the proposal following feedback from community members,
10. Following-up on the project status

Overall, the process was iterative: facilitated by the design team, community members expressed their aspirations; these were digitalized and the design team further illustrated them with the use of renderings, sections or photomontages which were represented to the community for additional feedback and revised accordingly.

As depicted in Figure 1, eight sites were selected because they were key gathering hubs for residents like the community centre, a recreation centre, schools, or the commercial centre. More specifically, they included: 1) Flemingdon Community Centre and Playground Paradise; 2) a city-owned unattractive community park adjacent to the Hydro corridor; 3) the lot of the Dennis R. Timbrell Recreation Centre and Flemingdon Park Library; 4) the Ontario Science Centre; 5) Flemingdon Park shopping centre; 6) the Valley Park Middle School; 7) Marc Garneau Collegiate School; and 8) a health centre with a food bank as illustrated in figures 1 and 7.

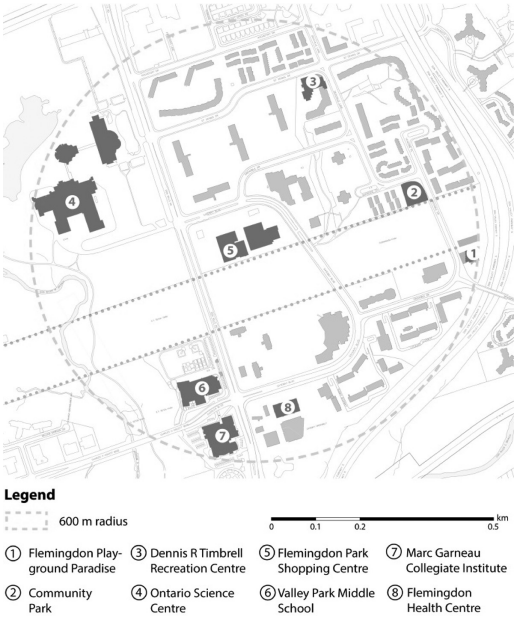


Figure 1. Map of the area of study within the Flemingdon Park neighborhood.
Sources: This map is based on data from the City of Toronto Property Data Maps (2013) available through Ryerson University's Geospatial Map & Data Centre.

The aforementioned sites were lacking a clear connection, hence, we investigated how to link them through pathways and an improved pedestrian realm by way of both gardening and integrating urban agriculture.

The first charrette included seven youth participants from the community. Volunteers were shown examples where urban agriculture was incorporated to public spaces. Then, they were divided into two groups and were asked to make a collage to improve the attractiveness of the park (identified with the number 2 on the maps figure 1 and 7). They were provided with a plan of the park, elements (benches, compost bins, tree bags, growing containers, picnic tables and raised beds), scissors, glue and colours as shown in figure 2. Following this participatory design charrette, youth presented their proposal to each other and we discussed how to move forward. The design team further developed the proposal based on ideas generated through this process, presented the working project for more feedback and then finalised it.

The second charrette combined a background introduction about gardening, urban agriculture and pedestrianization with a visual presentation based on the outputs of the first charrette, as well as an individual drawing exercise. A total of 25 youth participating in the school's summer camp joined this meeting and provided feedback on the working proposal. Their comments on work to date were taken into account towards improving their experience and responding to their interests.

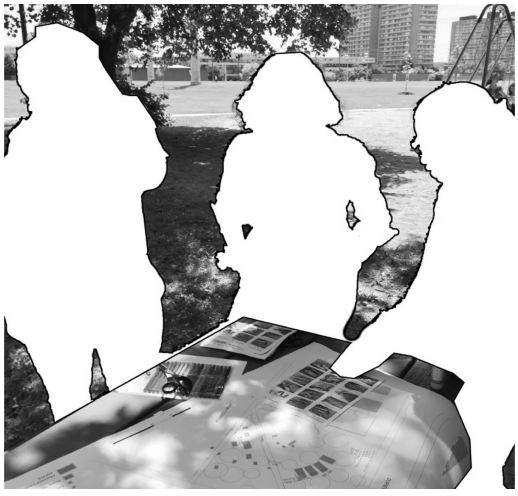


Figure 2. First charrette with community youth envisioning the future of the community park identified with the number 2 in figures 1 and 7.

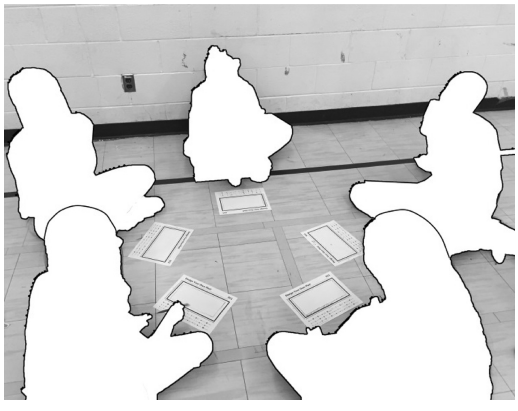


Figure 3. Second Charrette: youth from the community designing the layout of a plot along the Hydro Corridor.

Further, for the charrette component of this meeting, each youth selected a 3 by 6 meters site along the hydro corridor where they could intensify urban agriculture based on their preferences. Then, they gathered in smaller groups as illustrated in Figure 3.

Their ideas were expressed through marker drawings on a sheet comprising of a rectangle (illustrating the plot) and a list of 30 vegetables suitable for cultivation in the area.

3.3 *Designing the connecting trail*

Similar to the large vacant lots in the Flemingdon Park neighborhood, streets and pathways are in general very wide and rather uninspiring due to their scale, the lack of activity, programming and their single use. The envisioned connecting trail, illustrated in figure 4, aimed to improve the natural and social connections in the neighborhood through an enhanced public realm,



Figure 4. Schematic illustration of the proposal for a connecting trail.
Sources: This view is based on data from the City of Toronto Property Data Maps (2013) and Building Height Data (2015) available through Ryerson University's Geospatial Map & Data Centre.

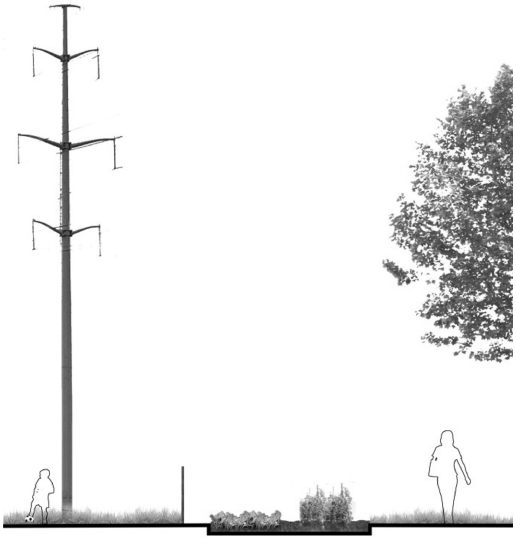


Figure 5. Section of a portion of the hydro corridor illustrating the inclusion of vegetable gardens.

by way of integrating urban agriculture, natural shading and creating an identity to the area engaging both residents and visitors.

To illustrate some proposed connecting pedestrian paths, sections and perspectives, as shown in figures 5 and 6 were used.

Trees, shrubs and ferns were selected based on a list of Toronto native plants (City of Toronto, Tree Planting); in addition, fruits and vegetables were also included.

While the hydro corridor is already used by youth for sports activities, we proposed to further intensify its usage and activate it by way of incorporating a community garden along the northern perimeter as illustrated in the section, Figure 5.

Further, to revitalise the Flemingdon shopping centre area (identified with the number 5 in figures 1 and 7), a wide outdoor space between two key commercial buildings was rethought. Taking advantage of an existing raised bed, we proposed to plant vegetables



Figure 6. Perspective illustrating a proposed aromatic garden in the Flemingdon shopping centre.
Illustration by Chenqi Zhu and Chu Li.

such as tomatoes, cucumbers and peppers (based on youth preferences) as well as crab apple trees – also found along the hydro corridor. As illustrated in figure 6, shaded gathering spaces were introduced under the trees. These urban sitting areas, initially inspired by a bench developed by Cox Architects, address a desire expressed by the youth to have more outdoor community spaces.

Overall, the value of these interventions is not only found in the greening and renaturalizing of part of the neighborhood; they have already engaged youth in the visioning process, and continue to involve them in the implementation. In 2013, our team developed a garden in Vendome Place, a noteworthy Modern housing project developed by Irving Grossman. In 2016, youth inaugurated another garden in front of the Flemingdon Playground paradise. We have also reached out to the Councillor and are in the process of investigating ways to further consolidate this work.

As illustrated in the map Figure 7, by connecting education, community and commercial hubs in a neighborhood, gardening activities can and already do have a larger impact when linked, contributing to a stronger sense of inclusion, cooperation, security and neighborhood identity.

4 CONCLUSIONS

The results from this PAR empirical case illustrate that such gardens can not only improve districts and re-naturalize the city, but also help towards repairing the social and urban fabric in numerous ways. First,

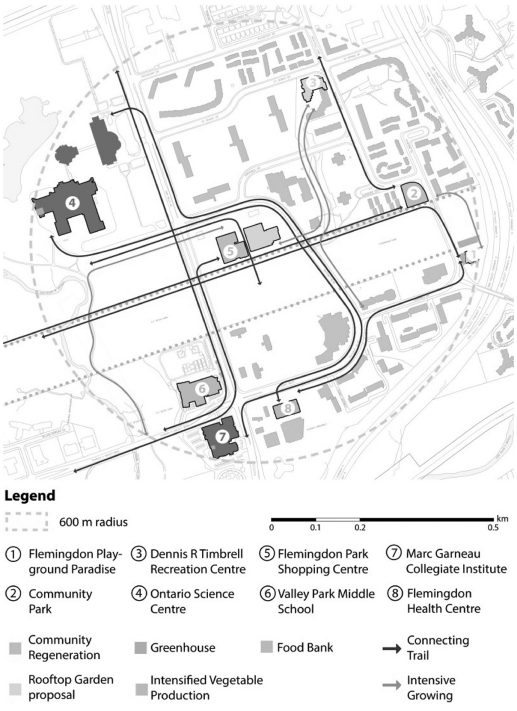


Figure 7. Map showing how a variety of existing and added practices related to gardening and urban agriculture in the neighborhood.

they can distinguish one's neighborhood. Second, the joint element of this effort presupposes, and therefore fosters a community spirit. Third, the building and operating of such a community garden re-engages younger with other community members (allowing for knowledge and advice to be transmitted), benefiting both; fourth by way of channeling some of their energy and time towards a productive and fruitful activity they can be proud of, it ultimately empowers the young.

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Constructing urban habitats: Investigating the ecological potential of integrating natural environments into buildings and landscapes in urban areas

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ABSTRACT: The integration of natural environments into urban areas can provide diverse economic, social, and ecological benefits. However, there is scant existing research on nature integrated urban landscape and building design strategies and solutions that effectively improve the ecological integrity of local ecosystems. Through a literature review, this paper investigates the relative ecological performance potential of stand-alone urban landscapes (ULs), incorporating natural environments into buildings (NIBs), and incorporating natural environments adjacent to buildings (NABs). The results indicate that the integration of natural environments into urban areas can substantially improve the ecological integrity of local ecosystems. NABs can be particularly effective, as they can be designed to foster the benefits of both NIBs and ULs, while also offering unique, and generally more effective, ecological benefits. Specifically, NABs can substantially contribute to reducing urban sprawl, in ways that improve the economic and social value of local communities.

1 INTRODUCTION

There is substantial evidence that urban natural environment design solutions *[urban habitats],* such as parks, building site landscapes, and building integrated natural environments, can be designed to make positive, effective contributions to the integrity of local ecosystems, depending on the design solution and context (Snep et al., 2011, Mangone, 2015b). However, there is currently a dearth of research, including effective ecological performance evaluation metrics, on nature integrated urban landscape and building design strategies and solutions that effectively improve the ecological integrity of local ecosystems (Lundholm and Richardson, 2010, Zari, 2012). Without this knowledge, it is difficult for design teams to produce design solutions that positively impact local ecosystems, which is demonstrated by the number of existing ineffective urban habitats, which in some cases negatively impact local ecosystems. For instance, design teams can focus on solving seemingly important issues, such as providing an extensive green roof to foster biodiversity. However, depending on their design and connectivity with local ecological corridors and habitat patches, urban habitats, including green roofs, can function as ecological traps (Battin, 2004).

However, comprehensive ecological performance evaluations of cities are not usually available for building and landscape design teams, or commissioned by municipalities. Thus, it's important to identify the relative value of various building and landscape scale ecological design solutions.

The focus of this paper is to investigate the relative maximum ecological performance potential of natural environments integrated into buildings (NIBs), natural environments integrated into building developments as adjacent, symbiotic environments (NABs), and standalone, exterior natural environments (landscapes), when sited within urban areas. The relative value of these three general types of ecological design solutions are discussed, in terms of their potential to improve the ecological integrity of local ecosystems. These ecological design solutions are based on the results of previous explorative research projects that investigated the maximum ecological performance potential of buildings and urban landscapes, (Mangone and Luscuere, 2012, Mangone, 2015a) as well as literature reviews of the effects of urban areas on local ecosystems, and the potential of urban areas to improve the ecological integrity of local ecosystems (Mangone, 2015b). This discussion provides both a review of existing literature that can be applied to ecological building and landscape design strategies, as well as proposes and assesses the ecological potential of an innovative landscape integrated building design strategy, based on the results of existing literature.

2 METHODS

In order to identify effective design solutions and strategies, it is important to evaluate the ecological performance of various design solutions and strategies at the correct scale. Although design teams tend to focus on the ecological performance potential of the project site, (Zari, 2012) or in some cases the city, (Chrysoulakis et al., 2013) existing research indicates that ecological design solutions at scales smaller than

individual regions, such as at the scale of individual buildings, neighborhoods, and landscapes, tend to be most effective when they address the ecological issues that are most important to consider at the scale of the local region (Schneiders et al., 2012, Kowarik, 2011, Noss, 2000). Thus, it is necessary for design teams to identify the ecological issues that are important to address at the scale of the local region that the site and local city are situated within. After identifying the most important regional ecological performance issues, the design team should assess which issues can most effectively be addressed through their project, given the project constraints, budgets, goals, and other design factors (Mangone, 2015b). Therefore, the ecological performance of the different ecological design strategies within this paper are discussed and assessed in this paper in terms of their potential contribution to regional ecological performance issues, rather than building or landscape scale ecological issues. These discussions and assessments are based on the results of existing literature.

In order to develop and assess ecological design strategies, it is important for design teams to consider a range of existing ecological design strategies. Design strategies that are focused on improving the ecological integrity of local ecosystems can be categorized into three general ecological design strategies: design to foster ecosystem functions, biodiversity, and ecological behavior (Mangone, 2015b). A detailed assessment of the relative value of these design strategies, and comprehensive identification of potential specific design strategies within these broad categories, is outside the scope of this paper. Mangone (2015b) provides a more detailed review. These design strategy categories are used in this paper to categorize the general potential ecological performance of the three general ecological design solutions discussed in Sections 3–5.

3 NATURAL ENVIRONMENT INTEGRATED BUILDINGS (NIBS)

At the building scale, the integration of nature into buildings, such as microforests, can provide a number of direct and indirect benefits to local ecosystems (Mangone, 2015b). However, existing research suggests that, depending on the context, the indirect benefits of nature integrated into buildings tend to be more effective, in terms of improving the ecological integrity of local ecosystems.

The integration of natural environments into buildings can add considerable construction costs to buildings, if the nature space is developed as an additional space to the building that is not used for any required building program areas. This necessitates additional external wall, floor, and potentially roof assemblies, among other additional building system requirements. Within this context, urban landscapes tend to be more cost effective to construct. However, the construction costs of NIBs can be reduced if they are designed to provide space for required building program spaces. In some cases, indoor natural environment spaces have been found to reduce the quantity of spaces needed within a building, thereby reducing building construction costs, while improving occupant work performance and well-being (Mangone, 2015b). NIB's provide unique ecological, social, and economic benefits, such as being accessible throughout the year and in inclement weather, as described in the following sub-sections.

3.1 *NIB ecosystem functions*

There are a number of research and built projects that investigate the use of natural environments within buildings to provide building services. However, in general, the effectiveness of these services tends to be substantially lower than alternate, more technical building system solutions, in terms of cost and quantity of service provided per unit of system area. Natural environment integrated building systems tend to require considerably more area than technical building systems (Lohan et al., 2011, Sproul et al., 2014). Furthermore, in terms of ecological and economic performance, it is generally more effective to provide building services via municipal scale infrastructure systems, such as district heating and cooling plants. These systems can be integrated into buildings, as hybrid infrastructure (Mangone, 2015a). Nevertheless, natural environment integrated building systems have the potential to be integrated into building spaces in ways that provide occupant performance and well-being benefits, promote ecological behavior, as well as reduce operation and construction costs, as discussed in Section 3.3.

In terms of wastewater systems, living machine wastewater filtration systems, which can be designed to provide interior natural environments, have been incorporated into a number of buildings. However, living machines require daylight access, as well as greater treatment area than advanced technical wastewater treatment systems, such as MBBRs. Moreover, living machines have greater initial, operations, and maintenance costs than advanced technical wastewater treatment systems, constructed wetlands, and pond systems per unit of wastewater (Anderson, 2012, Álvarez et al., 2008, Molinos-Senante et al., 2012). Hence, from an ecological performance perspective, it is generally more effective to integrate an advanced technical wastewater treatment system into a building as a form of hybrid infrastructure (Mangone, 2015a).

In terms of energy reduction, natural environments have been used to shade and insulate buildings, as well as filter air, particularly via green walls and roofs. However, besides vegetated shading systems, (Perini et al., 2011, Mangone and Linden, 2014) these benefits can typically be achieved more effectively, in terms of cost and performance, through alternate design strategies, (Joksimovic and Alam, 2014, Snep et al., 2011, Lohan et al., 2011, Sproul et al., 2014) and can avoid potential maintenance and operations issues of green walls and roofs, such as roof water leakage and the

common perception in building system code standards and specifications that vegetation is unreliable and variable in terms of long term operations (Homeowner Protection Office, 2007, Mangone and van der Linden, 2011, Orwell et al., 2006). Vegetation can also reduce building energy consumption via their psychological effects on building occupants. (Mangone and Linden 2014, Mangone et al., 2014) Moreover, in some contexts, the psychological benefits of plants have been found to be more valuable in terms of costs, energy reduction potential, social benefits, and ecological performance, than the physical effects of vegetation on buildings. For instance, dense vegetation work environments have been found to increase the thermal comfort range of building occupants, thereby allowing the heating setpoint to be lowered and the cooling setpoint to be raised (Mangone et al., 2014). The occupancy of a vegetated semi-outdoor courtyard in Accra, Ghana was found to save more than three times as much energy as shading the courtyard (Mangone and Linden, 2014). It is important to note that green walls and roofs tend to be less effective in terms of psychological benefits, due to their limited potential to interact with occupants, as discussed in Section 3.3. Regardless, it is important to consider that from an ecological performance perspective, the quantity of energy reduced through these building scale strategies has a minimal effect on the energy consumption of a region, unless the strategy is integrated in a substantial quantity of buildings in an urban area. However, in terms of improving energy consumption at the regional scale, there are more cost efficient strategies. Moreover, the integration of natural environments into buildings at the regional scale can typically more effectively improve the ecological performance of the region via alternate ecological design strategies. Section 5 describes a nature integrated building design solution that can reduce substantially more energy in some contexts, as well as provide a diverse range of other ecological, social, and economic benefits.

Building integrated food production is increasing in effectiveness, in terms of providing quantities of food that substantially contribute to a region's food demand (Grewal and Grewal, 2012). However, these building integrated agriculture spaces are not considered in this paper, as current effective growth methods are not perceived to be natural environments. Future research into the design potential of interior agriculture could investigate the potential of growing interior agriculture in ways that are perceived by occupants to be natural environments while maintaining growth efficiency, as well as the potential of building occupants of diverse building programs, such as office workers, to have personalized interactions with the crops, which would promote ecological behavior, as discussed in Section 3.3.

3.2 *NIB biodiversity*

The biodiversity potential of NIBs is constrained by their inherent lack of area. Due to their constrained size, building habitat patches tend to have high edge/interior patch quality ratios and a limited potential to provide resources and high quality habitat, thereby limiting their biodiversity potential, as discussed in more detail in Section 4.2. These factors can result in building habitat patches functioning as ecological traps, thereby negatively affecting the urban area's biodiversity (Battin, 2004). The potential of the building site to function as a high quality habitat patch, or positively contribute to the biodiversity of the region in another facet, partly depends on the connectivity potential of the site, as well as a number of design factors (Mangone, 2015b).

Buildings offer unique benefits that have been taken advantage of for centuries to foster biodiversity, such as in Victorian greenhouses. Buildings provide an actively climate conditioned environment that is sheltered from inclement weather, readily accessible for maintenance, and has access to diverse resources (Mangone, 2015b). Buildings can function as gene banks. Depending on the height and location of a building, the building can be designed to disperse locally important species throughout the area. For instance, Edouard Francois' M6B2 Tower of Biodiversity in Paris takes advantage of its dominant height to disperse plant species seedlings via wind dispersal. Protected habitat patches for rare species can be fostered through the high controllability of the interior environment that buildings offer (Mangone, 2015b). Common building skins, such as concrete, are natural analogues of rare natural ecosystems, such as cliffscapes (Lundholm and Richardson, 2010). Green roofs can provide habitat patches as well, although care must be taken to design a roof that provides a high quality habitat patch, as extensive green roofs commonly are low quality in terms of biodiversity (Gilroy and Sutherland, 2007, Battin, 2004). Building habitat patches can also function as support habitat patches for adjacent high quality habitat patches, as well as ecological corridors and nature reserves. They can also function as stepping stone habitat patches to interconnect adjacent high quality habitat patches. In addition, buildings can be designed to protect adjacent habitat patches, from inclement weather and human induced disturbances, such as noise, and depending on the design and interaction of the building with the natural environment, future demolition and development of the natural environment.

3.3 *NIB ecological behavior*

At the individual building scale, the results of existing research suggest that the most effective contribution that building integrated natural environments can make to the ecological performance of the region are typically to promote ecological behaviour, (Mangone, 2015b) unless a given context fosters the opportunity to effectively address a high impact negative performing regional ecological performance parameter. Moreover, ecological behaviour strategies generally can incorporate biodiversity and ecosystem function strategies as well.

Frequent positive experiences in natural environments promote a number of ecological behaviors and increases people's valuation of natural environments (Cheng and Monroe, 2012, Kaiser et al., 2013, Muller et al., 2009). Existing research suggests that direct, personal interactions with natural environments are more effective than indirect experiences (Kahn et al., 2008, Peschardt and Stigsdotter, 2013, Adevi and Mårtensson, 2013). Positive direct interactions with natural environments can also reduce building resource consumption and operating costs, and improve occupant well-being, comfort, and work performance (Mangone et al., 2014, Mangone and Linden, 2014, Vink et al., 2008, Mangone et al., 2015, Hartig et al., 2001). Moreover, depending on the design, natural environments within office buildings can reduce the overall office area, by providing workspace that can be used for diverse work tasks that typically require separate built spaces to accommodate, thereby reducing construction and operation costs (Mangone et al., 2015). Thus, by providing natural environments within buildings, where people spend the majority of their time, (U.S. EPA, 1995) the potential of individuals to have positive interactions with natural environments is increased, thereby promoting ecological behavior. Moreover, the inherent protection of interior environments from inclement weather allows occupants to interact with natural environments throughout the year. However, at the scale of an individual building, the quantity of people that interact with a building integrated natural environment is typically substantially less than an outdoors, public urban natural environment, such as a park.

4 URBAN LANDSCAPES (UL)

Urban landscapes are areas of planted and/or managed native and non-native species, such as public parks and gardens, that are situated within urban areas (Niemelä, 1999). Urban landscapes provide unique ecological opportunities, which are discussed in the following subsections.

4.1 *UL ecosystem functions*

Landscapes can be designed to provide diverse infrastructure services, such as flood protection, urban heat island mitigation, and storm water and wastewater retention, filtration, and infiltration. (Joksimovic and Alam, 2014, American Rivers et al., 2012, Molinos-Senante et al., 2012, Kandziora et al., 2013) In a number of cases, green infrastructure systems are cheaper and require less maintenance, depending on their design. (Muschalla, 2004, American Rivers et al., 2012). In addition, landscapes can typically be designed to provide these infrastructure services while simultaneously providing occupiable space for the local community. For example, the Wakodahatchee constructed wetland in Delray Beach, Florida filters wastewater, provides habitat, and functions as a public park.

4.2 *UL biodiversity*

Landscapes typically afford opportunities to provide larger habitat patches than buildings can offer. Their larger size fosters opportunities to provide more diverse habitats and resources, as well as higher quality and interior habitat patches, depending on the design solution. For instance, existing literature indicates that vegetated areas of less than approximately 1.0 ha typically cannot support self-sustaining habitat patches for a number of species, particularly those that prefer to inhabit the interior areas of habitat patches, such as megafauna (Burgess et al., 1981, Snep et al., 2011). Ecosystems that lack interior habitat patches tend to be less able to support a number of species that prefer interior habitat, including core, rare, and endangered species (McGuckin and Brown, 1995, Collinge, 1996). To this end, existing literature indicates that urban habitat patches tend to have relatively low quantities of interior habitat area, in comparison to natural ecosystems (Cameron et al., 2012, Rudd et al., 2002, Kowarik, 2011). It is important to note that the absence of certain species in urban ecosystems, particularly species that are adverse to edge habitats, such as a number of megavertebrates, has substantial, complex effects on the trophic dynamics of urban ecosystems. However, it is important to note that, particularly within urban areas, individual habitat patches tend to be smaller than existing literature indicates is necessary to generate source habitat patches. Moreover, minimum suitable habitat patch sizes differ by species, ecosystem type, the quality of the patch, resources available within the patch, as well as a number of other contextual and spatial factors. For example, habitat patches as small as 0.3 ha have been found to effectively function as habitat patches for a variety of species, particularly mobile species, even within urban core ecosystems (Goddard et al., 2010, Rudd et al., 2002, Snep et al., 2011).

4.3 *UL ecological behavior*

Public, easily accessible landscapes inherently foster opportunities for greater quantities of people to have positive experiences with natural environments than interior natural environments. However, the occupation of these landscapes can be reduced during inclement weather, depending on the design of the landscape and nature of the weather event. Moreover, the inherent outdoor nature of landscapes, and their larger area, allows for their design to accommodate more activities than an interior nature environment, particularly outdoor recreation activities. By increasing the frequency, quantity, and type of interactions with natural environments, landscapes can be designed to increase diverse ecological behaviors of the local community, as discussed in Sections 3.3 and 5.

5 NATURAL ENVIRONMENT ADJACENT BUILDINGS (NABS)

Direct habitat alteration is the primary cause of damaging the ecological integrity, or health, (Kandziora et al., 2013, Haines-Young and Potschin, 2010) of natural ecosystems. The development and expansion of urban areas is one of the largest drivers of direct habitat alteration (Noss, 2000, Vackár, 2012). Within North America, low-rise housing is a key contributor to urban sprawl and natural ecosystem degradation (Resnik, 2010, Hansen et al., 2005). Low-rise housing communities also tend to negatively affect the well-being of the inhabitants, (Resnik, 2010, Gauvin et al., 2008) and have greater resource consumption and increased infrastructure and public service costs (Holden, 2004, Ewing and Rong, 2008, Norman et al., 2006). Nevertheless, in North America, low-rise housing developments are currently being developed at far greater rates than mid-rise and high-rise housing developments combined (Corporation, 2015, Bureau, 2015).

A transition from low-rise to mid-rise housing communities will help mitigate urban sprawl. Thus, increasing demand for denser communities is an important ecological performance goal, because it's one of the most effective sustainable decisions individuals can make. This single decision outweighs thousands of daily choices to turn off lights, use less heat, or recycle a can. Although there is evidence that preference for dense communities is increasing, particularly among the elderly and young professionals (Wilson et al., 2012, Portland State University, 2015, Myers and Gearin, 2001), the majority of North American residents have preferred low-rise housing communities throughout the last half century (Morrow-Jones et al., 2006, Stewart, 2004, Portland State University, 2015, Myers and Gearin, 2001). Access to permanent vegetated spaces can increase North Americans' preference and valuation of higher density developments, (Morrow-Jones et al., 2006, Geoghegan, 2002, Anderson and West, 2006) and depending on the spatial qualities of the vegetated space, can potentially make denser developments as preferred as low density developments (Morrow-Jones et al., 2006). The integration of natural environments into mid-rise housing developments also provides opportunities to improve the integrity of local ecosystems, as discussed in Sections 2 and 3, as well as generate unique social and economic benefits and amenities for local communities. Thus, the integration of natural environments into mid-rise housing developments may increase people's preferences for mid-rise housing.

Siting mid-rise housing developments adjacent to natural environments promotes positive interactions with natural environments, which can promote ecological behavior and provide a range of benefits to the occupants, as discussed in Sections 3.3 and 4.3. These developments are a type of natural environment adjacent buildings (NABs), which are building developments that integrate the design and function of adjacent landscapes with the design and function of the building, in ways that are mutually beneficial. This is achieved through the provision of views and rapid, easy access to natural environments, for a larger quantity of people than is possible within low density developments. This is important because the majority of visits to natural environments are close to one's home, (White et al., 2013, Lankia et al., 2015) the quantity of human interactions with nature is decreasing, (Pyle, 2003, Baisre, 2013) and the majority of human interactions with nature occur within urban areas, typically with highly cultivated, non-stimulating, and homogenous environments, such as ornamental lawns (Savard et al., 2000, Vackár, 2012). This ongoing 'extinction of experience' limits the access of communities to the benefits that natural environment interactions provide, (Pyle, 2003) and leads to the perception of degraded natural environments as normal, particularly from generation to generation. This diminishes people's expectations regarding the quality and ecological functions of natural ecosystems, which can contribute to further degradation of natural ecosystems. This phenomena is referred to as 'shifting baseline syndrome' (Papworth et al., 2009, Baisre, 2013). By incorporating high quality natural environments into people's daily lives, such as nature integrated mid-rise housing, this trend can be reversed. For instance, the provision of natural environments that provide psychological and physiological benefits to occupants may generate a recursive nature-experience feedback loop, (Mangone, 2015b) by attracting more people to interact with these environments, and promote repeated experiences of these spaces by individuals. If these environments are perceived to be valuable for conducting a range of activities, the perceived value of these spaces would increase, thereby promoting the development of additional natural environments. These effects would increase the quantity of inherent and design dependent benefits and services that natural environments provide the local community, and promote more ecological behaviors among more people, including the restoration and preservation of natural environments, (Cheng and Monroe, 2012, Kaiser et al., 2013) thus fostering natural environment development in multiple ways (Mangone, 2015b).

There is scant existing research on building scale ecological behavior design strategies that have neighborhood or city scale impacts (Mangone, 2015b). Existing research on building scale ecological behavior strategies tend to focus on personal consumption behaviors, such as reducing personal water and energy consumption rates in homes and offices (Abrahamse et al., 2005, Abrahamse et al., 2007, Midden et al., 2007). In terms of personal resource consumption, mid-rise housing residents consume less quantities of several resources than low-rise housing residents (Holden, 2004, Ewing and Rong, 2008, Norman et al., 2006). Yet, design teams tend to focus on the performance of a building and its occupants, rather than the influence of a building on the larger scale community and natural ecosystems (Mangone, 2015b, Zari, 2012).

Nature integrated mid-rise housing is a potential building scale ecological behavior design strategy that has neighborhood/city scale impacts, is applicable to diverse contexts, and can provide diverse economic and social benefits to local communities.

6 CONCLUSION

Thus, the integration of natural environments into urban areas has the potential to substantially contribute to improving the ecological integrity of local ecosystems, while increasing the social and economic value and quality of local communities, depending on the design solution and local context. This finding demonstrates the relative potential value of integrating natural environments within and adjacent to buildings. In particular, the integration of the design of buildings with adjacent landscapes from an ecological performance perspective was found to be particularly effective. The results of this discussion can aid design teams in determining effective ecological design strategies for specific projects, and calls attention to the need for investigations into innovative, more effective ecological design strategies and solutions, as well as methods to evaluate the ecological integrity of local ecosystems and the effectiveness of various potential ecological design strategies and solutions.

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Camouflage: Design innovation for "Grey Infrastructures" in the city of the future

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ABSTRACT: Nowadays, 'Grey Infrastructures' are in contrast with an increasing demand for eco-friendly and sustainable cities. They have become an ineluctable component of the urban ecosystem, witnessing the divergence between the natural and artificial components of the city. They are undergoing a critical reflection about their environmental compatibility, as well as their aesthetic and functional configuration; for this reason, they could be rethought through a smart use of 'eco-tech-green' solutions. This approach is a precondition for a new environmental planning of contemporary towns, allowing their transformation into "multitasking ecosystems", creating a new aesthetic of *camouflage*. Greenery is also an opportunity to re-naturalize the city, because of the evident benefits that vegetation entails with regard to the environmental issues. This research aims at showing the existence of different design approaches to the urban infrastructures and suggesting the possibility to identify new techniques to re-naturalize these artifacts through the use of *camouflage* techniques.

1 THE DENSITY CITY AND ITS INFRASTRUCTURES

1.1 *The city of the future*

According to an intense debate on life in contemporary towns and their possible renovation, as well as to the more and more crucial role active citizens can play in such process, the European Union has recently adopted measures promoting a sustainable development, based on the needs of territory and people. Such governance model involves common perspectives and long-terms decisions, aiming at managing the ongoing transition and overcoming the problems of contemporary towns (EU, 2011). From the building scale to the urban one, we assist daily to a number of new ways to conceive, plan and build future towns, stimulating further reflections about their possible evolution and the priority decisions to take for this purpose. The aim of such researches is to turn towns into laboratories, setting up networks of anticipatory experiences, namely in the domain of environmental sustainability (Schröpfer, 2015), where nature plays a crucial role in the renewal of resilient towns (EU, 2015).

Recently, in fact, the role of cities in a sustainable development has become much more prominent for several reasons, the most evident ones being the high concentration of the world population in urban areas – more than half live in cities, and this number is expected to increase to 72% by 2030 (UNFPA, 2014) –, urban sprawl and its detrimental effect on the environment. This recognition is the result of the spreading awareness that cities are pioneering actors in increasing the ecologic performances of buildings and other infrastructures. So far, the concept of "sustainable city" has gained significant political momentum worldwide. Nonetheless, cities cannot contribute to the overall sustainability, unless their built environments are sustainable. In fact, planners and policy-makers have given increasing importance to neighborhoods, recognizing their environmental, social, and economic levels as the most meaningful to the citizens' life.

Measures aiming at ensuring the environmental quality in regard to the ongoing densification processes are also taken into account by the scientific debate. Compact cities' habitants are more than others called to find solutions to the problems related to overpopulation: traffic, congestion, pollution, waste production and everything that affects health and wellness.

Densification is assuming, in the collective imagery, an increasingly negative connotation, in that it is ever more associated to an irrational occupation of territory and, consequently, to critical environmental conditions. On the other hand, disciplinary researches tend to focus on new paradigms, such as efficiency, quality and sustainability, envisaging anti-sprawl strategies: long-term densification projects, based on high-quality standards, can allow both land preservation and the mending of urban wounds, involving social and environmental marginality (Ng, 2009).

These assumptions are also crucial aspects of "Sustainable Urbanism", a model longing for a smart "*Green Density*" (Rey, 2013), to bring in processes of renovation and reuse of abandoned interstitial areas. Furthermore, it limits the energetic impact

on the environment and restyles cities, adding new facilities to the existing ones. In this sense, infrastructures are fundamental elements in the concept of "*Urban Metabolism*", introduced by the urban-ecologist G. Herbert, since they can be considered as definitive solutions to the environmental impact of urban areas (Herbert, 1999).

1.2 *A new ecology for grey infrastructures*

The term "infrastructure" encompasses a number of meanings, which differ according to the domains they refer to. In the political discourse, for instance, it implies the various interventions supporting economic and political measures, whereas in urban design it refers to the activities necessary to guarantee the relations between the different modalities of territory occupation. It is thus possible to define infrastructures allowing a higher efficiency of the city functions, namely mobility, leisure and sport, education and culture, health, communication, waste and energy management, etc.

Grey Infrastructures, sometimes referred to as "hard or traditional infrastructures", are man-made, engineered components of a system. They, on the other hand, imply an approach to wet weather management that uses natural systems – or engineered systems that mimic natural processes – to enhance the overall environmental quality and to provide utility services. The term "Green Infrastructure" is relatively new to the lexicon of urban planning and landscape design. It was first used in a 1994 report on land conservation strategies by the Florida Greenway Commision (Firehock, 2010), with the intent to elevate the social worth and functions of natural lands and systems to the same level as Grey Infrastructures.

A second definition of "Green Infrastructure" has recently developed from the need to discuss the aesthetics and the functions of other artifacts of the urban context: according to it, they are systems and practices that use or mimic natural processes to infiltrate, evapo-transpirate (the return of water to the atmosphere either through evaporation or by plants), reuse stormwater or runoff. In contemporary Architecture and Planning, it is possible to identify large-scale and small-scale Green Infrastructures, the former being all over landscape elements such as parks, natural areas, greenways, and working lands (fields and forests), the latter being interventions on circumscribed parts of buildings: green roofs, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips and so on (Sinnett, 2015).

Considering Green Infrastructures from an overall perspective – the landscape one – it is possible to integrate built and natural environments, introducing benefits for the health and well-being of people and wildlife. This perspective envisages Green Infrastructures as a three-dimensional "envelope" surrounding, connecting, and infusing buildings, streets, utilities, etc. As such, they cannot be separated from Grey Infrastructures, with which they interact to create the background on which they exist. The erasure of symbolic boundaries between these two categories compels a holistic and interdisciplinary approach to the infrastructure planning and designing (Rouse *et al.*, 2013).

It is therefore extremely important, for researchers in infrastructures design, to take into account that these highly-heterogeneous artifacts often involve the creation of "infra-places" – defined by the interactions between the city and its infrastructures – and "non-places", low-quality urban areas and buildings. To such purpose, it is necessary to rethink traditional assumptions on the relations between infrastructures, city and architecture, overcoming worn-out paradigms such as that of *non-lieux* (Augé, 1992), shifting focus to the concept of "infra-scape". This term is a crasis between *infra* – a Latin prefix meaning both "below" and "in-between" – and *scape,* which evokes the widespread idea that infrastructures are likely to define new urban perspectives.

In this way, it is possible to turn ongoing researches on Green Infrastructures into the first step of a radical urban renewal, focusing on those ambiguous and undefined elements G. Cléments perfectly described in the 'Manifesto del Terzo Paesaggio' (De Pier, 2005). The new conception of landscape put forward in this volume considers not only all the facilities supporting the city functions, but also "infra-spaces" (*infra-spazi)*: areas generated in the neighborhood of such artifacts, which may be profitably exploited by the community.

One of the possible measures to be taken in order to increase the sustainability and biodiversity levels in high-density areas involves the integration of vegetation into Grey Infrastructures, in a constant dialectic between the city and the countryside, nature and artifacts. In this way, Green Infrastructures can take hold in the urban landscape, involving deep symbolic and concrete transformations: not only do properly designed parks, urban gardens, green roofs and walls contribute to preserve biodiversity and contain climate change; they also improve social cohesion and the quality of the living environment.

We need to stop considering Green and Grey Infrastructures separately: researches on the aesthetics and the function of Grey Infrastructures in relation to sustainability theories are orienting their design towards new paradigms that discuss the benefits they can bring to collectivity in terms of quality of life.

In the design of these new-generation infrastructures, therefore, process and product innovation must combine, in order to allow a shift from mono-tasking to multitasking solutions: Green Infrastructures are in fact connoted by the co-existence of a number of functions and techniques – implying, for instance, natural systems, architectonic methods and digital devices – aiming at creating resilient networks in synergy with the city, the environment and the community (Maksimović, 2015). These more and more widespread practices, besides reducing the increasing aversion people feel towards infrastructures, also

produce significant improvements in the collectivity's quality of life.

On the other hand, the quest for a balance between economic development, environmental safeguard and urban landscape aesthetics – as well as the reconsideration of infra-spaces – is pushing infrastructure design to overcome the traditional ways to conceive, build and manage them.

Infrastructures, no longer playing the role of organizing principles of the urban landscape, seem nowadays apt to new forms of landscape renovation, also thanks to Camouflage (Leach, 2006) and the Aesthetics of Disappearance (Virilio, 1989): the sole solutions permitting to eradicate the repulsion of eco-orthodoxy towards such artifacts.

An approach of this sort is possible thanks to techno-green solutions involving, for instance, the use of manipulated vegetation in order to turn infrastructures into other artifact masks, or to blur their presence in the context they are set in. In this sense, infrastructures cease to be isolated elements in the urban landscape and start being interpreted as elements of nature itself. Nonetheless, to this end, it is necessary to shift focus from the artifact to the context it is in, the most important issue being to understand how infrastructure can be placed, hidden, and put into a network.

Thanks to process and product innovation, we have nowadays access to a wide range of technological solutions allowing the naturalization of urban infrastructures, be they realized *ex novo* or undergoing renewal processes, as put forward by pioneers of ecologic architecture, such as Le Corbusier, F. Hundertwasser and M. Wells.

1.3 *The role of vegetation and eco-tech-green*

Vegetation and eco-tech-green can be employed in a number of ways to enhance the urban environment quality, together with biodiversity preservation, greenhouse gas emissions control, storm-water runoff mitigation, noise reduction, urban heat island control. One further service that vegetation and eco-tech-green can provide the urban context with is the improvement of air quality. Vegetation and eco-tech-green can reduce the presence of air pollutants both by deposition and by affecting the physical transport of polluted air masses, reducing or enhancing ventilation, altering the roughness of the building surfaces.

The extent to which urban vegetation and eco-tech-green can improve air quality has mostly been explored through the use of models. These research concluded that there is a large flux of air pollutants towards urban vegetation and these fluxes did not significantly affect local air pollution concentration, although even apparently slight pollution reductions represent a significant gain in human health. On the other hand, some researchers have maintained that the role of urban vegetation in reducing local air pollution has been exaggerated.

The theme of infrastructure design and renewal plays a crucial role, in order to guarantee high standards in terms of quality of life (Beatley, 2010). Nonetheless, this is only possible thanks to innovative design and building methods, involving the use of eco-tech-green solutions, a new way to implement projects using built-up vegetal material through their manipulation and transformation. The most evident effect it produces is the progressive 'demineralization' of the urban-scape, obtained by the proliferation of vegetal surfaces, be they vertical or horizontal. The implementation of eco-tech-green solutions also represents an interesting opportunity to help the creative reinsertion of open spaces in towns and to open future scenarios that anticipate the 21st century challenge of the "fertile town", which implies the overcoming of the town/country issues through the implementation of agriculture in the urban context.

Nowadays, eco-tech-green implies the adoption of complex technologies and techniques, offering a wide range of systems and products to use vegetation as an element of designing and planning, so as to determine the iconographic outcome of the intervention and to condition its environmental context.

From a technical point of view, it is possible to identify two distinct typologies of interventions: "green cover" and "natural wrapping".

Unlike hanging gardens, which have been more widely experimented, green covers have few applicative variations: the extensive green roof – that needs less maintenance and lower implementation costs, in spite of its low feasibility – and the more traditional intensive roof, that allows the use of a wider range of vegetal elements, be it to improve the aesthetics or to facilitate the use of eco-tech-green (Bellini, Daglio, 2009).

On the other hand, the spectrum of possible solutions for vertical open spaces is also articulated in two macro-typologies of systems/products: green façades, obtained by the use of climbing plants, generally growing from the ground, attaching to supports and frames, and living walls (otherwise called *murs végétalisés*), that generally make use of hydroponic techniques, and that vary according to the nature of the cultivated substratum.

1.4 *The function of 'eco-tech-green'*

Although sustainability and ecological choices are often mistaken for the mere use of green, it is self-evident that vegetation can bring in a number of advantages, some of which are by now put forward by innumerable scientific contributions and recent researches.

Eco-tech-green can carry out a variety of environmental and economic functions, bringing benefits to human health and wellness *tout court*. This is even more evident in high-density urban areas, where open spaces are usually limited and not always accessible.

Benefits issued from eco-tech-green solutions are extrinsic and intrinsic. They consist in hygiene/environment-oriented measures, aiming at determining positive repercussions on the urban microclimate (Foster, 2011). The integration of vegetal elements into Grey Infrastructures contributes to the management of

rainwater: it is in fact possible to control the volume of rainwater flow, reducing surface runoff, thanks to water absorption into the soil. Moreover, green components may also help controlling the infiltration of rainwater into the ground, so as to reduce the volume of the flow in sewer systems, and thus regulate the speed at which underground aquifers are fed. The presence of vegetation on the infrastructure also prevents the transport of pollutants in the surface water: once they have flown into the ground, plants and microbes can in fact naturally filter and destroy common pollutants.

Another important environmental indicator on which vegetation has meaningful effects is the quality of air and, consequently, of the urban microclimate. Three principle factors, affecting such indicators, are positively influenced by vegetation: temperature, humidity and wind speed. Not only do plants capture carbon dioxide through photosynthesis and other natural processes – emitting water vapor and oxygen into the atmosphere, humidifying and refreshing it – they also absorb and destroy smog components, such as fine particles and gas ozone: a gas that can form and react under the action of light, and that is present in two layers of the atmosphere. High up in the atmosphere, ozone forms a layer that shields the Earth from ultraviolet rays but, at ground level, ozone is considered a major air pollutant. Furthermore, a reduction of the thermal energy accumulated on the building surfaces involves both a natural refreshment and the destruction of urban heat island, with the consequent reduction of the demand for energy needed by air-conditioners.

Intrinsic benefits, on the other hand, have an ecological identity and can condition the quality of life of the natural ecosystem. They are a result of specific properties of vegetal systems, such as resilience, resistance and connectivity, and they can be synthetized into the homeostatic capacity of the ecological system.

Moreover, in spite of its limited extension, vegetation manages to create the necessary micro-ecological conditions for the insertion of a number of animals into the surrounding ecosystems, easily recreating forms of biodiversity.

According to *biophilia* theories, the presence of green spaces can positively intervene on human health, in that individuals, being in contact with nature, are better off in terms of productive work, learning and curing diseases (Wilson, 1984). As a consequence, the presence of vegetation in the urban context can also help reduce the level of criminality and violence, with positive repercussions on the sense of community and belonging.

The role and function of the vegetation and eco-tech-green in the density city have been widely documented in scientific literature.

2 GREENERY 'GREY INFRASTRUCTURE'

2.1 *Greenery infrastructure: A new challenge*

The awareness of the interconnectedness of all urban phenomena – definable as "set of possibilities", according to a systemic model – derives from the sciences of complexity (Tenreiro *et al.*, 2011). In the domain of architecture design, this consciousness has been implemented by computer science technologies. Researches on biomorphic architecture based on relational and interactive patterns could privilege the morphogenetic side of design, thus exalting the complexity resulting from the interaction of the forces involved in the formal creation. Interesting theoretical and practical researches are claiming a new conception of artifacts as open and reactive devices according to an ecologic and systemic approach (Feuerstein, 2001). This idea of architecture focuses on information, communication and virtual reality, rather than on physical presence, and yet it can promote positive transformations, turning up as intermediate dimensions in the constant quest for a balance between nature and artifacts.

To some extents, such assumptions can constitute the basis of deep renewal processes, concerning particularly the functions and the aesthetics of Grey Infrastructure: nowadays, their design is no longer bound to the necessity to enhance their formal appearance, but aims at blurring their presence through processes of dematerialization and re-naturalization. This shift is meant to put into effect, on a "mental-environmental level, the developing ecologist consciousness which, in the digital era, is more and more interested in multidisciplinary design perspectives considering arts, landscape and architectures. Similarly, the pioneering researches on *Land art*, *Environmental art*, *Ecological art* carried out by the end of the Sixties, were significantly influenced by environmental sciences, according to a conception of architecture "responsive to change" and to a new environmental awareness: born in response to the early Seventies energy crisis, such prerogatives are now the basis of contemporary eco-oriented design researches. All this contributed to spread the need of a balance between the planet transformations and the limits they impose, and the pursue of the convergence between "*Mind and Nature*" (Bateson, 1979).

Grey Infrastructures are integrant parts of the urban landscape, and for this reason it is necessary that they reflect the various aspects of the context they are set in, communicating their cultural and environmental identity (Wines, 2000). The purpose of ongoing researches on urban infrastructure is to integrate their traditional architectural paradigms with new landscape-based perspectives, in order to turn these artifacts into iconographical "systems of passages": stimulating material and immaterial flows – thanks to the integration of traditional systems with digital devices and the use of vegetal components – it is possible to proficiently include infrastructures into urban eco-systems, overcoming the long-standing issue of the incompatibility between nature and artifacts. In this way, infrastructures are more and more frequently conceived as "interfaces" combining different perspectives – architectural, productive, environmental – cultures and values. In particular, their surfaces no longer define

boundaries, but become mediums between two constantly exchanging domains (Virilio, 1984), osmotic membranes that turn edges into dissimulated thresholds. In the domain of infrastructure design, such dematerialization can be carried out according to four categories:

a) "aesthetics of disappearance": a no-volume architecture reflecting the idea of non-fixation of the image put forward by Virilio and Baudrillard, which is sometimes characterized by light interventions, as in most of the works of K. Kuma, Herzog & de Meuron, T. Ito, J. Nouvel, R. Piano, K. Sejima; other times by underground constructions reproducing the continuous variation of soil and vegetation, as the hearth houses designed by E. Ambasz, Abalos & Herreros, Mecanoo, MVRDV, D. Perrault *et al.*;

b) "nature and artifact overlapping": architectures in which mineral and vegetal components co-exist, as in the SITE residential tower in Mumbai (2004), inspired by the Hanging Gardens of Babylon, or in the Expo 2000 Dutch pavilion, designed by MVRDV: both are concrete realization of theoretical researches on the themes of density and the relation between architecture and landscape.

c) "neo-naturalistic metaphor": architectures aiming at conciliating the organic and the architectural space, through procedures borrowed by the natural world: in this way it is possible to communicate their inclusive identity, as in the sophisticated naturalized constructions designed, just to name a few, by Herzog & de Meuron, T. Ito, Diller Scofidio+Renfro.

d) "naturalistic camouflage": a sort of ecologic maquillage, sometimes turning into hypertrophic ornaments trying to hide architectural alterities (Repishti, 2008) as, for instance, in A. Gueuze's "vertical landscapes", in P. Blanc's "vertical gardens" and, more generally, in the eco-tech-green solutions adopted by E. Ambasz, S. Boeri, E. François & D. Lewis, F. Roche, K. Kuma, J. Nouvel.

Contemporary ecologic theories applied to architecture not only deal with environmental sustainability in terms of "low-tech" and "eco-tech" strategies, involving the use of recycled materials and alternative energetic sources; they start from a general reconsideration of urban infrastructures, trying to overcome their conventional "insular" conception and to establish relations with "infra-spaces".

3 INNOVATIVE DESIGN

Analyzing a different set of Green Infrastructures on the urban scale, it has been possible to identify some common design techniques, differing according to how eco-tech-green solutions were used. Each case study has been considered on the basis of the following paradigms: multi-functionality, connectivity, habitability, resiliency, identity, return on investment. Nonetheless, these considerations showed that the common strategy of the infrastructures examined is the principle of *camouflage*.

If, from a merely visual point of view, this may be intended as a strategy of invisibility, in environmental design it consists in an *artificium* allowing the disguise of bulky – and for this reason often disliked – urban infrastructures (Cesarin *et al.*, 2010). In a sense, infrastructure *camouflage* doesn't differ too much from those strategies used by weak animals in order to escape their predator's attacks, reproducing on their bodies the patterns of the surrounding space (Caillois, 1998).

In the domain of urban infrastructure design, camouflage is meant both to make the *camouflé* subject invisible, transforming its appearance thanks to a vegetated skin, according to techniques experimented in plastic arts, design and architecture. Recent researches carried out in this field have distinguished four environmental design techniques, inspired to camouflage: *Blending Camouflage; Disruptive Camouflage; Breaking into Pieces e Blurring Camouflage.*

3.1 *Blending Camouflage*

Blending Camouflage explores the different uses of vegetal components in order to alter the perceptive relation between objects and their background. In this sense, vegetation can weaken the visual impact of Grey Infrastructures, blurring their presence onto a natural background.

In other words, the artifact being covered with the very same elements of its context loses its artificial nature, and hence its visual impact on the context itself. *Blending Camouflage* is mainly used in landform architecture, namely when the very intention is to innovate obsolete design paradigms.

Combining the urban and the architectonic scales, camouflaged infrastructures are meant to remodel the traditional antithesis between nature and artifacts, figure and background. The transition from landscape to architecture is thus mediated by large, rough naturalized surfaces, defining green intermediate areas often usable by the community.

3.2 *Disruptive camouflage*

Disruptive camouflage alters the infrastructures nature, transforming their representative identity. As many animals do, it is possible to modify their appearance thanks to specific *disruptive patterns*, such as stripes or figures.

In these case, vegetation can be used in such interventions, being applied onto the infrastructure surfaces and edges, so to blur their aspects and disguise their presence. In this way, not only does *camouflage* make the artifact appearance more abstract and less definite, but it integrates its functional identity with renewed ecologic meanings, in antithesis with the negative widespread assumptions tied to this sort of constructions.

An example of *disrupting technique* is provided by vertical gardens grown on specific supports in order to provide infrastructures with a new aesthetic dignity.

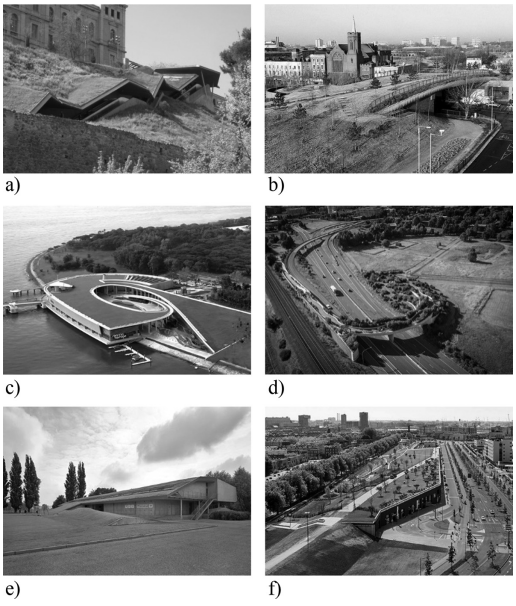


Figure 1. Examples of *Blanding Camouflage*: a) J. A. Martinez Lapeña & E. Torres Architects, *La Granja Escalators*, Toledo, ES, 2000, (© C. Dilla); b) CZWG Team. *Green Bridge,* Mile End, London, GB, 2000, (© Czwg); c) Architects Team 3 Pte Ltd, Marina Barrage, *Gardens Drive*, Singapore, SG, 2008, (© Team 3); d) Jones & Jones, *Land Bridge*, Vancouver, CA, 2008, (© Jones & Jones); e) Chartier Corbasson architectes, *Football Training Centre Amines*, FR, 2009, (© M. Phil); f) Buro Sant en Co, *Four Harbour Roof Park,* Rotterdam, NL, 2014, (© Buro Sant en Co).

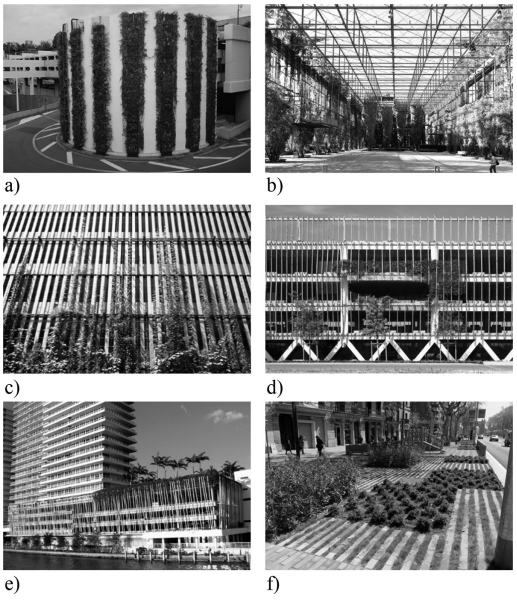


Figure 2. Exemples of *Disruptive Camouflage*: a) Canevaflor, Parrache *Parking*, Lion, FR, 2008, (© Canevaflor); b) Raderschallpartner Ag, *MFO Park*, Zurich, SC, 2002, (© O.E. Bellini); c) Theo Holz, *Parking SihilCity Shopping Centre*, Zurich, SC, 2008, (© O.E. Bellini); d) Jacques Ferrier architectures, *Parking Les yeux verts*, Soissons, FR, 2010, (© Ferrier); e) Arquitectonica, *Parking*, Miami Beach, Florida, USA, 2005, (© Robin Hill); f) Lola Domènech, *Passeig de St Joan Boulevard*, Barcelona, ES, 2011, (© Goula).

3.3 *Breaking into pieces*

Inspired by the animal world, as well as any other camouflage techniques, *Breaking into Piece* consists in changing the infrastructure original appearance covering it with the natural elements of the context it is set in, such as lawns, trees and bushes.

This camouflage technique may be applied to the domain of infrastructures design through the creation of circumscribed vegetated surfaces, partially covering specific parts of the artifact.

By breaking "into pieces" grey, mineralized surfaces through the insertion of natural elements, it is therefore possible to mitigate the artificiality of urban infrastructures, reconciling them with their surrounding contexts.

With this technique the construction becomes carpeted with appropriately studied and valued vegetation insertions in such a way that the construction loses its artificial aggression and assumes a more natural and ecological one.

3.4 *Blurring camouflage*

The last camouflage device current researches have elaborated in the domain of infrastructures design is blurring, to be intended as a way to confuse and cast ambiguity on what goes under it. In other, more concrete terms, it consists in the adoption of specific devices allowing to alter the identity of an object.

In the field of infrastructure design, such purpose can be carried out thanks to those devices which help blur artifacts, partially or totally hiding their presence.

This type of camouflage adopts techniques borrowed from other domains – such as packaging design – for instance installing vegetated skins confusing not only the presence of the artifact, but also its function. Thanks to vegetated components, it is possible to turn infrastructures into something else, only partly recognizable and yet putting forward, with their sole presence, crucial ideas for the sustainability of future cities. This technique, relying on a complete vegetal cover of the construction, creates a sort of natural mask that, faced with the new ecological conscience, tries to hide the presence, rendering it, involuntarily, even more visible.

4 CONCLUSIONS

Green Infrastructures are much more than a living wall, green façade, green roof and forested corridor: they are a different way of thinking or designing infrastructures. Conceived as a multi-scale network

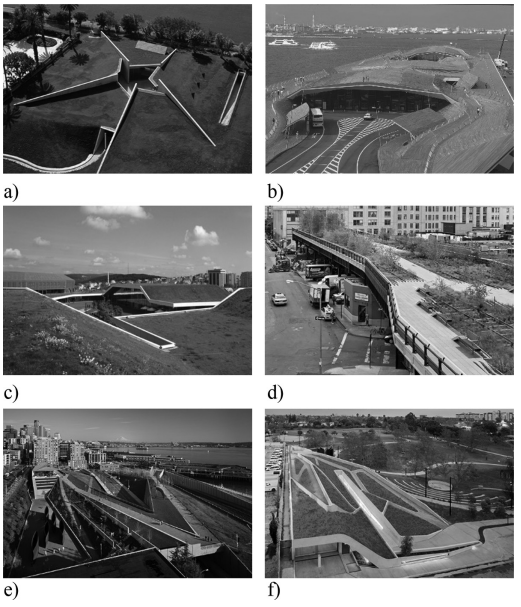


Figure 3. Exemples of *Breaking into Pieces:* a) Ferrater C., Guilbernau J., *Fitness Center Hotel Rey Juan Carlos I*, Barcelona, ES, 1996, (© L. Casals); b) Foreign Office Architects, *Yokoama International Port Terminal*, Yokoama, JP, 2002, (© FOA); c) Foreign Office Architects, *Meydan, Umraniye Retail Complex & Multiplex*, Istanbul, TR, 2007, (© FOA); d) Diller, Scofidio+Renfro, *High Line*, New York, USA, 2009, (© Diller); e) Weiss/Manfredi, *Olympic Sculpture Park*, Seattle Washington, USA, 2007, (© Weiss); f) Belzberg architects, *Museum of the Holocaust*, Los Angeles, USA, 2010, (© LAMH).

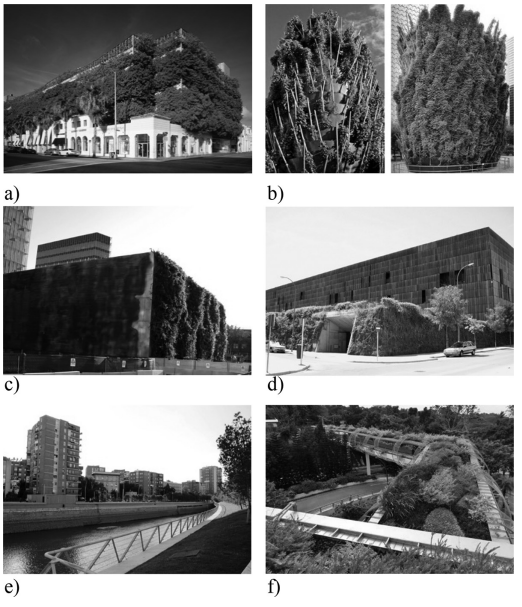


Figure 4. *Exemples of Blurring Camouflage*: a) Arquitectonica Geo, *Ballet Valet Parking Garage*, Miami Beach, Florida, USA, 1996, (© Arquitectonica); b) Edouard François, Patrick Blanch, *Wild Tower*, Défence, Paris, FR, 2003, (© P. François); c) Victor Rahola arcquitectes, *Subcentral Electrica*, Barcelona, ES, 2006, (© Rahola); d) Foreign Office architects, *Parking Bamboo Building*, Madrid, ES, 2007, (© FOA); e) West 8, Madrid, ES, 2011, (© Jeroen-Musch); f) CPG Consultants Pte Ltd, *Link Bridge, Coach Park*, Sentosa, Singapore, SG, 2012, (© Verditecture Pte Ltd).

of ecological features and systems providing a number of functions and benefits, they involve a systemic approach to planning and development, which recognizes the value of ecosystem services and aims at integrating them within our built environment. Green Infrastructures is not limited to a particular type of technology or feature carrying out a specific function; they are the result of a complex network of institutions, organizations, agencies, businesses, and citizens bringing ecosystem services back into planning and development. In order to realize the full potential of Green Infrastructure, coordination and collaboration are needed across several domains – political, jurisdictional, agency, organizational, sectoral, disciplinary, professional, to name just a few. The most significant challenge to advance a robust and integrated form of Green Infrastructure may be a bottom-up policy with a collective action from citizens. Both the design of new infrastructures and the renewal of existing ones demand an absolute accuracy and a constant research, in order to overcome their merely techno-functional nature and to involve a general reconsideration of their adjacent areas.

Camouflage devices, in fact, can bring in very interesting opportunities to improve the environmental sustainability of urban contexts and to develop new aesthetic and figurative solutions. Not only can such innovations contribute to spread an increasing acceptance of infrastructures but, as we pointed out throughout this paper, they can turn into pretexts to deeply rethink the function and the aesthetics of *"infra-luoghi"*.

Green camouflage techniques, in fact, are meant to order the chaotic and fragmentary coexistence of buildings, empty spaces, network, systems and infrastructures, not always working synergistically for the good of collectivity.

As a matter of fact, vegetation and eco-tech-green solutions can proficiently help mitigate the environmental and visual impact of unpleasant urban infrastructures; moreover, they are an extraordinary opportunity to provide cities with new green spaces, whose benefits have been demonstrated by this research. Environmental and health issues are, in the domain of Green Infrastructures, indissolubly tied to the processes of landscape reconsideration, in that they both contribute to enhance the quality of urban life: it is self-evident that healthcare and territory resiliency – together with the social and economic benefits they involve – strictly depend on the quantity and the quality of exploitable green spaces.

Natural *camouflage* for urban infrastructures increases environmental sustainability standards,

affecting the primary needs of citizens. Among them, security is to many extents one of the most strongly and transversally perceived as a fundamental right. In the collective imagery though, urban infrastructures and the surrounding areas are often thought as symbols of criminality, social diseases and violence.

Using vegetation and eco-tech-green in the grey infrastructure design, it is possible to move from mono-tasking to multitasking objects, capable of performing multiple functions simultaneously: ecological, environmental, landscape and recreational, for the sustainable city of the future.

Hence, a general reconsideration of environmental design paradigms – involving the adoption of the *camouflage* techniques so far described, as well as deep changes in the legislation and the training of specific professional figures – can be the first step of a profound shift in the collective and individual conception of sustainability in high density cities.

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Green infrastructure in New York City: Top down and bottom up initiatives to improve environmental quality

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ABSTRACT: European environmental policies so far have achieved important results at both Member State level and internationally. The United States has a different approach to Europe in this field: with a less prescriptive normative framework, several associations, organizations and public bodies work to improve environmental conditions in cities through the integration of green infrastructure. Vegetation can restore the environmental quality of dense urban areas by reducing the Urban Heat Island (UHI) effect, improving air quality and energy performance of buildings, and fostering biodiversity. The main objective of this research is to study initiatives and actions carried out and developed in New York City to help improve environmental and ecological conditions through the wider diffusion of green infrastructure. Top-down and bottom-up initiatives implemented in such dense city, considering the role played by Federal agencies, NYC Departments, and local communities, are analyzed.

1 INTRODUCTION

Environmental problems within cities have significant consequences for human health, citizens' quality of life, and urban economic performance (Commission of the European Communities, 2005). This is due in large part to urban areas' high vulnerability to climate change related flooding and heat waves. Since the majority of the world's population today lives in cities (Luederitz et al., 2013), these are important issues to address. While human lifestyles, consumerism, and unsustainable material production lead to alterations at multiple scales in urban systems, they also generate negative effects in residents' everyday lives (Grimm et al., 2008). Environmental problems and the ecological imbalances related to climate change, including especially biodiversity loss and environmental pollution, demonstrate the need to reduce material and energy flows and lessen environmental impacts (Luederitz et al., 2013; Seto et al., 2012).

Urban areas are responsible for 70% of global carbon emissions and nearly 70% of energy consumption (International Energy Agency, 2008). However, a denser urban environment could reduce the emissions connected to transportation needs and building energy use, and consequently their impact on climate change (Ewing et al., 2008; Hamin and Gurran, 2009); compact development add population to already developed places, concentrating human related activities and helping to protect underdeveloped and sensitive lands and maintaining viable habitats in the remainder (Farr, 2008). Therefore, through sustainable urban design, the negative effects of anthropic activities on the environment can be reduced, and environmental issues for human health and quality of life can be mitigated. After all, "The gamble for ecological survival has always been reliant on technology and design – and when technological limits are obvious, the design adaptation has to be made" (Plunz, 2008).

European environmental policies so far have achieved important results at both Member State level and internationally. The United States has a different approach to Europe in this field; five states have not yet adopted the Department of Energy's Building Energy Codes Program (U.S. Department of Energy, 2014), and several associations, organizations and public bodies work to improve environmental conditions in dense urban areas through the integration of green infrastructure. This community involvement can play a very important role in the field as many initiatives to improve ecological conditions of cities depend on the participation of urban citizens (Francis and Lorimer, 2011).

Urban and building design may aim to reduce environmental imbalances in urban areas and guarantee sustainability: on one hand, buildings consume a significant amount of energy (International Energy Agency, 2012); on the other, working on urban fabric is important considering the surface covered by built areas (e.g. in the case of New York City; www.nyc.gov). Vegetation can restore the environmental quality of dense urban areas by reducing the Urban Heat Island (UHI) effect, improving air quality and energy performance of buildings, and fostering biodiversity (Dunnett and Kingsbury, 2008; Ottelé et al., 2010; Taha, 1997). Therefore, a wider diffusion of vegetated green infrastructure in cities could

contribute to the achievement of several European environmental objectives.

The case of New York City (NYC) is considered in the present research. The main objective is to study and analyze initiatives and actions carried out and developed in New York City. Top-down and bottom-up initiatives to improve ecological and environmental conditions of dense cities through the wider diffusion of green infrastructure are identified; particular attention is paid to top-down initiatives implemented in New York, considering also the role played by Federal agencies in promoting the integration of green infrastructure. The effectiveness of mechanisms related to bottom-up approaches are similarly evaluated, with the concept of environmental justice defined and examples of initiatives implemented by local community organizations, grassroots associations, and citizen groups in the field of urban areas environmental sustainability and green infrastructure provided.

2 METHODS AND TOOLS

With the aim to study and analyze initiatives and actions carried out and developed in New York City to help improve environmental conditions in cities through the integration of green infrastructure, several methods and tools have been used. Bibliographic analysis, evaluation of tools used by public bodies and designers, and site visits allowed for the identification of improved environmental conditions through the integration of green infrastructure. An analysis of plans and regulations provided information on top-down approaches in the field while an overview of local community organizations highlighted bottom-up initiatives.

All the aspects analyzed in this research have also been deepened thanks to consultation with several experts in the field, researchers, experts working at the Federal and local level, and referents from community groups, among others. In parallel the main ecological and environmental imbalances within cities were analyzed, as the concept of environmental justice was. To deeply analyze all the aspects mentioned, both top-down and bottom-up green infrastructure projects will be discussed. These are: the Brooklyn Bridge Park and the Greenstreets program, both developed under Mayor Bloomberg administration in New York City, and the High Line, the Bronx River Greenway project, developed thanks to the efforts of local communities.

3 GREEN INFRASTRUCTURE (GI) IN CITIES

Today, more than 40% of the total land in urban areas is covered by impervious surfaces as roads, parking, and buildings (Benedict et al., 2006). Green infrastructure at city scale can play a key role in improving environmental conditions. When green infrastructure is proactively planned, developed, and maintained, it can guide urban development by providing a framework for economic growth and nature conservation integrating urban development, nature conservation, and public health promotion (Schrijnen, 2000; Tzoulas et al., 2007; Van der Ryn, 1996; Walmsley, 2006).

The term "green infrastructure" was coined in Florida in 1994 in a report to the Governor on land conservation strategies noting that natural systems important components of infrastructure (Firehock, 2010). Infrastructure is commonly defined as the facilities and services necessary for a society, community, and / or economy to function; these facilities and services can be "hard" (e.g. transportation and utilities) or "soft" (e.g. institutional systems such as education, health care and governance). GI is considered "soft" and is important for building capacity improved health, job opportunities, and community cohesion (Rouse, 2013).

GI includes natural, semi-natural, and artificial networks of multifunctional ecological systems within, around, and between urban areas (Tzoulas et al., 2007). This includes waterways, wetlands, woodlands, wildlife habitats, greenways, parks, and other natural areas that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality of life for communities and people (Benedict et al., 2006).

Vegetated GI mitigates climate change generally, transforming the CO_2 produced by automobile traffic and heating into carbonhydrates and oxygen; CO_2 is used by plants for the photosynthesis process, creating oxygen and biomass (Getter and Rowe, 2006; Köhler, 2008). Greened paved surfaces intercept solar radiation and can reduce warming of hard surfaces, thus reducing the UHI phenomenon by two to four degrees Celsius (Onishi et al., 2010; Taha, 2008).

Green infrastructure may include greenways, which, if systematically planned, can lead to a reduction of private transportation (use of cars) and, consequently, of their impact on the city environment (Hamin and Gurran, 2009). Vegetation improves environmental conditions in cities by acting on both causes and effects, collecting fine dusts and reducing the concentration of gaseous pollutants (Ottelé et al., 2010; Yin et al., 2011). Water quality can similarly be improved by natural systems filtering pollutants (Benedict and McMahon, 2001). As stated by the Environmental Protection Agency (EPA, 2011), green infrastructure is fundamental for stormwater management and as flood control as the loss of natural systems increases the risk of flooding and natural disasters (Benedict and McMahon, 2001).

The elements and components of green infrastructure are able to improve ecosystem health, defined as the occurrence of normal ecosystem processes and functions, free from distress and degradation, maintaining organization and autonomy over time and being resilient to stress (Costanza et al., 1992; Lu and Li, 2003; Rapport et al., 1998). Species rich heterogeneous habitats are considered more resilient than homogenous habitats in terms of habitats, species

and genes (Loreau et al., 2002), and influence urban ecosystem health by contributing to ecosystem resilience, organization, and vigor (Tzoulas et al., 2007).

4 TOP-DOWN POLICIES

Since 2009, the U.S. Environmental Protection Agency (EPA) under Administrator Lisa Jackson has endorsed the promotion of green infrastructure with the support of the New York State Department of Environmental Conservation (DEC). The EPA, with its mission to protect human health and the environment, writes and enforces regulations based on laws passed by the U.S. Congress, including, among others the Federal Water Pollution Control Act Amendments commonly known as the Clean Water Act (CWA), adopted in 1977, which regulates discharges of pollutants into water and sets quality standards for surface waters (www2.epa.gov\\laws-regulations; New York City Department of Environmental Protection, 2010).

Nowadays, the EPA provides local municipal grants, along with technical support, to cities to support an implementation of GI to fulfill CWA requirements (http://water.epa.gov/grants_funding).

Despite this approach, regulatory aspects at the Federal level also play an important role in the diffusion of GI; cities around the country have begun to manage stormwater runoff using green infrastructure to advance EPA regulatory requirements. This is mainly related to billions of dollars that local municipalities spend to reduce the volume of stormwater runoff in order to meet the regulatory requirements of the CWA to achieve swimmable and fishable waters (Crauderueff et al., 2012).

New York City (NYC) has 25,900 inhabitants per square kilometer, an urban density higher than figures registered in 40 American states and 800 times the population density of the United States (Owen, 2010), meaning that green infrastructure can play a very important role in reducing environmental and ecological imbalances (Rosenzweig et al., 2006).

During administration of Mayor Michael Bloomberg, several policies were developed reduce greenhouse gas (GHG) emissions by 30 percent by 2030, and to improve residents' quality of life, as outlined in PlaNYC, the City's comprehensive sustainability plan released in 2007. PlaNYC was created as a bold agenda to meet challenges related to growing population, aging infrastructure, a changing climate, and an evolving economy and to build a greener, greater NYC (New York Department of City Planning, 2011). The ambitious goal of PlaNYC is to reduce citywide GHG emissions by 30% below 2005 levels by 2030 (known as 30 by 30). According to the "PlaNYC Progress Report" of 2013, in six years, NYC reduced citywide GHG emissions by 16% with a cleaner energy supply, more highly efficient power plants coming online, and less polluting natural gas displacing energy generation by coal and oil. Among the initiatives launched



Figure 1. The Brooklyn Bridge Park, New York City.

to improve infrastructure, create or preserve housing, and reduce emissions related to transportation, green infrastructure received much attention. With the aim of bringing more than 250,000 New Yorkers to within a 10 minute walk of a park, green areas have been built.

The Bloomberg administration's policies played a key role on the implementation of green areas, an example is the Brooklyn Bridge Park. This is among the successful administrative initiatives in transforming and resurrecting public space in New York City. The Bloomberg administration facilitated a recalibrated urban landscape agenda through implementing a renewed emphasis on the importance of providing a citywide, connected public space network. As part of a progressive vision to activate and reconnect the City through the function of open space, the Administration's PlaNYC has been successful from urban and public health perspectives in activating and reconnecting the public realm, from a transportation and an open space perspective, and from an urban design perspective (Flynn, 2013).

Parks and public space importance is recognized for recreational amenities, ecological function, and economic development, as well as trees, green roofs and other forms of ecological infrastructure. NYC has invested in a network of green corridors, streets and other dedicated paths that perform multiple functions, including promoting recreation, capturing stormwater, and cleaning air (New York Department of City Planning, 2011).

Stormwater management also plays a fundamental role in this case, as New York City experiences a tremendous volume of rainwater runoff from rooftops, streets, and other impervious surfaces (New York Department of City Planning, 2011). To comply the Federal Clean Water Act, New York City built 14 sewage treatment plants, which were problematic in some area of the City (e.g. West Harlem), as demonstrated by local community organizations' protests (Angotti, 2008). In other cases, a green infrastructure approach has been adopted to prevent environmental degradation. NYC has launched several initiatives to increase the resilience of the built environment, including a $2.4 billion GI plan intended to better manage rainfall and reduce the impacts of Combined

Sewer Overflow (CSO) (New York Department of City Planning, 2013).

The "PlaNYC Sustainable Stormwater Management Plan" (New York City Department of Environmental Protection, 2008) was issued by an Interagency Best Management Practices (BMP) Task Force and concluded that green infrastructure – including bioswales, green roofs, and subsurface detention systems – was feasible in many areas in the City and could be more cost effective than certain large infrastructure projects such as CSO storage tunnels or tanks; in fact during heavy storms, these can exceed capacity and are designed to discharge a mix of stormwater and wastewater into New York Harbor to prevent treatment plants from becoming compromised (New York Department of City Planning, 2011). In September 2010, the City released its Green Infrastructure Plan, presenting an approach to improving water quality that integrated green infrastructure with investments to optimize the existing system and build targeted and cost-effective gray or traditional infrastructure (New York City Department of Environmental Protection, 2010b).

Among the several initiatives implemented in NYC to increase vegetation via widespread small interventions, the Greenstreets program is notable; transforming unused road space, traffic islands, and industrial areas into green assets, Greenstreets capture stormwater and improve water quality, and serve as important ecological respites within the urban landscape. Since 1996, they have been built throughout the City's five boroughs using specially designed soils and plants (New York City Department of Environmental Protection, 2013).

PlaNYC recognizes the important role played by the community with regard to parks maintenance, and the need to involve the public early in the park development process to engage citizens and community groups in the upkeep of their parks and green infrastructure. According to "PlaNYC Progress Report" (New York Department of City Planning, 2013), maintenance and stewardship are key priorities going forward. As stated in the NYC Green Infrastructure Plan, stakeholder participation is critical to build and maintain green infrastructure, and the New York City Department of Environmental Protection has led the outreach effort to involve community boards, stormwater advocacy and green job non-profit organizations, Citizens Advisory Committees (CACs), civic organizations, other City agencies, environmental justice organizations, and local communities (New York City Department of Environmental Protection, 2010b).

5 BOTTOM-UP POLICIES

Local participation in the United States has a deep rooted tradition (Angotti, 2013). The United States based Environmental Justice Movement (EJM) started its national campaigns in 1980s among a confluence of events that brought about the terms "environmental racism" (the disproportionate effects of environmental pollution on racial minorities) – and "environmental justice" (a social movement that emerged in response to this problem) into the public space (Sze, 2008, 2007).



Figure 2. Greenstreet in New York City.

Environmental justice, with its central concern the disproportionate impact of noxious facilities on communities of low income and of color, brings a progressive approach to sustainability by underlining the role of social justice in environmental and land use planning; as results, many of the current generation of community plans arose from the struggles of this movement (Angotti, 2008).

The EJM was founded to address the inequity of environmental protection in local communities (www.epa.gov/environmentaljustice); the EPA defines environmental justice as, "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies". In 1990, the EPA created the Environmental Equity Workgroup (since 1994 the Office of Environmental Justice (OEJ)) to address allegations that, "racial minority and low income populations bear a higher environmental risk burden than the general population". In the same year, New York's first African American Mayor, David Dinkins, took office with the support of a broad coalition of community, environmental, and other social movements (Sze, 2008).

The involvement of community in city planning and design is today widespread. In New York, immediately after his election in 2002, Mayor Bloomberg accepted the basic principle of community planning, as opposed to his predecessor Rudolph Giuliani (Angotti, 2008).

M3project principal Flynn was consulted on the role of the community in a firm activity, and of community boards in the urban design process, and notes that community participation, involvement, and approval has become a fundamental component to complex urban design initiatives and agendas. Successfully engaging the public realm into the design process and, ultimately, into the design solution, can in itself be a complex agenda. Engaging public interest as an initial design element contributes and informs the project's vision, ambition, and goals and in many cases promotes enhanced community support, increased stakeholder investment, and expedited planning processes (Flynn, 2013).

Flynn was part of the team created by James Corner, Field Operations with the firm Diller Scofidio + Renfro, which designed the High Line in New York City, a project that demonstrates the capabilities of productive collaborations that successfully merge architecture, landscape architecture, and urban design.

The High Line is a public park opened in 2009 that is built on an historic freight rail line elevated above the streets. The rail line was built in the 1930s as part of a massive public-private infrastructure project on the West Side of Manhattan and had not been used since 1980. It is owned by the City but maintained and operated by Friends of the High Line, a community-based non-profit group formed in 1999 when the historic structure was under threat of demolition. Friends of High Line works to raise essential private funds to support more than 90 percent of the park's annual operating budget (www.thehighline.org).

Although the High Line project rises in a very different neighborhood compared to, for example, the low income Bronx (analyzed as well in this research), it is an interesting example of a bottom-up project. According to Flynn (2013), the High Line project was a catalyst and product of the Friends of High Line'. From an administrative perspective, the Bloomberg administration was a great advocate and facilitator towards its realization, implementation, and potential, especially since the previous administration, the Giuliani administration, was contemplating tearing it down. The open ideas competition held in 2003 was the platform for demonstrating community interest and true value possessed in the, at the time, decaying and abandoned industrial landscape. During the first years, NYC Parks was not on involved while Friends of High Line was the real initiator and capital facilitator for the project. Although, at the time preceding the High Line's transformation and opening, Chelsea, the epicenter of Manhattan's Gallery District, and the Meatpacking District, were a burgeoning design, the addition of the High Line to its cultural landscape transformed the West Side of Manhattan into what



Figure 3. The High Line, New York City.

it is today. The High Line has given evidence of the importance of green infrastructure within urban landscapes and the profound effect and potential it can have on culture, economy, real estate, and public identity. The story of the High Line is a profound example of the impacts a strong community voice, determined private interest groups, and key private investment can have on the reshaping of our urban environments (Flynn, 2013).

Going back to the environmental justice movement, in New York City, some neighborhoods have seen important struggles carried out by local community organizations, including especially Sunset Park in Brooklyn, West Harlem in Manhattan, and the South Bronx. Planning policies had an enormous impact on these minority-majority and low income communities (Sze, 2007).

Among the most interesting bottom-up projects of urban requalification based on green infrastructure, the Bronx River has to be mentioned. The Bronx River flows through the South Bronx, a neighborhood which has struggled for nearly three decades under the negative connotations of its name as a flash point for violent crime, drugs, and unchecked urban decay; the neighborhood also houses 15 waste transfer stations and four power plants (Loria, 2009).

The Bronx River went from a flourishing and beautiful resource to a contaminated conduit for industrial and residential wastes over the past two centuries. The restoration of the Bronx River started in the 1970s. In 1974, in response to the poor conditions of the Bronx River, local residents formed the Bronx River Restoration Project, Inc. (BXRR) and removed debris from the shoreline of the Bronx River (New York City Department of Environmental Protection, 2010). Since then,



Figure 4. The Bronx River Greenway, South Bronx.

several initiatives were developed to improve the ecological and environmental quality of the river, with plans, protests, appeals. The many restoration measures directly implemented or pushed by the local community resulted in the foundation of the Bronx River Alliance, an organization aimed at the improvement and maintenance of the Bronx River; today, local community organizations and NYC Departments work together to improve the environmental and social conditions of the neighborhood to reduce ecological imbalances of the River, which is surrounded by a greenway and parks (built thanks to the efforts of the community), and is maintained with the efforts of citizen volunteers.

The case of the Bronx River demonstrates how effective a collaboration between local community organizations and public bodies can be in a low income community, and in a neighborhood with many social and environmental issues, while favorable conditions are important, the environmental justice activists of the South Bronx have played the most important role (Angotti, 2013). Following community priorities may bring about important results, providing projects with State and City resources that would not be possible otherwise due to the lack of resources to maintain all the green areas.

6 CONCLUSIONS

Green infrastructure (GI), since when the term was first used in 1994, has gained increasing attention as multifunctional ecological systems. U.S. Environmental Protection Agency (EPA) takes into account the use of GI for stormwater management and flood control, and in general for ecological, economic, and social benefits through natural solutions. The endorsement of EPA of the promotion of green infrastructure plays an important role in its diffusion.

With regard to the case of New York City (NYC), many policies have been implemented in the past 10 years to reduce greenhouse gas (GHG) emissions by 30% by 2030 and to improve the quality of life. The use of GI is considered especially important for maintaining water quantity and quality and bolstering the livability aspects connected to the public space.

Stormwater management is among the most important aspects of recent policies implemented for sustainability. This is due to the evidence of looming ecological imbalances (e.g. Hurricane Sandy) and especially various economic aspects, as green infrastructure can be a cost effective measure to manage stormwater and to meet the swimmable and fishable water quality standards fixed by Federal Government through the Clean Water Act and regulated by the EPA.

To facilitate the management and also creation of green areas, several programs implemented by NYC involve citizens' participation and the City invests significantly in communication and education.

Although the United States normative framework is not prescriptive as the European one, in the case of green infrastructure a local (city and state level) and community based approach reveals to be effective.

Community engagement in NYC is essential to city planning and design and, in addition to community involvement in such top-down initiatives, interesting examples of bottom-up projects were described. The community plays an important role in restoring environmental conditions of urban areas, not only related to functional contributions (e.g. parks maintenance) but also of the scale of environmental justice organizations campaigns that have resulted in improvement of environmental conditions in low income communities. The case of the Bronx River demonstrates how effective a collaboration between local community organizations and public bodies can be in a low-income community, in a neighborhood with many social and environmental issues. In fact, citizens worked since the 70' with NYC Departments to improve social and environmental conditions, reducing the ecological imbalances of the river, which is now surrounded by a green corridor and parks.

Also in other context, as in the case of the High Line, community was able to drive a very successful project. Following the community's priority allowed the creation of green areas in dense and polluted parts of the city.

At the same time, the Bloomberg administration promoted several interesting (green) projects in the city. Thanks to the benefits that vegetation provides, urban heat island mitigation, stormwater management, air quality improvement, contributing ecosystem health, etc. the environmental and social characteristics of the area analyzed were drastically improved. Therefore both top-down and bottom-up projects implemented in New York City in the last 10-20 years played a key role in improving environmental, ecological, and social conditions for citizens' quality of life.

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Emerging fields of architectural practice

The changing role of the architect



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Thinking + making: Digital craft as social project

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ABSTRACT: "That parametricism "goes social" is not a concession to the prevailing winds of political correctness (that divert and dissolve the innovative thrust of architectural discourse). Rather, it is a sign of parametricism's maturity, confidence and readiness to take on the full societal tasks of architecture, i.e. it implies the inauguration of Parametricism 2.0 … After 15 years of muscle flexing it is high time to put these innovations to more serious work." *Patrik Schumaker* (Schumaker, 2015) The 'more serious work' presented here is the presentation of craft, and specifically digital craft, as a historic and theoretic framework that extends the agency of computational thinking and parametric design in the social project of architecture. Ultimately, this paper argues for the development of a more robust theoretical position about the social application of advanced parametric design as a means to expand architectural agency in the discourse surrounding parametric design's relationship to large scale social issues.

1 INTRODUCTION

Architect and theorist Stan Allen notes in his article *Artificial Ecologies* that the practice of architecture has always been in the paradoxical position of being invested in the production of real, concrete matter yet working with tools of abstract representation (drawings, models, computer simulations and so forth). The paradox charges the question: does thinking (and its associated abstractions) or making (and its concrete matter) give architecture its agency? (Allen, 2003).

The capacity to craft, to think through making, instills architecture with an explicit agency to engage outside of the academy and the discipline. The introduction of digital craft into contemporary practice extends, rather than limits, this agency in the social (or political) project of architecture. The process of thinking through making and the accompanying nonlinear methods position architects to identify pathways of thought into contemporary issues, and then make visible that which remains unseen to other disciplines. Craft encourages imagination and through imagination the architect enters into the spheres of life, which are not immediate to personal experience: the social (or political) project of architecture. This imagination is a powerful agent as well. The ability to imagine a better world equipped with the capacity to act, is to craft an object with intentionality and purpose.

As the discipline continues to struggle with self-identity and the direction of its fragmented authority, craft remains the most valuable tool at the architect's disposal. This papers aims to define craft as it relates to architecture and the architect, to position craft as an agent of social and political change, and to identify digital craft as an extension of this agency.

2 DEFINING CRAFT

The term craft is derived from the Middle English *craeft*, meaning strength and skill. Craft can also be associated with the professional affiliation of a guild or trade association. Indeed, it first came into widespread use in conjunction with the advent of guilds – self-protective medieval associations or private clubs of artisans with formally cultivated talents rooted in innate and rare abilities. Craft creates intimate relations between problem solving and problem finding, technique and expression, play and work. (Sennett, 2008) It brings to mind material, matter, repetition, talent, time, pride and dedication. Craft comes burdened with accusations of nostalgia, luddite tendencies and perhaps even a regressive attachment to the past and the pre-industrial. In the mid 17th century Denis Diderot spent the better part of twenty years identifying and documenting crafts. The result: *The Encyclopedia, or Dictionary of Arts and Crafts*, exhaustively recorded how practical things are accomplished and proposed ways to improve them. In *The Encyclopedia* Diderot, places manual pursuits on equal footing with mental labors, asserting that the craftsman's labors were icons of the Enlightenment. He also scorned hereditary members of the elite who did no work and so in Diderot's opinion contributed nothing to society. His definition of craft is as follows:

> *"CRAFT. This name is given to any profession that requires the use of the hands, and is limited to a certain number of mechanical operations to produce the same piece of work, made over and over again. I do not know why people have a low opinion of what this world implies; for we*

depend on the crafts for all the necessary things of life."

Denis Diderot, *The Encyclopedia* 1747–1765.

As can be seen in Diderot's explanation, the idea of craft and its embodiment of the thinking maker produced discomfort as it upset a social order where thinking and making were separated and making subordinate to thinking. This separation is not new; it extends to the very foundations of philosophy. As Jacques Ranciere demonstrates in his book *The Philosopher and His Poor*: "So there is only one principle of exclusion (from political life). Plato's Republic does not decree that one cannot be a shoemaker and a citizen at the same time. It simply establishes that one cannot be a shoemaker and a weaver at the same time…" (Ranciere, 2004) In doing so Plato sets forth that the shoemaker has only been given enough time to do one thing and therefore cannot encroach on the monopoly of thought and leisure that the philosopher enjoys. The thinking-maker disrupts the neat hierarchical social order which preferences the philosopher, as thinker, over the artisan, as laborer.

3 HIERARCHY AND CRAFT: ANIMAL LABORANS AND HOMO FABER

Richard Sennet opens *The Craftsman* with a distinction between making and thinking. Much of Sennet's argument is an extension of Hannah Arendt's *The Human Condition* that "any maker of material things, is not master of his own house; politics, standing above the physical labor has to provide the guidance." To paraphrase Arendt's distinction between *Animal laborans* and *Homo faber*: *Animal laborans* is a "beast of burden" and *Homo faber* "man as maker." Therefore, *Homo faber* is the judge of material labor and practice, not *Animal laborans'* colleague but his superior. (Arendt, 1958) (Sennett, 2008) Sennett argues that Arendt's separation can be repaired through the act of craft:

> "Thinking and feeling are contained within the process of making (craft). What if *Animal laborans* might serve as *Homo faber's* guide? … History has drawn fault lines dividing theory and practice, technique and expression, craftsman and artist, maker and user; modern society suffers from this historical inheritance …"

Arendt's argument has a greater subtlety to it than Sennet allows. She casts labor as necessity and in these terms to labor means to be enslaved by necessity. It is this enslavement, which breeds the contempt of *Homo faber* who has been freed from these necessities by *Animal laborans* labor. Simultaneously *Homo faber is* aware that he has won his freedom by excluding *Animal laborans* from full participation in the political process by granting him only enough time to labor.

But what then of the artisan? What of Ranciere's cobbler who discomforts the philosopher? The dichotomy of productive (cobbling) and unproductive labor (philosophizing) has been a topic of interest for a range of scholars from Adam Smith to Karl Marx, who elevated labor above contemplation, reversing the traditional hierarchy. Arendt as well doesn't let *Homo faber* escape freely with his vision of separateness from the labor of *Animal labors*. She holds *Homo faber* in contempt, not innocent of but complicate in the acts of his counterpart, since he (*Homo faber*) invented the artifice, which initially spawned the labor. (Arendt, 1958) Kenneth Frampton picks up Arendt's argument in his essay "Intention, Crafty and Rationality" from *Building (in) the Future: Recasting Labor in Architecture*. He further elaborates upon Arendt's distinction by quoting again from *The Human Condition*:

> "If the *Animal laborans* needs the help of *Homo faber* to ease his labor and remove his pain, and if mortals need his help to erect a home on earth, acting and speaking men need the help of *Homo faber* in his highest capacity, that is, the help of the artist, of poets and historiographers, of monument-builders or writers, because without them the only product of their activity, the story they enact and tell would not survive at all. In order to be what the world is always meant to be, a home for men during their life on earth, the human artifice must be a place fit for action and speech, *for activities not entirely useful for the necessities of life but of an entirely different nature from the manifold activities of fabrication by which the world itself and all things in it are produced.*" (Frampton, 2010).

Frampton continues his essay by questioning the architectural profession's ability to confront this issue of separation: "the unreal split between the media cult of the individual star and the anonymity of divided labor that realizes the work." For Frampton this challenges the concept of singular authorship and also fails to address "the presence of a totally new breed of young architects-academics capable of working at both an intellectual and a manual-cum-technical level." (Frampton, 2010) Which is the architect: *Homo faber* or *Animal laborans*? And does craft allow an architect to dwell simultaneously in both roles?

4 DEFINING THE CRAFTSMAN

Who then is the craftsman? And how is the craftsman different than the artist? Sennet maintains that an artist claims originality and that originality is the trait of single, lone individuals (Frampton's "media cult of the individual star"). Conversely, craft names a more anonymous, collective and continued practice of authorship. In this case, originality becomes a marker of time and denotes the sudden appearance of something where before there was nothing. (Sennett, 2008) On the other hand, the quality and value of craft is considered to be a shared experiment of collective trial and error. In this sense, good craftsmanship implies socialism. Craft is carried out collectively, at least in spirit,

in a workshop or studio, a productive space in which people deal face-to-face with issues of authority and a gradient of skills. Skills become a source of legitimacy to command or to dignify obedience.

It is here, that the separation of head and hand are realized, not just as intellectual divides, but by social and economic markers. The architect, the master carpenter and the framer all function as craftsmen. However, the architect sets himself atop the hierarchy of makers imposed within the guild, closer to thinker than to maker. Despite the hint of elitism, the architect must also continue the process of making, grappling with Allen's paradox of abstraction and matter. (Allen, 2003) Additionally, the architect may feel contempt for his reliance upon others to enact his designs as it implies a relinquishment of control. Or as Renzo Piano states (italics are author's for emphasis):

> "An architect must be a craftsman. Of course any tools will do. These days the tools might include a computer, an experimental model in mathematics. *However, it is still craftsmanship – the work of someone who does not separate the work of the mind from the work of the hand.* It involves a circular process that draws you from an idea to a drawing, from a drawing to an experiment and from a construction back to an idea again. For me this cycle is fundamental to creative work. Unfortunately, many have come to accept each of these steps as independent. Teamwork is essential if create projects are to come about." (Piano, 1992)

Today's architect-craftsman has adopted technology as a way of bypassing the need for teamwork or reliance upon others to build. Instead of navigating Allen's paradox, this new breed of architect regains control of his craft through the use of the computer and tools of fabrication. However, the act of bypassing the collective and continuous aspect of craft creates a false sense of individuality and originality. As Scott Marble argues in his essay "Imagining Risk":

> "If craft is defined as a skill developed over time and in direct relationship to making and to working with materials, architects have long been disconnected from this skill, relying instead on builders and fabricators to actually carry out their designs. Architects work with abstract processes of representation that lead to abstract processes of making. This is a challenging context within which to position craft, if any conventional definition of the term. For craft to function as a useful concept today, it might best be rethought as a process of mediating not only between tools and the objects that are produced but also between design as a process of imagination and production as a process of technique. In fact, craft has always been mediated through a relationship between humans and technology." (Marble, 2010)

This mediation between ideas and objects is the indispensable aspect of craft, which makes the architect the craftsman of the building process. However, does the contemporary architect-craftsman maintain an element of agency?

5 CRAFT AND AGENCY IMPERILED

The American Institute of Architects provides template contracts to its members. One of the primary objectives of the contracts is to protect the architect from liability by distancing the architect from the making of a building:

> "The Architect shall not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences, or procedures…"
>
> 3.6.1.2 AIA Contract Document B101 Standard Form or Agreement Between Owner and Architect (AIA, 2015)

The advances and proposals made by Marble and others or the arguments set forth in Kieran and Timberlake's seminal *Refabricating Architecture* are undone by the very documents which define the profession as a profession (in the United States) separating *Homo faber* from those who build, *Animal laborans.*

Sennet says of *The Craftsman* "I am writing in a long-standing tradition of American Pragmatism, joining philosophy with concrete practices in the arts and sciences, to political economy, and to religion, to find philosophic issues embedded in everyday life.") (Sennett, 2008) In this sense craft reflects the objects of everyday life. Well-crafted objects inherit the pragmatism of their philosophical foundations and shed the necessity of the omniscient designer. Additionally, craft implies action and its associated physical products, falling in line with the history of American Pragmatism and the country's foundations built upon the Protestant work ethic. Craft usually hints at the concept of expertise, carefully guarded by professionalism, guilds, trades or unions. What happens though when an outsider takes up a craft, someone not ordained by the keepers of the craft?

Architecture Without Architects an exhibit curated by Bernard Rudofsky at the Museum of Modern Art in New York City in 1964 was a study of non-formal, non-classified architecture – architecture without architects. Rudofsky says of the show "for want of a generic label, we shall call it vernacular, anonymous, spontaneous, indigenous, rural…" Rudofsky continues by saying that "vernacular architecture does not go through fashion cycles. It is nearly immutable, indeed unimprovable, since it serves its purpose to perfection." And that "part of our troubles results from the tendency to ascribe to architects – or for that matter, to all specialists – exceptional insight into problems of living when, in truth, most of them are concerned with problems of business and prestige." (Rudofsky, 1964) It is here that Rudofsky's argument ceases to resonate – he assumes that architecture, vernacular or otherwise, is only tasked with solving problems, not with finding and defining problems.

The focus on non-classified architecture leads into a discussion of the architecture of groups underserved by the traditional profession: the other – be that the impoverished (or any otherness).

6 CRAFT'S AGENCY: IMAGINATION AND OBJECTS

Adam Smith argues, in the *Theory of Moral Sentiments*: "As we can have no immediate experience of what other men feel, we can form no idea of the manner is which they are affected by conceiving what we ourselves should feel in a like situation." Therefore, entering into others' lives requires a profound act of imagination. (Smith, 2009)

Impoverishment of any form – physical, emotional, or intellectual – can be interpreted as pain. In *The Body in Pain: The Making and Unmaking of the World* Elaine Scarry remarks on the de-objectifying effect of pain and its consequent destruction of language. On this lack of referential content Scarry says, "…it is not surprising that the language for pain should sometimes be brought into being by those who are not themselves in pain but who speak on behalf of those who are…" However, how do those who speak gain their voice and their agency? For Scarry this happens through the act of imagining. Through imagination, the speaker can enter into the unsharable space between the certainty of pain and the doubt of its objectlessness. (Scarry, 1985)

> "…Imagining may entail a revolution of the entire order of things, the eclipse of the given by a total reinvention of the world, an artifact (a relocated piece of coal, a sentence, a cup, a piece of lace) is a fragment of world alteration. Imagining a city, the human being "makes" a house; imagining a political utopia, he or she instead helps to build a country; imagining the elimination of suffering from the world, the person instead nurses a friend back to health." (Scarry, 1985)

Despite Scarry's conviction that imagination alone produces agency, she does allow that the objects resulting from imagination have their own agency: *"…through tools and acts of making, human beings become implicated in each other's sentience."* (Scarry, 1985) Or as John Ruskin, declared in *The Crown of Wild Olive*: "what we think, or what we know, or what we believe is, in the end, of little consequence. The only consequence is what we do." (Ruskin, 1866) It can therefore be reasoned that a consciousness of things cannot be independent of the things themselves. Through an engaged material consciousness, we become particularly interested in the things we can change.

The craftsman then can be considered a social philosopher at the intersection of practice and talent and this poses a general question about agency: we are minded to believe that engagement is better than passivity. Therefore, if craft gains its agency through action, and architecture its agency through craft, then how can craft beget the engagement of architecture with a larger social project?

Architects as producers of space, can also be producers of ideologies and of capabilities. Imagining a route out of poverty, requires architects to think and to act, to imagine and then to produce objects. These objects hold new ideologies and offer spaces to improve capabilities. This means architecture must offer not just shelter, but systems to operate within, schools to educate, infrastructure to travel, hospitals to heal, stages to perform, studios to paint. We cannot build what we have not first imagined, and architecture is uniquely positioned to do just that.

7 DEFINING DIGITAL CRAFT

> *"Virtual craft still seems like an oxymoron; any fool can tell you that a craftsperson needs to touch his or her work."* Malcolm, McCullough, Abstracting Craft *(McCullough, x)*

What happens then if architecture cedes craft to the digital realm? Or rather, gives up the very thing, which gave it agency in the first place? Is the digital realm an extension of the imaginary space or a replacement for physical space? And does this cyberspace extend architectural agency or limit it? Digital walls do not keep out physical rain or as McCullough states there is "the seeming paradox of intangible craft." Indeed, we may now be entering an age of the master-builder-craftsman or architect-craftsman that John Ruskin sought to revive, but getting there in a way Ruskin could not have anticipated. Issues of dimension, heft, tactility, and materiality remain essential to architecture as built environment, no matter how tantalizing the pixilated world may be. Digital fabrication and its associated tools provide a tactile counterpoint to the image-based environment otherwise prevalent in digital work.

> *"The best way to appreciate the merits and consequences of being digital is to reflect on the differences between bits and atoms."*
> Nicholas Negroponte, Being Digital (Negroponte, 1995)

For the purpose of this paper, the digital turn in architecture occurred in the early 1990s and is defined as the computerization of design, construction, and fabrication processes. This is marked by a transition from designs based upon a Cartesian grid to those constructed from a digital field condition abstracted within computational space. Specifically, the introduction of continuous computational splines that are variable within defined limits and can be notated as parametric functions or mathematical relationship between parts. (Carpo, 9)

Digital craft emerges from computational thinking, digital fabrication and robotic construction; processes that allow the full participation of architects in the

production of buildings and thereby extend architecture's agency to engage in a larger social and political project. A close reading of the *Human Condition* demonstrates that the spheres presented by Arendt: labor, work, and action are interconnected and in the present day are merged through architectural technology to extend the participation of architects in the construction process beyond the cultural and physical confines of bodily practice.

Craft has long been seen as the antithesis of the evils of modernity and industrialization. Against the rigorous perfection of the machine, the craftsmen became an emblem of human individuality, symbolized by the positive value placed on variations, flaws and irregularities in handiwork. However, does craft, like all traditional knowledge, inherit and pass on prejudice? As members of the University of Virginia School of Architecture Faculty wrote in an open letter to the board of visitors, the university administration, and the university community entitled *"What are the Jeffersonian Architectural Ideals?"*

> "Is there a problem in choosing an architecture to stand for the values of a university at the beginning of the twenty-first century when that architecture was inaugurated at an historical moment when racial, gender, social, and economic diversity were less welcome?" (UVA, 2006)

Does craft gain or cede authority by tethering itself to the continuity of human thought and event? Contemporary craft loses it agency when it becomes associated with the Luddite, romantic, or historic. In fairness, craft does not need to be mistreated by these associations. The combination of technology with craft, termed digital craft, prevents craft from this characterization.

David Pye defines craft in *The Nature and Art of Craftsmanship:* "Craftsmanship…means simply workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined but depends on the judgment, dexterity and care which the maker exercises as he works. The essential idea is that the quality of the result is continually to risk during the process of making…." (Pye, 1968)

If fabrication and digital craft is seen as the completion of an idea that is then constructed by the machine, then indeed the most valuable aspect of craft is lost to over-determination. Simulation can side-step this over-determination but it is a poor substitute for tactile experience. If the digital is used to eliminate the feedback loop of question finding through question answering, then craft itself is at risk. Machines break down when they lose control; whereas people make discoveries, stumble upon happy accidents. There is a nostalgia for a lost space of freedom – free space in which people can experiment, a supportive space in which they could at least temporarily lose control. A radical emancipatory challenge provokes:

> "Power in action requires some largeness and imaginativeness of vision. Men must at least have enough interest in thinking for the sake of thinking to escape the limits of routine and custom. Interest in knowledge for the sake of knowledge, in thinking for the sake of the free play of thoughts is necessary then to the emancipation of practical life – to make it rich and progressive…."
>
> John Dewey *"Concrete and Abstract Thinking" How We Think* (Dewey, 1910)

Therefore, how might digital craft re-engage the best aspects of craft, thinking through making, and the power of the digital realm? First, digital craft must embrace the spatial conditions of the computer environment. The term cyberspace first appeared in William Gibson's 1982 story *Burning Chrome* and was subsequently popularized by his 1984 novel *Neuromancer*. (Gibson, 1984) The concept of other or virtual space is woven throughout history, appearing in literature and cultural commentary from Plato's *Allegory of the Cave* to Descartes' *Evil Demon*. However, the concept of cyberspace is unique in that it offers not just a space of representation and communication but also provides a social setting within which these activities can exist. The resulting social relationships are what give cyberspace its physical presence and thereby architectural ramifications. In architecture, this conceptual space is often considered to be the space of the screen or monitor and therefore simultaneously the space within the computer and the internalized space of perception.

Is it possible, that the future of architecture lies in our ability to make the parametric sensate or to actualize the abstraction of cyberspace into meaningful physical objects? In digital culture, there is a new continuity between subject and the architectural object, with no void between them. As if the distance of vision was abolished by tactility. Craft and its inherent materiality will prevent architecture from falling prey to the complete cognitive internalization of the screen, it will halt the progression toward ocular space primacy, and it will create the interactive corollaries between cyber and physical spaces.

For digital craft to promote the agency of thinking through making, architecture must embrace the aspects of feedback mechanistic processes offer, by expanding the field of information to the tools used in the discipline.

8 CONCLUSION

Digital worlds should not be seen as alternatives or substitutes for the built world, but rather as an additional dimension which allows architects a new freedom of movement in the physical world. In other words, the transcendence of physicality in the digital world allows architects to extend their agency in the physical world. (Carpo, 10)

Digital craft brings together the physical and digital worlds. The historic and theoretic framework presented here aims to move forward the agency of

computational thinking and parametric design in the social project of architecture. The development of a more robust theoretical position about the social application of advanced parametric design will expand architectural agency in the discourse surrounding parametric design's relationship to large scale social issues: Schumaker's 'more serious work'.

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Emerging research: The architect's personal research through design competitions

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ABSTRACT: Architectural Design Competitions is a growing field of research in architecture theory and provide a laboratory view over the dynamics of the production of environmental design quality and the renewing process of culture and knowledge. Design competitions connect academia and praxis, can bring out the best out of architects and is a way to achieve excellence in design. Our argument, following previous research, is that architectural design competitions reflect a procedure of research (derived from the academia but in the praxis), develop personal and field competences, values and abilities, and foster innovation in architecture. In fact, there is evidence that during their professional practice, licensed architects, outside the academia and in praxis, use design competitions as fundamental research opportunities. These facts sustain the importance of the role of architectural design competitions as an important social, cultural and professional field of research that challenge the way we currently see the practice and the education of the architect. Recent research gives relevance to the way design competitions could also contribute to and stimulate Continuing Professional Development (CPD) and should be accepted as such.

1 INTRODUCTION

Architectural Design Competitions is a growing field of research in architecture theory (Rön et all 2010, 2013, Tostrup 1999) and generally provide a laboratory view over the dynamics of the production of environmental design quality, design quality and the renewing process of culture and knowledge.

Design competitions exist for a very long time (Lipstadt 1989, 2000, 2010). There are records of Greek competitions as early as 448bC, they flourished in Renaissance Italy (e.g. Brunelleschi's design for the cupola of Florence Cathedral) and are now major architectural procuring events to achieve the best design service (Kostoff 2000).

Design competition serve as a way to address an architectural or urban problem and to find its best answer. The debate about the value of competition is not only about the equitable distribution of design commissions but also about its important theoretical, ideological and ethical foundations. The openness in the distribution of public funds, the understanding of design process, and the participation in the shaping of the built environment may be better obtained with design competitions (Strong 1996, Spreiregen 1979, Collyer 2004, Chupin et all 2015, Rönn et all 2010, 2013). Other may argue that there are other ways of achieving this (Nasar 2006).

Nonetheless, it constitutes an opportunity for all parties involved (promoters, architects, public) to improve the quality of the built environment.

In this paper we will focus on the architect's point of view and in particular in the way competitions serve as stimulus to researching and improving one's abilities and competences as an architect.

Previous research (Guilherme and Rocha 2013, Guilherme 2014, 2016) has connected the importance and theoretical background of design competitions to the core curriculum of the academia (Malacrida 2010) (at its birth in the Beaux-Arts in Paris) and to the practice (praxis) of the licensed architect. The connection between academia and praxis that occurs during design competitions seem to be a proof of Donald Schön's (2003) "*research-in-action"* and Jeremy Till's (2012) evidence of *"architecture [as] a form of knowledge that can [, is] and should be developed through research"*.

Present research takes into consideration previous data (Guilherme 2016) in order to further link design research and competitions with professional development, thus illustrating the importance of design competitions in design research. It also takes into consideration recent studies and surveys (Van Alen Institute 2015a, 2015b, 2015c, *Forlati and Isopp 2011*) that further describe and give credit to design competitions as being part of a research activity within practice. We will present, discuss and recommend the possible use of design competitions as part of Continuing Professional Development (CPD).

2 ANALYSIS

The education of an architect (Brady 1996, Schön 2003) is not a static endeavor that can be easily defined by fixed and precise characteristics; it evolves with the

demands and developments of society. It must therefore encompass both continuity and change to prepare students to meet the demands of the profession. Given the dynamic and complex nature of architecture, the education of an architect involves not only what constitutes a course of study, but how an architect is educated.

Education is seen as a continuous progression of knowledge, beyond any age limit, and during the working life span of the architect (e.g. Oscar Niemeyer died with 105 and is said to have worked until he died).

To some formal extent (taking a holistic view of the working life span of the architect) it may encompasses three levels (layers) of education (using the Architects' Council of Europe structure):

- An initial formal academic education period with the basic principles of architectural culture and the design process. It may be different according to countries education policies, but may constitute a Bachelor of Architecture, a License Degree in Architecture or a Master Degree. More specific skills can be pursued by post graduations or doctoral programs in architecture;
- A second level of professional experience in contact with the core practice (praxis) of architecture;
- A third level of Continuing Professional Development.

We will elaborate on how architectural design competitions in practice (in the second level of education) may constitute a proof of architectural research thus providing a valuable contribution to continuous education (third level of education).

2.1 *Continuing Professional Development (CPD)*

The Royal Institute of British Architects (RIBA), established in 1838, oversees *"the advancement of architecture and the promotion of the acquirement of the knowledge of the Arts and Sciences connected therewith"* (RIBA 2009). RIBA has helped to develop and apply research-based knowledge of RIBA members, chartered practices and schools of architecture in order to promote links between practice and academia. In order to do so, it has defined key work areas, annual research themes. The objective is to *"raise awareness among practitioners of the benefits, both intellectual and economic, of research in practice"* (Anon. 2016).

Continuing Professional Development is beneficial for you as an individual, as well as to the profession as a whole, as it offers an assurance to the public the professional is up-to-date with the latest industry developments and innovations (Tyler 2016a). CPD enlarges the already acquired academic competences with other newer, recent and potentially more creative knowledge.

To the Architect's Council of Europe *"Continuing Professional Development (CPD) for architects is, at European level, of professional and public interest. Its necessity has been affirmed in directives of the European Union and its relevance is even greater in the enlarged European Union. As the diversity of training and practice has increased, CPD has become a necessary obligation for practicing architects and for the organizations that represent them."* (ACE 2006)

CPD is mandatory for all AIA (US) and RIBA (GB) members and is described by Joni Tyler (Head of CPD at RIBA) as being *"any learning you do under your own initiative, whether structured or informal. It's CPD you arrange, rather than CPD we bring you."* (Tyler 2016b) As a chartered member, architects are obliged each year to:

- Undertake at least 35 hours of CPD. These are the minimum amount of time you need to spend each year maintaining your competence;
- Undertake at least 20 of the required 35 hours from the ten topics in the RIBA CPD Core Curriculum (around two hours per topic per year). This is considered formal CPD;
- Award at least 100 learning points to the individual CPD activities you carry out. Assigning points represents your assessment of what you got out of the CPD activity, and will be the result of the time you spent reflecting on relevant subjects.
- Gain at least half of your CPD from structured learning activities, unless your circumstances prevent it;
- Record CPD activities.

CPD is considered to be a creative learning tool, and any activity from which you can learn – as long as it's relevant to the practice or business of architecture and contributes towards maintaining practice's competence – could count as CPD (Tyler, 2016c). As long one learns from the activity and it influences your professionalism and competence, despite the medium, you may be doing your CPD.

This is a recent profound change over the strict way of formal learning and is linked to professional ethics and to the diversity of competences, attitudes and knowledges needed for the architect. It is the architect's responsibility to attend to its needs for continuing professional development in order to honor its social commitments to the common good and to the profession or art itself.

According to ACE (2006) *"CPD aims to deliver to architects a means to maintain and improve their personal culture, practice and competence and to update their knowledge regarding arts, science and technology, where there is permanent evolution, with due regard for the aesthetic, social and legal regulation of their activities."* According to Joni Taylor (20161, 2016c) unformal learning (outside the minimum 20 hours formal learning and up to 35 hours) can be found in:

- Doing some online or distance learning;
- Working towards an additional relevant qualification;
- Attending local or community courses;
- Bringing CPD or training expertise in house;
- Attending a conference or workshop;
- Listening to podcasts or watch webcasts;

– Engaging in knowledge transfer;
– Attending industry trade shows and exhibitions;
– Undertaking research: informal self-directed research, formal research, or research in practice;
– Or any other informal activities, such as: reading, going on study tours, volunteering, siting on committees, blogging, having discussions on social media, mentoring, visiting exhibitions, learning from colleagues, being a school governor, engaging in reconstruction or disaster relief.

The most important question is in fact how you reflect on learning from your experiences and increase your professional knowledge and skills to your benefit, as well as that of your staff, business, clients and future.

This subject is deeply covered by Donald Schön (2003) with the notions of *reflection-in-action*, and *reflection-on-action*. First it involves looking at the experiences, connecting them with our feelings and attending to our theories in use. It entails building new understandings to inform the actions in the situation that is unfolding. Then testing out the *theories* or *leading ideas* and allowing to developing further responses and moves. The act of reflecting-on-action enables spending time exploring why one acted as one did, what was happening in a group and so on. In so doing new sets of questions and ideas are developed about the activities and the practice.

Thus learning, reflection and change appear to provide opportunities for professional development in praxis, to both ACE, RIBA and AIA.

2.2 *Architectural research*

Jeremy Till's position paper on *What is architectural research?* for RIBA Research Committee (2005) has become theoretically inspiring for those discussing whether by architectural research we mean *research about architecture*, *research through architecture* or *research for architecture*. These three categories, borrowed from the least known Christopher Frayling's pamphlet on *Research in Art and Design* (1993), describe a general theory of design in which the task of solving the problems involves conceptualization and explicit knowledge adaptation to individual design experience.

Ken Friedmen (2008) discusses experience and inquiry stating that *"tacit knowledge is valuable"* and *"central to all human activity, and the background of embodied individual and social knowledge provides the existential foundation of all activities, including intellectual inquiry."* (2008, p. 157) Even though ancient sciences, that have successfully linked empirical observation with inventing theorizing (e.g. Copernicus, Galileo, Newton and others) thru hypothetical and deductive thinking, apparently seem to be less useful in providing useful theories and end up by being scorned by modern science, they constitute the fundamentals of tacit knowledge. Friedman states that *"all knowledge, science and practice rely on rich cycles of knowledge management moving from tacit knowledge to explicit and back again. While the craft tradition of design has relied more on tacit knowledge than on explicit knowledge, it is time to consider the explicit ways in which we can build design theory."* (2008, p. 158).

Some authors (Groat and Wang 2013, Salama 2015) argument that we are familiar with forms of historical and theoretical research about architecture and with the improvement of architectural and design practice as the focus of design research by design practitioners and theorists. However, research through architecture presents us systemic doubts about its methods and legitimacy.

Also Albena Yaneva (2005), following OMA's Whitney project presents the hypothesis of research in practice and with the project at hand.

Current practices at a research PhD program in architecture in the University of Évora (Salema et all 2014) sustain the possibility that *the "project (as a methodology, a process of knowledge or simulation of a 'hypothesis') could be part of an advanced research in architecture"* (p. 471) in academia doctoral programs. The *project* is the subject and the result of the research thesis, and the opportunity of the *project* is motivating and nurturing the academic *scientific* research.

2.3 *Design competitions*

Design Competitions are one of the oldest forms for selecting one architect or one project amongst others. *"Architectural design competitions are quality-based, project-orient selection procedures to procure architectural services. Quality based means that the decisions are made on basis of the quality of the submitted proposal. It is the opposite of a quantity-based, or even solely price-based, decision. Project-oriented means that the decisions are based on expectations for the future, as the basis is the upcoming project, and not on past achievements (as in the case of a team-based selection procedure)."* (Forlati and Isopp 2011, *p.274*).

The submitted entry is part of an educated hypothesis to the solution of the problem posed by the competition brief by the author. It is an individual research (Guilherme & Rocha 2013), sometimes pursued over several design competitions or projects (e.g. Souto de Moura's *Salzburg Hotel* (1987/89) *The Bank* (1993), and *The Burgo Tower* (1991/95 Phase 1; 2003/04 Phase 2; 2007 Construction)) but using the supposed *scientific method* of the academic *atelier* competition first seen at the *Beaux-Arts* (Malacrida 2010), never deeply refuted as the atelier's way to teach architecture between the *enlightened teacher*/*celebrated master architect* and the *apprentice* (Guilherme 2014). The jury system, and the concurrent projects from others challenge the commitment and ideas reaffirming that architecture is not practiced in isolation, but a public art, with public and social responsibilities.

Competitions *"are favored by professionals mainly by its symbolic (social, cultural and professional) capital (Stevens, 1998) as they reflect one's opportunity to prove one's abilities and ascend to those whose dominancy in profession is unquestioned. The main architectural universities (academia) function is to produce professional architects (Stevens, 1995), and to do so it has to reproduce the ways of an architect, and the consecrated privileges of the class. The parallel discussion at universities is the production of knowledge and ways to relate with the profession (praxis). Competitions provide a place and a time when both worlds unite, were the student is expected to learn an important lesson on the status of the architect and learning at the same time, and were the professional reunites, once again, his practice with research."* (Guilherme 2014).

Competitions have been the base pedagogic process for the transmission of symbolic capital by masters to pupils under an organized system of implicit professional knowledge. Competitions ensure that the fundamental hierarchy of the members of the academia (the teachers and juries: who defined what good art and architecture was) and those that would ascend to it (the students: who were prized and hence were the good artists and architects) and perpetuated a secular way to ascend to stardom. We believe architectural competitions provide an opportunity to research in architecture in order to present (using predetermined models and mediums) one's research and its conclusions (statements). Each personal architectural research is in fact subjected to an *informal* (unstated) merit competition (were the teachers take the part of clients, sponsors and juries), to a peer evaluation, in order to prove its author's right to, step by step, become a graduated architect. The research is validated by the competition and assures the originality of the research, its significance and rigor.

Therefore, as previously argued, competitions are opportunities for research (Guilherme & Rocha 2013) and have been used by the academia to foster development in knowledge (Guilherme 2014), thus we firmly believe design competitions may also constitute research in architecture outside the academia.

2.4 *The wonderland manual for emerging architects*

Wonderland – platform for European architecture is a Vienna (Austria) based network for young Europe-oriented architecture practices aiming experience, information and knowledge exchange.

Wonderland takes part in collaboration projects with international teams to foster inter-European exchange, organizes *Project Spaces*, *Blind Dates* and Symposiums, conducts research on current challenges and approaches in the field of architecture as well as urban planning and shares results with members and the public by means of exhibitions and publications. It is an expanding network and is strengthening their presence in Europe.

Wonderland published in collaboration with *A*10 three thematic numbers previous to the *Manual for Emerging Architects: How to Establish and Run an Architecture Practice in Europe* in 2012. This *"accelerating [of] the exchange of information among young architects in Europe"* (Forlati and Isopp 2011) is a speculative manual for reaching to a higher degree of social status within architectural symbolic capital. This manual explains the profession to the young professionals. It includes a coherent amount of information and poll-based surveys on how to conceive, establish, develop and run an architectural practice today.

After addressing how to *get started*, and *making mistakes* – an important part of being creative, of accidental innovation and by stating *trial and error* as a fundamental method of solving problems – the authors affirm the importance of *being public*, *being specialized* or *making competitions (Forlati and Isopp 2011*, p.269–328). Forlatti further develops:

> "*Taking part in a competition is about testing one's abilities outside a predefined setting of personal connections, nationality, office size, or gender. It is about experimenting and developing a personal vision much more directly than in the usual architect-client relationship. And winning a competition is much more than just getting a job! It is about the possibility of growing big in a day, of shortcutting years of slow growth, or of jumping scale in the size of projects the practice deals with, of getting a footing in a different national context, of specializing. And finally it is about publicity and recognition in and beyond the professional context – from colleagues to the general public." (Forlati and Isopp 2011, p.271)*

According to *Wonderlands*' pole-based surveys, an average practice in Europe does around 3 competitions and invests around 2000 hours per year. It achieves a ratio of 4 out of 10 returns of some kind, 2 wins and 2 other prizes, but only one gets realized. In fact, it takes about 8.4 years to realize 2.5 projects won in competitions.

According to *Wonderland* survey: 83% of the respondents sees competitions as a way to develop the architectural thinking in practice; 84% sees competitions as a necessity for clients who want new ideas; 50% uses models to test ideas; 74% has collaborators specialized in competitions in the office; 71% is not so interested in the first-prize money when choosing a competition; and 76% sees the relation between work required and compensation as problematic.

This data confirms the relevance of competitions to research about practice to European architects and its relevance as architectonic events for acquiring (or enlarging) its own symbolic capital.

2.5 *RIBA competitions task group report*

The RIBA Council approved in June 2014 the findings of the RIBA Task Group Review of architectural

competitions (RIBA 2014). The group comprised clients, client advisers, architects and RIBA executives, and was set up by the RIBA in 2013 to review the use of competitions in the UK.

Key recommendations of the review included the promotion of best practice guidance and the celebration and promotion of the benefits of competitions for all types of buildings, which should lead to an increase in the quantity of well-run and well-managed competitions.

Other task group recommendations approved by RIBA Council include improved processes to reduce waste such as design charrettes, standardized prequalification templates and additional services including client mentoring for less experienced clients. These recommendations are intended to challenge both the quantity and the quality of competitions run in England. RIBA has extensive experience in delivering high quality and significant competitions and competitive selection processes. By doing so, it also manages to impose architects as those best suited and responsible for obtaining high architectural quality among the profession.

RIBA Competitions standards include principles of openness, fairness and transparency, as well as protection of copyright, honoraria payments to reflect the amount of design work required, efficient processes including use of digital entry, judging composition, involvement of independent client adviser, and feedback to competitors. These standards are consolidated with a service to approve and promote qualifying third-party competitions. The main recommendations from the task group were (RIBA 2014, pp.14–16):

- Celebrate and promote the benefits of competitions;
- Increase the quantity of well-managed, well-regulated competitions;
- Provide best practice guidance and support to clients;
- Promote best practice and continuous improvement to processes;
- Influence the standards of other competition providers.

During a wider consultation a majority (11/3) responses (RIBA 2014, p. 27) led the Task Group to recommend that "*Competition entries should count towards an architect's CPD requirement"*. In fact, there was an overall idea that competitions could be part or research or training, in particular when new knowledge could be obtained. However, when competitions were only seen as a repeated procuring tool, respondents felt no development could arise, giving credit to the idea of design competitions being directed to major events or uncommon problems and not to ordinary problems.

This relevance is quite clear in relation to key professional development supplementing CPD Core Curriculum, which is the main CPD Study Guide, and is comprised of 10 subjects: (1) Being safe health and safety; (2) Climate: sustainable architecture; (3) External management: clients, users and delivery of services; (4) Internal management: professionalism, practice, business + management; (5) Compliance: legal, regulatory and statutory frameworks and processes; (6) Procurement and contracts; (7) Designing and building it: design, construction, technology and engineering; (8) Where people live: communities, urban + rural design and the planning process; (9) Context: the historic environment and its setting; and (10) Access for all: universal/inclusive design.

By including competitions as unformal CPD the Task Group would be providing a place where all could be tested in the form of a research hypothesis, thus enabling a potential research.

The competition would then become a research experience and therefore would constitute an even greater place for providing the public service RIBA wishes architects could do. By including or selecting competitions as an unformal CPD, British architects would have to work not only to win the commission (and therefore use design competitions as procurement), but also make competitions a place to research (therefore making competitions more innovative oriented).

2.6 *The Van Alen survey*

More recently *Architectural Record* and *Van Alen Institute* (2015a, 2015b, 2016), with support from the Graham Foundation, systematically gathered input on what motivates designers to enter competitions, what they love and hate about the process, and their suggestions for how to make them work better. They released the results with more than 1,400 participations from 65 nations worldwide.

Key findings (Van Alen Institute 2015a) from the anonymous responses highlight some of the most interesting headlines from the survey:

- Designers enter competitions so they can work more creatively than they would be able to in everyday practice, and explore new topics, ideas, collaborations, and skill sets outside of typical constraints. Respondents indicated that the top three reasons for entering competitions are 1) the opportunity to experiment (57,0% of survey entrants); 2) an interesting issue (54,9%); and 3) an opportunity to gain publicity (39,0%).
- The lack of compensation for time and resources spent is a primary limitation to designers participating in competitions. Respondents indicated that the top three limitations to participating in competitions are 1) lack of compensation for time/resources spent (78,6%); 2) low probability of winning (29,4%); and 3) no or low chance of implementation (28,6%).
- Respondents indicated a desire for more feedback (48%). This is especially crucial among students: 65% said it would make entering competitions more appealing. Students were also particularly interested in collaborating with people outside of the design fields.

These key findings support the idea that competitions are fundamentally an optimistic praxis of architecture. It is the most recent and relevant raw data analysis (Van Alen Institute 2015b) proving competitions are fundamental for students and licensed architects as research into practice.

In April 2015 a *Design Competition Conference* took place, sponsored by the *Harvard Graduate School of Design* and *Van Alen Institute*, co-chaired by Jerold S. Kayden and David van der Leer, in order to *"review the state of design competitions today and their impact on competitors, sponsors, design, and the public interest. Using the lens of professional, ethical, business, legal, aesthetic, and public policy perspectives"* (Van Alen Institute 2016d). The conference (Anon. 2015) is a testimony of the *pros and cons* of making competitions and a vivid story of some competition entries.

Some of the respondents assured that *"competition allows to work on otherwise impossible issues or subjects usually reserved for the 50 architects that are known worldwide... It is the best format for architectural research and learning through investigating."* In addition, some spoke how specific competitions more appealing to young architects (less than 40 years old) could be described like being *"[Europan] a catalyst of Urban and Architectural Research"*.

The survey is an unexpected view over the preconceived ideas on competitions, challenging their supposed hierarchy and importance.

3 CONCLUSIONS

We gathered evidence from different sources that present the importance of design competitions to architects and to the public realm. In 2011 *Wonderlands* conducted a European survey and launched a Manual for Emerging architects sustaining the value of competitions to the development of the architect. Four years later the *Van Alen Institute* has produced a worldwide survey about design competitions which ended with a major conference with Harvard University over the fundaments, the theory, the advantages and hazards of design competitions. Both surveys sustain that competitions are seen and used as research opportunities by architects. These researches are evaluated thru their merit by a jury taking into consideration the promoter or public interest. These surveys show that design competitions can be much more than just a way to gain a commission and enlarge the possibility of their use over other subjects of knowledge. No matter whether competition projects are built or not, and despite all waste of time, human or financial resources, the prizes increase the winners' symbolic capital within the architectural field, and the public attention given to competitions raises the prestige of the architectural profession in general.

There seems to exist a link between design competitions and architectural research at the academia and there is a new theoretical corpus of authors sustaining the hypothesis of being able to research thru the design. There is evidence that competitions are potentially research oriented procedures in praxis, and should be taken into account as similar, to some account, to scientific research.

We acknowledge there is evidence of the relevance of continuing professional development in relation to the initial education of the architect and to the practice (praxis) of architecture. Some countries have been updating their vision of what can constitute CPD and have included unformal ways of acquiring new knowledge. RIBA competitions task group has further stated that competitions should be considered as unformal CPD as long as it would influence the professionalism and competence of the architect.

We are convinced that the by doing competitions an architect is researching or *reflecting-in-action* thru design projects which can benefit and influence the way that architect works. Thus design competitions ought to be considered as opportunities for continuing professional development and should become part of CPD core curriculum.

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Modern architecture Kuwait: The role of the architect

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ABSTRACT: Upon assigned deputy curator for the first representation of Kuwait at the 13th International Architecture Exhibition of *La Biennale di Venezia*, the author initiated a research work on building production and architectural practice in this country.

In 2012 the author organized, as parallel event to the country's representation,a conference on Modern building heritage which included a series of round-table debates between practitioners and the local community. The success of this event triggered several years of research, on-site and archive visits and interviews with architects, planners, contractors, historians, and former city officials. In 2013, with the support of Kuwait Foundation for the Advancement of Sciences and on behalf of Dar al-Athar al-Islamiyyah initiated in co-authorship a double volume book, "Modern Architecture Kuwait.1949–89," recently published by *Niggli Verlag* as the first systematic analysis on the country's building production.

The paper prompts to expose the research above. Among the major motivations for it are the lack of knowledge and common misconceptions regarding the national architecture production between the collapse of the Ottoman Empire and Saddam Hussein's invasion. Erasing this part of Kuwait's national history is a major loss for the country, and a missed opportunity to investigate the nation's "modern" state foundation. The magnitude of this problem is demonstrated by the fact that since the study began at least three major buildings, all subject of the research work, have been demolished to create space for high-rise office buildings, while others have been deeply modified or covered with shiny aluminium cladding.

1 BUILDINGS AND BUILDING CULTURE IN KUWAIT

The act of build and re-build is part of a post- oil Kuwaiti community behavior, a form of equality, the need for the new home or the fascination with the new. Motivation, that is followed by a delusion of superiority, a seizure or conquest rather than a strategic removal of the existing, the old.

Following the discovery of oil and the colonial disengagement (1952–62), the act of building – a house, a hospital, a mosque or even a *diwaniya* – developed into a continuous need, a social imperative. The community becomes dependent on those modes of social equality and representation. At this point, Architecture and Planning assume the form of "a way to" the new and the modern, that stimulates destructiveness of the old and the construction of the new.

With the "New Town Development" (1952), Sheikh Abdullah Al-Salem Al-Sabah spearheaded the first large planning and infrastructural project of the country, expanding the built beyond the city walls and encouraging the demolition inside. The city itself disappeared. The city once a coherent spatial organization, governed by the continuities of ritual, history and memory, was fragmented and reorganized. Although, the city's instantaneous re-formation by the disappearance of the traditional geometric references did not result in lack of resolution of architectural image, as one could imagine. During the early stages of this reformation (1949-65) the focus on infrastructure and network enhanced the interconnection of various sites and - despite the isolated architectural "masterpieces" that gave a nominal symbolic content to the architecture – tolerates a sort of anonymous state-sponsored Modernism.

The complete demolition of the Old City centre and the comprehensive redesign of the urban form, together with the creation of the new neighbourhood units, catalysed the attention of major international designers working in synergy with local firms and authorities and leaving on the ground important examples of late Modern Architecture. Over a span of 40 years the process of reshaping Kuwait involved designers such as Kenzo Tange, Alison and Peter Smithson, Georges Candilis, Alfred Roth, Sayyed Karim, Hassan Fathy, Dar Al-Handasah, Mohammed Makiya, Rifat Chadirji, Basil Spence, BBPR, Pier Luigi Nervi, Felix Candela, I.M. Pei, SOM and TAC just to name a few.

As Kuwait gained independence and autonomy, the necessity of a new landscape to represent the freshly founded state grew high. A new urban environment was envisioned for a new state, therefore major architectural practices found here the possibility to expand their professional horizons and the challenge to compose an entire city, building by building, almost from

scratch. The urgency for a modern town and the ambition of architects led to the construction of a city made of stand-alone buildings. The diversity of production sources, together with the strong motivation for experimentation, generated and still generates a series of remarkable architectural-urban models.

To this day, the right of the City to take the land ownership with the purpose of providing land assets to its citizens, subsidized access to housing, and the aspirations for "a better future" dominate the social and economic spheres. Kuwait remains a merchant city where promises of industrialization and neoliberalism were defeated by the "affluent individualism" of its citizens and city officials, and by architects devoted to the erection of their own modern monuments. Along with the exposure to the objective possibilities of new building forms, the architects were seduced into the representation of glorified domestic industrial achievements, encouraged as a form of national pride.

2 ARCHITECTS AND THE COMMON PRACTICE IN KUWAIT

"In this period has grown the understanding that the building's action on the shaping of the territory and the spatial shaping of the territory itself should be at the center of our work." (Smithson, 1996)

"We use architects and planners from all over the world (…) We want the best." Qabazard said "and we need their help, not merely to design buildings, but to collaborate with local architects. (…) Sometimes we just want their advice and send them an air ticket." (Gardiner,1983)

Since then architectural authorship is measured by object building and the general consensus within the discipline is that architectural efforts should be visible in the city. After the Invasion (1990) the community goal lays in the far distance, in that other world, the promised *Silk City*, a project initially planned in 1977 to build a new capital city 60km from the northern border with Iraq. Gradually, the idea of direction becomes the most important thing. The more distant the goal the better the prospect of its permanence. The seemingly indispensable principles of growth before invasion, have been replaced by something quite different: by image replica or by repetition.

The post-war reconstruction and beautification process opened a precedent on city development, that is today the urban support for many of the architects and engineers practicing in the country. Issues of instant city, construction of new identities, the tabula rasa condition and questions of environment all will come up and for the first time in 40 years of modernization, a collective motivational ambition to restore the face of the city by referring back to an alleged traditional building culture. Together with this emergent and most likely conservative approach, the exotic lifestyle of a liberated transitory culture became a sort of "image bites" that collapsed traditional forms and complex urban patterns into single, consumable frames. The city developers, who then inherited this rearranged landscape of highways, tall buildings, and parking lots declared the left over voids diseased sites and offered their own, corrected architecture to fill them with yet more buildings. The architects on the other hand believed themselves to be gentle where their predecessors had been ruthless.

In light of such evidence there is ample support for the assumption that the phenomenon of Shiber's "fluid city shell" (Shiber,1964) was no longer related to the implementation of large planning operations, though it has substantial explanatory strength when it comes to the production of individual buildings. This, in turn, reinforces the conceptualization of the architectural process as a mechanism of linkage through which architects, owners, contractors and contexts exert control over integral parts of the city's hierarchies beyond the normative instruments of traditional planning.

3 MODERN ARCHITECTURE OF KUWAIT RESEARCH

"Modern Architecture Kuwait.1949–89," the MAK project in co-authorship with Sara Saragoca and Roberto Fabbri, departs from this conceptualization. These apparently uncorrelated works, described through mostly heretofore unknown information, are fundamental to providing tentative answers to a series of hypothetical questions: How were architectural design processes and practices developed from the early infrastructure of the 1950s to the invasion of 1990? How was architecture practiced in the absence of historical heritage, major local architectural references, strong morphological elements, or a strong urban footprint, and (occasionally) in absence of adequate planning tools or their correct implementation?

The objective of the MAK is to understand these dynamics of practice, rather than to produce a history of Kuwait's urban development. Consequently, the methods applied here concentrate the analysis on the multiple and built elements that compose the modern city, contextualizing the design practices and architectural intentions behind them. Through the understanding of the territory as a loose canvas that allows the physical presence of these elements to be rendered in the urban landscape, it became clear that a survey of buildings was the principal subject of this investigation. The traditional methods of an urban-scale approach were inadequate to the task. Our investigation began therefore with architectural elements as pivotal subjects and with an intensive engagement with over forty years of building production in Kuwait, including on-site visits, photographic surveys, archival research, and interviews with architects, planners, contractors, historians, and former city officials. This work was multiplied by extensive multidisciplinary and multimedia research using old city

plans, building drawings, photographs, film footage, letters, legal documents, architectural and construction press, journals, the popular press, and a range of other documents, including the portfolios and corporate profiles of design firms and contractors, in order to document every possible construction or building project comprised in those years. By focusing on the professional trajectories of these designers and by reading the presence of these buildings in the urban environment at the architectural scale, the research examined and analysed a selection of buildings which is finally presented here as an architectural atlas.

This repertoire of hundreds of buildings is revealed as a collection of specimens, selected for their specific qualitative aspects, as examples of particular design methodologies or typologies, or else for their different adaptations to the severity of local environmental conditions. The method applied here has been to simultaneously read the differing chronologies and geographic linkages of urban and architectural practice in order to understand dynamics of change and innovation in terms of design principles, the city fabric, and construction technology. As a result, a different narrative from that of the chronological survey came to the forefront—what the building actually does, contrary to what it was intended or designed to do. In this way, the project pursues the value of the built object in the city beyond its function or program.

The final building selection involved a complex process of inclusion and exclusion. Some buildings are unequivocally—sometimes rhetorically—considered local landmarks, such as the National Assembly, *the Abraj Al-Kuwait* (the Kuwait Towers) or the State Mosque, while other types, such as single and multi-family dwelling units, exist in such numbers and diversity that they were impossible to account for and characterize in a overview study such as this and for that reason were excluded. With regard to housing, exceptions were made for certain mixed-use typologies, such as Hassawi Residential and the Nugra and Dasman complexes, that are relevant for their authors, their complexity of scale or their importance for understanding the city, as one can also argue in the cases of al-Muthanna or the Rehab complexes. The same approach gradually led the research into the systematic analysis of lesser-known projects, such as the Shuwaikh Power Station and Desalination Plant or the Kuwait Shipping Company offices, as well as unbuilt proposals such as the Sport Centre or the Low-Income Housing Schemes.

In this intricate realm, the availability of sources played a very important role in the selection of buildings. Despite the acknowledged efforts of some major local firms, it was not easy to gain access to primary sources in Kuwait, which are often dispersed or forgotten. Needless to say, some buildings could not be described here given the lack of these supports. On the contrary, the international projects, once discovered, were found to be well documented in archives, but these were scattered all over the world. It took the collaboration of several fellow researchers to collect these documents, creating a long-distance network of exchanges.

The research identified a selection of around 150 projects covering a span of forty years. A major effort was invested in creating a timeline and biographical references of architects, planners and contractors that could put these projects in relation to the region's recent history as well as to the architectural scene of the Middle East.

In a second moment, the project invites other scholars and researchers to develop further a critical understanding of the city and buildings.

3.1 *The role of the building*

In the course of selecting and chronologically mapping the buildings, it became clear that the diversity inherent to architecture and urban practice in Kuwait were over determined by the city's history and geography of modernisation. The chronological organization of the buildings in four chapters in the book allows a reading across historical time of the interactive processes by which the city was gradually generated and, through authored projects, the city's image. Such an organization highlights the role of practices, and of urban architectural knowledge, in the process of generating the city.

3.1.1 *Building as infrastructure*

The first of these chapters reflects the first generation of the country's modern architecture and its foundational principles established by an elite of British designers, contractors and officials. The core of this early development process was made of schools, power plants, hospitals, administrative and governmental offices. Among these, the usage and the construction technology and material are prevailing conditions. Although, projects such as the Southwell Hospital in Ahmadi (1951–60), the Vocational Technical College (1953–54) in Shuwaikh and the Institute for Physically Handicaped (1963–69) preceded later attempts by the Smithsons and Candilis, Josic and Woods to conceptualize low-rise, highly dense building types. Following Alison Smithson's publication on "How to recognise and read mat-building" for the British journal Architectural Design in 1974 and their proposal for the Ministries Complex (1969–72), these typologies became popular referents in many of the design briefs for schools and public institutions in Kuwait during the 1980's.

3.1.2 *Building as national identity*

The projects collected in the second section consider buildings but also some of the medium-scale urban schemes that best represent the Pan-Arab spirit of the "Al-Imara al-Haditha" (modern architecture). The term coined by Ihsan Sherzad for Iraq is commonly used by local scholars and historians to refer to the work of Sayyed Karim's in Kuwait and Shiber's well-known "architectural control"(Shiber, 1964). These principles expressed an ideal and mature Arab state

seeking to establish its own national identity through projects of often larger scale and international projection that could finally render the "City of the Future," a fluid territory in which projects such as the Khaldiya Girls Secondary School or the Governmental Hotel, for example, were allowed to change location or function within the span of a few years. Furthermore, Shiber's efforts to promote the revision of the First Master Plan through zoned and detailed urban plans led to the creation of the Central Business District Areas. In these areas Shiber called for the "rational building" of a "type of architecture suited for Kuwait."(Shiber, 1962) The considerable amount of buildings erected in these districts were either designed by Saba Shiber and his team or through international design competitions, which diversified the design approaches from those discussed in the first chapter. For instance, the "Grand Corniche" and the redevelopment of the old city harbour area constituted proposals for the first large-scale development process that was open to urban design where Shiber pursued the ideal environment for this "City of the Future."(Shiber, 1964).

3.1.3 *Building as cityscape*

The complexity and experiences resulting from such operations prompted a new elite of city officials, such as Hamid Shuaib and Ghazi Sultan, to look into the city's historical layers and read them against the regulation plans. In the third chapter of specimens it becomes clear how the unstable environment of Kuwait's urbanization made conventional methods of planning and urban homogenisation difficult to implement in subsequent years. In 1968 the invitation "to Prepare Urban Form Studies for the Old City," given to Alison and Peter Smithson, Reima and Raili Pietilä, Candilis, Josic and Woods, and BBPR, and the multiple design competitions for Low Income Housing schemes, called for more agile and assertive techniques of intervention. What was expected from these proposed architectures was not simply a vision of future development but the actual capacity to generate physical impact in shaping the city's visual appearance, as well as the functionality of the cityscape itself.

The brief for Al-Riqqa Low-Income Housing, addressed to Jafar Tukan, requested "units of classic Arab design, in harmony with local architecture." Meanwhile, Macklin L. Hancock called for an Islamic-arabic inherited approach to "understand how this can be achieved [considering] materials which will help to keep maintenance costs low [and] effective solutions to technical problems unique to this part of the world"(Hancock, 1969). During the 1970s practices such as Iraq Consult, PACE, KEO, KEG, and Sabah Abi-Hanna (later SSH) initiated a remarkable body of work related to the private development of mixed-used programs which seek, in their own ways, the aesthetic values identified by Hancock.

The functionality of this new cityscape required strategies that were architectural as well as urban. It required urban buildings that engaged the city at the level of the urban plan. In this sense, the Demonstration Areas, identified as consequences of the 1968 "Urban Form Studies for the Old City," fully expressed this condition: "The intention was to illustrate principles by actual buildings for known demands" (Smithson, 1974). This initiative resulted in multiple modern souqs and high-rise buildings scattered all across Kuwait City. The consultant to the Municipality, Roland Kluver, encouraged the idea of a self-contained unit in order to recover the residential component within the city centre. The ambition of the late Sheikh Sabah al Salem al Sabah, was here finally rendered throughout different projects: "Kuwaitis are entranced by the fanciful idea of roofing over Kuwait and air-conditioning it all, with powerful planetariums projecting beautiful skies day and night. This little country has the money to think big." (De Carvalho, 1965)

3.1.4 *Building as program*

Finally, during the 1980s, Kuwaitis' extensive interest in building construction became more of a business matter rather than a welfare policy. The celebration of the building boom uncritically offered the city up to market forces. The capitalization of formal and informal stock exchanges in Kuwait was by 1982 ranked third in the world, behind the US and Japan. But by the summer the Kuwait informal market stopped trading. The Souq Al-Manakh crash, still referred to until recently as "the greatest stock market bubble of all time," revealed the volatility of oil and the speculative finance economy prevalent in the country (Kubo, 2012). In the following year construction in Kuwait dropped by 50%, leading to the interruption of some of the undergoing projects, and eventually to the bankruptcy of contracting firms and designers such as TAC. Within this scenario, the forth chapter covers the remaining interval of production until the Iraqi Invasion in 1990. This time frame of uncertainty represented a new beginning in urban policy, which eventually extended beyond the Invasion. As a result, architects and other building actors were forced to adjust to frequent changes and learned how to instrumentalise these changes in their own interest claiming for the autonomy of the discipline from the building function as an attempt to revive local tradition and culture. In this way, the building program becomes the central argument to provide the spatial nature and capacity to evoke visual imaginaries and aspirations. The architecture elements are then defined by choice of either parties and oscillating between exuberance and some disillusionment with the modern. The Conference Centre in Bayan is a clear reference to this: the architect of 'Sava Centar', the most modern convention centre at the time and once called the technological marvel of Tito in Belgrade, is here reinterpreted in a typology of the past claiming for other architectural roots than those being displayed in the city buildings. Initially without purpose the Conference Centre was the excuse to perform the scale and exuberance aspired.

Under the guidance of well-educated owners or client representatives, building practice often developed into personalized and emotional narratives, proper to a post-modern condition and well described by Krzysztof Wiśniowski, co-author for the Port Authority Headquarters. For this project Wiśniowski recalls the Centre Georges Pompidou being a strong reference in the client's requests, consequentially bringing more analogical arguments into the design process: "the four car ramps were [conceived] as mooring lines that secure a Dhow." The Arab Organizations Headquarters Building in Shuwaikh, developed between 1982–90 by Mohamed Makkiyah in association with Archicentre and completed in 1994 by PACE, is a good example of a design process initiated here and perpetuated to this day.

3.2 *Mapping modernity in Kuwait*

Each specimen was dissected, analysed and presented here as part of the kaleidoscopic heritage of modern architecture in Kuwait. Time-wise, modernism is conventionally situated in the first half of the 20th century and geographically placed, in most cases, in Europe or in the Americas. The definition of Modern Architecture is widely misused, often confused—for example with contemporary—and is not conducive to shaping a close classification, especially if it is understood that a real modern movement never really existed as one tight movement with a single agenda, but rather through multiple contingent collaborations, debates, and confrontation between architects and artists that often shared highly divergent points of view and approaches to design.

Marcel Breuer, whose studio was also involved in Kuwait at a later stage of his career, expresses in an undated note his concern regarding the word modern, for the multiplicity of meanings that it can trigger. He labeled it as an excellent sales term, and as such he tried to elaborate the concept in a way that seemed relevant for this research: "Now, if we use the term 'modern architecture' I mean something quite different. And I should say that I call the most modern architecture the one which longest remains 'modern'. (…) In the sense in which I use this term, modern design or architecture is not a form or a motif, but rather an instinct, or rather, a tendency. (…) As I mentioned before, not the outside characteristics are real significance of this movement but rather the fundamental instincts behind its forms. Going down to the roots of our work, I see three basic principles: First: the direct approach. Second: the tendency for clarity. Third: the tendency to create with truthful elements; (or indifference to create with forms of illusion, or with decorative covering forms)."(Breuer, 1986)

These basic principles also suggest common characteristics among the varieties of different buildings, from different times and by different authors, that have been selected to compose this study. The Kuwaiti architectural context can perhaps be better inscribed in the frame of other modernisms, borrowing the—nowadays frequently used—title of the Do.co.mo.mo (Docomomo International) conference in Turkey 2006, which gave an impulse to reconsider less orthodox forms of modernism.

3.3 *Recovering a lost identity*

Modernization efforts were halted in 1990, and after the Invasion for the first time since the inception of the Antiquities Law in 1960, conservation ideas began to take hold. Nevertheless, following the death of Saddam Hussein in late 2006, the country recovered its trust in a certain future and new initiatives for design and building started without the addition of any critique of the prior standards.

As with other cities in the region, the town center of Kuwait has suffered a gradual deterioration in areas once characterized by their modern architecture, and today faces the challenge of conservation, confronted with the current processes of urban development. The residential urban periphery, although an urban fabric characterized by single-unit structures, includes a number of modern buildings of significant quality that have been modified or are at risk of demolition. In fact, the value of these modern structures is not always understood, so that often the buildings are demolished and replaced. This phenomenon has been encouraged by an elite of politicians, scholars and even architecture and planning practitioners that have labeled these architectures as "foreign" and therefore implicitly indifferent to local history and building tradition. Only recently, under narratives of "nation building" through memory and identity, an emerging community of young, well-educated artists and professionals from the most varied sectors of society has started to project an "archeological status" onto these buildings, urging for their preservation.

4 CONCLUSION

Among the major motivations for conducting this study are the lack of knowledge and common misconceptions of the architecture produced within this timeframe in Kuwait. Kuwaiti citizens often show disaffection and a low sense of belonging to these spaces, and the authorities have taken very few measures in the past to promote the conservation and restoration of this important heritage. Erasing this part of Kuwait's national history, as well as its international architectural heritage, is a major loss for the country, and a missed opportunity to investigate the country's recent past. The magnitude of this problem is easily demonstrated by the fact that since this study began at least three major buildings, all present in this book, have been demolished to create space for brand-new towers, while others have been deeply modified or covered with shiny aluminium cladding. While it is impossible not to feel a deep sense of loss every time a trace of the past has been erased, it is equally impossible to pursue preservation practice or policies without creating

a proper baseline. This requires a scientific, systematic database similar, for instance, to Evangelia Simos Ali's survey of Kuwait's surviving pre-oil structures, conducted in the early 1980s.

Two major goals can be ascribed to the survey presented here. First, to create the first database of the most significant modern architectural specimens in Kuwait, identifying the key players and distinctive features of relevance to both the culture of Kuwaiti citizens and a wider professional audience. Second, to reopen the discussion of building conservation decisions and an examination of emerging approaches related to the rehabilitation and adaptive reuse of modern architecture, nowadays suffering from a lack of recognition and an almost nonexistent framework of legal protection. Contrary to the idea of fossilization in a sort of a modern archaeological park, where every building becomes a monument to itself or a museum, compatible transformations can perhaps bring back life to the abandoned and reestablish new functions for the outdated.

A renewed architectural consciousness has emerged in recent years throughout the several publications, articles, exhibitions, conferences and lectures hosted both in academic and cultural contexts in Kuwait. These efforts have made modern architecture in Kuwait and Middle East the main subjects of academic research for local and international scholars and research institutes, which MAK has acknowledged throughout this research.

A peak of this ongoing process can also be read in the participation of Kuwait in the last two architectural editions of *La Biennale di Venezia*, where the national pavilions were produced by local curators around the subject of national heritage. All of these combined efforts have been capped by the submission of *Abraj Al-Kuwait* to be listed as a UNESCO World Heritage Site. If successful, this will be the first nomination for the modern architectural and urban heritage of Kuwait. The blogosphere, a space in which a mass audience sharing comments and thoughts on the subject of the city in transformation becomes visible, has led to more tangible actions in the street, like the first public protest against the demolition of the old Chamber of Commerce, in 2014. For those who are not familiar with the Gulf, this is not common.

In the authors' intentions this research was never to be an exhaustive representation of forty years of architectural practice in Kuwait. The aspiration is rather to deepen our knowledge of the city's built environment, with the declared intention of informing contemporary architectural and urban practice. A better understanding of this important heritage can open architects, planners and city officials to a different way of doing, providing not only a collection of information, documents and drawings, but a practical tool that could trigger a better use of these buildings.

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The architect and interactive buildings: From builder to composer and conductor?

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ABSTRACT: Three upcoming technologies – Internet of Things, Wearables, and Cloud Computing are seen to converge in support of smart buildings and smart cities. In this paper characteristics of interactive architecture is discussed, and how the mentioned technologies may impact such buildings. The conception, design, and creation of interactive architecture requires a rethinking of the design process by the architect. Some preliminary strategies are outlined to achieve this. The role of the architect moves to a composer- or conductor-like style.

1 THREE DISRUPTIVE TECHNOLOGIES

Technological developments have a large influence on buildings and the urban environment on an increasing wider spectrum of aspects. This concerns not only the widening capabilities in the design process (rapid prototyping, generative design, parametric modelling, design-to-production) but also the world around us itself. Environmental pressures require architects, urbanists, and society to come up with sustainable solutions. Smart Buildings and Smart Cities are coming up that take advantage of advanced control systems (for buildings) and connected networks (for cities) to make more responsive environments which ca n reduce some of these pressures (for example energy, carbon footprint, congestion, and so on).

In this paper we propose that there are three technologies which will have a disruptive effect on architecture: The *Internet of Things*, *Wearables*, and *Cloud Computing*.

The Internet of Things (commonly abbreviated as *"IoT"*) combines physical objects with their computational representation so that the objects can be manipulated by virtual entities. The term was first introduced in Ashton (2009). Intelligence and knowledge about location and state of things is transferred to the objects themselves, and needs no longer be inferred top-down. IoT lowers the boundary between physical and virtual systems and actually allows them to operate in a physical-virtual continuum.

Wearables are simple or more advanced sensing and computing devices that people wear on their body (for an early example, SensVest, see Knight et al. 2005). Wearables often have GPS functionality and track user vital statistics such as heart rate, respiration, caloric burning, and so on. Wearables form a middle layer that can inform smart systems about the physical condition of the user. Additionally, the environment may provide wearables with relevant information for the user (for example training-wearables that get information about smog levels in a city – thus able to advise the user where to take their jogging route).

Cloud computing is a comprehensive set of servers and network technologies that are outsourced and scale with user's needs, meaning transfer of data and computing resources from locally managed systems to network-based services (Buyya et al. 2009). Smart devices may obtain necessary data and computational resources from Cloud services thus reducing the need for large capacity facilities within the devices themselves. Additionally, since most of the services run through virtualized machines, the exact location of the real resources becomes less important. Therefore it is sufficient to connect wireless to local resources, thus reducing bandwidth and transmitting capacity.

In short, we can summarize the effect of the three technologies together as follows: through IoT, building components become more aware of their surroundings. They can infer valuable information about inhabitants through Wearables that people have on them, via direct communication or via Cloud technology. Local inference by the building components themselves, or facilities through Cloud services, allows buildings to respond to user needs. Through this convergence of technologies we can achieve interactive architecture.

There are many technological developments in each of the mentioned fields, and the implications and technical aspects are much wider than we as architects are able to understand, process, or influence. What is important to note however, that it is not necessary to be completely knowledgeable of all things happening in order to take advantage of these developments? Applying IoT, wearables, and Cloud computing to buildings

sets a number of boundary conditions which simplify the application of these technologies:

1. *Location*: buildings are precisely localized, therefore their services are localized as well. Inhabitants are either present in the building (direct interaction), or in a different place (requiring agency of the services in that different place). High accuracy indoor location sensing can be obtained with well-placed RFID tags. Public location-based services can breach privacy (they gather information about place and interest of a user), but this is less the case in the home/occupant relationship. Additionally, because of fixed location devices need only take into account objects and people around them in a limited area.
2. *Characteristics*: Technological requirements for indoor environments are less demanding than for the whole outside world: indoor environments typically have small network size, few users (family members), rechargeable batteries power source, Wifi, 3G, 4G LTE backbone Internet connectivity, local server, RFID and WSN devices, and small bandwidth requirements. For public buildings these services scale up and have to include also anonymous users.
3. *Easier orchestration of services*: the amount of smart objects and services which have to coordinate their tasks in a building context is much less and also more specific than in the general IoT context – which needs to cover the whole outside world.

These technologies by themselves are not enough to reliably and without fault infer what the needs and desires of a building's inhabitant are. It will still take intelligent user profiling and learning algorithms to understand the needs (see for example Wemlinger & Holder 2015). However, the combination of Internet of Things, Cloud computing, and Wearables will lower the information gathering task for an interactive system in a substantial amount. Wearables by themselves monitor physiological data of the user, and most likely will combine this with social data as well (smart phone functions like agenda and so), so an interactive system can simply ask the wearable rather about the condition of the inhabitant. Cloud computing and IoT add locational information to create from which a spatial understanding of both inhabitant and building can be derived.

2 DISRUPTION, THEN WHAT?

The notion of disruption is quite complex and under ongoing development and refinement. It has to be pointed out that it is more proper to speak of disruptive processes rather than technologies – the disruption is not in the technologies but in the (in)abilities of companies to deal with changing technology (Christensen 2006). Nevertheless, in mainstream discussion the term "disruptive" is usually associated with technology, and it has come to mean any game-changer that will have a profound influence on a particular sector.

In the previous section we have argued why the particular combination of IoT, Cloud computing, and Wearables will be disruptive. What will actually be disrupted, is the conventional state of the built environment as a passive object. With cities and buildings acquiring responsive capabilities, we will need design offices, teams, legislative bodies, and the general public to adopt different design thinking, strategies, norms, and expectations. In the further part of this paper we will discuss in particular interactive architecture as a concrete emerging phenomenon from this disruption.

3 INTERACTIVE ARCHITECTURE

Advances in technology are leading to buildings that can autonomously act more of their own and change according to particular settings in a more or less intelligent way. Such buildings have been termed in various ways, for example: *Building Automation System*, *Smart Home*, *Sentient Building*, *Adaptive Building*, *Dynamic Building*, *Interactive Building*, *Kinetic Architecture*, *Intelligent Building*, or *Portable Building* (Achten 2014a). The variety in terminology indicates that much of this is still in preliminary stage, and indeed many of their applications seem like "a *solution* looking for a *problem*" (Maia & Meyboom 2015). The most consistently developed systems at the moment are Smart Homes, which take up most of the references of research in this field (see for example Crowley & Coutaz 2015).

In our research we are interested in the phenomenon of *interactive architecture*. To be precise, for a building to be interactive, we desire of the building (or of the building components) to engage in a meaningful transfer of information with the user, such that the state of the user and the building may be changed after this exchange of information. Therefore many semi-autonomous actions in buildings, such as automatically opening doors, opening or closing blinds, thermal control, and so on that take place without active consideration of the user are *not* interactive in our view.

3.1 *Orientations in interaction*

In today's situation, most interactive environments are either geared towards optimal performance (mostly Smart Homes) or to information or entertainment activities (mostly media facades). We propose that there are more orientations possible for interactive systems, in total *performance*, *sustainability*, *service*, *symbolizing*, and *entertaining*.

1. *Performance*: the interactive system aims to obtain optimal performance according to a set of objective criteria (for example lighting conditions, acoustic requirements, thermal comfort, and so on).

Table 1. Interaction attitudes.

	Instruct	Conversation	Manipulate	Explore
Performance	Trainer	Fellow	Specialist	Explorer
Sustainability	Mentor	Helper	Scout	Discoverer
Service	HAL	Host	Assistant	Technician
Symbolizing	Icon	Peer	Chaplain	Guru
Entertaining	Idol	Buddy	Crew	Entertainer

2. *Sustainability*: the interactive system aims to maximally reduce carbon footprint and other aspects that impact energy consumption (for example use of daylight, heat recovery treatment, operating passive systems, and so on).
3. *Service*: the interactive system aims to provide an optimal set of services for building users (for example pathfinding of visitors, allocation of resources for building functions, adaptively managing elevator and escalator routines combined with user patterns, and so on).
4. *Symbolizing*: the interactive system aims to optimally convey a societal, symbolic, religious, or metaphoric function that deepens community commitment (for example supporting life phases and steps like wedding, baptism, or funeral; events of state, or community).
5. *Entertaining*: the interactive system aims to express an entertaining value to the inhabitant and visitor (for example through display of images and sound, to create illusions or trompe-l'oeil, generate effects to impress or awe visitors, and so on).

We have to note that perhaps the distinction between five orientations may be too fine-grained. There definitely is a distinction between "performance" and "sustainability" (high performance usually comes at the cost of larger energy demands), but maybe "service" could be integrated into "performance." Similarly, "symbolizing" and "entertaining," since they both have representative function may be combined into one category, thus leading to three main orientations rather than five. This is something that can only be assessed through application of the theory, and see where the distinctions make sense.

3.2 *Styles in interaction*

According to interaction design theory (Sharp, Rogers & Preece 2007), interactive systems can try to *instruct* a user, have a *conversation*, *manipulate*, or *explore*.

1. *Instruct*: the interactive system aims to clarify the use of an object or technology to the user (for example how the user has to operate the indoor climate system to obtain thermal comfort while maintaining good energy footprint).
2. *Conversation*: the interactive system exchanges information with the user in a dialogue kind of fashion (for example the building delivers monitoring data about its functioning to the user, or an online security system may inquire about the purpose of a visit).
3. *Manipulate*: the interactive system and user aim to achieve a particular goal through manipulation (for example setting the desired levels of comfort in a building without the user needing to know how this is achieved).
4. *Explore*: the interactive system and user try out various options without clear goal-fulfilling behavior (for example experimenting with lighting settings, or different options for opening and closing blinds, and so on).

Interaction style determine ways how an interactive system may engage with the user in a dialogue. These styles influence for example which information is shown, how consequences are displayed, which options are available, and so on.

3.3 *Attitudes of interactive buildings*

From the combination of orientations (performance, sustainability, service, symbolizing, and entertaining) and interaction styles (instruct, conversation, manipulate, and explore), we can derive 20 possible interaction *attitudes* (Achten 2013) – see Table 1.

By giving the attitudes descriptive names like personalities (trainer, helper, fellow, buddy, etc.) we want to indicate that each attitude has distinctive qualities. It does not mean that these attitudes act like a personality per sé. They form guidelines for the designer rather than a fixed set of norms and values which have to be obtained.

The realization of an attitude can be split up in two parts: the outward part that is visible to the user, and the inward part that controls the mechanics of the interactive system.

The outward part concerns changes in the building like moving objects, different light levels, signals, displayed information, and so on. As the user may infer intentions of the outward part, we may call this the "intentional level" of the attitude. This part will be the main concern of the architect and the design team that have to come up with the interaction concept of a building.

The inward part concerns changes in the sensors, controllers, and actuators that effect the interaction itself. Since the inward mechanics part is usually hidden to the user, we can call this the "cognitive level" of the attitude. This part will be the main concern of the

specialists, programmers, and technicians who build concrete interactive systems. In Achten (2014b) we demonstrated the split between intentional and cognitive level on the hypothetical design for an interactive museum.

3.4 *Keeping things consistent: the narrative*

A noted characteristic of attitude by assigning them a personality is that we want these attitudes to remain consistent in the way they act. It is quite easy to lose this consistency if we treat interaction as a series of unrelated events between inhabitant and building. Lehman (2013) notes that interaction occurs through a series of interaction points (between system and user) that should support the "narrative" of the user – the logical unfolding of a series of events that comply with the user's needs. Users may go through different narratives in the same environment as their needs dictate. For example, in a hospital environment, the user as patient may have several narratives (undergoing therapy, having consultation, getting visitors, and so on). Each of these narratives need to be supported by an interactive environment.

In the same way as Lehman argues for a user-based narrative, we believe that narrative is instrumental for the system side as well. In that sense an "*interaction narrative*" is the logical and consistent unfolding of a series of interaction events in an interactive system. The notion of interaction narrative strengthens the concept of attitude because both focus on consistency. Attitude does this through assigning a 'personality,' and narrative does this through a consistent series of interactions.

4 TOWARDS INTERACTION DESIGN

Who should design our future interactive buildings and environments? We propose that this is not a question to be solved by installation experts, but is something that has to be considered by the architect from the very start. We expect that interaction will have a large impact on the character of buildings, and thus architects need to find an adequate expression for this. There are however, very few theoretical frameworks that can support architects in the design of interactive buildings.

Cedric Price (1934–2003) and Gordon Pask (1928–1996) have to be mentioned as the earliest pioneers who actually tried to realize interactive buildings. In 1971 already, Cedric Price realized the Inter-Action Centre in Kentish Town, UK (Kronenburg 2007: 209). This building was the realization of a more ambitious concept, the Fun Palace, proposed in 1961 in collaboration with theatrical director Joan Littlewood. The Inter Action Centre consisted of an open frame in which modules could be inserted and changed at will. Gordon Pask argued as early as 1969 that architects should design systems rather than buildings. As Pask wrote: "*Another consequence is that architects are required to design* dynamic *rather than* static *entities. Clearly, the human part of the system is dynamic. But it is equally true (though less obvious) that the structural part must be imaged as continually regulating its human inhabitants*." (Pask 1969: 494).

Most of the ideas of those times were ahead of technological possibilities, and this applies even some decades later when the first so-called interactive structures were built – such as the *Tower of Winds* project by Toyo Ito in 1986, Yokohama (Mignonneau & Sommerer 2008: 94). The majority of likewise realized projects focused on some visual representation of dynamics because that was technologically speaking the most feasible way. A widely noted next step of a dynamic structure with actually moving parts was achieved with the so-called *Aegis Hyposurface* installation in 2000, a project lead by Marc Goulthorpe (Liu 2001: 36–41).

In the past decade many sensor-, actuator-, and controller-technologies, as well as easy programming tools became increasingly more available. This allowed many people to experiment with responsive technologies, both in practice and in academia. Trying to summarize who is actively investigating responsive technologies today is a near impossible task. Notable architects who have tried their hand on interactive buildings and installations from the early beginning are for example Michael Fox & Juintow Lin, Tristan d'Estrée Sterk (Orambra), Kas Oosterhuis (Hyperbody & ONL), Chuck Hoberman (Hoberman Associates), and so on. Many experimental practices with younger generation of architects and researchers have a close connection between industry and academia. Examples of such researchers among many others are Omar Khan & Laura Garofalo (Liminal Projects), Jason Kelly Johnson & Nataly Gattegno (Future Cities Lab), Madeline Gannon (Carnegie Mellon University), Alessio Erioli (Co-de-iT, Bologna), Manuel Kretzer (Responsive Design Studio), Andrew Vande Moere (KU Leuven), and so on.

4.1 *Small projects – great expectations*

Many buildings today feature responsive components such as self-regulating blinds, escalators, surveillance systems, and so on. The largest interactive structures in architecture by and far are media facades. Advanced electronics firms like Philips (Aarts & Marzano 2003) and Samsung [1] offer interactive solutions without considerations of the architectural side. Smaller companies, in particular active in home automation, but also office automation, offer specialized products such as virtual sky ceilings [2] and home control hubs like *ivee* [3].

Architects who experiment with interaction usually do not have the backing of an R&D unit that electronics firms have, so mostly they are limited within the resources offered on a project basis or within a research

budget at a school. Sometimes we can see a combination with material investigation due to availability of rapid prototyping technologies and the application of unconventional materials. Most of the time however, materials and interaction are two separate worlds (research groups with strong material research are for example *Institute for Computational Design* Stuttgart (headed by Achim Menges), MIT's *Mediated Matter* (headed by Neri Oxman), MIT's *self-Assembly Lab* (headed by Skylar Tibbits), or *Kokkugia* (headed by Roland Snooks and Robert Stuart-Smith).

The view of the architect that emerges from all this work is an experimentation-involved practice that advances knowledge step-by-step on a project basis. There is a certain ad-hoc character to this experimentation because available means depend on contingencies in budget, available technology, team composition, local authorities, and so on. Consistent lines of inquiry are usually supported in the collaboration or integration in a research unit. Universities (for example those mentioned above, but there are many more) can allow longer timelines of investigation that are separate from practical applications.

It is fair to state that most actually built projects are of modest size. In fact, a complete interactive building yet has to be realized to the best of my knowledge. The Prairie House project (2011) by Tristan d'Estrée Sterk's Orambra [4] comes close but was not built. What is happening however, is that through many projects, installations, new material experimentation, collaboration between architects, scientists, and artists, and so on, the discipline of architecture is building experience and confidence with this very new phenomenon. I sincerely believe it is only a matter of time, within a very short time horizon (within two or five years from now) that a highly interactive building will see the light – chances are it may already be in development somewhere.

4.2 *A changing perspective*

Based on the discussion above, we can see an increasing number of opportunities for architects to experiment with interactive buildings. This is not just a technological story. To successfully design interactive buildings we need a different design process and changes in the design team composition and roles.

The focus of the architect in the design process changes. Rather than designing a static structure, the architect has to compose a dynamic and responsive structure. More than ever, what the architect should be considering first, is the experience of the inhabitant in the building. Designing such an experience is not trivial, because it is no longer based on a user observing a static object. The building's responsiveness and dialogue with the user comes into consideration as well. Furthermore, "the inhabitant" as such is not a single individual, but can be any number of people. Additionally, some of these people will have regular contact with the building, but others may be one-time passers-by and anonymous.

In order to tackle this well, architects should have the following skills:

1. *Analyze dynamics of existing context and future built environment*. This analysis goes beyond traditional analysis of people and traffic movement. Dynamics of existing context deals with energy, material, people, and information flow of all kinds. It is in particular important to identify patterns of density and exchange that can indicate important activities and occurrences in the environment. Additionally, it is important to understand that a future design will influence these patterns. The aim obviously is to create a design which has positive effects, but even with advanced simulation tools these are difficult to predict.
2. *Design a dynamic experience of the building*. More than ever, user experience design becomes an important aspect of a building design. User experience consists of a complex set of interactions of the user with the building, all of which lead to an understanding of the user of the building. This is strongly related with the attitudes listed in Table 1, in order to avoid an ad-hoc collection of unrelated interactive user experiences.
3. *Synchronize the various interactive components* to establish a consistent whole of the building activities. The interaction narrative outlined before organizes the themes of interaction between user and building. These have to form a consistent story so that the user understands and to some extend may anticipate what he or she can do in the building.

In earlier work we have outlined a number of design methods that may assist architects in the design of interactive architecture (Achten and Kopřivá 2010).

Understanding a dynamic future, creating a dynamic experience, and synchronizing components are skills often encountered in *music composers* and *conductors*. Throughout the ages, composers have written scores that provide a particular musical experience. By means of notational system the main music was set down, however, leaving freedom for the actually playing musicians how to interpret the music. In the same way a conductor, dealing with a score, has to decide on an interpretation to make the music really come to life.

Architects arguably are not composers nor conductors. We would claim however, that architects would benefit if they were inspired by some of the sensitivities of composers and conductors to dynamics, transfer of emotions, and orchestrating sounds, timbre, and quality. Such inspiration may come from any composer at any given time period. In particular the American composer John Milton Cage Jr. (1912–1992) seems to be closest to both worlds of music and architecture. In his works he dealt with chance and the absence of control. These are indeed critical points where the parallel between composers and architects is at its weakest. Even the most carefully considered user experience

has to deal with contingency – unexpected occurrences and behavior of people. This is more so when we are dealing with buildings that service large numbers of anonymous users. An alternative way to consider the design of interactive architecture may be game design – a position often claimed by Kas Oosterhuis (Hubers et al. 2001; Oosterhuis and Feireiss 2006).

4.3 *Bottlenecks*

The discussion above cannot be complete without considering bottlenecks that have negative influence on the development of interactive architecture. Currently, most initiatives come from architects who are willing to invest time and resources into this domain. There are a number of bottlenecks that slow down these developments:

1. *Inadequate budget*. Interactivity is not factored in the budget of the building – thus left to less structural funding.
2. *Not included in competency*. When interactivity is considered, it is usually seen as an addition, rather than an integrated feature of the design. Therefore, the interaction design is taken aboard in the design team.
3. *Not included in fee*. The design of an interactive building is not seen as the main job of the architect, and thus not included in the fee.
4. *Missing theoretical framework*. Interactive architects develops on a project-by-project basis without theoretical considerations from the field what interaction is about. Therefore many things are discovered on an ad-hoc basis rather than through systematic inquiry.
5. *No proven performance*. Most examples of interactive architecture do not have obvious positive effects on buildings, thus making investors and architects alike hesitant to explore this direction.

5 DISCUSSION

Buildings are become increasingly knowledgeable about their surroundings and show more and more intelligent behavior. Most of this is developed in the domain of building installations. Additionally we see architects experimenting with responsive technologies that depart from the performance and functional side. We believe that the technologies of Internet of Things, Cloud computing, and Wearables is going to have an accelerating effect on interactive architecture. We have outlined a number of theoretical considerations what this interactive architecture may require. We see the role of the architect changing, and taking on characteristics of composer and conductor, although we are also aware of the limitations of these metaphors.

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The emerging role of the architect as system designer

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ABSTRACT: This paper offers a possibility of a revised understanding of the position of the architect. First, the new science of our age, biomimetics, and its potential in architecture is examined. The need for a methodological approach for the implementation of biomimetic strategies in architecture is addressed. Second, the nature of general system theory and the introduction of systems thinking in architecture is identified. The link between biomimetics, systems thinking and architecture is clarified. Finally, the focus is put on the changing role of the architect from the form-giver to the designer of the systems that designs a building.

1 MAN AND NATURE

Since the relationship of man and nature is as old as the history of mankind, man always observed nature and tried to find solutions through his experience. Until the very end of 19th century, man has learned shapes and forms from nature through the observation of natural structures. After the industrial revolution, development of new technologies and advanced tools for observation enabled analysis of nature and enhanced man's relationship with nature. In time, the behavior of nature became much more important than how she looks like. Earlier attempts of such a tendency towards nature was seen in the sustainable development of the 1970s, with a global approach to energy and resources. In the end of 20th century, all these resulted in a new branch of science, named as biomimetics.

Biomimetics, in general, implies the study of natural processes and systems for solving problems, creating innovations and developing new technologies inspired from nature. In this regard, biomimetics can be seen as a result of the enhanced relationship of man with nature, through new technologies and advanced tools for observation. Biomimetics differs from sustainability and energy issues being more of an instruction than a prescription. Every time it demands to design a new system abstracting principles from nature. We need to start from the beginning, developing, trying and testing systems inspired by various biological systems as potential prototypes.

Today, with growing impact of biomimetics, we find the promise of a new direction for many fields in the 21st century, such as engineering, manufacturing, material science and even in medicine and fashion. In architecture also, many current approaches are trying to transfer strategies from natural systems. By integrating the logic of nature to digitally-driven design processes, architects are trying to transfer strategies of natural systems from the nano-scale up to design and construction of very large buildings. However, many current approaches to apply biomimetics in architecture are either limited to form based mimicry or synonymous to older notions of sustainability. In order to move beyond these existing attempts and to overcome the challenges of implementing biomimetics in architecture, there is a need for a systematic approach. In this regard it is crucial to provide a systematic and then a system design to analyze complex structures of nature. Then it will be possible to propose new implementations in architecture, as it is in other disciplines that developed their own methods.

2 ARCHITECTURE AS A SECOND NATURE

Since biologist Janine Benyus proposed Biomimetics as a science, the term has been used to address studies that learns from and then emulates natural forms, processes and ecosystems to create more sustainable designs (Benyus 1998). Benyus pointed out that nature has already solved many of the problems we are grappling with. Different from simply observing and mimicking nature, she suggested *"consciously emulating nature's time-tested patterns and strategies"* (Benyus 1998). To solve a problem, instead of looking to a particular species of plant or animal, Benyus explains, biomimicry looks across all classes of organization-bacterium, fungi and plants and animals in order to get a breadth of mechanisms. When these mechanisms are gathered into a catalog of solutions there would appear some commonalities. Eventually this would give some very simple design principles about the problem.

To this end, biomimetics basically provide three fundamental ways to learn from nature in order to solve a specific problem, considering nature as a model, as a measure and as a mentor. Firstly, nature as a model for design implies emulating nature's forms, processes,

systems and strategies to solve human problems. Secondly, as a measure of design, nature is taken as an ecological standard to judge the rightness of man-made innovations. Lastly, nature as a mentor offers a new way of viewing and valuing nature, *"which may introduce an era based on not only what can be extracted from the natural world, but what can be learnt from it"* (Benyus 1998).

In biomimetics, biological structures are analyzed and understood as material hierarchies self-organized into structures that are achieved by a bottom up process of self-assembly, from which their properties and performances emerge. This approach requires looking more deeply into biological materials and structures to see where their success lies. Moreover, it necessitates the recognition of the patterns in the way problems are solved in nature. Since the complex integrated systems exist successfully in all natural organisms, drawing analogy to biological models might provide a deeper insight for the development of new architectural solutions.

At this very point, it will be useful to mention that earlier, the idea of architecture that learns from natural structures and processes seemed impossible since nature builds molecule by molecule, out of responsive, self-repairing materials. Offering the ability of processing massive amount of data and information, computational technologies brought new mindsets that understands the precision and complexity of natural models. Having the potential to encode nature's behavior into algorithms, digital technologies enabled the conception of nature as an operative model rather than a mystical one. Analogous to these advances, the interest has shifted from nature's beauty towards its morphogenetic and adaptive processes, which might provide new insights and solutions for architecture.

In short, today, we have the opportunity to *"learn from nature with advantages of massive scientific knowledge, better tools and aesthetic sensibilities unconstrained by historical dogma"* (Pawlyn 2011). The relations we find in nature and integrated systems of natural organisms can be used for structural, functional and ecologically efficient buildings. It is possible to mimic processes in nature in order to create life-like structures. With the capacity to analyze and simulate nature's behavior through digital tools enables its employment in the early stages of design process with a higher range of precision that was impossible to accomplish before the advent of these tools. Designers now seek to advance nature's principles in structuring matter by designing artificial synthesis of natural materials and substances.

Despite these developments, to date, biomimicry has only been applied to architecture to a fairly limited extend, often relying on straightforward mimicry of natural shapes and forms. This could be seen as a result of challenges in implementing biomimetics in architecture, which can be summarized as: 1) the search for, and the selection of an appropriate strategy or multiple strategies from the large database provided by nature, 2) scaling difficulties of the strategies- a strategy working at one scale might not work at another 3) conflicts between solutions of integrated parts of the concept design (Badarnah Kadri 2012). It would exceed the scope of this paper to argue these challenges in detail. However, the paper suggests introduction of systems theory applies a shift in architecture and enables the translation of inspirations from nature.

The shift implies a dismissal of the view of architecture as a monolithic unity, comprised of entities in static isolation for one which defines architecture as the culmination of independent and interrelated systems which interact with its context. In systems understanding, nothing exists in isolation but it is dependent on a shifting network of other things. With a holistic approach, systems thinking will liberate architecture's dead matter state towards a novel system, redefining architecture's new role as (a) *second nature* (Oxman 2010).

3 SYSTEMS THINKING IN ARCHITECTURE

Even though he understood the parts in isolation, Aristotle laid the first stone in understanding systems as a whole which is more than the sum of its parts. Adding to this, Descartes offered the idea of understanding processes by way of simple causality, with relationships deduced from at most two interacting elements. Later on, in the mid-20th century, Ludwig von Bertalanffy, introduced general systems theory, criticizing deductive methods of classic physics that focus on isolated phenomena. According to him, such methods were inappropriate for biology, since nothing in nature exists in isolation or in simple dependencies, but rather needs to be understood as complex systems of interactions. Challenging the mechanistic world view which was closely related to the domination of machine and rendering living beings as machines, Bertalanffy asserted that concepts of modern scientific developments have their most obvious exemplification in life itself. With this in mind, he aimed to develop *'general systems theory as a universal scientific discipline to decipher the laws which rule the definition of organized wholes'* (Bertalanffy 1968). He described the idea of general system theory as *"trying to derive, from a general definition of system as a complex of interacting components, concepts characteristic of organized wholes such as interaction, sum, mechanization, centralization, competition, finality, etc. and to apply them to concrete phenomena"* (Bertalanffy 1968).

In the 1960s, evolving in parallel with general systems theory, architecture took on board systems theory in particular with the writings of the architect Christopher Alexander. Challenging with traditional design approaches, Alexander tried to visualize the structure of design problems. He claimed that an overall design problem cannot be divided into sub-problems as such it is impossible to arrive at a novel design solution as a summary process of solving individual

problems one after the other. Alexander considered the idea of a system synonymous with the idea of an abstract model of some specific holistic behavior, which is accomplished through *interaction among parts* (Alexander 1968). As defined first by Aristotle and later extended by Bertalanffy, the interaction of the parts is intended to be greater than just their combination. The holistic behavior cannot be understood in the individual part, nor can it be seen with the addition of its parts. In order to speak of something as a system, Alexander identifies, we must be able to state clearly: 1) the holistic behavior which we are focusing on, 2) the parts within the thing, and the interactions among these parts, 3) the way in which this interaction, among these parts, causes the holistic behavior defined (Alexander 1968).

Meanwhile, in the early 1960s, some cyberneticists -Gordon Pask in particular- began to think of architectural design and its numerous interrelations as a cybernetic system. Cybernetics, appeared in 1948, is the theory of control mechanisms in technology and nature and it is based upon the principle of feedback or circular causal traits providing mechanisms for goal-seeking and self-controlling behavior (Bertalanffy 1968). In his 1969 article "The Architectural Relevance of Cybernetics", Gordon Pask identified a significant void in architectural theory and claimed cybernetics as *"a discipline that fills the bill insofar as the abstract concepts of cybernetics can be interpreted in architectural terms (and, where appropriate, identified with real architectural systems) to form a theory (architectural cybernetics, the cybernetic theory of architecture)"* (Pask 1969).

In his article, Pask suggested that architects are *"first and foremost system designers who have been forced to take an interest in the organizational system properties of development, communication and control"* (Pask 1969). Even in this case, he points out, architects were asked to solve problems entailing the regulation and accommodation of human beings; hence, to design systems. For him, they were trapped by the quite rigid codes of architecture and by the conventions of society or the individual practitioner. There were well accepted communication media for conveying instructions, directives and ideas and a metalanguage for talking about all these ideas, for comparing, criticizing and evaluating them. Problems could be solved by the reasonable application of architectural rules. As a result, *"architects did not see themselves as system designers, even though they designed systems"* (Pask 1969).

In Pask's application of cybernetics to design, the antagonism between designer and machine serves to unsettle the traditional top-down hierarchy (Steenson Wright 2014). Pask states, *"But notice the trick…the designer does much the same job as his system, but he operates at a higher level in the organizational hierarchy…Further, the design goal is nearly always underspecified and the controller is no longer the authoritarian apparatus which this purely technical name brings to mind"* (Pask 1969).

The article closes with "a simple cybernetic design paradigm" which could alter the interaction between the designer and the system with which the designer worked*: "Let us turn the design paradigm in upon itself, applying it to the interaction between the designer and the system he designs, rather than the interaction between the system and the people who inhabit it"* (Pask 1969). It could be stated that Pask considered architecture as a problem to be formatted and solved, particularly in the case when the designer uses a computer as his assistant. He argued that computers change the design paradigm by altering the relationship between the architect and the system, not the system and his inhabitants.

It may be argued that Pask's theories on architecture were too far ahead of their time and were not fully grasped by the wider architectural community. However, his theories had a profound influence on different groups of architects, who find completely different areas from Pask's theories relevant to their own work. In the 1960s, Pask worked with the architect Cedric Price on his Fun Palace, where he introduced the concept of underspecified goals to architecture systems. In the 1970s, his influence on Nicholas Negroponte contributed to the philosophy of MIT's Architecture Machine Group, which was focused around the notion of architecture as an enabler of collaboration (Negroponte 1975). Later, in the early 1990s, architects such as John Frazer were particularly interested in how Pask's adaptive systems might be applied to architectural design process in order to evolve building forms and behaviors (Haque 2007).

Computational theories and methods inspired by biological principles have impacted Pask's theory. In the early 1960s, Pask worked on inorganic analogue models of organic growth processes but he had moved on mathematical experimentation on cellular automata in the later 60s, taking advantage of novel mathematical structures, to simulate processes of growth, evolution, and adaptation within the computer. The architect would supply the computer with a 'seed' structure for building, which the computer would then evolve, taking account of co-evolutionary interactions with the building's environment. At the same time, the architect could interfere with this process, in the choice of the seed, by selecting certain vectors of evolution for further exploration, and so on.

It is crucial to state that Pask's work on architecture is not about designing aesthetic buildings or making urban structures more spectacular. Pask's notion of architecture as systems is about designing the system that designs a building. In this way, starting from local relationships and simple units, it allows bottom-up design as opposed to top-down. More importantly, it gives rise to emergent behaviors and forms and to create complexly ordered structure. The geometric definition of the system has to overcome the primacy of shape and related metric, descriptive characteristics. Therefore, the designer has to facilitate the set-up of a computational model not as a particular gestalt specified through a number of coordinates, but

rather as a framework for possible formations affording further differentiation that remains coherent with the behaviour observed and extracted from physical experiments and explorations of the relevant system.

Today, Pask's theories are particularly important since they provide basis for a systems oriented thinking in architecture. In the case when buildings are conceived of systems, every component of the building and its environment interact, adapt and create one another, merging into one holistic system. To put it in another way, while the system of the building is coevolving with its environment, it would also be constantly interacting with its own parts, sending information back and forth. This, in turn, would lead up to an integrated and holistic design approach and eventually it might contribute to the application of biomimetics in architecture.

4 ARCHITECT AS SYSTEM DESIGNER

Without systems thinking in architecture, the attempts to draw analogies between biological entities and built environment cannot go further than simply mimicking natural forms. As it is described above, in order to transfer strategies of organisms in nature to built environment, first it is needed to investigate and analyze these strategies and their dominating principles, then a catalogue of solutions might be created. In order to learn from the multidimensional relationships of nature, the requirements of the system have to be defined, then analogue systems in nature that perform similar functions need to be identified. Computational design generating tools enable the transitions between the domains, in particular the identification of biological analogies and their abstraction. Then the relations we find in nature and integrated systems of natural organisms can be used for the design of architectural systems.

Such a design approach demands new strategies for design, in which form is no longer predetermined. When we see architecture through this perspective, we no longer conceive buildings as monolithic unities but structures constituting multiple and diverse components that operate at different scales and levels. We grapple, then, both independent and interrelated sub-systems co-exist in a building.

In completing the mode of thinking for biomimetics in architecture, the changing position of architect must be addressed. As Oxman denotes, *"the image of the architect as form-giver has dominated the profession for centuries"* (Oxman 2007). Today, this concept is being challenged by increasing involvement of computers in the design process together with potentials of systematic knowledge transfers for the development of biology inspired solutions in architecture. Computation, be it digital or natural, does not function with explicit description of form and finality. With this we see a development in the very nature of the architect from the demiurgic 'form-giver' to the architect as the controller of generative processes, where the final appearance is a product not of the architect's imagination alone, but of the generative capacities of the rules he set up. It is not that the architect here is any less imaginative; rather, *"the architectural imagination has been displaced into a different arena: into the imaginative use of various processes"* (Leach 2009). The idea of conceiving of the architect not only as the designer of buildings but also as the designer of systems that design buildings might open up new horizons in architecture.

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Mapping the expanding and fracturing field of architecture

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ABSTRACT: This paper illustrates and discusses a unique mapping of architecture practice, tracing arrays of critical, compared to commercial, practice approaches. It visually interprets the sociologist and philosopher Bourdieu's theories on the interactions between agents and institutions to the field of architecture. Discussions relate Bourdieu's concepts of habitus and capital to key stages of UK architectural practice from the mid-1950s through 2015. The paper contributes to contemporary knowledge and debates about architects' shifting roles and practice types in privatised, market-led processes by providing a spatial framework to trace the increasingly fractured nature of the profession. Established and emerging areas of architecture, derived from literature reviews and primary sources, are evaluated as practice types in which agents seek – at one end of the field – to preserve, protect, or enhance traditional norms, versus those – at opposite ends – who challenge, and at times subvert traditional practice norms in favour of more critical approaches.

1 INTRODUCTION

Since the late twentieth century, architects increasingly work in larger-scale urban development frameworks, and in more diverse practice types where the private market has impacted the architecture field and the majority of individual architects' roles as creative professionals. This paper examines UK architecture practice-futures through related debates in academic and institutional settings, particularly those within the main UK architectural governing body, the Royal Institute of British Architects (RIBA). The paper sets out concepts underpinning original visual and text-based analysis, part of a larger body of research, which illustrates how architects face increasingly diverse roles as more (visually) prominent but less influential agents in privatised and global design and construction processes.

Beginning with a review of architectural, and sociological literature, the paper discusses practice structures and processes that combine creative and entrepreneurial skills with more explicit intellectual and value-laden action. Key theories about practice, and agent/field interactions are derived from the sociologist/philosopher Bourdieu's treatise of habitus, disposition, and motivation for individual agents in any given field.

Discussions frame conclusions about critical practice, spatial design, autonomy, and contingency in architecture, which are established, emerging, and increasingly divisive topics between individual practitioners and the RIBA.

2 PRACTICE FUTURES IN THE 21ST CENTURY

Architecture remains one of the most publicly visible disciplines working to shape the built environment in the twenty-first century. Despite decreasing levels of influence on urban development decision-making, it is the discipline most often associated with building design and the production of urban space. In reality, most of the key decisions from strategic planning and land acquisition to setting out a particular project brief and its financial parameters are far removed from the influence of the architecture profession.

Debates about where knowledge and training should focus in the future include differences between core creative versus financial or technical skills (Building Futures, 2010a; RIBA, 2005), and between personal ethics compared with practice principles (Young, 2013). Prominent arguments often centre on how the professional field has and should continue to respond to the increasing dominance of private markets, which account for almost half of professional earnings (RIBA, 2013a).

The architecture profession is fragmented by internal debates about how to address the decline of roles valuing architects' creative design skills, and what might be the most appropriate future practice priorities; further supporting commercial and market-led forces as exclusively building design agents or rethinking architects' role as more socially driven agents for the wider public. Oft-cited questions include whether architects can or should be socially responsible, and the

extent to which they can influence change (Crawford, 1991).

Key debates about architects' skills examined here centre around calls for:

- Greater proficiency in commercial and economic skills – to support market-led development (Building Futures, 2010a);
- Calls for more autonomy as aesthetic experts and artists (Schumacher, 2010);
- Other voices, collectively known as transformative spatial agency, promoting alternative or more expansive forms of practice that might engage more with political and social contexts, rather than aligning to the control and values of the marketplace (Awan et al., 2011).

Contemporary arguments for greater architectural autonomy tend to focus on the status quo of architects as design experts with traditional building design/management skills enhanced by new technology (Schumacher, 2010). Technical, commercial, artistic, and activist views compete. Research promoting spatial agency includes international practices and project examples, evaluated for spatial judgement, mutual knowledge, and critical awareness skills that might challenge "strong normalising tendencies of mainstream architectural production" (Awan et al., 2011, pp. 26–27). There is no clear consensus about either the future centre of architectural culture or how to interrogate the status quo, and change it for the better (Awan et al., 2011).

Relative to UK professional context debates about existing and emerging practice types and skills training, the research here sought to first better define and visualise the centre and broader extent of architectural practice from the literature. The following section discusses how the RIBA and other influential bodies perceive the changing nature of the architectural profession to trace and discuss how UK practice has evolved since the post-war period.

2.1 *The RIBA and practice future debates*

Reports commissioned by the RIBA reflect widespread consensus at professional and academic levels that architecture has become less distinctive as both an occupation and a discipline (Building Futures, 2010b; RIBA Practice, 2000). The RIBA continually reviews the breadth of established and emerging practice types as part of it annual monitoring, and its established role to protect and promote the statutory title of architect in the UK.

The Institute's report, *The Future for Architects?,* conceded that practice contexts are "continuing to change so dramatically that the skill sets required must also shift" (Building Futures, 2010b, p. 34). Practice types and work areas continue to be benchmarked in traditional building-related areas for housing, residential, education, mixed-use and offices; a single umbrella category covers all "other project types" (RIBA, 2013a). According to the *Future* report and further research, 93% of the Institute's *Chartered* architects (i.e., only those ARB licenced architects who register and pay annual fees to the RIBA) continue to earn their fees from "full services," meaning from building design and construction contract management.

Additional RIBA research shows that there was a 40% reduction in demand for architects' services between 2007 and 2010, the first years of a global finance and property market recession (Building Futures, 2010a). From all full-service fees in a given year, almost half are reportedly earned by only 3% of Chartered practices (RIBA, 2013a). RIBA guidance suggests architects should adapt pro-actively to changing professional roles as an "opportunity to change attitudes toward development" and to demonstrate how good design is one of the values of the profession in "shaping better places and helping deliver a better quality of life" (RIBA, 2011, p. 01).

Practice types within the field, recognised by the RIBA, have expanded from a Post-WWII establishment view of "full service" designers and contract managers to a diverse, expanding, and contested roles including *local generalists*, *niche specialists* (including both design and technical specialisation), and *larger multi-disciplinary firms*. Additional practice types the RIBA has documented in annual monitoring surveys (Building Futures, 2010a) include:

- General design-led or more commercially-driven consultancy;
- Networked services, focusing on technical or design services;
- Globally networked practices, delivering all services on 24-hour timescales;
- Small metropolitan boutiques, offering "boundary pushing design . . . qualities of the star architect on a smaller scale";
- Entrepreneurial BOOT (Build-Own-Operate-Transfer) design services; and
- Creative Agencies, practices "not committed to architectural services . . . more flexible in following the market."

The definition and measure of practice sizes range from sole practitioners and micro practices of up to five members, to large offices with over fifty members (Building Futures, 2010a). Generally, larger commercial firms continue to dominate over smaller to medium design-led practices, while more traditionally architect-led roles in the design and construction industry are increasingly taken up by outside professions including planning, surveying and project management; bringing uncertainty about the (or any) future meaning and role for architects (Building Futures, 2010b).

The following table (Table 1) illustrates increasingly fractured practice trends from the post-WWII period to the present, interpreted from the literature.

With an increasing focus on systems-led forms of planning and private-led mechanisms for development in the 1960s – 1980s, architects influential roles as

Table 1. Changing professional roles, 1955–2015 (Source: Author).

Key Date/ State of Practice	Established/ Traditional modes and roles	Emergent/ Challenging modes and roles
1955 Established	Public sector Full-service designer Masterplanner Corporate agent Planner	Academia/ Philosopher Urbanist Activist Facilitator
1975 Challenged	Corporate agent Artist-practitioner Community facilitator Activist Public sector Full-service designer Urbanist Philosopher Planner Academic	*Starchitect* Community facilitator Environmental activist Polemicist/ Theorist Design-led Design-build Multi-disciplinary generalist
1995 Fracturing	*Starchitect* Corporate agent Facilitator Academic Urbanist Multi-disciplinary Design-build Specialist designer Full-service designer Philosopher	Technician (computer) Parametricism Activist (critical practitioner) Design manager Facilities manager Master planner Practice-led research Design consultant
2015 Fractured	Corporate agent Niche-boutique/ Specialist Local generalist *Starchitect* Design consultant Design-build Multi-disciplinary B.O.O.T. CAD Technician Activist	Community enabler Network/ Collaborative practitioner Spatial agent Cooperative/ Entrepreneurs Creative agents

masterplanners working in the public sector decreased while more market-driven roles emerged. Changes in design team structures initiated by the UK Government during the 1990s led to declining roles for architects as team leaders and full-service designers on larger scale projects; roles increasingly challenged by professionals outside of architecture. In the early millennium, particularly the period following global financial crises and property value collapse after 2007, architects' esteem in roles as starchitects and corporate agents became increasingly challenged from within the profession.

The most recent review of the architecture profession at a strategic/government level in the UK began in April 2013 when the Department for Culture Media and Sport (DCMS) appointed architect Sir Terry Farrell to work with the main professional architectural governing bodies, including the RIBA (DCMS, 2013; RIBA, 2013b). *The Farrell Review*, as it is commonly referred to, was completed in 2014 and represents the first important architect-led Government assessment of the profession and its role in shaping the UK built environment since Rogers' 1999 *Urban Task Force* report (The Urban Task Force, 1999). *The Farrell Review* acknowledged that "the nature, scale and scope of? built environment design have changed beyond all recognition" (*The Farrell Review*, 2014, p. 08). It addressed the following themes: education, outreach, and skills; design quality; cultural heritage; economic benefits; and UK Government built environment policy. Some of the key focus areas included,

- How architecture could be "taught as a business and better connected to the marketplace, engineering and construction";
- Globalisation;
- The role architecture's institutions should play in future practice;
- How to regain trust about design quality and "placemaking" issues in the built environment,
- Increasing architecture's influence at all development scales – "from local improvements to nationally significant projects.";
- Encouraging "leading architects […] to help the broader, more unsuccessful and unloved parts" of the built environment; and
- How to "prepare for the changing world order and rapid urbanisation across the globe in the twenty-first century"

The Review conclusions include recommendations for the profession to "reflect the major shift [in practice] toward two opposing tendencies – greater specialisation and diversified career paths on the one hand, and a greater need for integrating and joining things up on the other" (*The Farrell Review*, 2014, p. 67). The research presented in this paper addresses the above architecture specific challenges through a sociology-based approach, which is set out and discussed in the following section.

3 GAMES IN A FIELD: BOURDIEU'S SPATIAL THEORIES OF PRACTICE AND AGENCY

Bourdieu is regarded as one of the most prominent late twentieth century sociologists, contributing to education, culture, and art theory (Stevens, 1998). He established influential agent-field principles including key concepts about individual-collective structures and interactions in a given field (e.g. education, art, politics), cultural-environmental influenced disposition, *habitu*s, and taste/values, *distinction* (Bourdieu, 2010).

Bourdieu's treatise *Distinction* examines cultural preferences relative to social hierarchies, *capital*,

across the French bourgeoisie, and has been adapted to qualitative/comparative studies in many fields including economics, art, and law (Grenfell, 2008). As architectural discourse has increasingly focused on aspects of agency and architects' interactions with each other and society – beyond a focus upon building outputs and design or theory for its own sake – Bourdieu's reflexive methods to document and evaluate what de Certeau called the genesis of practice – i.e., not what practices produce, but what produces them (de Certeau, 2011) – has become more prominent in architectural research.

Bourdieu's work has been characterised as drawing upon the language of architecture to convey both physical and non-physical spatial aspects of social interaction in everyday life (Dovey, 1996). Fourcade observed spatial references in Bourdieu's writings about financial markets; how, for Bourdieu, "markets are not structured by connections between buyers and sellers (over goods) but by homologies between the 'space of producers,' the 'space of consumers,' and the 'space of goods"' (Fourcade, 2007, p. 1022) The architect and urban theorist Dovey has noted in a related way that Bourdieu's concept of habitus "suggests that the built environment constructs the real as spatial ideology – a congruence between the "division" of space and our "vision" of the world (Dovey, 1999, p. 03).

Bourdieuien theory and methods – set out further in the next sub-section – were selected as particularly suited to this architectural practice-led research, to address how architects, as actors and agents, relate to institutional and social structures, and how culture and society interact (Webster, 2010). Bourdieu's subjectivist and grounded approach to agency-structure research (Stevens, 1998) also corresponds to the research (and researcher's) interpretivist aims and methodology.

3.1 *Field theory: Individual dispositions and professional spheres*

Bourdieu describes fields as "a network, or a configuration, of objective relations between positions, objectively defined, in their existence and in the determinations they impose upon their occupants, agents or institutions" (Bourdieu in Wacquant, 1989, p. 39) He defines fields as bounded spheres and universes of activity and influence over certain people or objects. He identifies people and agents who enter a field as being "at once founded and legitimized [. . .] by their possessing a definite configuration of properties" (Bourdieu and Wacquant, 1992, p. 100) and,

> [B]y their present and potential situation (situs) in the structure of the distribution of species of power (or capital) whose possession commands access to the specific profits that are at stake in the field, as well as by their objective relation to other positions (domination, subordination, homology, etc.) (Bourdieu in Wacquant, 1989, p. 39).

Bourdieu's research addresses individual agents' actions, and motivations to act in a particular field, which he describes as akin to "being in a game," knowing the "rules of the game," and having interest. His concept of interest in relation to action correlates to themes examined in this architectural research, including how architects understandings of professional intention, motivation, and participation correspond to their approach/actions in practice. His metaphor for the norms of a field as a game allows rules to be challenged; thereby potentially affecting the game and those who might be dominant within a field in a given timeframe. Agents in a field, as players in a game, have choices to make relative to disciplinary doxa. Adapted to architecture in this research, it frames the findings about possibilities to challenge perceived material and symbolic norms.

At one end of a given field Bourdieu describes particular agents who "can play to increase or to conserve their capital," meaning they can remain "in conformity with the tacit rules of the game and the prerequisites of the reproduction of the game and its stakes" (Bourdieu and Wacquant, 1992, p. 99). Conversely, he describes how players with a different perspective can also aim to transform, partially or completely, the established rules of the game (Bourdieu and Wacquant, 1992). The latter type of players, what are referred to here as transformative agents, can apply "strategies aimed at discrediting the form of capital upon which the force of their opponents rests (e.g., economic capital) and to valorise the species of capital they preferentially possess" (Bourdieu and Wacquant, 1992, p. 99). In other words, agents including architects – as players – may be constrained and impacted upon by economic and political situations, but they are not trapped in a deterministic setting whereby their actions and position in the field are fixed, or on a stable trajectory.

The concept of play thereby introduces an agent's tacit skill and explicit choice to conform to or transform the tacit rules of the game;

> Social agents are not 'particles' that are mechanically pushed and pulled about by external forces. [. . .] They have the propensity to orient themselves either toward the preservation of the distribution of capital or toward the subversion of this distribution (Bourdieu and Wacquant, 1992, p. 108).

The above themes are synthesised by Bourdieu's *practice-field (capital-habitus)* model (Bourdieu, 1986; Maton in Grenfell, 2008), which sets out a relationship shown in Equation 1, whereby the totality of habitus, individually acquired "systems of disposition," and capital, defined as "one's position in a field," is considered jointly "within the current state of play [doxa] of [a chosen] social arena (field)" (Bourdieu and Wacquant, 1992, p. 102). Capital can refer to an architect's position in the professional field relative to economic, social, or cultural position among other factors.

$$[(\text{habitus}) \times (\text{capital}) + \text{field}] = \text{practice} \quad (1)$$

Bourdieu also set out three "necessary and internally connected moments" to study any given field (Bourdieu and Wacquant, 1992, p. 105):

– "First, analyze the field vis-à-vis the field of power."
– "Second, map out the objective structure of the relations between the positions occupied by the agents or institutions who compete for the legitimate form of specific authority of [the] field"
– "Third, analyze the habitus of agents."

He argues that fields can be examined to "assess how concretely they are constituted, where they stop, who gets in and who does not, and whether at all they form a field" (Bourdieu and Wacquant, 1992, p. 100). He further states that researching fields is an "endless to and from movement," wherein "one must identify the forms of specific capital that operate [and] know the specific logic of the field" in order to "construct [its] forms of specific capital" (Bourdieu and Wacquant, 1992, p. 107).

Within the scope and constraints of this research and the contexts of contemporary UK architecture practice relative to the RIBA, the field of architecture is thus examined through a Bourdieuien lens. The outcomes and conclusions, which are both architecture specific and transferable to other professional fields are set out and discussed in the next section.

4 FINDINGS: MAPPING ARRAYS OF PRACTICE AND PRACTICE TYPES

Arrays of practice refer to unseen as well as more tangible aspects of architects' career trajectories, choices, practice contexts, and other parameters that establish one's professional identity as social, creative agents. The mapping structure and graphics presented herein (Figures 1–4) are the author's adaptation of Bourdieu's well-known and widely published figures, used to display and discuss his research (Bourdieu, 2010, 1998).

Four original diagrams correlate individual architectural practice types and themes to different professional dispositions and relations between individual architects and the collective architectural field from the period following the Second World War into the new millennium. Different sets of axes illustrate arrays of architecture practice, and critical, compared to commercial, practice approaches in a visual format. The visual format provides a spatial framework to understand how architects can adapt to more critical practice in privatised commercial contexts, and to evaluate the research as a unique contribution to debates on the changing architectural profession. The findings reflect the greater diversity of architecture practice, and the increasingly destabilised field, discussed in Section 2.1, and detailed in Table 1.

Figures 1 through 4 trace perceived changes in architecture from a more established (stable) field in the immediate post-WWII era to a fractured (dynamic, contested) field in the new millennium. Different practice types (architects practice roles) and themes (key theories or issues from the literature) are shown relative to the two sets of axes and the indicative centre of the field (representing normative building designled roles). The locations of each practice type, and the centre of the field, shifting over time, are interpreted from the practice and theory literature. The following sub-sections set out and review each mapped stage in detail.

4.1 *1955: Relative stability and widespread capital*

Figure 1 illustrates the field in a more stable and less complex state. The starting date is coincident with an important international milestone for architecture, planning, and what evolved into the separate/related discipline of urban design. As a base point for comparison, the 1955 map aims to capture the state of the UK field prior to the 1958 Conference on Architectural Education, a seminal event that brought in new systems of professional architectural training that remain more or less intact (Roaf and Bairstow, 2008).

The map indicates the traditional building design and contract management centre of the field as firmly established, with some areas or practice emerging during the post-WWII period. Traditional agency is shown balanced on the social/cultural and economic centreline, encompassing "full services" by architects, as artistic and corporate architectural agents, including roles in key land acquisition and planning decisions as well as influence over the design, detail, and management of individual buildings. Urbanism is recognised and incorporated as an emerging, and already integral part of the centre of the field.

Two dotted-line shapes show important changes impacting the traditional centre. These changes include new processes and qualifications for professional academic training (left-hand), in which university based systems increased in intellectual and

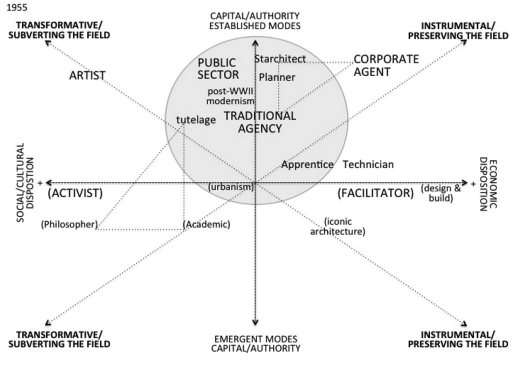


Figure 1. The field of architecture, ca.1955 showing traditional norms (grey) & established practice roles with emergent types.

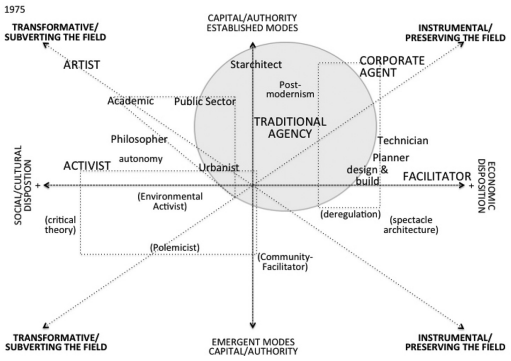


Figure 2. The field of architecture, ca.1975 showing traditional norms (grey) & established practice roles with emergent types.

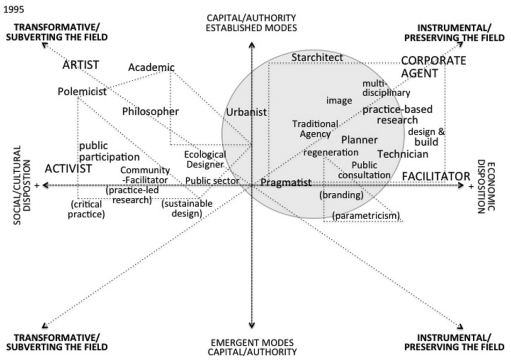


Figure 3. The field of architecture, ca.1995 showing traditional norms (grey) & established practice roles with emergent types.

economic capital, replacing apprenticeships and tutelage as the primary route to professional qualifications. The post-WWII growth of corporate agency, larger international firms is shown as established, and impacting traditional roles for designers, planners, and the twentieth century version of 'starchitects' (important individuals including Mies Van der Rohe, Le Corbusier, Gropius, and others). The next mapping stage, 1975, continues to trace the field's trajectory through a post-Keynesian era, when a resurgence of free-market ideology influenced architects to support increasingly dominant economic forces.

4.2 *1975: Challenging norms; resistance & retreat*

Figure 2 illustrates the field as corporate and free market influences became established across the traditional centre, shifting it in the direction of instrumental practices favouring economic capital over transformative and socially driven ideals. Postmodernism replaced modernism as the dominant theoretical and aesthetic practice by the early 1970s. Public sector roles for architects, and the number of architect-planners trained as spatial designers were both in decline, connected to changing policies for funding urban development and training/practice shifts in the 1960s from spatial to systems-led approaches (Cuff, 2000). Within architecture therefore, the mapping indicates that planning is shifting out of traditional architectural roles, becoming less esteemed (i.e. lower status/capital) and associated with facilitator rather than designer roles.

The mapping reflects the growth of activism and critical theory in architecture, which developed from socio-political and economic periods of protest and civic unrest in the 1960s and early 1970s. The architecture profession was criticised as anachronistic, associated with the failures of large scale urban renewal projects and functionalist modernist housing estates (Papanek, 1985).

Shifts within the profession include an increasing status for both commercial roles and theory-driven academic areas, and emerging roles focused on community and the environment (Dutton and Mann, 1996). Dotted-line shapes here indicate increasing complexity of roles/types in the field, including the emergence of polemical theorist-practitioners and activists, and influences on the centre; denoted as the increasing capital of philosophical/autonomous modes of thought, as well as opposite trends toward economic/instrumental practices, and the approaching era of deregulation.

4.3 *1995: Change and challenge; a fracturing field*

Figure 3 illustrates the impact of resurgent free market urban investment, and urban policy changes, established after 1979 by the Conservative Thatcher-led UK government.The archetypal standing of full-service architectural agency becomes less certain, reflected in the mapping text. Layers of dotted-line shapes show increasingly complex commercial, critical, and communicative aspect of professional practice. Transformative approaches and widening participation became established in professions like planning; emerging from allied social and planning theory into architecture in the mid to late 1990s (Ghirardo, 1991; Gutman, 1988; Healey, 1993; Sorkin, 1991). The traditional centre is shown shifting further toward an economic, instrumental, and self-preservationist trajectory. The mapping thus reflects a fracturing of architectural practice types with new roles commonly aligning toward economic extremes, indicating practice efforts to survive and preserve the field.

During this period important strategic changes included new policies and investment mechanisms for urban development, which remain as larger-scale masterplanning and private-led models of regeneration in the twenty-first century (Bell, 2005; Dietsch, 1995). Both the private sector and government bodies increasingly sidelined architects' status as design-team leaders, and as influential actors in decisions affecting

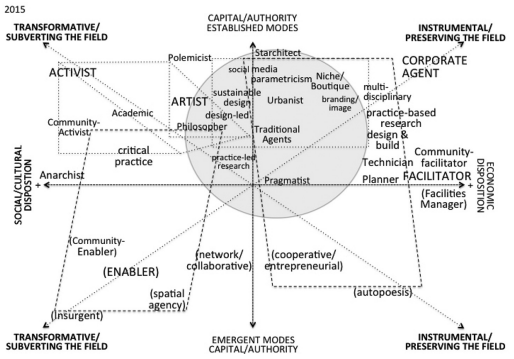


Figure 4. The field of architecture, ca.2015 showing traditional norms (grey) & established practice roles with emergent types.

the built environment (Duffy, 1994). Government-commissioned reports including *Constructing the Team (Latham, 1994)* and *Rethinking Construction (Egan and Construction Task Force, 1998)* contributed to a restructuring of UK design and construction teams, a trend that continued into the millennium period despite dramatic increases in property-led development.

4.4 *2015: Border crossings; a fractured field*

Figure 4 illustrates architecture in the new millennium period of rapid urban development and increasing complexity within architecture practice, both of which define contemporary struggles between the social and economic space of the field. A substantial number of architects left the field or shifted their intended trajectory vis-à-vis the traditional centre during a sustained period of recession and uncertainty after 2007. The density of the mapping, and additional connecting shapes, reflect the fractured nature of practice. Emerging practice types appearing at the transformative/subversive extremes denote the expansion of practice roles beyond the recognised architectural field; a trend to normalise border crossings between architecture and other disciplines that is resisted within the establishment, and the RIBA (Gunkel, 2001). There are increasing calls to remove or blur the boundaries of the field yet the commercial core remains the dominant power.

Two broken-line shapes show a growing divide between agents/practice types seen as preservationist and instrumental, and types seen as promoting opposite aims, to break open the field and its training processes toward more social/transformative ends. Established types of commercial practice at the preservationist end include management, design and build, specialist technical services, while more subversive types include enablers and insurgent architects, network/collaborative forms of practice, and new forms of critical spatial practice (Awan et al., 2011; Hou, 2010). Critical practice has shifted toward more active, real-world, and transformative approaches, in contrast to autopoetic, theory and computer-driven practices (Doucet and Cupers, 2009; Schumacher, 2010). While the traditional centre is shown intact as a space, it has shifted back toward the centre axis and is shown as increasingly congested by different competing practice themes and types, including design/artist-led, commercial, and new media-driven approaches; each vying for varying degrees of capital in the design and construction industry, and influence over the profession's future.

5 CONCLUSION

The mapping relates to the second of Bourdieu's connected moments, necessary to study a given field and the relations between "the positions occupied by the agents or institutions who compete for the legitimate form of specific authority of a field" (Bourdieu and Wacquant, 1992, p. 105). Thus, in the diagrams, a Corporate Agent is shown at opposite economic-socio/cultural scales to an Artist, yet both are shown with similar levels of established capital/status. Activists, an example of both an emerging and established type, are located at the socio/cultural end with increasing levels of status.

Contemporary practice challenges, reflected in the mapping, and in proposed new and redefined practice types "provide a glimpse of a world to come" where there are opportunities for change, and for interested architects to become agents of change (Hardt and Negri, 2012, p. 03). The examples and types, while indicative and subjective in one sense, represent real examples of practice choices available to architects. The findings demonstrate the extent to which other ways of practicing architecture exist, challenging limited skills training, and career guidance available to young practitioners, which overwhelmingly focuses on past norms where architects were full-service designers with high level of influence on development decision-making.

Finally, the research findings reveal a significant trend amongst architects to reframe their future practice and professional training as a means to proactively redress declining levels of influence; learning to adapt their training as designers and managers, to act transformatively, without ignoring or denigrating their innate and learned skills as creative professionals. These findings are supported by the extent to which once peripheral protagonists and practice roles are shown to challenge the status quo of commercial practice for esteem and professional capital.

ACKNOWLEDGEMENTS

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Designing for a sustainable environment



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On the ground … and into the air – Research & Development for an eco-friendly habitat on rural commune named Ambert

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Researcher at CRESSON, architectural and Urban Research Laboratory UMR CNRS 1563 (Architecture, Ambiance, Urbanity) since 1983, doctor in urban planning and development, (1992, Qualified Research Director (2002)
TPCAU professor at National School of Architecture of Lyon

Gérard Mai
Assistant Planning Officer in the town of Ambert

ABSTRACT: To suggest some answers to questions about the future of the living environment of human settlements in rural areas, this article will discuss intensification assumptions adapted to new or rehabilitated housing projects in the rural commune of *Ambert*, administered by the department of Puy-de-Dôme, France. These assumptions are derived from shared education between the two Higher National schools of Architecture in Lyon (an area of study called master AA & CC "Architecture, Ambiances and Constructive Cultures") and Grenoble (an area of study called master A & CC "Architecture and Constructive Cultures"). They are based on the research and partnership of two laboratories of the Grenoble architectural school, the research unit AE & CC (Architecture, Environment and Constructive Cultures, Labex MCC) and the research unit CRESSON (Centre for Research on the SOUND SPACE and the urban environment, UMR CNRS 1563 *Architecture, Ambiance and Urbanity*). This collaboration foreshadows the construction of a solar powered habitat in *Ambert*, showing an approach centered on pleasant surroundings and local building habits.

Keywords: Habitat, Ambiances, Constructive Cultures, sustainability, energy and rural environment

1 THE HABITAT OF THE FUTURE, CAN IT REMAIN LOW-RISE?

Our world is changing radically. The effective spatial awareness of sustainable development issues due to recent crises (social, environmental, financial and energy) leads to other approaches to habitat, land, social mix and tools to be used within the framework to be built. First of all, in rural areas, this finding prompts the building of an ecological, responsible and economical habitat, attractive for newcomers, reflecting new surroundings in rural conditions, integrating energy issues and ecological thinking, as well as on the level of materials employed and the production line of the components used.

Secondly, and in response to the request of some rural municipalities, the need for density, to avoid urban sprawl, invites us to restore value to all open spaces, on the ground and into the air. The designer is then asked to imagine buildings and environments that combine infrastructure, landscape, architecture, events, society, customs, cultures, energy and local resources. Thirdly, reflection across the territory implies rethinking the inhabitants' logistics mode. We must rethink both the modes of management of natural resources essential for life (such as water), and agricultural space management methods, transport methods between food production areas and consumption areas, and modes of travel between different living areas. A new symbiosis must emerge between agriculture, mechanics and architecture by combining, in a more organic way, available and vacant lands, vehicles, housing and the working place.

Overall, this awareness challenges us about our lifestyles (increase or decrease?) and our major societal choices (centralized or decentralized?). At the political level and at the individual level, however, it is extremely difficult to make these choices without concrete indications of the opportunities available to us. These decisions can obviously not be taken solely on the basis of theoretical reasoning. Therefore, to gain the support of the majority and become effective, and more efficient, these choices should be informed by research and experiments carried out together on the constructive aspects and living ambiances of tomorrow's society, which bring quantified and tangible evidence of the feasibility or consistency of the proposals.

Hence the following proposals that attempt to connect, around the issue of habitat, in the small rural town of *Ambert*: sensitive approaches and technical education, landscape and individual living spaces, perceptions and measurements, sustainable approaches to the territory and expectations of ambiance, all these actions to address the transformation of multiple *Ambert* sites. At the heart of our concerns, the renewal of the rural habitat questions the alternative to the private home and considers density compatible with proximity, multiplicity of services, a gradual decrease in the use of the car, effective pooling of resources, rationalization of transport investment, and a guarantee of quality of life in shared spaces and a relationship with nature.

2 DEMOGRAPHIC CHALLENGES IN THE AREA OF AMBERT

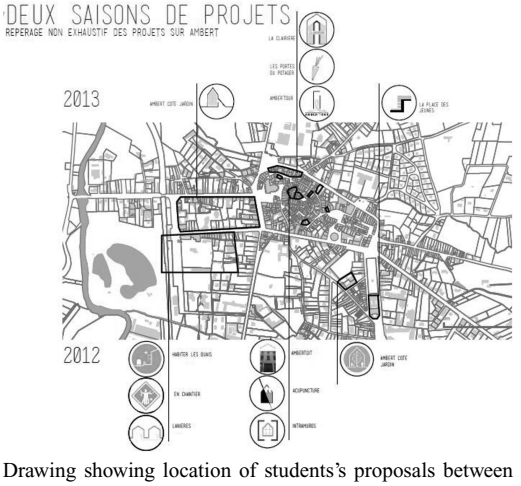
Faced with population decline, the town of *Ambert* (6600 inhabitants) wishes to retain young people and welcome new populations. Many SMEs in the valley have developed in the areas of weaving, the wood industry and chemicals (*Sanofi*). If they have today 2500 industrial jobs, however, they have some difficulties in recruiting or keeping their employees. The obstacles come from the image of a town far away from active centrers where a spouse has trouble finding a job and, specifically, a town without good housing: it appears unsuited to the needs of a population willing to settle there, who seek comfort, air, sun, nature-friendly buildings, and a feeling for the environment.



What is this new population? It is primarily well-paid executives. They come first for a year keeping their original housing, or they prefer to rent on site to reduce transport time. They seek a modern lifestyle with outside spaces, light and sunshine: a furnished or unfurnished rental. After the first completed year they move to *Ambert*, enjoying the quality of life, no longer having to make car journeys. They hope to buy a home in an existing or a new building. Of course they can settle in the countryside, but they often need spacious accommodation close to the services offered by the town (leisure, culture and community activities are very lively in *Ambert*). The desire of the municipality is to encourage architecture students to imagine homes that attract: comfortable and contemporary interior architecture opening on to the outside, (not necessarily a privatel garden) but an exterior accessible according to the season; housing in the city centre, bright, spacious, plush, with a history, that is close to services, giving a sense of comfort, particularly in winter.

Secondly there are salaried workers who are hopefully recruited locally. Coming from rural areas they prefer the new or old houses on the outskirts of the town, with a garden (depending on their budget). They live while slowly modernizing their house bought for between 100,000 and 150,000 Euros. The most urban among them accept the shared garden.

Thirdly there are foremen, apprentices and medical aides who come to train for a few months. Numbering two hundred, they generate every year a high turnover of people. These employees' supervisors look for small or shared apartments, comfortable, with terraces and no gardens. The company *Sanofi*, owner of many homes for the reception of workers, converted them into temporary foster homes for foremen. But the houses are lacking and not really suited to employees who want to get away from the workplace and get nearer to the "town". A similar desire exists among the "many care assistants" who have little income and who accept small furnished, shared apartments near the hospital, rehabilitated homes in the town centre. As for apprentices, they would rather find shelter in hostels for young workers that do not exist locally. Some are housed in the local boarding school.



Drawing showing location of students's proposals between 2011 and 2013. *Floriane and Emilie Delesglise Ettori, DEM master AA&CC Promotion 2013.*

The city council finally states that there is a demand for seasonal housing designed for pensioners living in villages or hamlets, and coming downtown in winter "because it is cold and there is nothing to do up there" on the one hand and on the other, for seasonal workers on construction sites and public works.

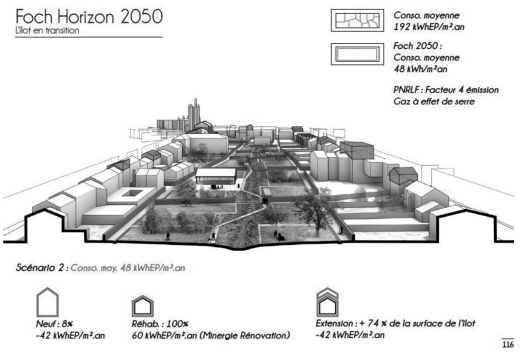
In conclusion the demands of the new townspeople are numerous and varied. The town centre should suit students, health workers, as well as those who love opulent homes. Today it attracts a few lonely people with small budgets. To reverse this tendency, the architecture students of Lyon and Grenoble were encouraged to offer new comfortable and attractive homes. Around the *Chabrier* garden (see map for location) a new rather up-market development is planned but the municipality wants a social mix. This leads the students to consider a spatial distribution of new inhabitants described above. On the land called "Prairie" in *Ambert*, near the station, would be built, for newcomers, new housing, some furnished rental, as well as seasonal homes. On the island development called "Island Foch", a field on the western edge of the town centre, students propose an alternative to the house in the country by redeveloping an outdoor space, shared by the inhabitants, which would provide social and age diversity, suited to higher density.

3 PROPOSALS FOR THE HABITAT

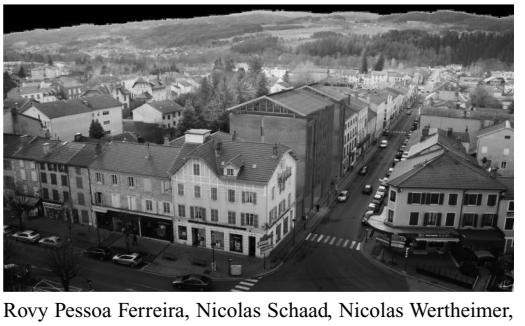
But when we proposed this, many other issues were raised. What density is really tolerable? Which urban forms are adapted to this density? What former architectural styles allow integration into the existing ecosystem so as to maximize energy performance while preserving social diversity, equal access to services and the privacy of individuals, while addressing responses to fuel poverty? What substances or materials should be used to achieve economical levels while participating in the creation of an environment appropriate to habits and neighborhoods? What symbolic presence and what climatic role can plants have in this built-up environment? Which building systems and construction organizations are best suited to perform these complex assemblies while remaining compatible with the financial means of the majority? Which helpful devices can be envisaged to allow the poor to access housing, to meet the basic right of a roof over one's head?

To submit an early answer to these questions that examine the future of the living environment of human settlement, here are some ideas shared between the national schools of architecture of Lyon and Grenoble.

1/The habitat model which is preferred by 86% of French people, the detached house, is no longer compatible with life in *Ambert* because of transport costs between the home and the "town centre", and between the home and the workplace. A new development located in the quarter called "Foch", just on the edge of the ancient medieval fabric of the sub-prefecture, becomes possible if a large number of spatial sensations of a detached house (360 degree circular vision, neighborhoods a little way off, activities outside extensions, an accessible common garden, the existence of outbuildings …) can be preserved, improved and integrated into the local architecture of the *Foch island* near central town. The "rules" regarding the assumption of vertical densification have to be written so as to remain on a human scale. It is not a model that can be applied systematically, but one that can be adapted as for the *Foch island* built in the nineteenth century, an island with a large interior "garden" belonging to and appreciated by its residents, as the proposal below shows.







Rovy Pessoa Ferreira, Nicolas Schaad, Nicolas Wertheimer, DEM master AA&CC promotion 2014.

2/In*Ambert*, houses in the medieval town are narrow and have two or three floors. In a new configuration of apartments designed for wealthier people, leading to social diversity, the top floors can be converted into further elevation, to accommodate a laundry, a "sunbathing spot", a summer kitchen, a barbecue, a greenhouse, which would provide an additional common sheltered space for young children to play, get-togethers between tenants on public holidays, that



Rovy Pessoa Ferreira, Nicolas Schaad, Nicolas Wertheimer, DEM master AA&CC promotion 2014.

would contribute to the development of the spirit of the spirit of neighbourliness and solidarity.

3/Ground floors of the town houses can easily include small industries or shops, as the sale of fabrics is very much alive in *Ambert*. Hence the idea for offices or business premises comprising a productive diverse urban mix, reducing travel stress for some people, ensuring also the exchange, or sharing of single person transport such as bicycles or electric vehicles.



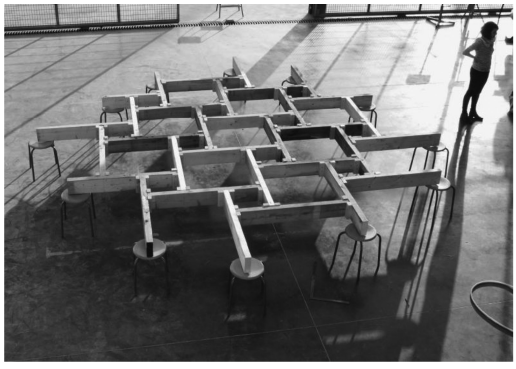


Anne-Claire Bouvier, Alexandre Chavanne, Aurélie Rodroguez-Fallard, Maud Royer, DEM master AA&CC promotion 2013.

4/The rehabilitation of the town centre can be achieved through a construction system based on a prefabrication of small elements which can easily enter through doors and windows, thus reducing installation costs, increasing the quality control of the construction, both these aspects constituting a critical given for the construction of buildings to "high" energy performance in the current French professional context.

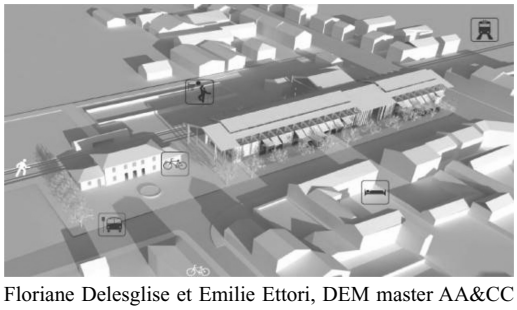
5/Other innovative hypotheses? The idea of a large training workshop shared with a craft cooperative received the Award for Young Architects given by the city of Lyon. This project would help revive local construction procedures, wooden and earth pathways, by involving them in a youth training project.

The erection of buildings for food production has never been part of architectural and landscape proposals in *Ambert*, as it has traditionally been a "service" town. However, a change is taking place for at least two reasons: firstly, because food might give work to one half of a young couple who arrive without jobs. The second reason concerns pensioners and people in isolated hamlets, who "come down" to *Ambert* and are used to a vegetable garden. They could teach gardening to the new young couples. For example, on the outskirts of the town, this meeting between the two generations could totally renew the landscape.

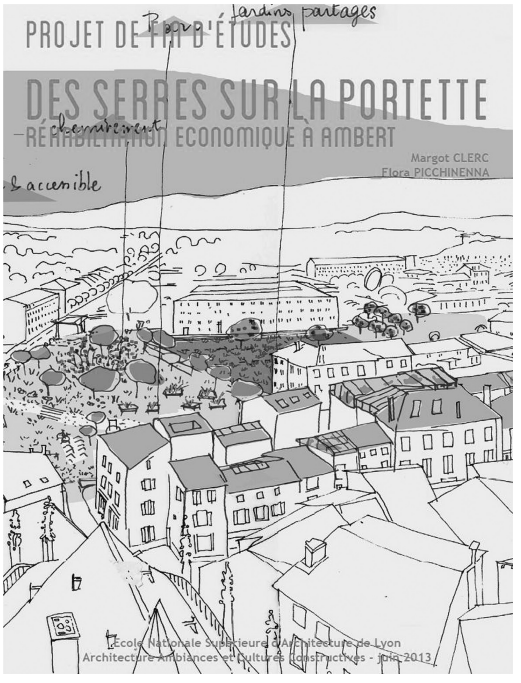




Florent Faye, Adrien Gaillard, Noémie Paperin, Nicolas Vernet, DEM master A&CC promotion 2012.



Floriane Delesglise et Emilie Ettori, DEM master AA&CC promotion 2013.

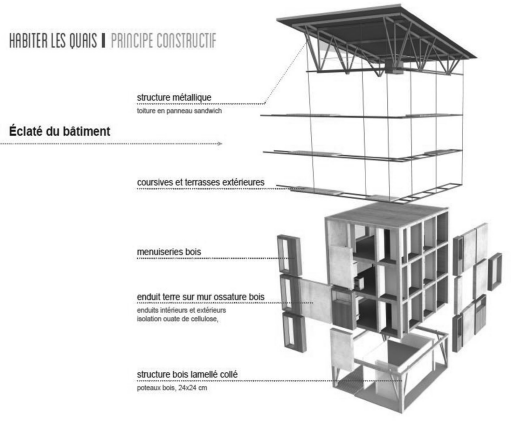


Margot Clerc et Flora Picchinenna, DEM master AA&CC promotion 2013.

4 CONCLUSIONS

The teaching staff proposed the construction of a solar habitat prototype for *Ambert* in 2015/2017. The municipality has agreed to underwrite the architectural renewal of *Ambert* with renewable energies. It would be designed by a group of students and produced by local entrepreneurs sharing the project. An architect has offered to submit the building permit and supervise the students so that the project can be managed in their own name.

The prototype will have to demonstrate the ability of *Ambert* to survive the energy challenges of tomorrow. It will also demonstrate, once built and tested in situ by locals, the ability to meet local multiple perceptions and significations for number of people. All spatial planning, even the poorest, can be the bearer of meaning; and any construction, even the most complex, can be carried out mechanically. Project management on site might propose a profitable strategy to deliver energy and build a dwelling, but this strategy may be insignificant for people of that area. The meaning is personal and it also focuses on spatial and practical signs recognized by all. How then can we advance in energy saving by ignoring this phenomenon? What meaningful support can this ecological movement bring to *Ambert,* today? Can it be shared between architecture students and resi dents of rural areas?



Delphine Bugaud et Alice Gras, DEM master A&CC promotion 2012.

The reader can see that new issues appear and because they deserve answers, the teaching staff has committed itself to research, funded by the French Office of Architectural and Landscape Research of the Ministry of Culture and Communication.



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Exploration of multiple zone daylighting and energy performance for senior housing

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ABSTRACT: Building shape and orientation have significant impact on building's daylighting and energy performance. Daylight conditions in buildings have strong association with occupants' health and comfort, especially for seniors. Although numerous studies have been done about building daylighting performance simulation and evaluation, most of them focused on the analysis of a single room or typical rooms. However, in complex multi-story buildings, daylight conditions vary greatly from room to room. Little research has examined this multiple zone daylighting performance variation. This paper demonstrates a simulation and evaluation process that uses several evaluation metrics and statistical methods to compare multiple zone daylighting performances of different designs. The case study is a senior housing project with eleven design options. Great differences in daylighting and energy performance are found, and locations of unsatisfactory units are indicated in building floor plans. The research outcome highlights the importance of daylighting evaluation, and provides design recommendations for architects and property owners.

1 INTRODUCTION

Daylight is essential for occupant's health and life quality, especially in buildings where occupants are more susceptible to environmental impacts, such as hospital inpatient departments, rehabilitation centers, and senior housing. Occupants in this kind of buildings stay in their rooms almost throughout the day, and both their physical and psychological condition are in vulnerable state.

Studies have shown positive impact of daylight on building occupants' health. The effects of daylight mainly fall into two categories: light on the skin and light reaching the retina (Edwards and Torcellini, 2002). Direct sunlight on the skin could stimulate vitamin D production, which has been proved to be linked to many health outcomes, such as increased bone health, reduced risks of cancers, heart disease and autoimmune disease (Holick, 2004). Full-spectrum of light from the sun reaching the retina could affect circadian system, which is found to be related to Seasonal Affective Disorder (Rosenthal et al., 1984), mood and sleep efficiency (Lieverse et al., 2011), alertness, cognitive performance, and affective responses (Vandewalle et al., 2009).

Variation in built environment, including the room orientation, daylight condition, and views would cause a great difference in occupants' health, recovery time, life qualities, etc. A study found that bipolar patients assigned to rooms with more sunlight had an average of 3.67 days shorter hospital stay than patients with the same symptoms in rooms with little or no sunlight (Nelson et al., 2005). Another study of a cardiac intensive care unit found overall a shorter length of stay and lower mortality rates of in the bright rooms than dim rooms (Walch et al., 2005). They also found that patients in sunny rooms used significantly less pain medication, and showed less stress at discharge. Therefore, it is important for designers to consider that all residents of the building should get appropriate and healthy environmental conditions.

The case study project is a senior housing. Countries throughout the world are facing the problem of population aging (Wong, 2008). There is an increasing number of senior housing projects being built worldwide, and the built environment of senior housing is getting people's attention.

Daylighting in senior housing is particularly important for several reasons. First, seniors need two to three times more light than young adults to see clearly (Hebert, 2007). Second, the full-spectrum of light produced by the sun is beneficial for their vision (Hebert, 2007). Third, there is a high frequency of Vitamin D deficiency in seniors because of inadequate sun exposure (Parfitt et al., 1982). Existing senior housing projects have problems of inadequate daylight. It is found that only 45% of the 165 investigated senior housing rooms can comply with the daylight design recommendations (Lewis, 2015). Large-scale senior housing projects often have complex building shapes and rooms with different orientations and daylighting conditions, and the health and life quality of the senior residents of these rooms could be significantly different.

This research explores building designs through the analysis of different daylighting evaluation criteria, and demonstrates how the building design would lead to different performance between buildings and within each building. Design suggestions are made for designers to consider the equal chance for occupants to have good built environment.

2 METHODOLOGY

2.1 *Design introduction*

In this study, a hypothetical senior housing project is to be built on a site of 80 meters by 80 meters. The project is located in Atlanta, Georgia, with a humid subtropical climate. The senior housing should have at least 240 daylight available units. The 240 units could be used as residential rooms, stairs, offices, medical services, storages, etc. For the simplicity of daylighting simulation, all units are modeled as identical residential rooms. There are a restroom and a balcony for each unit, and the dimension of the room is shown in Figure 1. The design model is built in software Rhinoceros.

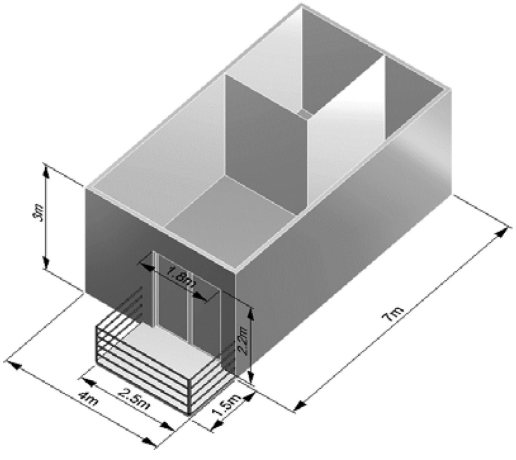


Figure 1. Standard senior housing unit.

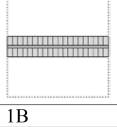
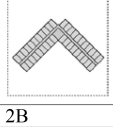
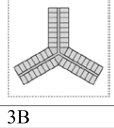
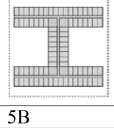
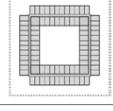
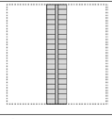
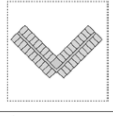
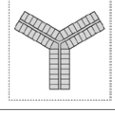
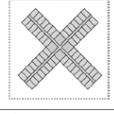
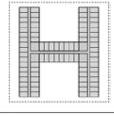
The designs to be tested are prototypical multi-story senior housing in the US. Six most common senior housing building shapes (Perkins, 2004) are chosen for this study, and five of them have two different orientations, so there are totally eleven buildings being analyzed. All buildings are between three to six floors. The building layouts and detailed information are listed in Table 1. For convenience, the buildings are names based on its building number and orientation. For example, 1A means building 1 with the first orientation. Each room is also labeled with a unique number with its building, orientation, floor, and room location.

2.2 *Simulation and analysis process*

The first set of daylighting analysis is indoor illuminance simulation. The daylighting simulation tool is Diva for Rhino with the simulation engine Radiance. Diva for Rhino is a daylighting and energy modeling plugin developed by Solemma LLC for the modeling tool Rhinoceros. The reflectance of the ceiling, floor, interior and exterior walls are respectively 0.8, 0.2, 0.5, and 0.3. The window is assumed to be double pane glazing with visible transmittance of 0.8. Each room is considered as a zone, and four sensors are placed inside each zone as a group. There are 240 groups of sensors in each building. An example of the sensors placement on one floor can be found in Figure 2.

The main performance metrics output are Daylight Factor (DF) and Daylight Autonomy (DA). Daylight Factor is the ratio of the interior illuminance level and the exterior illuminance level. It is usually considered as a static metric, and stays the same throughout the year, whereas Daylight Autonomy is a dynamic metric and is climate-based. It is the percentage of time that the average illuminance of a room that can achieve a baseline on daylight available hours (Reinhart et al., 2006). In this study, the illuminance baseline is set to 300 Lux, and the analysis periods are 6 am to 6 pm each day, with totally 3650 hours per year.

Table 1. Design information.

Building	**1**	**2**	**3**	**4**	**5**	**6**
Building Name	1A	2A	3A	4A	5A	6A
Orientation A						
Building Name	1B	2B	3B	4B	5B	
Orientation B						
Number of floors	6	6	5	4	3	3
Number of Units each floor	40	40	48	60	80	80
Surface area (m^2)	5686	6039	6385	6774	7222	7226
Footprint (m^2)	1280	1345	1792	2176	2816	2820

The second set of daylighting analysis is direct sunlight hours analysis. The tool used is Ladybug (Roudsari et al., 2013), which is an environmental analysis plugin for modeling tool Grasshopper and Rhinoceros. A test point is placed at 0.8 meters above the center of the balcony outside each room. The Sun-Path component (Fig. 3-a) is able to demonstrate the 3650 sun positions from 6 am to 6 pm each day in a year, and Sunlight Hours Analysis component (Fig. 3-b) calculates the hours that the sunlight can directly reach the test points. An evaluation metric is developed called Sunlight Availability, which is the percentage of direct sunlight hours in the total 3650 hours. These two sets of daylighting analysis methods should complement each other in the performance evaluation.

Energy simulation is also considered in this study, and the aim is to compare the heating and cooling loads of different building shapes and orientations, as a support for daylighting analysis. OpenStudio, developed by the National Renewable Energy Laboratory (NREL), is used as the energy simulation tool. OpenStudio is a plugin for modeling tool SketchUp. The energy models use ASHRAE Standard 90.1-2010 mid-rise apartment as a template, and occupancy and plug load changes are made to better represent senior housing energy consumption (Fang and Cho, 2014).

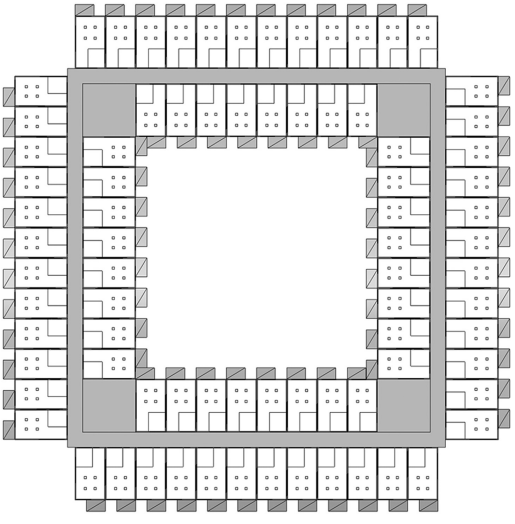
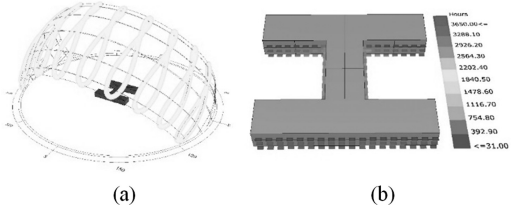


Figure 2. Example of illuminance analysis model.



(a) (b)

Figure 3. SunPath and sunlight hours analysis.

3 RESULTS AND ANALYSIS

3.1 *Traditional daylighting metrics and analysis*

The daylighting simulation results of 11 different building shapes and orientations are shown in Table 2, and these daylight metrics are some of the default outputs. Different metrics can show different aspects of the design features. Mean Daylight Factor and Mean Daylight Autonomy both examine the overall daylighting condition of the building (Fig. 4). The two results also show conflict with each other. For example, Building 5 Orientation A has the highest mean Daylight Factor, but the mean Daylight Autonomy is among the lowest.

To examine the percentages of daylit area in buildings, there are two metrics available in the simulation output: Sensors with Daylight Factor of 2% or higher and Area with DA of 50% or higher. These two metrics show similar trends (Fig. 5) as the previous figure, and same conflicts exist. Using these measures to evaluate daylit area is problematic. Whether the well daylit sensors are in the same room or different rooms make great difference in the evaluation of the building daylight performance, but these measures are not able to

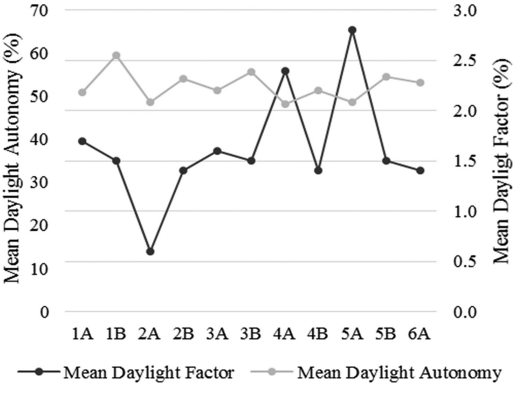


Figure 4. Mean of daylight autonomy and daylight factor.

Table 2. Default daylighting simulation output.

Building Name	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A
Mean Daylight Factor (%)	1.7	1.5	0.6	1.4	1.6	1.5	2.4	1.4	2.8	1.5	1.4
Sensors with Daylight Factor of 2% or higher (%)	27	25	3	24	27	26	45	23	52	24	24
Mean DA (%)	51	60	49	54	51	56	48	51	49	55	53
Area with DA of 50% or higher (%)	56	61	49	60	52	60	49	55	53	55	57

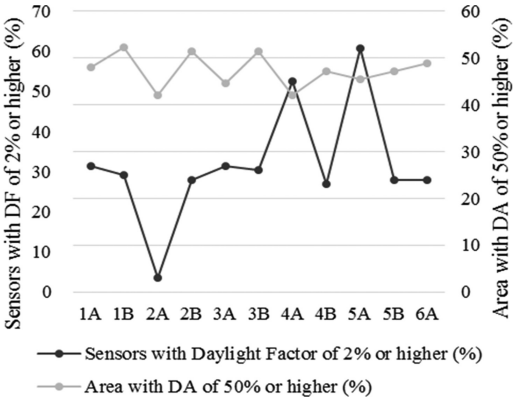


Figure 5. Percentage of daylight area.

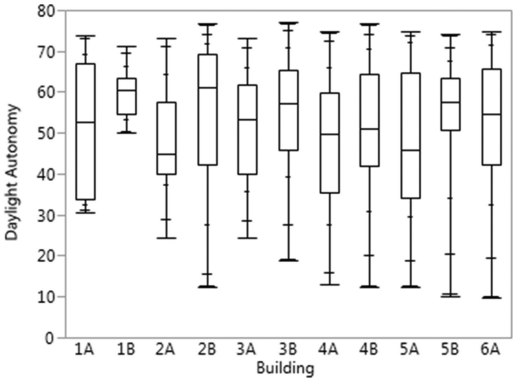


Figure 6. Plots of daylight autonomy.

tell the difference. Therefore, further exploration of the simulation data is needed.

3.2 *Extended daylighting analysis*

Two main daylighting metrics used in this section are Daylight Autonomy and Sunlight Availability. First, box plots are used to graphically present the distribution and variation of daylighting data of the buildings. Figure 6 is the plot of Daylight Autonomy. Each bar shows the distribution of the Daylight Autonomy of 240 units in one building. Great difference is found for different buildings and same building with different orientations. The distributions are skewed to the left, which means most data is relatively large, and there are a few ones with small values. DA spans from 10% to 80%, and the median of the data is between 50% and 60%. As the building shapes get more complicated, the variation gets larger. From building 1A, pure north facing rooms have DA of at least 30%, but in buildings 2A to 6A, there are lots of rooms with much worse DA values to as low as 10%. Figure 7 is the box plots of Sunlight Availability of 11 buildings. The distributions are quite symmetric around the median. Sunlight Availability spans from 0% to 100%, and the median is around 40%.

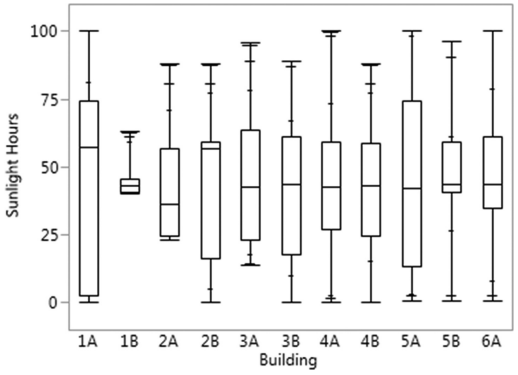


Figure 7. Plot of sunlight availability.

Another method is to directly compare the percentage of rooms in each design that can reach certain daylighting threshold. Four thresholds are proposed, and the data is listed in Table 3. Daylight Autonomy of 50% is considered as moderate target, and 35% is minimum target. Sunlight Availability of 30% is considered as moderate target, and 15% is minimum target. Figure 8 and Figure 9 present the number of units in each building that can reach the minimum and moderate thresholds. It is clear to tell the performance difference between buildings. The results of two metrics generally conform to each other. For the minimum daylighting target, all units in 1B and 2A are able to meet the target, and the other designs with higher performance are 3A, 4B, and 5B. Regarding moderate daylighting target, all units in 1B are still able to meet the target, but only half the units in 2A can meet the target. The other better designs are 5B, 3B, and 6A.

Figure 10 shows the locations of the all the units below the minimum daylighting requirement. All rooms in 1B meet the requirement, thus not displayed in this figure. Because there are no balconies and rooms shading the top floors, top floors rarely have rooms with poor daylighting. The lower floors the more problematic rooms there are.

Daylight Autonomy considers all direct sunlight, diffuse light, and reflect light, whereas Sunlight Availability is only a measure of direct sunlight. The two metrics can identify different rooms in some circumstances. For example, some east, west, and even south facing rooms in building corners can get some hours of direct sunlight, but on average the room illuminance is too low to reach the Daylight Autonomy requirement. On the other hand, for some rooms facing north, northeast or northwest, there is no chance to get enough direct sunlight, but the room illuminance can be enough due to the ambient and reflect light. It need to be mentioned that Radiance runs with stochastic randomness, which means the rays are randomly sent out in each simulation and the simulation output can be inconsistent. That explains why some rooms in the same building locations can have slightly different DA output. However the output of direct sunlight hours is always consistent.

Table 3. Percentage of units reaching daylighting target.

Building Name	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A
Percentage of units DA reach 50% (%)	50	100	40	60	55	67	49	53	45	76	62
Percentage of units DA reach 35% (%)	65	100	95	85	94	96	76	86	72	90	88
Percentage of units Sunlight Availability reach 40% (%)	50	100	49	61	59	67	61	57	53	78	65
Percentage of units Sunlight Availability reach 15% (%)	61	100	100	79	95	79	81	90	75	92	83

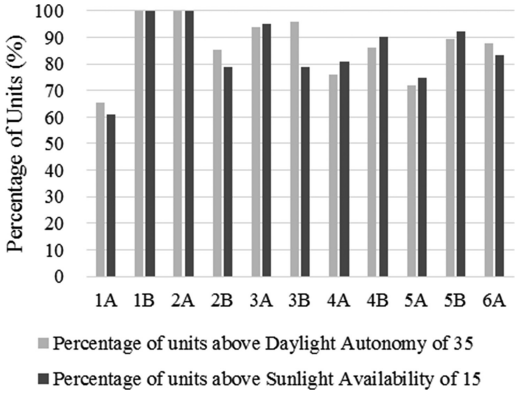


Figure 8. Units reaching minimum daylighting target.

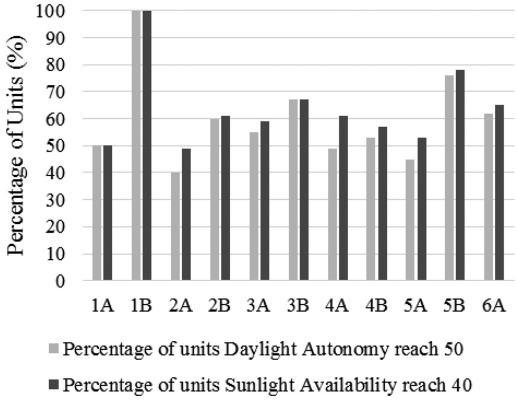


Figure 9. Units reaching moderate daylighting target.

3.3 *Statistical analysis of daylighting performance*

When buildings have a large number of rooms and each room has a different performance metric data, instead of comparing means or medians of the data, there are lots of statistical tests available to tell the building performance difference. R is used in this study to test if the overall daylighting conditions are statistically different between designs. R is an open source software for statistical computing and graphics.

First, Kruskal–Wallis test is used to test the overall difference. Kruskal–Wallis test is a non-parametric method for testing whether samples are from the same distribution. For the Daylight Autonomy, a p-value < 2.2e-16 is found. A p-value of 0.05 or lower indicates a significant difference, and the smaller the p-value, the more significant the difference is, thus there is significant difference between the DA of the 11 buildings. However, a p-value of 0.319 is found for the test of Sunlight Availability, which means there is no significant difference. This could be explained by the similar distributions of Sunlight Availability in Figure 7. When significant difference is found in overall test, the next is pairwise test for multiple comparisons to see which building is significantly different from others. The test used is Conover's-Test (Pohlert, 2014). Table 5 presents the p-values of pairwise comparisons of Daylight Autonomy. Most of the pairs are significantly different, and 1B is different from all other buildings. It is also easy to identify buildings of similar performance, such as 4B and 1A, 3B and 2B.

3.4 *Energy analysis*

Heating and cooling simulation outputs are reported in Table 4 and Figure 11. Different heating and cooling loads are found between building shapes. Same building shape with different orientations also showed big differences. North and south dominant orientations have less heating and cooling load than other orientations. For example, 1A is less than 1B; 4A is less than 4B; 5A is less than 5B. Building 1 requires the least heating and cooling energy, and building 2 requires the most. There is a trend that as the building floors get lower, and building shapes get more compact, there is more requirement of heating energy and less requirement of cooling energy (excludes building 1). The room to room difference in energy requirement and thermal comfort could be the topics in future study.

3.5 *Discussions*

The above analysis shows the daylighting performance difference of residential rooms within each building and between buildings, which could lead to the life quality difference for the senior residents. To guarantee proper daylight condition for all residents, daylighting simulation and analysis is necessary. For new senior housing projects, building shapes and orientations should be considered carefully along with floor layout. For existing projects, the rooms with poor daylighting should not be used as residential units for seniors. Carefully designed artificial lighting could be used to enhance the illuminance condition of residential rooms. Easily accessible public area with

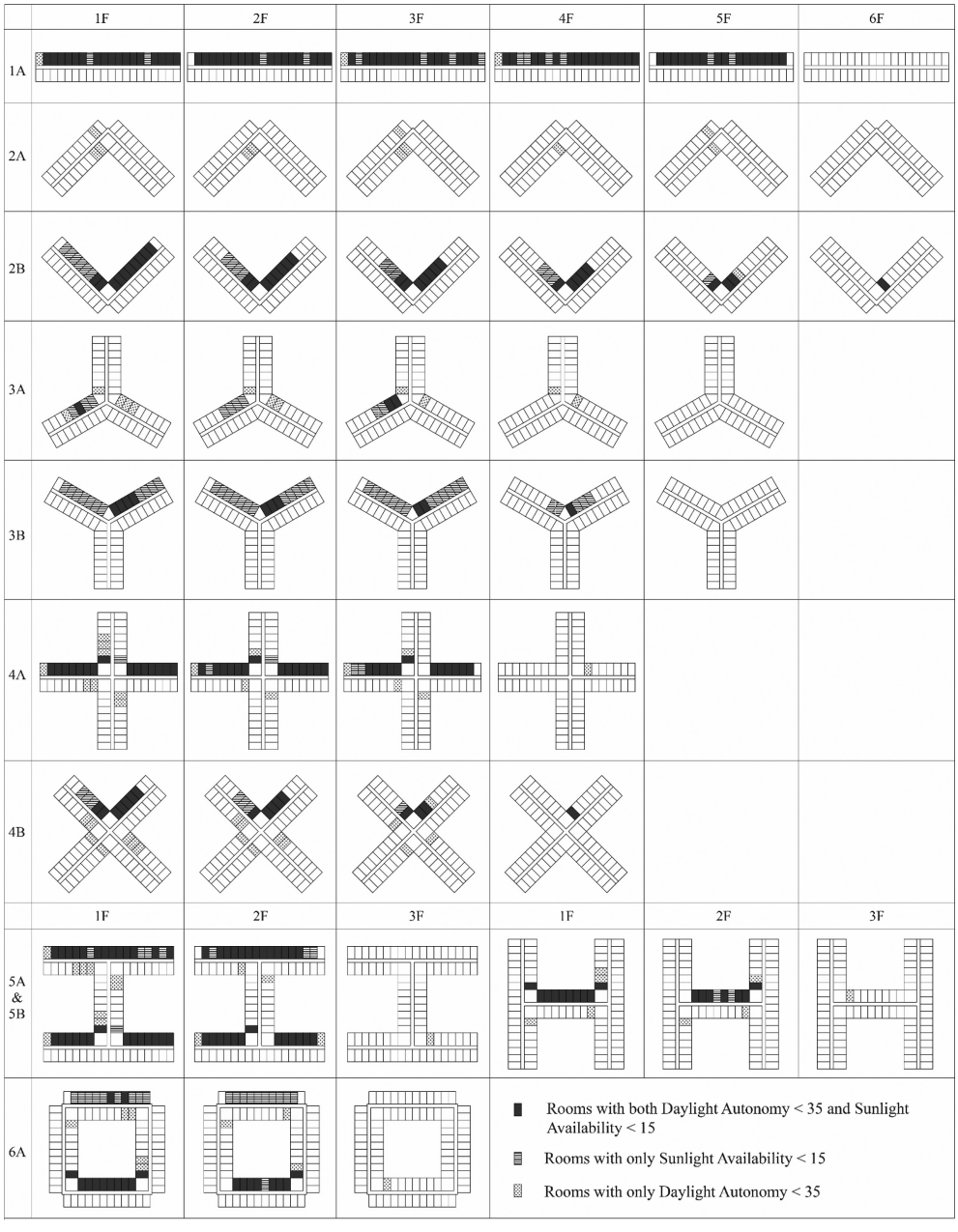


Figure 10. Locations of rooms below daylighting target.

Table 4. Energy simulation output.

Building Name	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A
Heating load (GJ)	774	787	758	743	783	782	844	848	907	916	913
Cooling load (GJ)	929	1095	1245	1252	1195	1196	1101	1107	960	1048	1001
Heating + Cooling load (GJ)	1703	1882	2003	1995	1978	1978	1945	1955	1867	1964	1914

Table 5. Pairwise comparisons of daylight autonomy.

	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
1B	0.000	–	–	–	–	–	–	–	–	–
2A	0.001	0.000	–	–	–	–	–	–	–	–
2B	0.007	0.010	0.000	–	–	–	–	–	–	–
3A	0.385	0.000	0.019	0.000	–	–	–	–	–	–
3B	0.005	0.014	0.000	0.890	0.000	–	–	–	–	–
4A	0.006	0.000	0.647	0.000	0.059	0.000	–	–	–	–
4B	0.916	0.000	0.002	0.005	0.445	0.004	0.008	–	–	–
5A	0.047	0.000	0.218	0.000	0.265	0.000	0.439	0.060	–	–
5B	0.042	0.001	0.000	0.517	0.004	0.432	0.000	0.033	0.000	–
6A	0.165	0.000	0.000	0.198	0.024	0.154	0.000	0.135	0.001	0.522

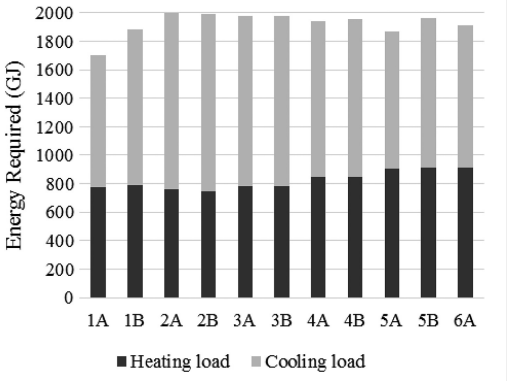


Figure 11. Heating and cooling loads.

abundant daylight could also be added to compensate the inadequate sunlight in residential rooms.

4 CONCLUSIONS

This paper presents the daylighting and energy performance evaluation process of senior housing designs through simulation and statistical analysis. Advantages and disadvantages of different performances metrics are discussed. Significant differences of daylighting are found between designs. Rooms of poor performance are located in each design, and design suggestions regarding these rooms are proposed. This evaluation process is recommended for comparing building performances in the early design stages. This study is the first step of multiple zone building daylighting optimization, and the next step will include window and shading adjustment based on room daylighting differences.

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Forms of the Earth and elements of the city in Muratori's urban projects

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ABSTRACT: In the contemporary age, the dialogue that man always leads with nature through architecture has been interrupted.

In the contemporary city, characterized by an open form and an expanded dimension, the techniques of urbanization don't care about the orographic form of the landscape.

This is the major cause of conditions that today hit the city.

However, it is possible to recognize that the city could find the reason of its form in the relationship with the form of nature.

In Italy, over the past century, the theory of the urban project tried to deal with these issues and to define the syntax of urban construction in relation to the form of physical geography.

Some of the more interesting design experiences, in this sense, are those run by Saverio Muratori at the end of the fifties: the projects for the "districts" of Magliana (Rome) and the project "Estuario uno" (Mestre).

1 INTRODUCTION

1.1 *The crisis of contemporary cities*

Over the centuries, civilizations have chosen the places to settle in according to the recognition of specific values and particular characters corresponding to their specific cultures. Every foundation process has always been consequential to a process of interpretation of the territory. Because of this dialectic relationship with the physical substratum, each human settlement has contributed, over time, to exalt the original characters of chosen places.

This interaction has radically changed during the last century. Today, cities assume an "extended" dimension and an "open" form. Infrastructural triangulations split the territory and compare themselves with the elements of wide-open landscape; they absorb large portions of land and agricultural fields. The limits between city and countryside are already indistinguishable and edge urban spaces cannot be considered urban places and, even, places of nature. They are ambiguous spaces.

The form of contemporary cities is no longer compact and well defined like the form of ancient cities, but it is "diffused" and "scattered" on the territory (Arís 2005).

The *town in extension* is about to explode, since the radical change of its structure and of its dimension is not supported by a different way to interpret its relationship with the elements of physical geography.

Urbanization policies seem to be indifferent to the form of natural substratum in which cities are built.

Cities unconsciously grow without direction. The empty space, among the parts of the city, is deprived of its collective value and becomes *junkspace*, residual space, without character, without identity, surrounded by the anonymous buildings of the *generic city. The Joyful Science"*.

1.2 *The role of urban project*

On the basis of the recognition of this crisis, a theoretical reflection should be made in terms of form.

The Mediterranean landscape (the set of cities, country sides, natural places that are the result of a deep and ancient interaction between man and nature), in particular, raises two central questions to the reaffirmation of its own identity: the awareness that the condition of the contemporary *city-territory* ("boundless" and "polycentric") needs a new interpretation of the relationship between city and territory and the acknowledgement of the etymological value that the form of geographic elements assumes as regards to the urban form.

In fact, the city, today, is no longer based on a mutual exclusion principle, as it happened with the ancient city, compact and closed on itself and built in complete opposition to the surrounding rural area, but rather on a "simultaneous presence" of artificial and natural facts (Motta & Pizzigoni 2011).

Significant are the words of Antonio Monestiroli 'we cannot think to built the city like historic centres, like it is only one thing, we have to build it divided into parts' (Monestiroli & Venezia 2011) since the bond of mutual influence between natural facts and urban facts is established when the parts of the scattered city attempt to find a connection with the elements of the landscape to give a new form to the urban structure.

With regard to these considerations, the discipline of urban project should define "new grammars" for the construction of contemporary city. These ones should be able to overcome the indifference of *generic city*, in order to find a possible alternative to the theories that consider natural empty space like "shapeless" space (Moccia et al., in prep.).

In Italy, during the past century, the theory of urban project tried to deal with the objective of defining a new syntax of urban construction, which is elaborated in respect of the form of physical natural substratum.

Saverio Muratori had one of the most significant experiences, during the 50's and 60's. He developed the projects for the Magliana "quarter", in Rome and for the Barene of San Giuliano, in Mestre. These projects represent a significant attempt to define the form of parts of the city, through the acknowledgment of the "generative" value assumed by orography.

2 THE PROJECTS FOR MAGLIANA DISTRICTS, ROME, 1956–1957

The projects for Magliana districts (the ridge-project and the valley floor-project) deal with two different conditions of physical substratum (the hills and the river bend), to which correspond two different "parts of the city", separated by a natural range consisting in hill slopes.

2.1 *The quarter on the hill range (1957)*

In the different versions of the project for "high" quarter, the composition of urban elements (squares, streets, blocks, public buildings) looks for a harmony with the elements of natural landscape (mountain pass, hill ridge, valley floor, plateau).

Saverio Muratori takes advantage of the long-shaped hill ridge to built long perspectival streets, enclosed by two facades of residential buildings. They are not parallel to each other and the pillars of the porches, in the ground floor, articulate them. So, Muratori can define a machine capable to channel the open landscape of Tiber river valley inside the new settlement (Palmieri 2013).

In some places, these streets are interrupted to allow the positioning of specialized buildings, to enable the creation of public spaces that serve the urban sub-units, in which the project is articulated.

In certain variants of the project, parallel blocks and, otherwise, in other variants, courtyard residential buildings are located on the hillsides, between the ridges. They are placed orthogonal to the ridge and define their own dimension on the basis of the conformation of the slopes. Courtyards are sometimes open to the landscape; sometimes they are closed and introverted with an inner character.

The declension of residential buildings types, in the different versions of the project, seems have the purpose of the experimentation of different "characters" that define themselves in relation to the places that they overlook (Monestiroli 2011). The relationship with the territory generates, once again, the character of architecture.

The public spaces, which have to be representative of community life and, so, of human settlement identity, are positioned in the places that have an appropriate character to this function.

Hill saddles and plateaux are focal points due to their particular geomorphological conformation and, for this reason, become the places of the collective spaces. In fact, the streets on the ridges converge in the saddle point on the hills, and it is the perspective focal point of the quarter. For these reasons, it should be deemed to be a place of a great civic value and it becomes, in the different project variants, a natural public space or a great urban square.

The plateaux, however, are easily identified, also at the territory scale, due to their height and to their punctual form. Here, Muratori places isolated public buildings.

2.2 *The quarter on the river bend (1956)*

In the Magliana project on the valley floor, the radiocentric form of urban structure is generated by the Tiber bend.

A great "street-plaza" lies on the bend itself, gathering urban polarities and collective buildings. It represents the central point of the neighbourhood.

This place is chosen once again for its particular geographical configuration, which makes it appropriate to become a public space.

Five radial paths spread from the street alongside the "blend-square" and distinguish four sections, in which the settlement is divided. Each of these urban zones contains a small public area with essential services for the neighbourhood.

At the end of the five principle axes, under the hillside that separate the "down" quarter from the "high" one, the presence of residential towers forms a counterpoint to inner polarities, which are set on the linear square on the river, at the intersections with the five radial streets.

The dialectic between inner and exterior polarities make it possible to visually perceive the dimension of the quarter, and so to strengthen its finiteness nature and, more importantly, to contribute to establishing its unity.

Also in this project, there are different building typologies. From perimeter residential towers to four-storey buildings, which define the fronts of the principle streets of the settlement. And again, there are two-storey row houses, which build the insides of each urban zone and there is the public plaza, in which collective buildings are located on the meandering curve of the river bend.

This composition of building types, along the Tiber, declares once again the etymological value assumed by geographical elements for the construction of these projects.

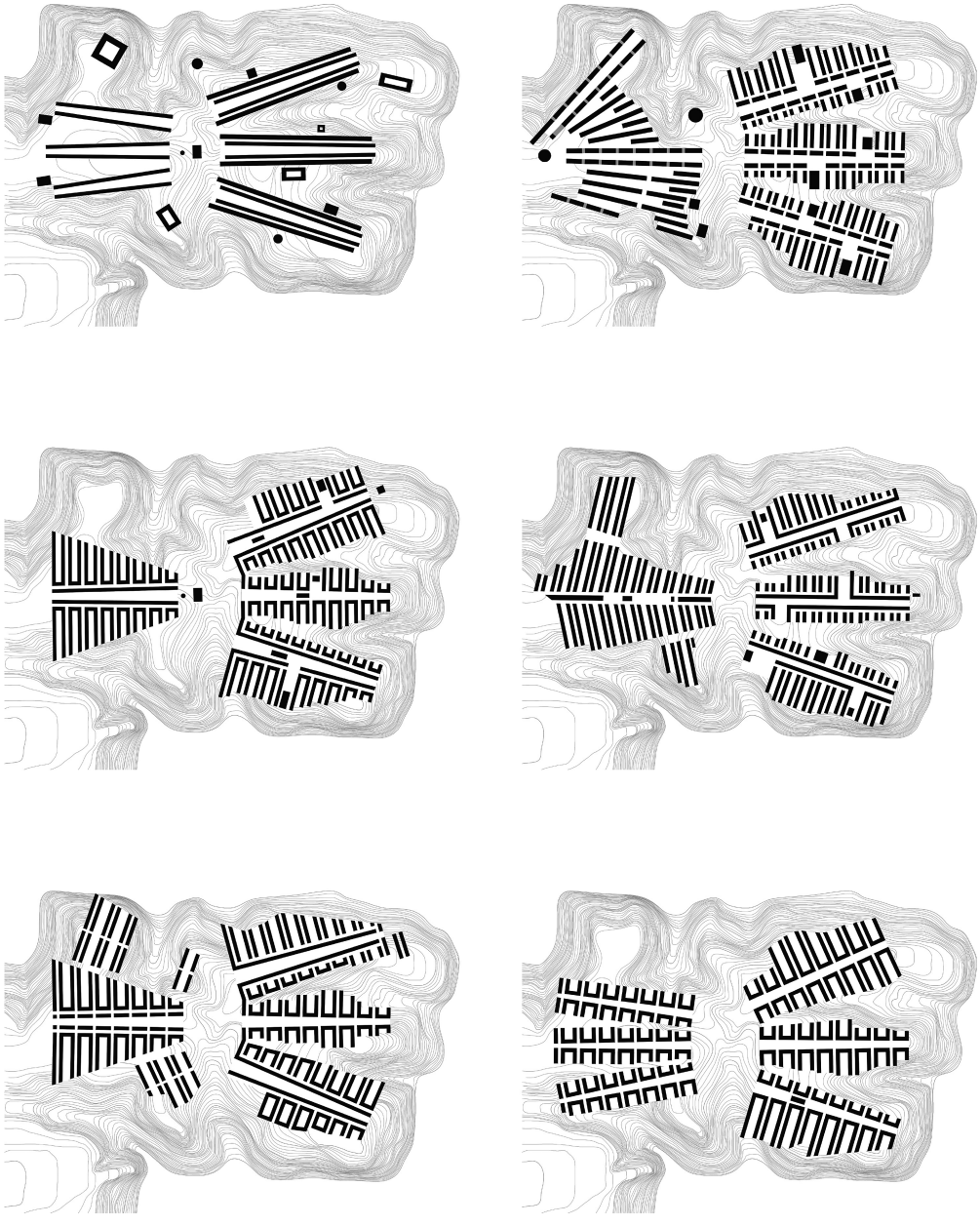


Figure 1. Saverio Muratori, different planning solutions for Ina-Casa quarter, Magliana II. Rome, 1957. Drawing by the author.

3 "ESTUARIO UNO" PROJECT FOR "BARENE DI SAN GIULIANO" COMPETITION, MESTRE, 1956

The purpose of "Barene di San Giuliano" competition was to build a quarter for 40.000 inhabitants, between Venice and Mestre.

On this occasion, as is well known, the group led up by Saverio Muratori elaborated three design concepts, which correspond to the interpretation of three essential moments of Venice urban development. So, he identified the three typical urban systems that characterized Venice urban structure throughout its history: the type with a quadrangular square, the type with a comb-shaped plan and the type with foundations flanked by canals. These paradigms represent the Venice of X–XI centuries, the Gothic Venice and the Renaissance Venice of XVI–XIX centuries, respectively (Maretto 2012).



Figure 2. Saverio Muratori, project for Ina-Casa quarter, Magliana I, Rome, 1956. Drawing by the author.

The project called "Estuario uno" is the most significant for this research, because it assumes the morphology of lagoon archipelago as etymology for the construction of the new quarter.

The form of the "elemental part" corresponds to the dimension of an "urban island" that, through its repetition, builds the whole city.

Each individual island declares its autonomy, by placing itself with its own orientation.

The buildings are organized around a central empty space, called "campo". This place becomes the little square of each island-unit. On one side, there are the buildings for community services, while on the other three sides, residential blocks composed by different building types ("close courtyard", "passing courtyard", "row houses") take place.

Near to the road that connects Venice and Mestre, Muratori builds a great square, which is an exception in the iteration system of urban islands. This long square is able to look on one side at the Venetian lagoon and, on the other side, at the hinterland of Mestre.

Also in this project Muratori develops a complex and hierarchical urban organism and it is undeniable that urban structure is very closely bound up with the character and the form of the place.

The meandering water-space of lagoon stands in opposition to the finiteness of island-units that identifies the archipelago, through their repetition, as a plurality in which individual elements lives together even though they are unavoidably separated.

4 CONCLUSIONS

In the light of the above considerations, the analysis of Saverio Muratori's urban projects becomes very important and makes possible the acquisition of useful tools to build a new "idea of the city", which should allow to deal with the state of being contemporary.

Whereas, in other circumstances, Saverio Muratori carried out his research on urban project in different ways, trying to operate in a spirit of continuity with the formation processes of ancient city (for example through the processual extension of urban fabric and the saturation of empty spaces), instead, in these planning experiences, we can individuate a great intuition, which consists in the recognition that the form of physical geography assumes an etymological value in respect of the urban form.

Other important themes, other significant relationships start from this recognition, such as, for example, the relationship between the parts of the city and the system of open spaces. In these projects, natural interstices (which are peri-urban areas, shreds of untamed nature, uncultivated country sides or even empty spaces produced by decommissioning process) are considered like "intervals" which confer identity to the individual parts and which define them in their finiteness.

These project experiences show us that the empty space of nature, absorbed by the *town in extension*, may acquire a syntactic value in the urban structure and that it makes possible the creation of long-distance relationships between the quarters, making them formally autonomous.

The identity of city-territory may be based on this set of relationships and it will be stronger if the single elements can harmonize with the morphological characters of the Nature and if it the connective value of empty urban spaces is recognized.

Moreover, Muratori carries out experimental studies on the principles of appropriateness of buildings



Figure 3. Saverio Muratori, "Estuario uno" project for "Barene di San Giuliano" competition, Venice, 1959. Drawing by the author.

types trying to make variations depending on the characters of natural places.

Through the use of mixed building typologies, Muratori builds these quarters, as formally autonomous organisms, but they are also strongly hierarchical and complex inside.

Finally, the simultaneous presence of delimitated and compressed urban spaces (in which the character of interior prevails) and of extended and dilated natural spaces (in which the character of esterior prevails) enriches the contemporary city and refers to the complex spatial articulation of ancient city, which is able to evoke different characters (from the collective essence of squares, of streets, to the semi-private essence of courts and alleys).

So, in the different projects, Muratori develops different strategies that take in consideration the idea of a deep dialectical relationship between architecture and Nature and that confer a strong identity and a suggestive character to the different settlements. Theses quarters become, in this way, extraordinary examples of *city-nature* (Moccia 2015).

Therefore it can be said that Muratori's thought, in its theoretical complexity, outlines some guidelines for work that even today offer several suggestions. These ideas might be resumed with interest since they are highly topical and they might be very relevant to the present situation.

These projects contain the seeds of possible developments.

Potentialities therein have a great operational usefulness for the construction of contemporary cities.

This is why I find interesting to analyse and to interpret the urban projects that Muratori defines in '60s, in light of these beliefs; looking for the several fruitful insights that characterized these experiences.

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Landscape design and restoration as an educational hub: An experience from Costa Rica

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ABSTRACT: Landscape can be defined as a mirror of the interactions between man and nature trough time. Landscape design is an intentional cultural act to change some elements of those interactions. "Landscape restoration" can be defined as an intentional cultural act to remove and/or add some elements to places and interactions in order to bring them to a more "healthier" state. It's a process where communities, architects and ecologists, politicians and educators must work together. To develop this concept, in October 2015 the first course on "Landscape Conservation" was held in Costa Rica, promoted by the Organization for Tropical Studies. This course linked architects with ecologists, politicians, community leaders, researchers, economists and planners, in the restoration of a protected wetland. All of the participants ranked the experience as very good or excellent, and landscape design and restauration proved to be an important approach to the development of a global working framework, connecting views and skills needed for achieving a more sustainable future. This presentation describes these concepts, experiences, results and desirable future developments.

1 INTRODUCTION

Biological diversity or biodiversity – the variety of life forms that inhabit the planet and the natural patterns that make up between them (ONU, 2010) – is at the limit that humanity can continue to develop and prosper, now and for future generations, without creating abrupt and irreversible environmental changes (Steffen et al, 2015). One of the key problems that the conservation of biological diversity faces is the loss, degradation and fragmentation of habitat (UICN, 1980; ONU, 2010).

Urban growth can lead to loss of habitats of high value, adjacent to cities (Hansen et al, 2005; McDonald et al, 2008; Radeloff et al, 2010) and this in turn can result in high rates of extinction of native species (Kowarik, 1995; Marzluff, 2008). Urban growth therefore can be deeply associated with some of the main causes affecting biodiversity, and this can alter environmental qualities at different scales (Grimm et al, 2008).

As a result of human activities, four of the nine "planetary boundaries" have been crossed. In order of importance and impact, the loss of the integrity of the biosphere, biogeochemical cycles altered, the change of the earth system and climate change. The integrity of the biosphere and climate change have been identified as possess on its own the potential to lead the system of the Earth to a new state, should these be substantially and persistently transgress (Steffen et al, 2015).

In recent years and in growing numbers various researches on this topic have been conducted. For instance, one have concluded that the conservation of urban biological diversity should focus on promoting the preservation and the restoration of native species (McKinney, 2006).

The biodiversity loss and climate change must become fields of interdisciplinary actions, where architects and planners can play a part. For that, it is needed for them to get a global view of the subject and a common language. This article concerns this new field of work, and provides details on how architects and planners can work together with ecologists, local communities, NGOs and public bodies, reflecting on the experience the authors had on the coordination of a course in landscape design and restoration in Costa Rica.

2 LANDSCAPE PLANNING, DESIGN AND RESTORATION

Landscape can be broadly defined as a mirror of the interactions between man and nature trough time (Cancela, 2001). In the year 2000, the member States of the Council of Europe approved the European Landscape Convention, with the aims to promote landscape protection, management and planning, and to organise European co-operation on landscape issues (EU COM2011 244). In the mentioned Convention, landscape is defined as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors". In the same document, "landscape protection" means actions to

conserve and maintain the significant or characteristic features of a landscape, justified by its heritage value derived from its natural configuration and/or from human activity; "landscape management" means action, from a perspective of sustainable development, to ensure the regular upkeep of a landscape, so as to guide and harmonise changes which are brought about by social, economic and environmental processes; and finally "landscape planning" means strong forward-looking action to enhance, restore or create landscapes.

For the objectives of the present article, we can define "landscape design" as an intentional cultural act to change some elements of those interactions. "Landscape restoration" can be defined as an intentional cultural act to remove and/or add some elements to places and interactions in order to bring them to a more "healthier" state (Hourdequin & Havlick, 2016). It's a global process where communities, architects and ecologists, politicians and educators must work together to achieve proper results. So, accordingly to the Landscape Convention, the actions leading to the restoration of landscapes can be classified under the global name of "landscape planning". We personally don't agree with this encompassing definition, mainly because landscape planning and landscape design lays on the approach that the system will be manipulated until the original target or design endpoint is reached, whereas landscape restoration is open ended and cannot reach a specific endpoint with a great level of certainty (Clewell & Aronson, 2013), thus leaving more space to accommodate natural changes and evolution. The inference is more "guidance" than "insistence" (Clewell & Aronson, 2013). This evolution strategy seems more appropriate in a world where change and chance are the rule, the future is as unpredictable to other organisms as it is to humans and natural disturbance is to frequent for equilibrium models to be useful (Drury, 1998).

2.1 *Why architects should be involved in landscape design and restoration*

According to the point "E.S. 1.3 Natural and Cultural Heritage" of the 2015 Code of Ethics & Professional Conduct of the American Institute of Architects, "members should respect and help conserve their natural and cultural heritage while striving to improve the environment and the quality of life within it" (AIA, 2015). This is only mandatory for the architects enrolled in that specific professional body but serves as a general guideline for architects worldwide. Due to the fact that architects work mainly in urban environments, and urban development is a great cause of habitat degradation and loss, is obvious that architects that want to comply with the mentioned Code of Conduct should be involved in activities that minimize and restore environmental degradation. This we can call the ethical approach for landscape restoration.

Due to the fact that in the planet most of the natural factors are intertwined, as the global biogeochemical cycles demonstrated (Cain et al, 2011), an effect in a particular place and time can have impacts in other places and times. In a globalised world, architects cannot be confined to the knowledge of their limited spaces and times of intervention, but must comprehend their impact, positive or negative, in a "small world". This we can call the informed approach for landscape restoration.

Well planned and appropriate landscape restorations, compared to loss of ecosystem services, may provide benefit/cost ratios of 3–75 in return of investments and an internal rate of return of 7–79%, depending on the ecosystem restored and its economic context, thus providing in many cases some of the most profitable public investments including generation of jobs directly and indirectly related to an improved environment and health; ecological restoration can further act as an engine of global and local economy and being a source of green employment (Nellemann, 2010). This we can call the economic approach for landscape restoration.

Science and technology shape our world and, as a society, we need to make well-reasoned and scientifically literate choice about everything (NS, 2015); thus for architects the opportunity to work with teams that normally will have a great amount of science and technology careers involved (geologists, engineers, biologists, ecologists, etc.), is a key issue for professional development and scientific improvement. Landscape restoration is a new field of science but already has a specific professional association (the Society for Ecological Restoration), and a good number of journals and conferences of worldwide level. The scientific approach to landscape restoration is an expanding field, in which architects should also thrive and develop the corresponding competences to deal with hard science data that allows them to deal with this issue on other sides of the profession.

2.2 *A particular aspect of landscape design and restoration: wetlands*

Wetlands provide services of near USD 7 trillion every year (Nellemann, 2010); this is roughly the same amount (USD 7.6 trillion) that all "Travel & Tourism" activities (travellers on trips outside their usual environment with a duration of less than one year), generated for the global economy in 2014 (WTTC, 2015). So, from an economic point of view, wetlands have roughly the same value than travel and tourism activities. However, wetlands are at risk of disappearance (due to climate change, pollution, habitat degradation, overexploitation of resources, etc,) and travel and tourism activities are increasing at a steady pace (WTTC, 2015). The services that wetlands present, if they all disappeared, would need the total amount of money generated from travel and tourism activities to be replaced.

Also, from data collected in 2003 in Sri Lanka, the services provided from a local wetland were calculated at more than 2000 USD per hectare, per year, within a

huge range of direct services that included flood attenuation, industrial wastewater treatment, agricultural production, downstream fisheries, firewood, fishing, leisure, domestic sewage treatment, local freshwater supply and carbon sequestration (Nellemann, 2010).

3 THE COSTA RICA EXPERIENCE

In order to develop an approach between architects and ecologists, an "specialty field course" was organized in Costa Rica. This country has 4.98% of the world's biodiversity (Obando, 2007), being considered as one of the top 20 countries in the world within this parameter; this is mainly due to its geographical position in the Mesoamerican isthmus, combined with a varied topography and climate (Kappelle et al, 2002).

The course was developed by the Organization for Tropical Studies (OTS) at "Las Cruces Biological Station and Wilson Botanical Garden". The Organization for Tropical Studies (OTS) is a non-profit consortium of nearly sixty universities, colleges, and research institutions from around the world. In the early 1960's, scientists from U.S. universities forged working relationships with colleagues at the Universidad de Costa Rica in the interest of strengthening education and research in tropical biology. Intense interest, both in the U.S. and in Costa Rica, led to the founding of OTS in 1963. OTS was founded to provide leadership in education, research and the responsible use of natural resources in the tropics. To this end, OTS offers intensive field courses for undergraduates, graduate students, and natural resource professionals in tropical biology and related disciplines in Costa Rica and South Africa. In 1985 OTS was the first organization to receive the Tyler Prize for Environmental Achievement; in 2000 OTS was singled out for Special Recognition and Merit by the Ecological Society of America; and in 2006 OTS was awarded the first Diversity Award from the Organization for Biological Field Stations (www.ots.ac.cr).

Las Cruces Biological Station & Wilson Botanical Garden is located on the southern slope of the Pacific Coast of Costa Rica, in the Puntarenas province, at 1200 meters above sea level and 300 km to the southeast of San Jose – Costa Rican capital – in the canton of Coto Brus (Fig. 1). Las Cruces is part of the La Amistad Biosphere Reserve and is a key site in the study of restoration ecology and biological corridors.

The main objective of this course, was to complement academic formation with interdisciplinary and transdisciplinary professional performance in the area of landscape analysis, design and restoration. Architects interacted with ecologists, the local community, national and international professionals, and local authorities (Fig. 2). This allowed that their future professional intervention proposals share and understand a common ecological language, are designed and developed according to scientific data and are seen as an opportunity to conserve, manage and restore ecosystem services at different scales. Also,

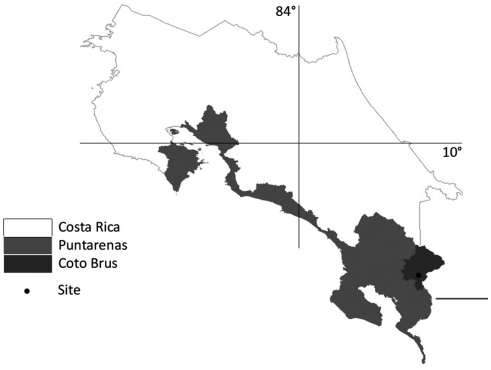


Figure 1. Location of Coto Brus and the wetlands site, in the Province of Puntarenas, Costa Rica.

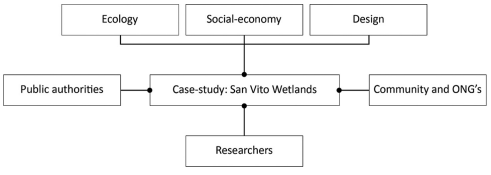


Figure 2. Scheme of interactions for the landscape restoration of the San Vito Wetlands.



Figure 3. San Vito Wetlands, general view.

for ecologists that normally are very able to study and interpret a local ecosystem but might lack the ability to produce good conceptual designs, powerful communications and construction details, to link with architects was a surplus of intervention very much welcomed. According to the experience, to help architects to gain effective knowledge on landscape issues, the comprehension of the factors of time, change, complexity and chance in the "natural" world, were fundamental.

The activities were developed within a theoretical-pratical approach, with an objective and real case study to intervene: the wetlands of San Vito de Coto Brus, a small protected area, with circa 20 hectares, in the periphery of the town of San Vito (Fig. 3). These wetlands are located near the main road from San Vito to Panama and neighboring a small airport. The hydrographic basin is mainly occupied by agriculture and small patches of fragmented forest. These wetlands are important as a food resource for a great variety of birds, and due to its scenic beauty and its proximity to San Vito, has the potential to become an ecological urban park. The course also emphasized the opportunity for

members of the communities around the wetlands and local authorities, to discover the potential of the site as an educational, economic and eco-touristic regional hotspot.

Within this practical learning and applied experience, the architects enrolled in the course were involved in the interpretation of the landscape, proposing integrated solutions within the specific ecological and social context, assuring the development of the place's identity. They were also guided on innovation criteria for design guidelines, with the implementation of scientific data on the conservation, restoration and rehabilitation of the landscape, in order to decrease the loss and fragmentation of habitats, generating a strong conceptual basis about the ecology and landscape connectivity of the site. The more "traditional" approaches of green architecture, respecting the local conditions and the cultural and natural characteristics of the site, were also a point in which architects developed interesting work. All this tasks were seen as a complement to the academic formation and professional experience, developed within a transdisciplinary framework.

4 THE FUTURE ROLE OF ARCHITECTS IN LANDSCAPE DESIGN AND RESTORATION

The EU Biodiversity Strategy aims to halt the loss of biodiversity and ecosystem services in the EU and help stop global biodiversity loss by 2020. It reflects the commitments taken by the EU in 2010, within the international Convention on Biological Diversity. It's an ambitious strategy setting out 6 targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU by 2020. In particular, the "Target 2 – Maintain and restore ecosystems", states that "by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems" (EU COM2011 244). If this target is to be effectively applied, if only partially, the actions involved will create a huge potential market for ecological studies and monitoring, species and landscape conservation and restoration projects, academic research, ecological rehabilitation and management.

Due to the fact that worldwide nowadays, the landscape is mainly multi-layered or "cultural", architects and planners must be involved, considering this kind of actions inside their professional capability. In fact, as happened to food systems in urban planning that were once called a "stranger to the planning system" (Pothukuchi, 2000) and are now an indispensable issue on urban planning, we believe that biodiversity that is now the new "stranger" to that system, can also become – due to its increasing importance in the technical and political arena – a significant issue on landscape design, planning, management and restoration.

Climate change also plays an important role on this subject, obliging planning to be more adaptive and concerned with the maintenance or creation of natural systems that can act as barriers, sinks or sponges to contain raising water levels at coastal areas. Being these areas the most heavily urbanized, the work of architects and planners on this issue is of primordial importance for the years to come (Costa, 2013).

Due to its specific education and practice, architects already are and will be very important in teams dealing with landscape restoration, biodiversity and climate change issues, as the before mentioned Costa Rican experience has demonstrated, particularly in the capacity of architects to create global visions for an achievable future, change them into graphical documents that interpret and coordinate the work of different team members, produce construction documents and have the skills to supervise and evaluate the work done on site.

But also from the results of the mentioned Costa Rican experience, for architects to become more relevant in these fields, they need to know more about ecology, interpretation of scientific data, global biogeochemical cycles and land ethics.

5 CONCLUSION

Landscape conservation and restoration can be important new fields of work for architects and planners. Biodiversity loss and climate change are two contemporary mega-trends that need to be stopped or mitigated, and for that, need the contribution of all technical disciplines involved in spatial decisions. The Costa Rica course that linked in an practical way architects with ecologists in the restoration of an wetland, proved to be a very effective way to architects rapidly gain basic know-how about these issues and become an important part of teams dealing with landscape restoration, particularly for their capacity to deal with complex spatial data, create coordinated visons, transform them into easily understood communication tools, produce construction documents and potentially supervise the construction of the site. They were very appreciated from other team members with an education on biology or ecology, able to study a site but with less capacity to propose coherent visions, communication and construction documents. As the results of the course showed an appreciation of 75% of the participants considering it as "excellent", we may conclude that this kind of interaction between architects and natural scientists is acknowledge, and a good process to architects to gain fundamental skills to help tackle the global issues of biodiversity loss and climate change, new important fields of work to architects and planners, in order to help to achieve a more sustainable future.

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Urban species

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ABSTRACT: The physical world and our bodies act as constraints on the spaces we design, build and use. As process and product, the project underlying this paper is a human-imposed spatial design solution and environment. But as concept, it has some degree of independency or autonomy. It seeks for its own unique identity, crossing natural and man-made patterns. What kinds of space and place can code be designed to make? Or in other words, can the new computational technologies, interpreting the nature's processes, significantly change the role of design in the futures of space conception? This paper will present an urban project proposed for Luanda city outskirts, dealing with specific geographic conditions, common in semi-arid climates, contributing for the idea of a native functional urban development. This proposal intends to create a model able to translate social and cultural particularities of being African, using material systems inspired in singularities observed in African biological diversity as source of inspiring forms and shapes. The complexity of Nature's shapes is built up by modulated repetition of a few basic types of structure. The exploration of biological entities, like the African Anophelines Larvae, as an information source from the viewpoint of evolution, differentiation and self-organization of geometries and shapes was used as a metaphor for the development of this "Urban Species" dwelling project.

1 INTRODUCTION

According to Allen (1992), immaterial ciphers, or codes, are substituted by the material traces that give rise to shapes. Adopting this idea of biological-genetic code that drives differentiation and the emergence of shapes in environment, the aim of Urban Species project is to create a morphogenetic protocol to the implementation of a modular housing aggregate. This project adopts an analogous generative system (Mitchell 1989) looking at an existing system and its operation, in order to interpret it and recreate it under other circumstances: establishing a comparison with the generative power of the Hox genes. This project is not a literal interpretation of any profound knowledge of the Genetics Science. It is an analytical methodology with the support of programming languages applied to design as a metaphor to the complexity underlying the genetic code (Carroll 2007). Particularly the comparison with Hox complexes where gene expression is initiated in the embryo and is responsible for shaping the many biological entities was inspiring to undertake this research. The analysis of site specific conditions for the implementation of the project in a real geographic location, Angola, made us start the concept design looking closely to a particular African larvae, the Anophelines, as a generative source (Monnerat et al. 2002). The complexity of the Anophelines body is built up by modulated repetition of a few basic types of structure (Alberts et al. 2002). Thus, the underlying expression pattern of genes confers on each segment of the larval body a different identity. Hox gene expression is initiated in the African Anophelines Larvae embryo and is responsible for shaping its body (Akam 1994). This way code seems to play an evolutionarily role in patterning the axis of the body. This idea of biological-genetic coding that drives differentiation in environment is used to create a morphogenetic protocol to the implementation of a modular structure for "Urban Species" houses. The genome that determines the geometric pattern of the Larval development is used in this project as a metaphor to design a growth system applied to the housing structures. The success of the housing models will be achieved by the intricate manipulations made from the departure point of the generator elements, or "genes" (Figs 1, 2). Such "genes", or structural elements, are able, through association and repetition to produce complex housing structures.

With this insight it is possible to build an unpredictable variety of spatial organizations. We tried to demonstrate how the discovery of methodological standards – code – could guide the development of constructive and architectural components.

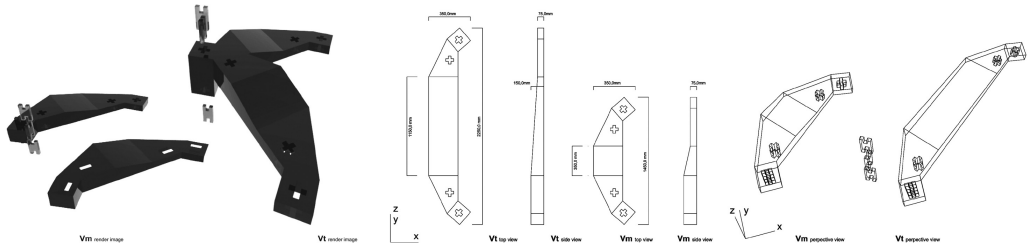


Figure 1. Hardwood structural elements, Vt and Vm. Diagram with possible connector between elements. Overall dimensions: Vt = 2.25 m × 0.35 m and Vm = 1.45 m × 0.35 m. Variable thickness, from 0.07 m to 0.15 m.

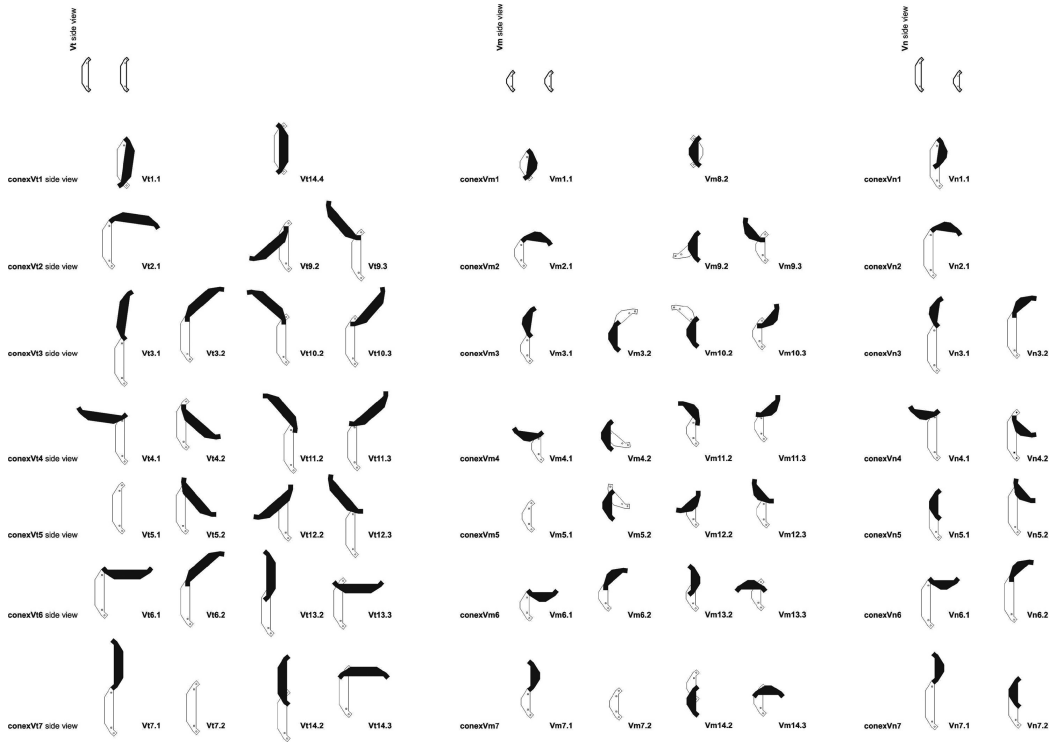


Figure 2. Diagram of possible combinations between the structural elements Vt and Vm.

2 CONTEXTUALIZING GENERATIVE SYSTEMS IN BIOLOGY AND DESIGN

The idea of generative systems and self-organization in the design creative process makes use of interdisciplinary analogies, whether in Biology or other Science fields, addressing different scales of functioning of an ecosystem. The analogy involves the study of self-organization process, rules, constraints and final results, in order to abstract these characteristics and apply them in the context of design.

As described by Camazine (2001), the generative systems are formed as processes through which emerges a global structure, as a result of interactions of the elements forming the system. The rules that specify these interactions are applied to constituent elements to achieve highly complex overall structures. Combinatorial theory and configuring of modular components as generative techniques have been applied extensively in biological systems (Lindenmayer 1968, Flake 1998). But only recently in architectural and urban design, especially with the introduction of computation as an increasingly easy-to-use tool applied to visual graphics applications (Maeda 2001). One of the earliest records on the use of this combinatorial thinking (Mitchell 1978) is found in Aristotle on "Parts of Animals, Book One" in which Aristotle presents a methodology in biology as a combinatory system of

parts that would drive the diversity and differentiation for potential animal making (Barnes 1984). The same methodological approach can be observed in the work of Palladio and the use of grammatical combinations of architectural elements to design space and building geometries (Tafuri 1989). More recently the work of Simon (1968) and Stiny (2006) merging computational procedures, combinatorial optimization and design inspired the new generations of architects making use of the computational power of modern desktop computers. In particular the work of Herbert Simon demonstrated to be inspirational for the development of this research project. Simon presents several strategies in applying combinatory and optimization logics to find alternatives in the design of real world problems. As Afonso & Magalhães (2012), these experimental processes are unlocking architects from the exclusively anthropological point of view in producing architecture. In a time of perceptible technological change, and through the application of the computational force, design is becoming a more experimental practice. Similar to the generative processes in genetics or biology fields, the architecture discipline procedures do not rigidly determine forms anymore, but simply direct and constrain their development.

3 PROCESS, PROJECT BACKGROUND

The metaphor of the genetic code and evolutionary processes has a clear application to the objective of this project: designing a radically cheap-to-build single-family housing system for Luanda, a city under intense demographic pressure and fast urban transformation. In 2013 in Luanda, seven out of ten people was living in slums (Silveira 2013). The housing system should be implemented to tackle this emergent phenomenon. It should allow adaptation in time and the possibility of fast evolution to different family scenarios. The system should be built through self-construction, adapting thus to the processing speed of the Angolan social fabric and life style of low-income populations.

The free interpretation of the genetic code as a generative concept for this project is adapted during this project to specific variables. The definition of a computational generative process, using scripting techniques, is crossed with the project brief and functional needs. In this sense, the paper proposes a housing system as replicable model that reflects the social, economic and cultural specificity of Luanda, making local construction industry technology and current materials of the local architecture.

This project also faces issues of efficiency in the design and construction of architectural structures and deliver of a non-standard product that correspond to the personalized demands of the target users. To respond to the previous brief and simulate the diversity of possibilities underlying the changing lifestyle of the user, the African families in emergency situation, we applied a strategy of high modularity to achieve the adaptability needed to suit unique end user requirements. We simulate this system using the power of high level programming languages as Python, applied to common architecture graphic visualization software. The use of code also simulates a scenario very close to the experience of auto-construction, where the end-users are able to create their own design through simple association of the structural elements Vt and Vm following the connectivity rules as suggested in the Figure 2 mapping diagram. The next section will explore in detail how the power of emergence in generative processes using code has yielded both unpredictable and aesthetic appealing structures.

Table 1. Overall functional areas for a single housing unit.

Gross built area: 100 SQM
Plot area in flat topography surface: 250 SQM
Plot side facing the street: 10 m
Depth of the plot: 25 m

4 PROCESS, FROM CODE TO SHAPES

4.1 *Code as generative strategy for housing structures*

The success of the housing models was achieved by the intricate manipulations made from the departure point of the generator elements, using bottom-up techniques (Jacobson 1994). Within bottom-up strategy, the information processing gives rise to complex systems, by piecing together single elements, "genes". These genes (or construction elements in architecture) were linked to shape larger structures until a desirable top level is achieved. This strategy resembles the behavior of genetic code; in fact each structural element function as a genotype, having this way a specific capacity as generative seedling (Fox et al. 2006). These base elements are combined with the direct input of the designer (or any user running the Python script) during the formation process of the housing models. In that sense the succession of architectural models presented in Figure 3, are the result of applying specific connectivity rules between the wooden structural elements Vt and Vm. The house could then be programmed using the power of scripting or manually constructed by their occupants using the admissible connectivity mapping system (Fig. 2).

With this insight it is possible to build an unpredictable variety of house shapes and functional organizations. It is an alternative design to rigid planning procedures and an antidote against pre-conceived ideas. It is also a possibility to the inhabitants to participate in the construction or even conception process, personalizing and upgrading their own houses. The resulting architecture is a highly combinatory system. Different combinations can be produced ad infinitum by simply adding more elements to the system (Fig. 4). Section by section the house will be shaped and packed by an algorithmic territorial protocol, rather it be analog (human driven) or digitally computed.

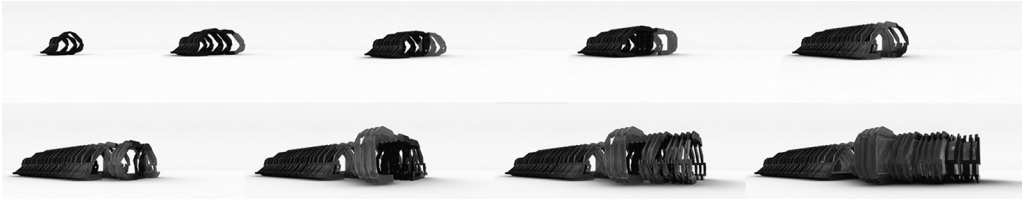


Figure 3. Evolution scenario of the housing model by combination of structural elements. Run script with 70 iterations.

The functionality of the script is shown in the following pseudocode:

– **Definition of Main function**

– Ask the user to select 3 points on the structural elements Vt and Vm
– Take the 3d element (Vt or Vm) to produce copies according to the amount of iterations
– Ask the user the amount of iterations to produce
– Iterate according the desired amount
– Execute the Connect function to produce the final aggregation/housing structure

– **Definition of function Connect**

– Function that connects every component – Vt and Vm – to begin the aggregation or proliferation process
– Shift the elements of the current aggregation to next aggregation content
– The next aggregation list of structural elements will be called recursively
– Loop through the components – Vt and Vm – in the current aggregation
– Generate the connection of components and collect them in the next aggregation set
– Build the geometry of the last aggregation/iteration result

– **Definition of function StructElement**

– Indicate the common points for the connection between elements
– List to collect the points of the new elements to be created according to the number of iterations
– Compute and append the connection points in the list
– Return the newly connected elements

4.2 *Urban species housing script using Python programming language*

```
def connect(VtVm):
        VtVm.newIteration = []
      for curElement in VtVm.curIteration:
      VtVm.newGeneration.append(VtVm.struct
Element (curElement) )
        VtVm.newIteration[-1].render()
        VtVm.curIteration = VtVm.newIteration [:]
def structElement(VtVm, curElement, sharedVertices
= [1,2]):
        newCoord = []
        newCoord.append( curElement.coord[ 2 ] )
        newCoord.append( curElement.coord[ 1 ] )
      vec=rs.VectorCreate(curElement.coordinates[1],
curElement.coord[0])
        temp = rs.VectorAdd(curElement.coord[1],vec)
          newCoord.append(temp)
      vec=rs.VectorCreate(curElement.coord[2],
curElement.coord[3])
        temp = rs.VectorAdd(curElement.coord[2],vec)
          newCoord.append(temp)
        return Element(newCoord)
def Main():
ptOrient = rs.GetObjects("Select the 3 points in the
Structural element to connect and iterate ", rs.filter.
point)
      while len(ptOrient)=3:
      if len(ptOrient)<3 :
      ptOrient = rs.GetObjects ("Select exactly 3 points
in the Structural element to connect and iterate",
rs.filter.point)
      elif len(ptOrient)>3
      ptOrient = ptOrient [0:3]
coord = []
    for ptOrient in ptOrient:
      coord.append( rs.PointCoord(ptOrient) )
      Connection = connect(coord)
iterations = rs.GetInteger("Input number of iterations",
5, 1, 10)
      for i in range(iterations):
        Connection.connect()
Main()
```

The 'infinite' quantity of compositions the algorithmic process may generate, will lead progressively to a more ordered formations applying constraints that selectively reduce suitable possibilities. For example, we can drive the program to generate geometries capable to contain and implement a specific functional demand (host a family with 4 elements) and be adapted to the plot size of 250 SQM. Figure 5 shows a possible housing unit as a result of the scripting techniques. The designer during the process of running the script may take important decisions on the construction of the housing shape. Selection of the contact position of the structural elements Vt and Vm, and the amount of repetitions, or iterations, the program will perform may drive completely distinct geometries. The obtained results are in fact aesthetically unpredictable but in some extent controllable.

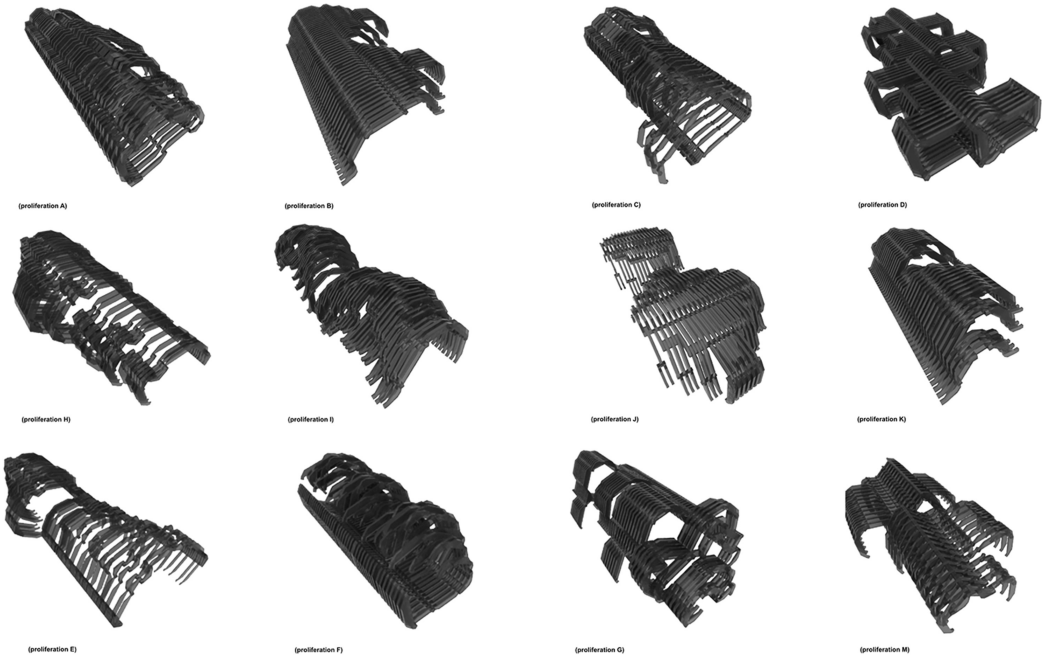


Figure 4. Mapping of different possibilities of housing structures by combination of elements Vt and Vm as structural beams. The diagram is the result of the implementation of the Python scripting language for visual graphics software.

5 PROCESS, FROM CODE TO DESIGN

5.1 *Components, or genes*

In the construction of the Urban Species housing units, every single element is part of an overall system. The three-dimensional generated pattern – or the final geometry of the house – results from combination of simple hardwood elements: the construction components that act like "genes" in our first design concept. Inspired by the information embodied in the development of the African Anophelines Larvae and through experimentation with the first physical prototypes (Fig. 5), we were able to design and fabricate two components (Vt, Vm) but which allowed us to achieve multiple variations morphologies. Those elements were cut from a block of wood using the local resources and contributing to the local industry of wood production. In 2011 Angola was exporting only around 12,000 cubic meters of wooden logs through the main wood industries in the country located in northern part of Angola in Cabinda and in Luanda (Saatchi, 2011). The production of the hardwood construction elements for each housing unit could lead the occupants to plant more trees and sensitizing the Angolan families to the importance of the forestry sector. This is also a possible contribution to forestry conservation of existing protected areas which biological diversity is noticeable.

To develop their proliferation in a system it was then necessary to conduct a thorough investigation of different aspects: (1) the connection between two components, to establish each type of possible connections, (2) the connections between groups of components and how these focus on the final aggregation structures and the possible morphological configurations defining how to use our system, so that clear instructions could be given to non designers in order to assemble a housing unit (Fig. 2), and finally (3) the simulation of the real-time connection of components according to the established rules.

5.2 *Proliferation rules to generate housing structures*

They focus on communication between elements, or the combinatory rules between the generative elements Vt and Vm. Each resulting housing structure has an imbedded code that can be changed and adapted by the user.

This allows us, with appropriate strategies, to generate a new and adaptable concept of modularity, which encourages endless morphological differentiation (as many as the number of potential system users or occupants of the house) but with certain standard layouts. It means that each family may implement and improve its own concept of functional organization. It means also that it is possible to grow the construction just by aggregation of new elements to the house, within defined limits. The system is then evolving in time. This way the emerging "cultural urban structure" is promoted by the social values and the lifestyle of this society, expressed in terms of spatial organization.

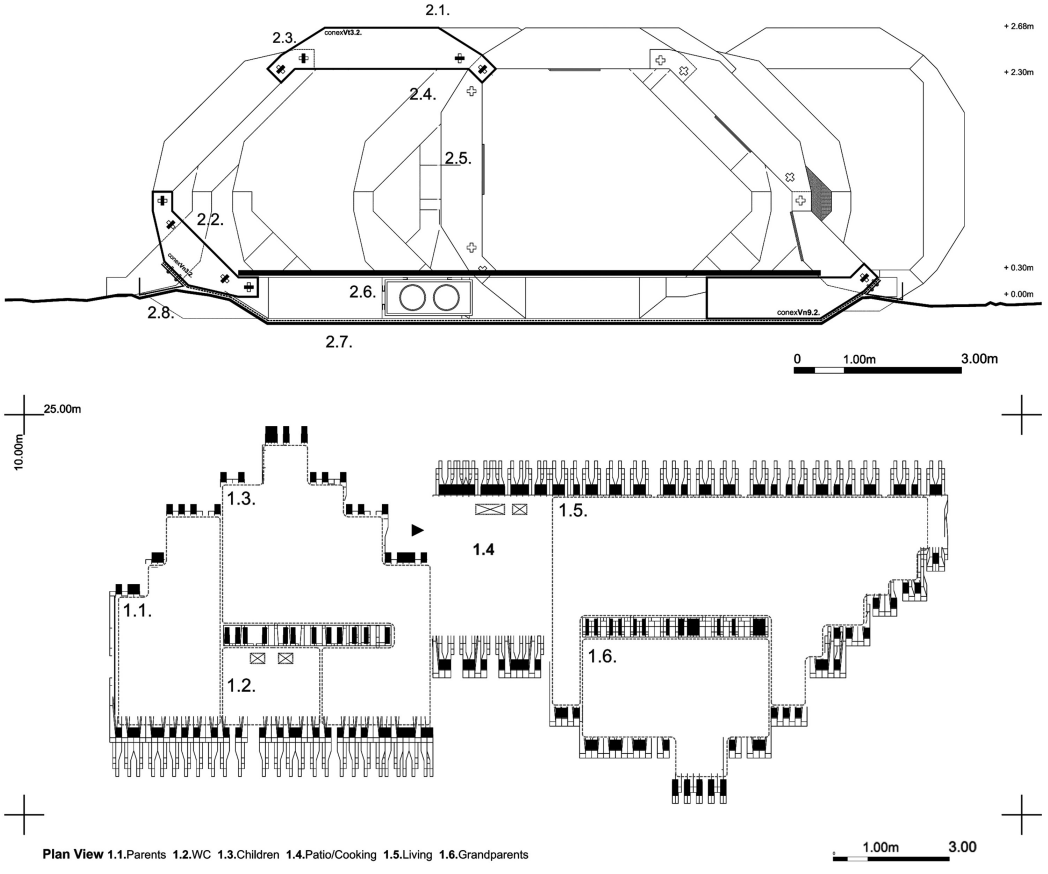


Figure 5. Plan and detail section of a possible housing unit resulting from the running the Urban Species Ptyhon script.

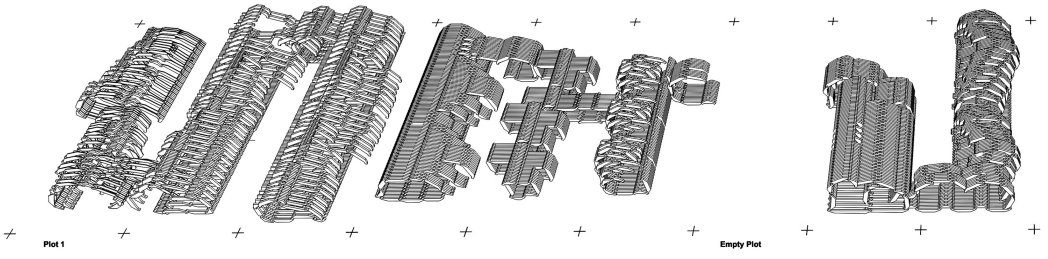


Figure 6. Simulation of a street view. The computational system created introduces the possibility of diversity at the urban scale. This could also be seen as a preview of the street alignment of the self-constructed houses by the end-users.

6 SELF-FABRICATION

6.1 *Do it yourself*

Can we combine traditional construction values of self-sufficiency that preserve local resources with the contemporary technological advances? Cultural and architectural heritage is taken as an active resource and used in the project. The identification of forces and characteristics that shape local architecture and how they may be incorporated into the present: the assessment of human interaction in the appropriation of architectural forms as the end result of social norms and codes, spontaneity or mere instinct to solve the challenges were considered to design a generative process for this project. This anonymous or spontaneous way of building included in the construction process allows an endless formal variation, with the intervention of the end-user (Fig. 6). The system we propose includes the participation of the local population and promotes an architecture developed by the tacit



Figure 7. Final design proposal based on the combinatory power of computational tools. Hypothetical scenario.

"know-how" of this society. This understanding involves the manufacture of modular elements (hardwood beams) adapted to local requirements and specific local wood industry. These construction elements, and the way we can combine them, ensure the principle of adaptability of the buildings to new needs and uses that may evolve over time.

6.2 *Handmade computing*

The self-construction method can be itself seen as a computation. It is a step-by-step process of combination and connection of structural elements to genere an architectural space. It can be performed by the occupants of the house. We tried to design a system of rules and assembly instructions more than just a single housing prototype to be repeated by future contractors and real estate developers. We can call it "handmade computing", and the outcome of this strategy is similar to the geometries produced using scripting techniques. One emergent characteristic of this project is that at some moment it shifted from being developed digitally to being developed physically.

The underlying general guideline for this research is to propose a method in which the conception of architectural space and form generation comprises a logical sequence of combinations of simple structural elements. The system's simplicity makes it accessible to non-designers and can be replicated by the users of the project itself, which in this case actively participate in the design process of their own houses. We still speak of a computational process, but without the use of computers. In both cases (digital and analog processes) formal result is an emergent design induced by the development and intrinsic characteristics of the generative system.

7 CONCLUSION AND DISCUSSION

The goal of this paper is the resolution of an architectural problem, or architectural brief, in order to create a scope of solutions that tackle the several questions rose within the conceptual process. By bringing other fields of knowledge to the architecture working process, this paper tries to question what sorts of design are created through the analogy to the internal logics borrowed from those disciplines. We could call it "scientific imagination" referring Wiener (1964). Such an approach mimicking scientific procedures could be transported to architectural production. The system we tried to develop, based on the idea of generative design, combines the few issues formulated through the working process to create a family of possible solutions. More than just an architecture project, it is a system, as suggested by Weinstock et al. (1998), using generative design as an answer to a specific problem.

This project was conceived as a flexible system that could be easily modified. Developed with Python Scripting components, the main properties of the system are modifiable through parameters that express the functional demand of space but also produce a specific aesthetic quality. This paper seeks for open solutions that permit us to establish networks between the architect and procedural strategies common in other scientific fields, but which are understandable to non-designers.

The identification of biological entities (like the African Anophelines Larvae) as an information source from the viewpoint of evolution, differentiation and self-organization of geometries and shapes was used as a metaphor for the development of this "Urban Species" modular houses. We tried to demonstrate how the use of code can guide the development of constructive and architectural components and how the insertion of this "Genetics" logic of assembly can determine the geometry and functional program of a modular house for Luanda. The ability of our system to achieve endless variations by the active intervention of the end-user, the African families that with their specificity may personalize their houses, is contributing to the general idea of "binding" social aspects with design intentions. The use of these kinds of techniques represents a new way of thinking architecture in terms of computational process. Nowadays, advanced architecture production is not working on traditional themes by using computer tools. Using digital-computational resources we come to a completely revolutionary and surprising pinnacle of architecture (Estévez 2005).

At the other extreme is the total absence of computational tools, or the non-use of desktop computers to generate architecture, but still perform a kind of computation. It is what we tried to simulate by introducing the possibility of self-construction by anonymous people, not designers. Our generative housing system allows the local populations to participate in the design of their own structures, using the predefined construction components and the admissible connection rules of the system. We promote this way a kind of anonymous architecture (Ferretto 2015) but that generates a

sense of place and space with collective history and memory. Figure 7 presents a possible future scene of the adaptation of the housing structures to the real site.

The research has demonstrated the importance of physical implementation of the architectural space. At a time when design studios are increasingly making use of digital technologies, and when architecture is designed digitally, it is important to recognize that space and available resources can impute physical limitations to architecture.

Our future research could involve the study of the optimization of this generative combinatory system and the adaptation to other real scenarios. Also should be studied more in detail the relationship between digital computation and analogue process of self-construction, programing a real-time platform that could help non-designer to participate in the concept design process along with architects, understanding this way the consequences of the making of the architectonic space.

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Revisiting forgotten energy technologies – a comparative performance history of a residence with an underfloor air plenum and ground-coupled water-source heat pump

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ABSTRACT: This paper summarizes a 36-year recorded performance history of a ground-coupled water-source heat pump system in a residence in Texas with a ductless underfloor air plenum, known as the Plen-Wood® system. Beginning in 1980 and continuing through 2015, monthly records were kept for the heating and cooling energy consumption, as well as the heat pump's incoming/outgoing water temperatures, outdoor temperatures, and monthly degree days. Measured data during 2013–2014 were also used to validate a heat pump simulation model in an independent research program of monitoring and calibration. Energy consumption from the study home was compared to a reference set of 2.7 million same-sized homes in Texas from the 2009 RECS (Residential Energy Consumption Survey). The study home showed 21.2% less energy use and 19.6% less cost per unit floor area than the reference homes of the same floor area. Attempts to assign savings separately to either the WSHP or the plenum were not undertaken.

1 INTRODUCTION

1.1 *Challenging the status quo*

Environmental control systems (ECS) is a topic quite familiar to architectural educators. To many, it conjures up images of mechanized appliances like compressors, fans, heaters, pipes, ducts, heat pumps and the like. To others, it might also include solar collectors, Trombe© walls, super insulation or low-e windows. The theme in this paper is to discard the notion that ECS is isolated to mechanical gadgets and components, but rather, it must equally include other role players like the building's architecture, its physical features, daylight access and its placement on the site. From ancient times, habitats were configured to accommodate the best of the natural settings – shelter from water and winds, shading from the sun, and/or the admission of sunlight (and heat). The Industrial Revolution of the early 1800's introduced a new paradigm that encouraged a "build anywhere; comfort can be arranged" attitude. This led many designers to adapt to a disregard for early well known approaches and sound fundamentals of environmental control. This paper does not reject the inclusion of mechanized systems; it does include an examination of the performance of a ground-coupled water-source heat pump (WSHP) system, but it also features the performance of the nearly forgotten underfloor air plenum that was promoted in the late 1970's, known as the Plen-Wood® system (NAHB 1978, 1985.)

1.2 *Objectives*

The home featured in this study is an all-electric residence in Texas, built in 1979 and occupied constantly by the same people for 36 years. Records were kept for that period for monthly electricity use, monthly weather conditions of heating and cooling degree days, and the electric utility bills and rates. No gas was available in the subdivision, so all energy use data are in kWh of electricity use.

The objective of this study was to discover if the underfloor air plenum feature would achieve competitive energy-efficiency results when compared to the conventional slab-on-grade residence in the study region. The study home is not special as far as envelope insulation goes, basically meeting the typical energy efficiency standards that were in place in 1979. It does use a solar thermal system for service water heating, but the resulting savings due to the solar system are not factored into the environmental control savings comparisons. As for the HVAC system, the WSHP system is certainly not a new concept, though it is not the common choice for residences in the south central Texas area studied.

The efforts in this study were focused on the impacts, if any, of the combined influences of the WSHP and the underfloor air plenum system. Identifying the savings separately from these two systems was seen as a nearly impossible task, so any savings reported herein are the combination of these two systems working together. The combined

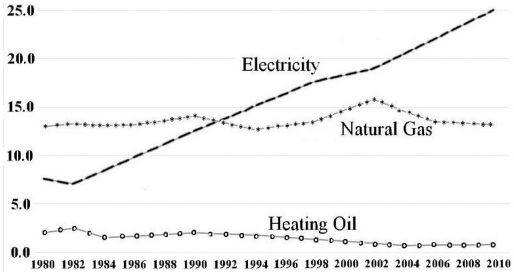


Figure 1. Fuel use in Southern US (in millions of households.).

performance was easy to extract since the kWh consumption of HVAC could be disaggregated from the whole-building electricity use. The electricity uses and monthly heating and cooling degree days were recorded for the entire 36-year period, making for some cause and effect relationship observations.

1.3 *Fuel use trends in southern USA and Texas*

Prior to 1970, the number of homes in the USA using natural gas for heating was approximately equal to the number using electricity, at around 5 million each. By 1980 the gas heated homes had risen to about 13 million while electricity only grew to about 7.5 million homes. Oil heated homes trailed far behind at only 2 to 3 million homes, a trend that continues to this day. Around 1980, however, the number of homes using electricity for heating began to increase dramatically, matching the gas homes in 1991 (at 13 million each). By 2010, electrically heated homes reached 25 million, while gas heated homes remained at around 13.5 million homes. (See Figure 1.)

In Texas, around half the homes still use natural gas for heating or cooking, but more are moving toward electricity as the preferred energy choice. Electrically heated homes have continually evolved from resistance heating (prior to 1970) to heat pump systems, and many of these have evolved from air-to-air heat pumps to water-source heat pumps. Since heat pumps provide air conditioning as well as heating, and air conditioning is already in use in 98% of Texas homes, the water-source heat pump seemed to be a natural and logical choice when the study home was designed in 1978. Water source heat pumps and especially the underfloor air plenum designs, however, are still very rare. Solar water heating does exist in numerous homes, though it is still not the norm.

1.4 *The underfloor air plenum concept*

The underfloor air plenum idea is not the same as the one typically used for computer room floors in office buildings, known as UFAD (underfloor air distribution, Carrier 2006). Rather, it is aimed mainly at residential use. It's based on a simple, proven concept that replaces supply air ducts with a sealed underfloor "crawlspace" plenum to distribute conditioned air to floor registers in the rooms above. The floor is of wood construction, accompanied by sealed and insulated foundation walls. This is depicted in Figure 2 (NAHB 1985). No insulation is placed in the floor that separates the plenum from the rooms above. This permits the floor to act as a radiant panel for both heating (24.2 C ave.) and cooling (22.1 C ave.)

The air plenum is in direct contact with the earth below (separated only by a polyethylene moisture barrier). The earth mass becomes a large capacity thermal storage system that enables daytime heating or cooling to carry over into the nighttime hours. As such, hourly variations in outdoor weather conditions have little impact on indoor temperature and comfort.

The heating and cooling behavior is slightly different than the ducted systems that are designed as air displacement systems. The system does use air as the medium of heat transfer, but an important difference is that the floor acts as a radiant panel. Temperature differences between the floor and the spaces are so slight that occupants have no sensation of this. Instead, the floors are just slightly warmer in winter and cooler in summer – a feature that is openly welcomed by most occupants. The plenum concept is certainly not new; it follows the concepts of the "hypocaust" system invented by the Romans over 2000 years ago to heat rooms in public bath houses through underground chambers (Ring 1996). Similarly, the Korean Ondol has been in use even longer (Kim & Lee 2003).

2 CLIMATE REGION FOR THIS STUDY

Most of Texas can be characterized as having a very warm or hot climate. Average electricity consumption per Texas home is 26% higher than the national average. The average annual consumption is around 85.77 kWh/m^2 (around US$10.50), which is among the highest in the nation, though it is similar to other warm weather states like Florida. Not surprisingly, air conditioning accounts for a greater portion of home energy use (18% compared to 6% nationally) while space heating accounts for a smaller portion (22% compared to 41% nationally). In addition, Texas has an abundance of sunshine, increasing the need for air conditioning, though offering opportunities for solar assisted water heating and PV energy.

Observing the last 36 years, there are indications that the Texas climate is undergoing a gradual increase in average temperatures. Using 15 C as a temperature base, Figure 3 shows a 6-year trailing average of cooling degree days for the years 1980 through 2015, recorded locally in College Station, TX.

Figure 4 indicates a decline of heating degree days for the same period. This observation was not part of the original study plan, but is does add an interesting sidelight about our changing climate nonetheless.

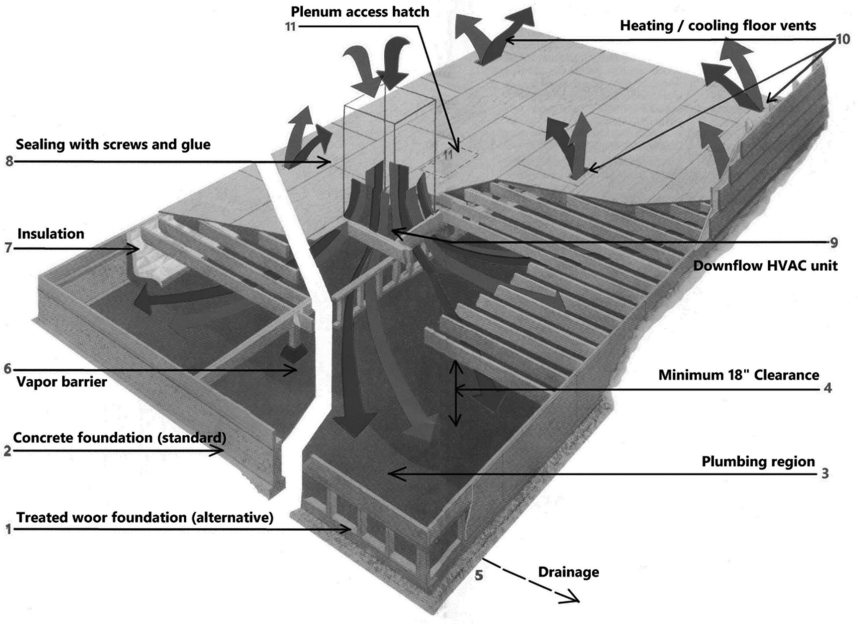


Figure 2. Schematic pictorial of the Plen-Wood system (adapted from NAHB 1985).

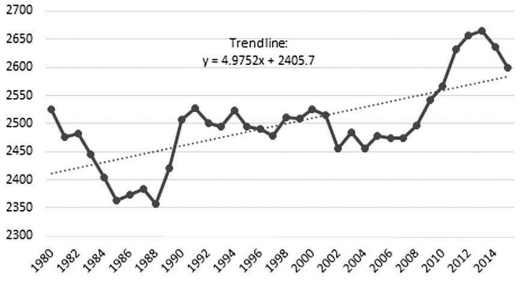


Figure 3. Six-year trailing average of cooling degree days in College Station, TX (Base 15 C, years 1980–2015).

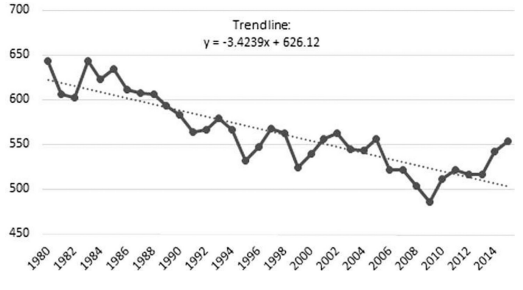


Figure 4. Six-year trailing average of heating degree days in College Station, TX (Base 15 C, years 1980–2015).

3 TYPICAL RESIDENTIAL CONSTRUCTION IN TEXAS

Almost no homes in Texas have basements – due mainly to expansive clay (increases 30% when wet and then back to normal quickly when dry), near-zero frost line making below-grade excavation unnecessary, and mostly level sites leading to lack of drainage due to impenetrable soils. In effect, excavating for basements is typically regarded as an unnecessary and unjustifiable expense by most builders. Slab-on-grade foundations with no slab-edge insulation are the norm. Figure 5 shows a schematic cross-section sketch of the typical home, though the homes can be either one- or two-story.

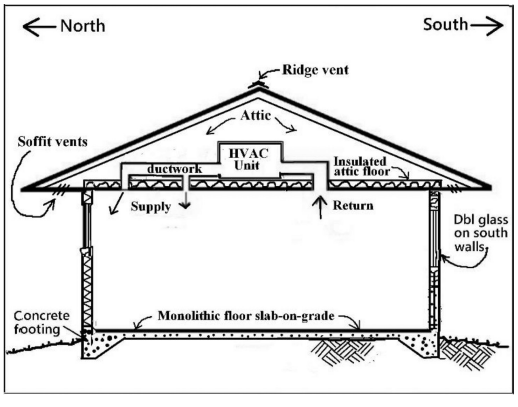


Figure 5. Typical slab-on-grade reference home construction.

The HVAC system in Figure 5 is typically an all-air system with ductwork in the attic, with air being delivered to the living space from ceiling or high wall diffusers. Another typical building feature includes tight fitting air infiltration barriers (not shown), referred

to as house-wrap. That feature was not prevalent in late 1970's homes, but has become more common in recent years. The study home in this project does not have the house-wrap, though it will be contrasted to the reference homes that were built between 1980 and 2015, many of which do have the infiltration barriers installed.

Home builders prefer the traditional slab-on-grade construction mainly for economic reasons. It's simpler and faster; however, a number of features of that approach can cause significant, well-known, drawbacks with regard to energy efficiency. (1) Placement of the HVAC unit and ductwork in the attic leads to air leakage into the attic and conducted heat gains and/or losses through the duct walls. Both of these reduce the heating and cooling efficiencies. (2) Insulation is normally placed on the attic floor in order to minimize the heat losses and heat gains into the living space. This causes the attic itself to become overheated due to the uninsulated roof surface (which is typical of these homes), and thus causes the HVAC unit to be overworked. (3) Attics are typically ventilated via ridge and soffit vents, but this never totally eliminates the excessive heat buildup in the attic space. Often, attic ventilator fans are also used, but this is yet another electricity consumer. (4) Though the air-conditioning season dominates most of the year, there are a few months per year when heating is much needed. During cold outdoor conditions, which can last 3 or 4 days at a time, the cold floor slab presents an uncomfortable condition for occupants, causing some people to raise the thermostat.

The foregoing is not to claim that all traditional homes are inefficient energy hogs. Many have upgraded features of good insulation, solar screens, efficient windows, and high-efficiency HVAC units. However, any home that incorporates the underfloor air plenum system will not encounter any of the aforementioned problems. More details on this will follow.

4 DETAILS OF THE STUDY HOME

4.1 *Main features of the home*

The study home was designed in 1978 to have an underfloor air plenum and a water-source heat pump. Construction was completed in 1979 and the home was occupied on 3 January 1980. A number of "passive" features were incorporated into the design, including orienting the major glass areas due south, placing the home in the shadow of a large tree at its western side, double-glazed windows, and no glass on the west exposure. The east exposure has a greenhouse with removable solar shade screens and a large tree that shades the eastern exposure in summer. The interior has a two-story massive fireplace of concrete and stone construction. South-facing clerestory windows admit daylighting (and direct sun in winter) to all rooms on the north side of the house. Throughout the interior, all



Figure 6. SE general view of the study home.

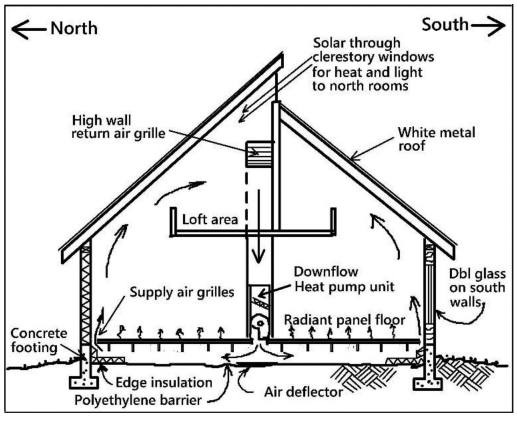


Figure 7. Concept section showing air flow patterns.

spaces have cathedral ceilings, resulting in no attics. The roof is high-reflectance white enamel on galvanized steel backed with Rockwool insulation (R-value 3.87 m^2K/W). The main floor is hardwood and ceramic tile over the closed air plenum crawlspace. Second level floors have carpeting. Walls are insulated 115 mm stone masonry throughout.

The total floor area is around 288 m^2. A solar water heater was installed in 1981 and has operated through the year 2015 constantly. The house has two ground-coupled water-source heat pumps – a larger one (12.3 kW) for the main ground floor area and a smaller one (3.2 kW) for the second floor and master bedroom area, which is not directly influenced by the underfloor air plenum. Both heat pumps have a COP of 13. The home was updated with low-e windows in 2006, converted from incandescent to LED lights in 2015, and heat pumps replaced in 1995 and 2006 – each time with slightly improved system efficiencies. A general view of the home is shown in Figure 6.

A concept section schematic of the study home is shown in Figure 7, illustrating the air distribution patterns. To counteract the effects of temperature stratification, the return air grill is placed high in the center of the house to redistribute the warmer air back to the

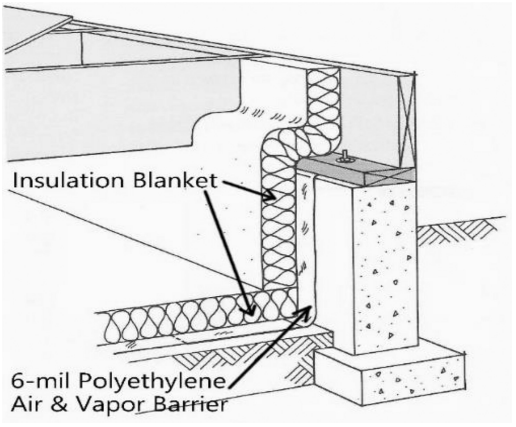


Figure 8. Foundation wall with insulation detail.

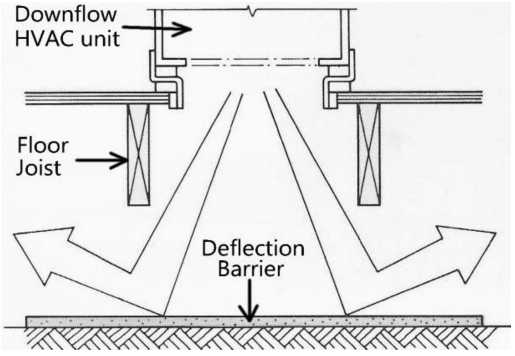


Figure 9. Section showing HVAC unit over plenum.

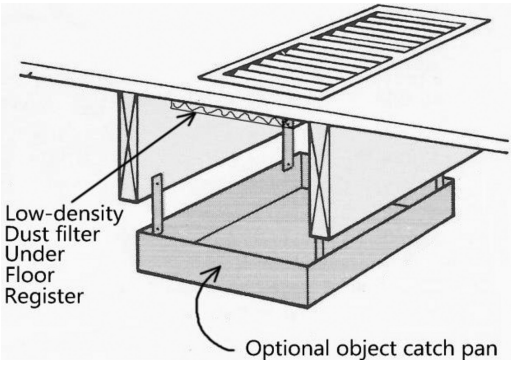


Figure 10. Detail of floor register in wood floor.

plenum. The house acts as a single volume so as to enhance the effectiveness of the plenum air flow.

Figures 8, 9 and 10 show details of the plenum, foundation insulation and floor registers.

4.2 *Mechanical system – WSHP*

The mechanical system is made up of two water-source heat pumps served by a 734 m horizontal closed loop of PVC pipe with 51 mm diameter. The horizontal loop is buried an average of 1.7 m and is in 3 segments: 137 m in earth, 317 m in pond water, and another 280 m in earth. The actual depth of the pipe varies from 1.5 m to 1.8 m throughout the circuit.

A site plan showing the loop layout and the pond is in Figure 11, the top being due North. In the 2013–2014 year, a PhD researcher undertook an independent research project (Do 2014) to validate a heat pump simulation model by comparing simulated performance values to ones obtained by monitoring ground loop water temperatures in the study home.

5 STUDY APPROACH

In order to compare the study home's energy use to the reference homes' energy, two sets of data were obtained: (1) for the study home, the data were 36 years of actual monthly records for electricity use, electricity cost, average temperatures and heating and cooling degree days; (2) for the reference homes, the data were obtained from the ***eia*** (US Energy Information Agency) database called RECS (Residential Energy Consumption Survey, RECS 2009), which covers 30 years of residential energy consumption data for the period 1980 through 2009.

The data for the study home comprised 36 years of monthly records. The electricity use was disaggregated into climate dependent (HVAC use) and non-climate dependent (baseline use, i.e., water heating, washer/dryer, dishwasher, interior lights, exterior lights, 3 refrigerators, 3 air cleaner/purifiers, TVs and computers). Solar collectors provided over 80% of the water heating energy, so that electricity was measured separately and was not considered as part of the HVAC use. It was, however, used in the comparison to the overall energy use in the reference homes since the reference set did include service water heating. The solar collector analysis and electricity used for water heating in the study home has been documented in an earlier publication (Degelman 2005). Baseline electricity use was extracted by documenting the electricity use in months in which there was neither heating nor cooling required. In the 36-year period, the average monthly baseline use was determined to be 1200 kWh; thus, the remaining use was allocated to HVAC use (climate dependent.) The baseline electricity use was further broken down into individual components through use of a portable watt meter that measured specific appliances (computers, TV's, etc.)

The RECS data were selected for homes only in Texas, for the same year of construction, same building floor area, and same fuel type used. Other categories (number of occupants, education level, income level, and owner or renter occupied) were ignored. The RECS data were in overall annual energy consumption and energy use per unit floor area. This measure is called the EUI (energy use intensity), and is expressed in either kWh/m^2 or MJ/m^2. This was the metric used for all the comparisons. The RECS report broke down

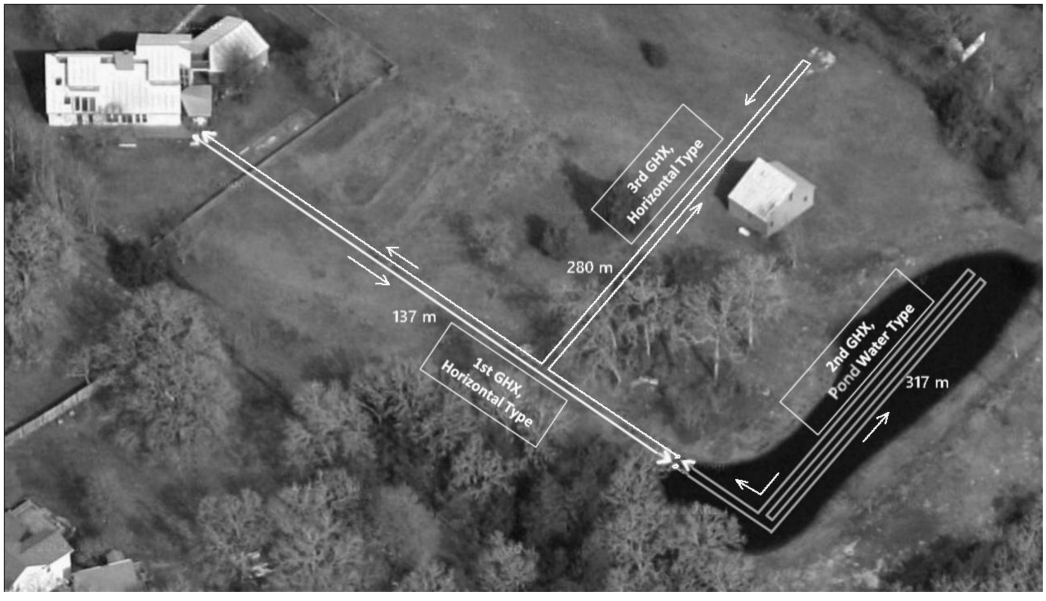


Figure 11. Google Map® site plan showing the ground loop heat exchanger pipe (reprinted with permission from Do 2014).

energy use into categories of heating, water heating, cooling, refrigerators and other appliances, so some non-climate related energy use comparisons could also be made. These breakdowns were only compared out of general interest and had no effect on the HVAC comparisons that are the main focus of this paper.

Results of the study were summarized and are presented in graphs of electricity kWh, broken into categories of energy use: HVAC only and baseline (washer, dryer, dishwasher, lighting, water heating, refrigerators, air purifiers, computers, TVs, other small appliances.) Other graphs were made for the climate data, specifically heating and cooling degree days. Comparisons to the reference data set were then synchronized to the same categories of energy use.

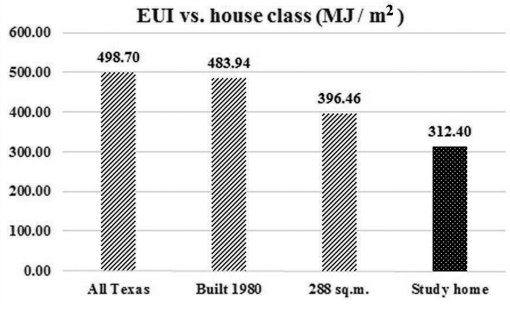


Figure 12. Whole-building EUI comparisons between reference buildings & the study building.

6 RESULTS AND DISCUSSION

The first comparisons were made on the overall EUI values for both the reference homes and the study home. The annual EUI values for the reference homes in the RECS database are in several classifications: all Texas homes, those built around 1980, and those with floor areas around 288 m^2 Figure 12 shows EUI values for those three classes compared to the study home. It seemed that the fairest comparisons should be made to those homes of the same size as the study home. Using that as the criterion, the reference homes annual average EUI was 110.2 kWh/m^2, or 396.5 MJ/m^2, and the 36-year average EUI for the study home was recorded as 86.8 kWh/m^2, or 312.4 MJ/m^2. Therefore, the study home shows a savings of 21.2%. This is for whole-building energy use. To better understand which categories of energy use are credited with the savings, the overall energy was disaggregated, as shown in Figure 13. By isolating the individual energy users, it is revealed that the drop in energy use of heating and cooling alone was from 159 MJ/m^2 for the reference homes to 123 MJ/m^2 for the study home – a savings of 22.6%.

The significant saving for water heating shown in Figure 13 is due to the solar collectors, so these are not credited toward any savings attributed to the plenum or the WSHP. Nonetheless, the heating and cooling alone dropped by 22.6% below the reference homes. Appliance and lighting energy are higher in the study home than the reference homes, but no details are given on how appliance data were collected in the RECS homes.

The issue of annual cost was also examined. Those results are shown in Figure 14, comparing the energy costs in the RECS dataset to the measured utility bills in the study home. Annual energy costs are \$9.42/m^2 for the reference homes and \$7.57 for the study home,

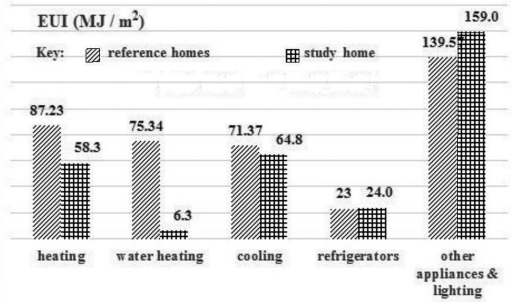


Figure 13. Comparison of EUI for end use categories in the reference buildings & the study building.

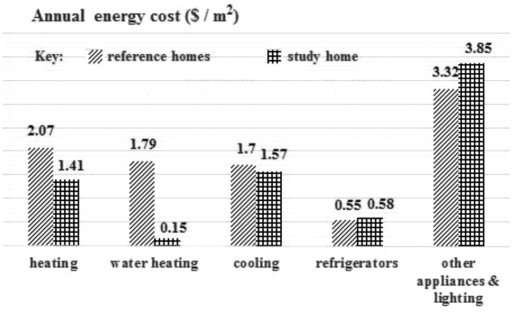


Figure 14. Comparison of annual energy cost for end use categories in reference & study homes.

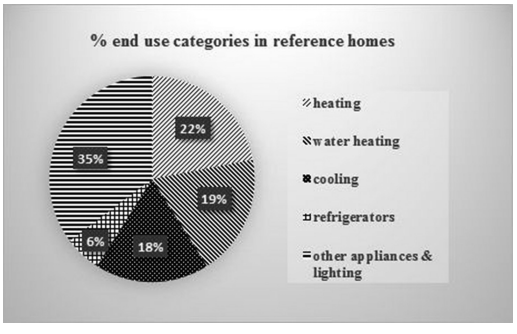


Figure 15. Percent breakdown of energy use in reference homes in Texas.

a savings of 19.6%. The most likely reason that this does not coincide exactly with the percent savings in energy could be related to different electric rates and/or the possibility that gas fuel might be used for heating in some of the RECS homes data.

Aside from annual energy use in absolute terms, it was also interesting to observe the percentage breakdown in the energy end-use categories. Figure 15 shows the breakdowns for the 2.7 million homes in the RECS database. There is a notable difference between these and those in the study home shown in Figure 16.

The study home has extremely small energy use for water heating (due to the solar system), causing a much

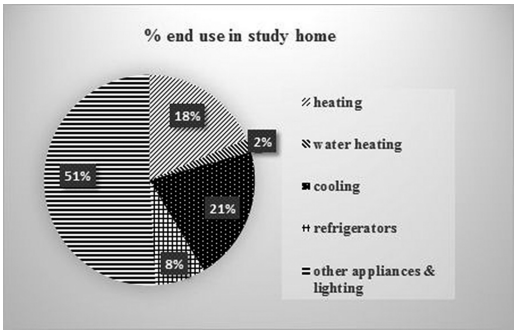


Figure 16. Percent breakdown of energy use in study home.

Table 1. Comparison of features and energy use.

Parameter	RECS homes	study home
Years of records	30	36
Number of homes	2.7 million	1
% of all Texas homes	31.8%	–
Floor area, m^2	288 average	288
Window wall ratio (WWR*)	n.a.	24%
South facing WWR	n.a.	39%
West facing WWR	n.a.	0%
East facing greenhouse WWR	n.a.	31%
Roof color	n.a.	white
Wall material	n.a.	stone
Orientation on site	varies	Due N-S
Energy spent for water heating	19%	2%
HVAC system type	air-to-air a.c.	WSHP
EUI, MJ/m^2	396.5	312.4
Energy savings, %	-0-	21.2%
Annual energy cost, $\$/m^2$	$9.42	$7.57
Annual energy cost saving, %	-0-	19.6%
Annual savings for Heating + Cooling only:		
HVAC only energy, MJ/m^2	159	123
HVAC energy savings, %	-0-	22.6%
HVAC only costs, $\$/m^2$	$3.77	$2.98
HVAC only savings, %	-0-	21.0%

* WWR = 100 × window glass area/wall area.

larger fraction of energy for small appliances and lighting. The fraction of energy use for heating and cooling appears to have changed very little (from 40% to 39%) even though the absolute amount of energy for heating and cooling reduced significantly. The presence of the solar hot water system has impacted the fractional distribution of end uses.

To illustrate the overall comparison of the energy results from this study, Table 1 was developed to summarize all the aspects of the HVAC savings and the other non-climate related used, both for the reference homes and the study home.

The WSHP water loop has 43% of its 734-m length under the pond surface at a depth of around 1.8 m when the pond is full, which is typically all winter. In summer the pond water depth is as low as 1.2 m.

Though heat pump validation was never the focus of this study, some important results are worth noting. From the time that ground-coupled heat pump systems

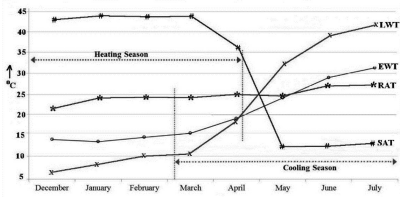


Figure 17. Entering and leaving water temperatures and supply and return air temperatures for the WSHP system.

were introduced, many expressed concerns that the earth (the heat sync for the system) might experience an irreversible temperature saturation over the years that would render the system ineffective. The concern was that increased soil temperatures in summer would defeat the ability of the heat pump to reject heat to the earth, and compromise cooling of the house interior. There was similar concern that the declining soil temperature over the winter would make the heat pump unable to produce the desired warm air inside. Fortunately, none of the issues showed up as problems during the 2013–2014 monitoring phase carried out by Do (2014). Since the system had been operating for 34.5 years, concerns over future performance degradation should not occur. The research project recorded the incoming and outgoing water, as well as the supply air and return air temperatures every 20 minutes covering both cooling and heating seasons. Results are shown in Figure 17 for December through July.

Temperature data of this system showed favorable conformance to the comfort criteria for standard heating and air conditioning equipment. Supply air temperatures (SAT) were around 43 C for the heating season and 12 C for the cooling season. Return air temperatures (RAT) were around 22 C in winter and 27 C in summer. The entering water temperatures (EWT) were about 13 C in winter and 32 C in summer. Leaving water temperatures (LWT) were at 7 C in winter, gradually increasing to 42 C in summer. All temperatures match the performance specs for these particular heat pumps. Do (2014) was able to confirm his simulation models (based on theory and other empirical data from other sources.)

7 CONCLUSIONS

Recorded data suggest that the study house performs somewhat better than the typical Texas home of similar size and period of construction. This was not a surprise since the study home has the solar hot water system, though when that contribution was removed, there were still significant energy savings for the environmental control systems. The interior temperature settings for the study home were constantly at 23 C in winter and 25 C in summer. The second floor had a separate heat pump and had almost no interaction with the underfloor air plenum.

A few side issues of interest were also observed in this study: (1) the 36-year period was sufficient to reveal a trend toward rising annual temperatures, resulting in increased cooling degree days and decreased heating degree days, (2) when set to fan-only mode, the underfloor earth mass showed evidence of daytime charging of large amounts of heat and releasing that to the interior spaces at nighttime – effects being felt for up to 2 days, and (3) measured temperatures in all first-floor rooms were consistently within 0.5 C of each other and within the settings on the thermostat, so comfort was never compromised.

8 SUGGESTIONS FOR FURTHER STUDY

Another worthy endeavor would be to perform a similar study using standard air-to-air heat pumps, in which case any savings accrued could be attributed to the underfloor air plenum system. Incorporating occupancy differences would be an interesting study, but could present new challenges.

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Evaluating the energy performance under the LEED-ND criteria by using EnergyPlus

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ABSTRACT: In present era, rapid technological changes are also expended through architectural practice. In this study, we focus on establishing a new framework to integrate the building energy performance evaluation into urban scale evaluation strategies. This study presents the results of a literature review on the principles of LEED for Neighborhood Development and sustainable urbanism. Moreover, two case studies – a commercial building and a small-scale neighborhood – have been simulated using EnergyPlus to evaluate the performance of the building after using the LEED-ND principles for green buildings.

Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) is a system for rating and certifying green neighborhoods – developed by the United States Green Building Council (USGBC). LEED-ND integrates the principles of new urbanism, green building, and smart growth into the first national standard for neighborhood design, expanding LEED's scope beyond individual buildings to a more holistic concern about the context of those buildings.

1 INTRODUCTION

According to various approaches, sustainable urbanism makes towns and cities more desirable places for people to live (Beatley, 2012; Farr, 2008; Kelbaugh, 2002; McGeough, Newman, & Wrobel, 2004; Mostafavi & Doherty, 2015; Newman & Jennings, 2008). Those approaches have also helped to shape sustainable cities. Xiufeng Pang, Tianzhen Hong, and Mary Ann Piette (2013) state that implementation of well-developed energy efficiency measures and emerging technologies is slow, even though these to decrease energy consumption in buildings have existed for years. Also, they claim that unmotivated building owners, high implementation costs and operation difficulties are the reasons for the fact.

At the operational level, establishing a context by using accurate energy calculation tool helping building owners in obtaining best approach to improve existing building/s and new developments is the purpose of this study. Mainly, this study establishes a framework that shows flow toward sustainable urbanism aiming to reduce energy consumption in a neighborhood scale throughout LEED criteria by using EnergyPlus tool. Furthermore, best practice is to promote energy efficiency at the urban scale.

Sustainable urbanism requires both a naturalist and orientation to the regional and local ecology and an urban planning emphasis for development to occur. Sustainability occurs successfully when there is a balance among economic, social, and ecological (environmental) characteristics of towns and cities. There are many ways in which sustainability can be applied successfully in urban areas. The principles and elements of sustainability, planning policies, analysis and design methods, and green technology are all part of sustainable urbanism.

With growing population, ecological footprint is increasing accordingly. The amount of land that an individual needs to maintain himself is called an ecological footprint (Bovill, 2015). One of the essential consequences of ecological footprint is higher carbon dioxide emission by energy consumption. McGeough et al. (2004) refer specifically to American problems, such as overpopulation in big cities and unsustainable practices, providing percentage of growth in population and energy usage. This knowledge requires promoting sustainable/renewable energy sources. In fact, a sustainable environment can be created when different strategies are used and integrated into policies, regulations, and systems.

2 LITERATURE REVIEW

2.1 *Sustainable urbanism*

Many environmental issues exist at the different levels such as local, regional, and global. In 1987, the definition of sustainable urbanism was created, and the United Nations World Commission on the Environment and Development published a report called "Our Common Future" (McGeough et al., 2004). Human habitation affects environment in a variety of ways. It leaves behind an ecological footprint that indicates the water, energy, and materials that occupants

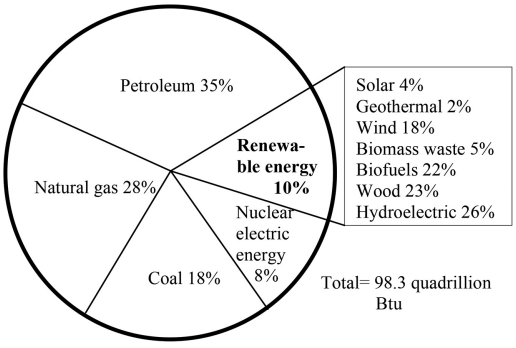


Figure 1. U.S. energy consumption by energy source, 2014 ("Monthly Energy Review," 2015).

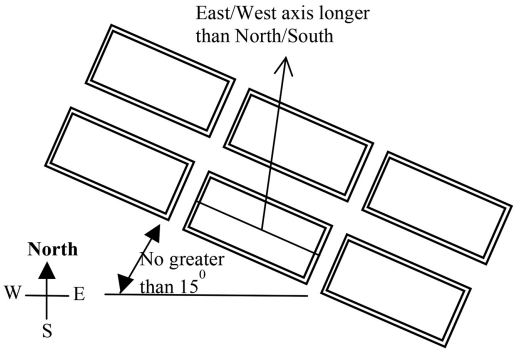


Figure 2. GIB: Solar orientation criterion for solar-oriented blocks (Congress, 2009, p. 97).

have consumed. Overconsumption is a risk for these resources. Therefore, it becomes necessary to integrate new technologies into economic, environmental and social dimensions within the process of sustainable developments. "Sustainable development is the ultimate goal of the energy planning process" (Neves, Leal, & Lourenço, 2015, p. 111).

There are different types of energy that have been used in the US (**Figure 1**) such as petroleum, natural gas, coal, renewable energy (consisting of hydropower, wood, biofuels, biomass waste, wind, geothermal, and solar), and nuclear electric power (2015). According to monthly energy review, residential (22%) and commercial buildings (19%), industry (32%), transportation (28%), and electric power generators are the main energy users (2015). As it has seen non-renewable energy (89%) consumption is higher than renewable (10%) energy.

The most important element of sustainable urbanism is the creation of smart cities, innovative cities, and green cities. Smart technologies include public transportation, district heating, and green building design (Beatley, 2012). According to Beatley (2012), sustainable development starts with the local government. Local activities are the major cause of the problems and solutions. Local governments also can achieve sustainable development within local government programs (Beatley, 2012; Farr, 2008). Farr (2008) states that it would be better if the integration of human and natural systems could take place within sustainable urbanism. In addition, sustainable urbanism supports this balance to create stronger cooperation between the two systems. He proposed a category that aims to support creating high-performance-buildings and neighborhood-scale infrastructure systems containing sustainable (alterative/renewable) energy systems. Fossil-fuel energy usage needs to be reduced, and energy-saving systems need to be commonplace. In this study, we are trying to present how we can make energy-saving systems as commonplace by encouraging LEED-ND certificate program to include accurate calculation tool (EnergyPlus) for energy consumption. This tool will give opportunity to provide results of before and after intervention (after upgrading with renewable energy resources) for building and/or neighborhood.

2.2 *Leadership in Energy and Environmental Design (LEED) for neighborhood development*

LEED-ND stands for Leadership in Energy and Environmental Design for neighborhood development. LEED-ND criteria offer ways to improve livability in the area by means of critical analysis and design practice. The purpose of certified green building is to support green infrastructure improvement in structures and buildings. Building structure needs to follow requirements provided by the IAF accreditation body ISO 17021, ISO/IEC Guide 65 and ISO/ IEC 17065 (Congress, 2009). Some of the LEED-ND criteria that are emphasized in this study are 'minimum building energy efficiency', building energy efficiency', 'solar orientation', 'on-site renewable energy sources' and 'district heating and cooling' under green infrastructure and buildings (GIB) (2009). Certified green building is for energy metric to provide sustainable energy usage for the target area within green building performance. Basically, the criterion serves to support green building practices (2009).

LEED-ND Solar Orientation criterion aims to encourage energy efficiency by generating optimum conditions for the use of passive and active solar approaches (2009, p. 96). The requirement to get one credit either for block or building orientation is to locate the project on existing blocks or design or orient 75% or more. According to this criterion, solar-oriented (**Figure 2** and **Figure 3**) buildings or blocks with east-west lengths (longer axis) should be equal to or greater than north-south axis, and east-west axis within fifteen degrees of geographic east-west (2009, p. 96).

On-site renewable energy sources as a criterion of LEED-ND intend to encourage using renewable energy sources. These energy sources are solar, wind, geothermal, small-scale or micro hydroelectric, and biomass. Earning one credit is dependent on production capacity of used source. At least five percent of buildings' electrical and thermal energy cost must

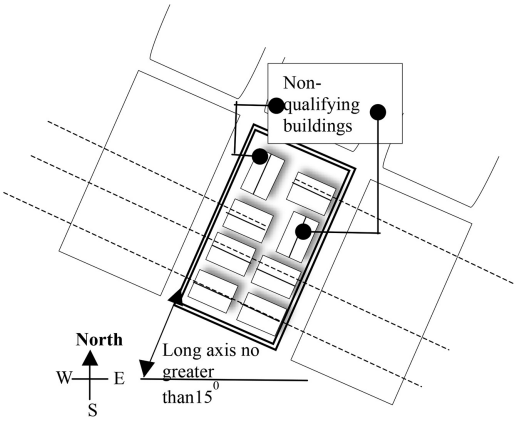


Figure 3. GIB: Solar orientation criterion for solar-oriented buildings (Congress, 2009, p. 97).

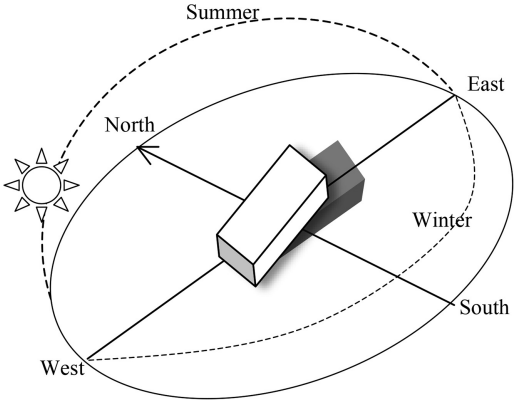


Figure 4. A single building solar orientation.

be supported by renewable energy sources (Congress, 2009).

Sun orientation (Figure 4) of buildings is becoming a crucial for builders to reduce energy costs by using Sun's free energy (Gromicko & Gromicko, n.d.). According to Gromicko and Gromicko, there are several advantages of solar orientation of buildings such as increasing the building's appeal, marketability, and reducing the energy bills. They state that building orientation, along with daylight and thermal mass, are important deliberations of passive solar construction that can be combined into practically any new building design.

Despite an overall view of LEED-ND criteria with a focus on the correlation among elements within each emphasized criteria set has strong basis, within the scope, there is lack of finding necessary data and programs/ software to utilize the criteria. In other words, LEED-ND program should indicate energy efficiency calculation tools such as EnergyPlus to assist projects before implementation. Also, implementation strategies can be shaped based on findings from specified tools. One of the other benefits of indicating specific tool/s is to reduce implementation cost by using various measurements of building and neighborhood to apply best practice.

LEED-ND might encourage public and private sectors to provide data and make it accessible by institutions and development groups. Xiufeng Pang et al. (2013) presents a framework to encourage the large-scale energy efficacy by motivating building owners and decreasing the operational cost through data sharing and amending the process through the cloud-based real-time building energy simulation in their study. In their study, data-sharing process at each individual building is done over three mechanisms such as weather station network and client software and the Energy Management and Control System (EMCS). There is no current weather station network that could provide all the essential constraints. Xiufeng Pang et al. (2013) state, "The emerging low-energy technologies and urban energy systems, such as radiant heating/cooling, demand response, district heating/ cooling and renewable energy, require more weather measurements, e.g. global horizontal solar, direct and diffuse solar, wind speed and direction, to ensure their proper operations."

GIB should be stretched out to correspond larger scale by providing projected framework. In other words, a suggestion for LEED-ND is to resolve scale issues by evaluating criteria suitability depending on this particular framework.

2.3 *EnergyPlus tool*

EneryPlus, which goes beyond DOE-2 (building energy use and cost analysis tool), is the advanced energy modeling tool that is used by the Department of Energy (Bovill, 2015, p. 240). EnergyPlus can help to measure energy efficiency and passive solar design metrics, comparing mechanical system types and operating costs, performing ROI analysis of any sustainable characteristics, such as improved insulation or better windows, performing daylighting analysis of the building, calculating LEED energy reduction credits, showing compliance with ASHRAE 90.1, and so on ("EnergyPlus Energy Modeling," 2016).

2.4 *Establishing the framework*

Within the scope of this study, EnergyPlus tool is used to establish a framework for sustainable urbanism throughout considering LEED-ND criteria (**Figure 5**). This framework is adapted from 'fundamental objectives hierarchy' (Neves et al., 2015). It consists of three dimensions of sustainable urbanism (environmental, economic, and quality of life), related LEED-ND criteria, simulation software (EnergyPlus), and two different cases – one is small-scale neighborhood and one commercial building.

Mostafavi and Doherty (2015) mention two issues: first is affordability of the practices of ecological planning and sustainability; second is scale. The national standard for the evaluation of sustainable buildings is LEED, a program that is used throughout the

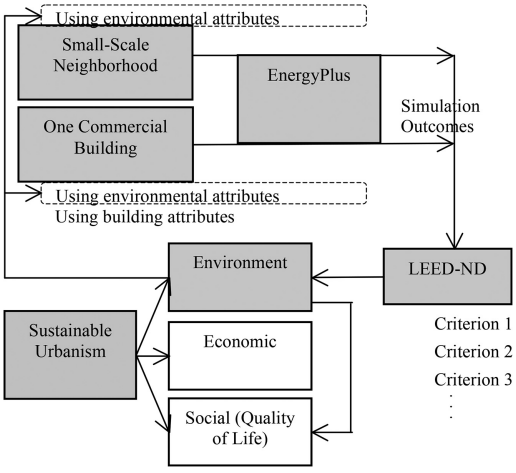


Figure 5. The proposed framework for urban scale energy efficiency regulation (defined attributes are remarked with grey boxes).

country. However, urban systems are designed around a local scale, as opposed to being developed across region. The scope of urban responsibility includes both future and current needs that must be considered for sustainability.

3 METHOD

3.1 *Case studies*

The proposed cases provide a baseline for the LEED-ND program to improve energy efficiency measures to support sustainable urbanism. This study consists of two cases – one commercial building simulation and one small-scale neighborhood simulation – to examine the 'solar orientation' criterion. The case study buildings have been modeled using SketchUp and OpenStudio plugin. In the next step, the geometry files have been imported into the EnergyPlus tool to add the internal heat gains (people, light, and equipment), and HVAC systems to the model and develop the base case models based on the ASHRAE 90.1 2004. The outputs from both models are heating and cooling energy consumption.

The city of Raleigh, North Carolina is chosen as a location for case studies. Raleigh geographically locates on latitude of 35 degree 46 minute and 59 second and longitude of 78 degree 39 minute (Cornwall, Horiuchi, & Lehman, 2016). Both a single commercial building and a small-scale neighborhood were located in regard to similar physical conditions as well as solar orientation in the city of Raleigh locates in mid-Atlantic region.

4 RESULT

The two settings defined in the method section were simulated using the proposed framework and results are presented in this section. The focal objective of these initial results is to understand the energy consumption and energy savings process calculated by EnergyPlus considering solar orientation and on-site renewable energy sources criteria. We aimed to use Raleigh weather data file in EnergyPlus model calculate annual energy saving by taking into account LEED-ND criteria.

Table 1. Pairwise correlations analysis of one commercial building and a small-scale neighborhood.

Variables		N	Coef.	*p*-value
SB cooling	SB heating	365	−0.5614	<.0001*
SN cooling	SB cooling	365	0.9736	<.0001*
SN cooling	SB heating	365	−0.5409	<.0001*
SN heating	SB cooling	365	−0.5809	<.0001*
SN heating	SB heating	365	0.9934	<.0001*
SN heating	SN heating	365	−0.5581	<.0001*

* Correlation is significant at the 0.01 level.
SB: Single commercial building; *SN*: Small-scale neighborhood.

The results of the correlational analysis are presented in Table 1. There was a significant positive correlation between the variables: Single commercial building and small-scale neighborhood' cooling and heating energy use. In contrast, single building heating and small-scale neighborhood's cooling have a negative correlation as well as single building cooling versus small-scale neighborhood heating in terms of energy use.

5 CONCLUSION

This paper presents a framework that can potentially improve scope of LEEN-ND certification program and other urban scale energy efficiency regulations. Sustainable urbanism helps us to understand importance of energy reduction and leaning to renewable energy sources; and EnergyPlus helps us to accurately calculate energy consumption of buildings by using some of the environmental and building attributes. Today, cities that are growing fast need more land, water, energy, and resources to satisfy human needs. It is important to spear out energy efficiency strategies across the nation.

This study provides better understanding of sustainable urbanism elements and emphasizes possibility of replication energy efficiency strategies of single building in the same neighborhood. EnergyPlus software provides accurate results for both single commercial building and small neighborhood scale for the same measurements. The intention of this study was to analyze case studies a commercial building and a small-scale neighborhood's energy performance by using EnergyPlus in order to reduce building energy consumption by promoting energy efficiency measures. This study suggests the improvement in Green Infrastructure and Buildings (GIB) criteria under the

LEED-ND principles that relates to energy efficiency such as ‘solar orientation’ and ‘on-site renewable energy sources’.

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Urban glare and death ray potentials from glass towers

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ABSTRACT: Glass facades have become popular for contemporary towers in urban settings due to its aesthetic consideration and abilities to maximize view-out and daylighting potentials. Given the increasing popularity of glass facades with issues such as energy transfer and glare controls, close coordination between designers and engineers is indispensable to minimize life cycle energy consumption and to enhance occupant's comfort. Recently, fully glazed facades have been recognized as a possible source of urban glare and death ray problems, introducing a risk to built environment and public health burden. Starting from the Disney concert hall in LA, the Vdara hotel in Las Vegas, to recent examples of the Museum Tower in Dallas and the 20 Fenchurch st. tower in London, those buildings exemplify unforeseen design problems that required remedial solutions after construction. This research paper focuses on theoretical metrics of urban glare and death ray problems and discusses empirical and analytical methodologies that allow designers to identify such problems during the schematic design phase of a building. Architectural design and technological solutions to mitigate urban discomfort were also discussed.

1 INTRODUCTION

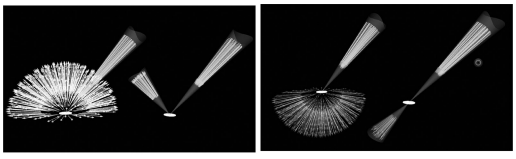
Energy efficiency of urban towers largely depend on a great variety of factors such as climate, physical settings, social norms, and user awareness. Passive design strategies including building massing and orientation responding to site climates can make significant improvement in building energy conservation. Physical settings of urban buildings such as density, materials, and geometrical layout affect building energy usages. Building skins incorporating energy efficient façade technologies become critical for reducing energy transfer through building envelopes. Social norms to adopt more stringent energy codes and to implement voluntary energy programs will enhance energy profiles and carbon footprint from the built environment. Finally, human behaviors and awareness of energy conservation will further result in energy conservation.

Glass facades, despite of being a major source of building energy transfer, are becoming widely executed as an architectural element primarily due to the benefits of daylighting and view-out. However, the glass facades of high rise towers in urban settings have been identified as a potential source of urban glares and death rays to nearby drivers, pedestrians and neighborhood buildings. The solar rays falling on a glass facade are absorbed, transmitted, and reflected. Higher the reflectance of a facade, stronger reflected rays adversely affecting urban discomfort. In addition, the problem associated with facade reflection in the urban context is reinforced by the reflectance level of facade materials. Building forms and façade geometry further intensify urban discomfort. The urban glare could adversely affect visibility and visual comfort. The death ray could create additional heat gain that impact thermal comfort and energy bills especially cooling loads. Further, it could impose a risk to neighborhood property, materials and public health. This study discusses case study buildings that exemplify urban glare and death ray as unforeseeable problems during design process, and discussed possible solutions. Further, the research utilizes empirical and analytical methods to validate urban discomfort potentials.

2 URBAN DISCOMFORT: URBAN GLARE AND DEATH RAY

2.1 *Material reflectance and geometrical reflection*

Façade reflectance has implications on energy performance of a building in heating and cooling loads. The visual reflectance is the ratio of reflected visible light to incident visible light on a façade surface, wavelength of 390–700 nm, which affect daylighting transmittance. Solar reflectance accounts for full solar energy spectrum, wavelength of 300–2500 nm (ie. UV-visible light (VL)-infrared (IR)). It is the ratio of reflected solar energy to incident solar energy on



(a) (b)

Figure 1. Diffuse and direct reflectance (a) and transmittance (b) of solar rays. (image source: DiLaura et al., 2011).

a façade surface, and affects heat gain into a building. Architects are typically concerned with the visual reflectance that determines aesthetics of being visually neutral or reflective. A higher visual reflectance will likely cause more urban glares than non-reflective facades. A higher solar reflectance will likely develop more incidences of death rays onto outdoor environment and heat gain onto neighborhood buildings. The visible light spectrum of the solar spectrum attributes to 48% of the energy content while the near IR contains about 50% of energy content with the remaining energy content is attributed to the UV. The solar reflectance consists of diffuse and direct reflectance. Diffuse reflectance reflects solar rays in all directions while the direct reflectance reflect rays with the same incidental angle of the sun (Figure 1(a)). Likewise, solar transmittance is composed of diffuse and direct transmittance. Diffuse transmittance allow solar rays to scatter in all directions while direct transmittance preserves the direction in which the light travels (Figure 1(b)). Depending on surface geometry and texture, diffusivity varies. The albedo refers to the diffuse reflection while the reflectivity represents direct reflection.

The variety of colors, hues, textures of façade materials affect both visual and solar reflectance. Glass material reflects and transmits visible light. Low-e coating on a glass, typically a thin transparent layer of silver, is a spectrally selective coating in that it maximizes visible spectrum yet minimizes the thermal IR. Low-e coating can be reflective or non-reflective depending on aesthetic preferences. It further improves the thermal transmittance (U-factor) by lowering the radiative heat transfer or by reflecting long wavelength radiation due to the low emissivity. It should be encapsulated within the air cavity of a double insulated glass unit (IGU) for durability. The visible reflectance of low-e coating within an IGU varies from 10% reflectance to as high as 65% reflectance. However, the solar reflectance does not necessarily follow the magnitude of visual reflectance because it encompasses a full solar spectrum. Glass reflects, absorbs, and transmits solar energy. Due to advanced coating technologies, a low-emissivity coating in an IGU for example could offer10% visual reflectance and 40% solar reflectance to maximize visible light transmittance while minimizing solar heat gain. Table 2 shows visible and solar reflectance of IGU with different low-e coatings.

Table 1. Visual reflectance and solar reflectance of different low-e coatings according to LBNL standards.

IGU type	Visual reflectance	Solar reflectance
clear glass, 6 mm	8.2%	7.8%
IGU w/o low-e	15.1%	14.2%
IGU w/ ve 2 m	10%	41%
IGU w/ve 65	27%	34%
IGU w/vre46	34%	39%
IGU w/vre38	46%	58%
IGU w/iposol	64%	66%

Table 2. Specular reflectance of opaque materials.

	% specular reflectance
Mirrored and optical coated glass	80–99%
Metalized and optical coated plastic	75–97%
Processed anodized and optical coated aluminum	75–95%
Polished aluminum	60–70%
Chromium	60–65%
Stainless steel	55–65%

Data from http://www.uncg.edu/iar/elight/learn/determine/lc_sub/mat_prop.html

Opaque cladding materials offer both visible reflectance and solar Reflectance. The visible reflectance of an opaque cladding concerns aesthetics while the solar reflectance matters for energy transfer of a building. The reflectance is measured by spectrophotometric meter which determines the reflectance at each different wavelength of solar spectrum. An opaque material can achieve a typical value of 80% solar reflectance with maximum reflectance of 95%. Both reflectance and emittance affect material's ability to reject solar heat. The specular reflectance of a polished anodized aluminum could go up to 95%. Table 2 shows specular reflectivity of opaque materials.

In addition to the reflectance material property, building shapes and geometry of a façade system could exacerbate urban glare and death ray. For example, reflective concave geometry of facades will create a solar convergence point outdoor and adversely affect urban discomfort. The Vdara Hotel in Las Vegas or the 20 Fenchurch st. tower in London are examples of the reflective concentrating geometry. Such geometrical reflections could be mitigated by integrating diffused surfaces such as adding external shading devices or applying diffusive surface treatment. Façade geometries with both convex and flat surface could also cause urban glare and death ray depending on the reflectance level of façades.

The discomfort or disability glares are perceived when viewing angles are aligned with the angle of solar reflection off the facades. Discomfort glare will

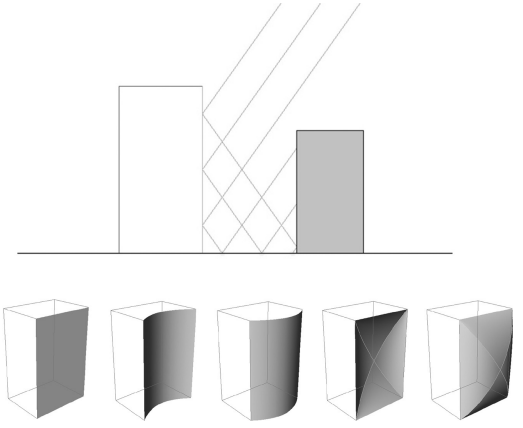


Figure 2. Possible geometrical reflection.

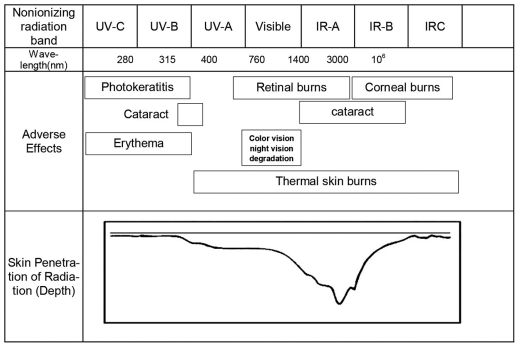


Figure 3. Adverse effect of solar spectrum on ocular hazards (reproduced from Slingy, 2001).

force viewers to look away or change viewing directions. The disability glare reduces visibility due to a bright light source reducing luminance contrast of the retinal image. Therefore, understanding solar positions as a function of solar altitude and azimuth is fundamental when assessing urban glare risks. The photometric and radiometric intensity obeys the inverse square law; therefore, the distance between the intensity of source and effective area should be taken into consideration.

Table 3. Luminance levels on different objects.

Luminance, cd/m2	Representative objects
10	Horizon, overcast sky at sunset
310	LCD computer display max
1000	Scattered clouds
3100	Complete overcast daytime sky
10,000	T8 fluorescent lamp, candle flame
310,000	Blackbody at 1950K
3,10,000	Tungsten lamp filament
10,000,000	Sun at the horizon
100,000,000	Sun at midafternoon

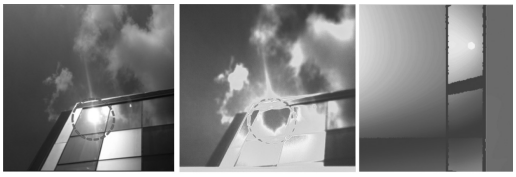
2.2 *Urban glare and health impact*

Scientific evidence suggests that ocular health is correlated to sunlight exposure. Constant exposure to the intense sunlight can lead to impaired vision and eventually blindness. Further, the eye can sustain damage from reflective sunlight to water, sand, or snow as well as eclipse and light sources such as lasers surgery devices or laser pointers [Slingy, 2001]. The ocular exposure over the open water from both direct and diffuse sunlight for example is found to be ,of the order, of 20% of sunlight. The American Optometric Association reported that “Exposure to UV and intense violet/blue visible radiation is damaging to retinal tissue in laboratory experiments, thus scientists have speculated that chronic UV or intense violet/blue light exposure may contribute to aging processes in the retina” [AOA, 2015]. Figure 3 shows adverse effects of solar spectrum on ocular hazards. Photokeratitis is caused in the short wavelength region of the visible spectrum while retinal burns occurs due to the visible spectrum and the infrared A while Corneal burns is caused by the longer wavelength of the infrared region. It is important to mindful of ocular exposure to intense light sources. The use of fully glazed facades has gained popularity in contemporary buildings due to its aesthetics and unique performances such as daylight and view-out. The influence on direct reflection from facades becomes evident in creating environmental problems on pedestrians, drivers and occupants of adjacent buildings. Figure 3 shows an overview of ocular hazards when exposed to different wavelength of solar spectrum.

In addition to the ocular effect due to solar exposure, glare represents visual performance under the presence of light source. Glare occurs when luminance is too high or luminance ratios between minimum and maximum luminance areas are too high. According to CIE definition, glare is defined as two categories: disability glare and discomfort glare. Disability glare is physiological glare and reduces visual performance and visibility. Discomfort glare is psychological glare and produces discomfort without interfering visual performance and visibility. Table 3 shows light intensity measured in cd/m2 on various surfaces. Sun at the horizon and midafternoon can damage eyes.

The luminance level of the sun is estimated to be around 1.6×10^9 cd/m^2. The sky luminance in the daylighting study area considers clear sky, partially cloud and overcast conditions. The highest luminance of the clear sky condition, for example, occurs in the circumsolar region with around 20,000 cd/m2 luminance (DiLaura et al., 2011). More complex sky models are available based on weather data. Solar illuminance measured on a plane normal to solar rays can reach as high as 100,000lux (DiLaura et al., 2011).

The luminance of a façade can be obtained by both physical measurements and simulation (ie Radiance).



(a) (b) (c)

Figure 4. Field taken (a, b) and simulated (c) HDR images of a façade reflecting the sun.

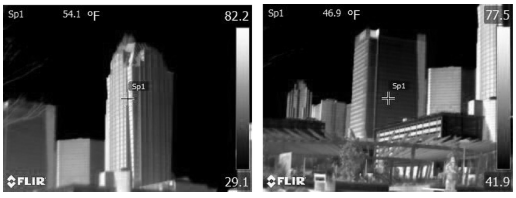


Figure 5. Thermographic images of Charlotte uptown on a winter day.

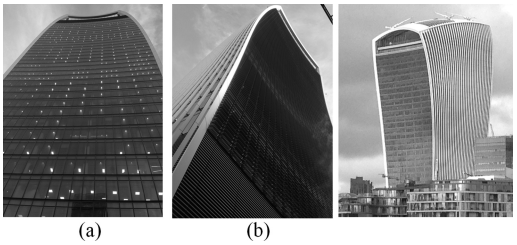
Figure 4 shows hdr images that are field taken or simulated using radiance software. Radiance software uses backward ray tracing and a weather data driven sky model that simulates direct reflection of a glass façade.

2.3 *Urban death ray*

Heat flux reaching on a material consists of reflectance, transmittance, and absorptance. The surface temperature of a material primarily depends on absorptance. Absorptance rate varies depending on material color, emissivity, geometry, and so on. The intensity of solar reflection depends on reflectance rate. Solar reflectance is the ratio of heat flux reflected by a surface to the total heat flux incident on it. Solar transmittance is the ratio of heat flux transmitted by a surface to the total heat flux incident on it. Solar absorptance is the remaining ratio that is not reflected nor transmitted. Therefore, total heat flux equals to summation of reflected, transmitted, and absorptive heat flux (ie. Solar reflectance + transmittance + absorptance = 1).

Urban death ray is caused by solar reflection from reflective facades or reflective concave facades. It adds heat built-up on the ground level or heat gain onto neighborhood buildings. Both solar reflectance level and concave geometry will increase the incidence of death ray problems. Thermographic images of urban buildings can be one way of identifying possible hotspot locations. Simulation techniques such as whole building energy simulation or irradiance analysis can be utilized to understand potential impact on heat gain to neighborhood buildings.

There are a few notable buildings that caused urban discomfort problems after construction, and provided insightful lessons. The Walt Disney Concert Hall (2003) in LA was reported to cause glares and heat to drivers and neighborhood buildings due to the reflective curved stainless steel metal panel. Both the solar reflectance and the curved geometry of the metal panel intensifies glare and death ray. Problematic metal panels were modified with dull finishes to diffuse sunlight. Another example of reflective concave geometry is the Vdara hotel (2009) in Las Vegas. The South facing concave facade with a reflective glass curtainwall intensified solar rays on the pool deck, causing temperatures to reach up to 99 degree C (210 degree F) that burned things on the deck. Trees and umbrellas were added to absorb converged solar rays. The 20 Fenchurch street tower (2015) in London is another example of reflective concave geometry. The parabolic glass curtainwall burned car part on the street and built up heat on pedestrian level. The Fenchurch tower had installed aluminum shading louvers to mitigate sun reflection problems (Figure 6). Lastly, the Museum Tower (2011) in Dallas is a convex glass tower that emitted detrimental sunlight to the Nasher Museum (2003). The reflectance of the convex glass façade is around 45%, and the direct reflection is strong enough to damage curated art work indoor and outdoor. Three different remedy proposals were discussed – 1. to add anti-reflective film on the Museum tower glass curtainwall, 2. to redesign the skylight oculus of the Nasher museum, and 3. to install a free standing sculptural shield. However, none of the proposals have been accepted and implemented due to practical and financial reasons.



(a) (b)

Figure 6. The Fenchurch tower installed with external louvers to mitigate urban hotspot; before (a) and after (b).

3 PRACTICE INVESTIGATION

The Children's Hospital of Philadelphia (CHOP) designed by PCP and Ballinger is a research and office tower located across the Schuylkill river in Philadelphia. The tower is 23story tall with 46,450 sq. meter (500,000 sqft) gross floor area, sitting on a parking podium. The building mass responds to climates, views and neighborhood context. The facades consist of concave and convex geometry with glass curtainwall with around 30% visual reflectance. The lower level of the building is enclosed with terracotta and glass claddings with metallic tube fins. The upper level of the building facades consists of reflective curtainwall with metal tube fins. The metal tube fins along the curtainwall mullions reduces solar gain.

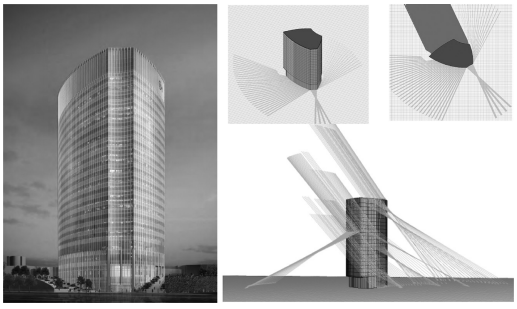


Figure 7. Solar ray analysis using forward ray tracing.

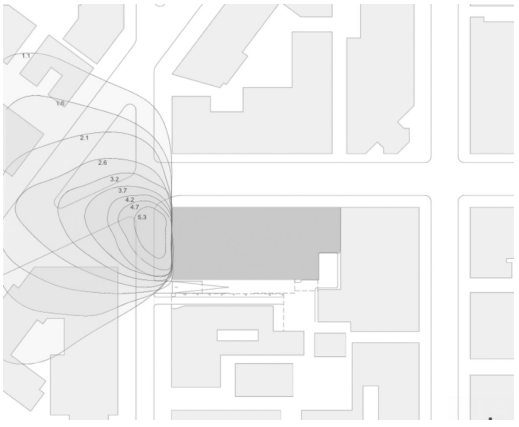


Figure 8. Urban glare analysis that shows an extent of street level glare problems resulted from the west façade.

The solar ray study allowed us to identify solar convergence point from the Eastern concave façade and to visualize the effective area of solar rays that are falling on the ground. Understanding of solar converging areas could suggest potential urban glare and death ray problems. The urban glare study specifically concerns glare to pedestrian and drivers due to the direct reflection from building facades. Death ray in this project specifically concerns thermal comfort at pedestrian level. Figure 7 shows solar ray and glare analysis for the tower.

The 2050M st. office is located in downtown Washington, DC. It is a new construction and its gross floor area is around 37,160 sq.meter (400,000 sq.ft.) The building enclosure consists of flutted glass curtainwall and a concrete wall with punched windows. Due to the concave geometry of the flutted glass panel, it was expected that the curtainwall facade generates multiple reflections from the glass converging on viewers. The solar ray study focuses on defining a solar convergence point to confirm the death ray potentials, and the effective areas on ground that could impose a risk to neighborhood properties, materials and public health. Further, computer tools using Radiance determined maximum luminance level of the flutted glass and glare potentials. Figure 8 shows daylighting study to understand the degree of glare problems imposed by reflected facades.

4 CONCLUSIONS

Glass towers in cities have gained popularity with an intention of aesthetics and access to daylight and view out. However, the glass facades in urban settings have been identified as a potential source of urban discomfort such as glares and death ray to the built environment.

This study discussed scientific matrices of urban glare and death ray, and potential health hazards. The research methodology consists of field measurements and simulation. HDR photography taken in a field allows designers to understand potential glare. Thermographic images assist in identifying hotspots of facades or pedestrian/car roads. Daylight simulation using Radiance is an analytical method to identify luminance and glare level. Solar ray analysis is to assist death ray potentials by using forward ray tracing and identifying solar convergence points. The solar ray analysis also provides the extent of effective areas on ground or neighborhood buildings that may cause glare or death ray problems. The reflective concave geometry intensifies solar rays, and it is important to confirm urban discomfort potentials during the earlier design process. In addition to the geometrical reflectance, the reflectance level of cladding materials also plays an important role in urban glare and hotspot issues. The higher the reflectance is the stronger the reflective solar rays from facades. Façade reflection could adversely affect visual glares, forcing viewers to look away. The death ray from facade reflection could increase cooling energy bills or air conditioning equipment for neighborhood buildings due to additional heat gains. Further it could introduce a risk to properties and public health. Possible mitigation solutions include shading devices, frits, anti-reflective coating/film to reduce reflectance level. Concave or parabolic geometry require special attention. It is important to balance out aesthetic preference, energy performance, and public health.

ACKNOWLEDGEMENT

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Statistical analysis of academic performance in Ohio's Green Schools

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ABSTRACT: School buildings are tools used in service of society and should be designed to meet the needs of people serviced by them and paying for them. Surveys have shown the public cares most about academic success in schools. Therefore, the impact of design decisions on student performance should be understood. Research has established lighting, indoor air quality and thermal comfort as the building design elements influencing human performance. The goal of this research was to identify through statistical analysis any significance or priority among these design elements. Ohio is uniquely positioned for such research because it has by far the largest group of green schools in America (over 250). The analysis found that daylighting significantly influenced student performance in the short term, whereas thermal comfort and indoor air quality did not. This study is a unique contribution to the growing body of evidence linking indoor environmental quality and human performance.

1 INTRODUCTION

1.1 *Green design priorities*

It was only a couple of decades ago that the public and the building professions began to work together to define, design and construct green, high-performance buildings. Since then, significant advances have been made in the design of the buildings we spend over 85% of our lives in (Kats, 2003). Today our buildings are more efficient, they are of higher quality and they cost less than the buildings of yesterday. Research has shown that resource efficient building design makes economic sense when all costs and benefits are considered over the life of a building. In 2002, the U.S. Senate Committee on Environment and Public Works and California's Sustainable Buildings Task Force both commissioned reports detailing the costs and benefits of green buildings. The reports completed by the U.S. Green Building Council (USGBC) and private consultants showed the financial benefits of resource efficient design far outweigh the costs (Kats, 2003). Most experts and building professionals now agree that resource efficient buildings are a good investment because research has clearly defined the benefits. In addition, national programs have been successful in educating the public about the benefits of resource efficiency. For example, over 80% the general public recognize the ENERGY STAR label and understands its purpose (USEPA, 2014). Today, decision makers involved in the building process, from the design community, the government and the public, understand the value of building design impacting energy and resource efficiency.

There is also a body of work suggesting the financial benefits of green building design impacting human health and performance may exceed the financial benefits of resource efficient design. For example, a report completed for the Massachusetts Technology Collaborative showed the long term financial benefits of human impact can be 2 to 3 times greater than the financial benefits resulting from energy efficiency (Kats, 2003). However, there is no consensus around the value of improved human health and performance. The financial benefits have not been as clearly defined as they have for resource efficiency. In addition, the public is not well informed of how green design impacts their health and performance. As a result, most building standards and government regulations continue to emphasize resource efficiency over indoor environmental quality. A good example of this is the green building rating system Leadership in Energy and Environmental Design (LEED). LEED is the most popular green building certification in the world with more than 72,000 projects in over 150 countries (USGBC, 2015). Figure 1 shows how resource efficiency is given priority over indoor environmental quality in LEED for Schools 2009.

As shown above, there are 44 credits available for resource efficiency and 19 credits available for indoor environmental quality under LEED for Schools 2009. Since only 40 credits are needed for certification it is possible for buildings to earn the green label without significantly impacting the health and performance of occupants. When designers do decide to address indoor environmental quality they must decide with other stakeholders what to incorporate into the design of the building. Without research clearly defining the benefits of improved human health and performance design priorities can be enigmatic.

	Credits Available
Energy & Atmosphere	33
Sustainable Sites	24
Indoor Environmental Quality	19
Material & Resources	13
Water Efficiency	11
Innovation	6
Regional Priority	4
	110

Indoor Air Quality	10
Thermal Comfort	3
Daylighting	3
Other	3

Platinum =	80
Gold =	60
Silver =	50
Certified =	40

Figure 1. The structure of LEED for schools version 2009.

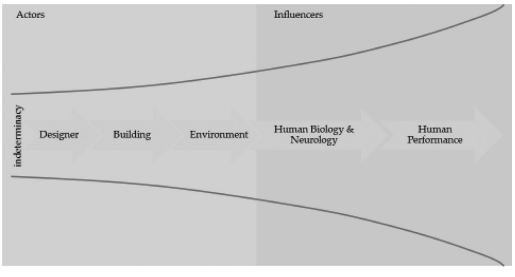


Figure 2. The relationship between designer and human performance.

1.2 *Building design and human performance*

Understanding the impact of design on human performance starts with understanding relationships connecting designers and occupants. While designers talk about designing for human performance the relationship is not a direct one. The designer is an actor and acts on the building. The designer exercises control over the building. The building is also an actor and acts on the built environment. The building exercises control over the built environment. Therefore there is a strong control relationship between the designer and the built environment. Figure 2 illustrates this point.

The built environment is described by qualities such as thermal comfort, lighting and air quality. These are the qualities over which the designer has control. These qualities have been shown to influence human biological and neurological processes which in turn influence human performance.

For example, research has shown there is an optimal temperature range for human productivity in both office and academic environments (Seppänen, 2006; Pepler, 1968). Studies have also shown human performance improves in both office and academic environments as ventilation rates increase (Federspiel, 2004; Wargocki, 2006). Finally, research has shown daylighting improves student performance (Heschong, 1999). Daylighting is the use of natural light to illuminate

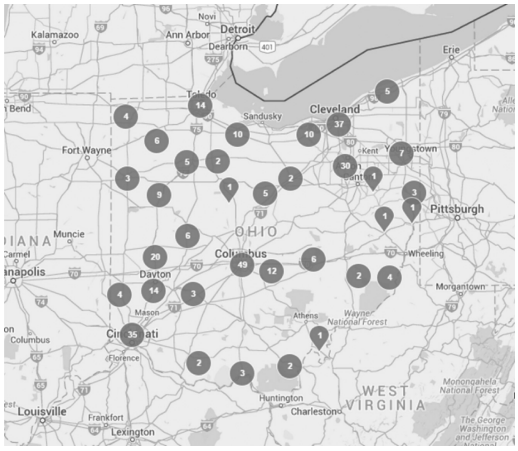


Figure 3. Map of Ohio's green schools courtesy of the green building information gateway (2016).

spaces within a building. The relationships between these qualities of the built environment and influencers of human performance are not strong control relationships. It is difficult to precisely quantify the impact of design on human performance because indeterminacy increases in influencer relationships. However, it may be possible to establish significance or priority among indoor environmental qualities that influence performance.

1.3 *Ohio's Green Schools*

Ohio is a unique and ideal place to study the impact of green building design on human performance. A bit of history helps explain why. Ohio was one of the first states to encourage green design with legislation. The Ohio EnergySmart Schools program was enacted under Governor George Voinovich in 1999 and its structure closely resembled that of LEED, the newly developed green building rating system from the USGBC (Ohio Energy Project, 2000). Ohio's program emphasized resource efficient design because policy makers were looking for an economical, long term solution to the state's infrastructure problems. At the time, Ohio's schools were ranked 48th in the nation for indoor environmental quality and last in overall structural condition (Ohio Energy Project, 2000).

Over the next decade, improving educational infrastructure remained a priority in Ohio and policy makers developed close relationships with the USGBC. In 2007, the state launched the Ohio Green Schools Program which required a minimum of LEED Silver certification for all new school projects receiving state funds (OSFC, 2014). The program included a resolution with language specifically prioritizing credits in the energy and atmosphere section of LEED (OSFC, 2014). As a result, there are now over 250 LEED certified schools in Ohio, making it the national leader, but the impact on student performance is unclear. Figure 3 gives the location of Ohio's green schools.

Since school buildings are tools used in service of society they should be designed to meet the needs of people serviced by them. Surveys have shown parents and taxpayers care most about the academic success of schools (Zeehandelaar, et al, 2003). Therefore, the impact of design decisions on student performance needs to be understood. The group of green school buildings in Ohio provides a unique opportunity to study relationships between building design and student performance. In addition to being the largest sample in the country, most of the buildings earned at least a LEED Silver certification. Therefore most schools addressed indoor environmental quality in some way. Also, most of the buildings were designed using LEED for Schools 2007 and 2009 which have nearly identical indoor environmental quality standards. Finally, Ohio makes standardized student performance data for these schools available through the Ohio Department of Education. By bringing the performance data together with design data this study aims to inform green design priorities for future schools.

2 ANALYSIS OF BUILDING DESIGN AND STUDENT PERFORMANCE

2.1 *Developing the statistical model*

Studies have established which qualities of the built environment influence human performance. Other studies have attempted to quantify the magnitude of the impact of individual environmental qualities on human performance. The goal of this study was to use statistical analysis to identify significance or priority among the design elements influencing human performance.

Since Ohio has chosen to define green schools using LEED it was important to keep the nature of LEED in mind when designing this analysis. Design freedom is a core principle of the LEED program. LEED standards have always been consensus based and voluntary. The relationship between LEED and designers is intended to be symbiotic. Designers make decisions that influence LEED and LEED in turn influences design decisions. The structure of the LEED program (the credit system) can influence design priorities but does not set priorities. Given the variability allowed under LEED for design leading to certification it's possible for buildings to be certified without incorporating various design elements that influence human performance. As shown in Figure 1, these elements are found in the indoor environmental quality sections of LEED. The LEED program also includes prerequisites in some categories. A prerequisite is a design condition that must be met in order to earn certification and therefore is a firm priority. For example, the indoor environmental quality section of LEED for Schools 2009 includes a requirement for minimum indoor air quality performance. However, there are no prerequisites addressing thermal comfort or lighting. In addition to the minimum indoor air quality performance prerequisite, there are 10 voluntary

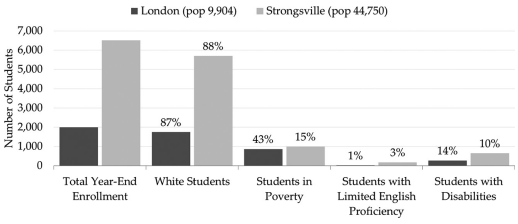


Figure 4. Comparing school district student data 2011.

credits available for indoor air quality. All the credits available for thermal comfort and lighting are voluntary. Therefore, indoor environmental quality may vary significantly from one LEED building to the next. In designing this analysis the goal was to explore these variations in building design. The method developed here was used to correlate differences in academic performance with differences in building design.

There has been one study of human performance in Ohio's LEED certified schools. The preliminary results were presented as a poster at the 2013 USGBC Greenbuild International Expo & Conference. In their study, The Impact of Sustainable Design on Educational Outcomes in Ohio's K-12 Public Schools, Davis and MacGregor compared average student performance for LEED schools and non-LEED schools. They used the performance index (PI) as measured by the Ohio Department of Education to determine average student performance for a group of LEED schools and a group of non-LEED schools. The performance index measures the academic performance of every student in a school using standardized tests. Davis and MacGregor attempted to control for a variety of socioeconomic factors impacting student performance with standardized coefficients. The results were inconclusive but surprisingly suggested that non-LEED schools outperformed LEED schools (Davis, et al, 2013). No further analysis has been published.

It's possible that Davis and MacGregor's use of standardized coefficients to adjust for socioeconomic factors made comparisons of performance from school to school unreliable. Therefore the first step in developing the method for this analysis was to study the socioeconomics at play in Ohio schools districts. Demographic case studies were conducted across the state of Ohio. The demographic data was obtained from the Ohio Department of Education. The case studies included large urban school districts, suburban districts, smaller more rural districts, districts in mid-size cities, wealthy districts and poor districts. The case studies revealed significance variation in socioeconomic factors from school to school. Figures 4 through 6 compare some socioeconomic factors influencing student performance for two Ohio schools.

The example above is typical of results from case studies across the state. After confirming that schools performed differently when there were variations in socioeconomic factors the case studies sought out schools with similar socioeconomic profiles.

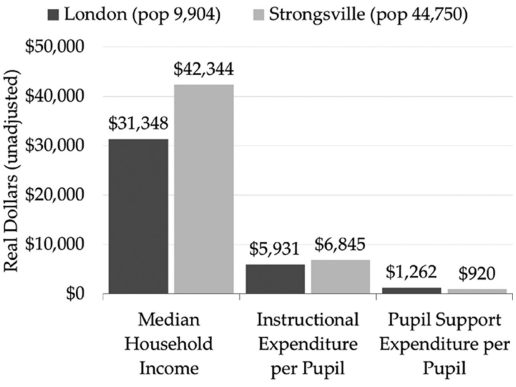


Figure 5. Comparing school district economic data 2011.

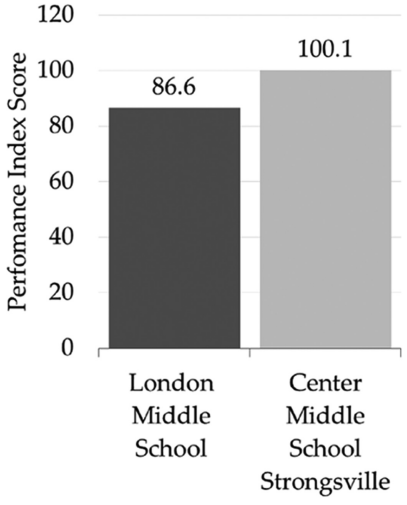


Figure 6. Student performance 2011.

The thought was perhaps schools with similar socioeconomic profiles performed similarly. However, it quickly became clear that groups of schools with similar socioeconomic profiles would be too small to make statistically significant conclusions.

The demographic case studies did reveal an opportunity. A pattern emerged among the case studies which shifted the focus from comparing different schools to studying changes in individual schools over time. In the demographic case studies socioeconomic factors influencing student performance remained fairly constant for an individual school over a short period of time. Figures 7 and 8 present an example to illustrate this point.

As shown in the example above, socioeconomic factors such as median family income, instructional expenditures, enrollment, race and other factors did not change significantly from 2011 to 2014. In other words, the socioeconomic makeup of communities did not change much over a period of only several years. Therefore, when a new school building replaced an

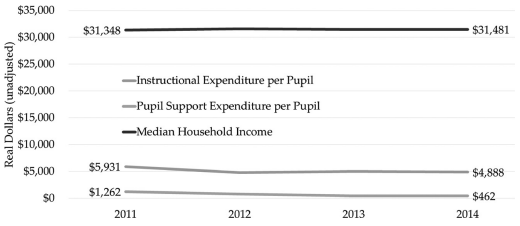


Figure 7. Change in economic data the case of London, Ohio.

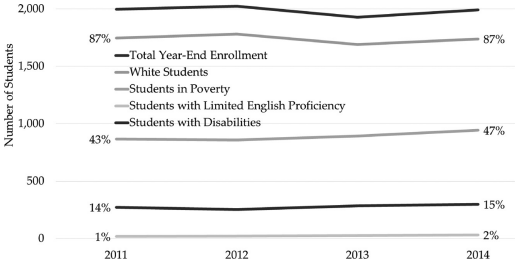


Figure 8. Change in student data the case of London, Ohio.

old building the subsequent short term change in academic performance correlated with the change in the built environment. The method described here controls for socioeconomic factors influencing student performance with boundaries. Instead of comparing academic performance between different schools across socioeconomic boundaries, an individual school was compared to itself.

LEED schools were selected for the study if an old traditional building was replaced with a new LEED certified building servicing the same age groups in the same community. The new buildings had to be certified under LEED for Schools 2007 or LEED for Schools 2009 which have nearly identical Indoor Environmental Quality standards. The resulting sample group included over 150 of Ohio's 250 plus LEED certified schools. Change in performance index was calculated using data from the Ohio Department of Education for each individual school over a period of 4 years (2011–2014). There was no change in the method used by the Ohio Department of Education to determine the performance index in these years. As shown in Figure 9, change was calculated using the slope of the line of best fit with performance index as the dependent variable and time as the independent variable.

The rate of change in performance index (PI points/year) was calculated for 115 of the 150 green schools which met the selection criteria. The schools that were eliminated were excluded due to availability of data from the Ohio Department of Education. Finally, the design data for each school was obtained from the USGBC and paired with the calculated change in academic performance. Table 1 presents the data collected for each school.

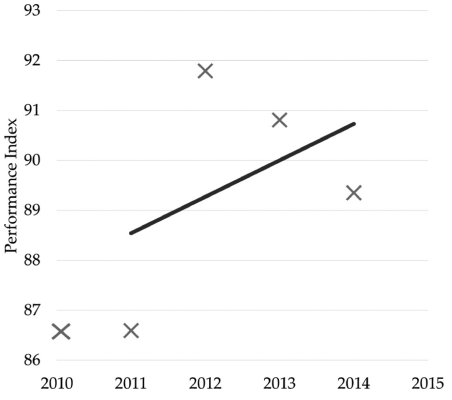


Figure 9. Change in student performance London, Ohio.

Table 1. Examples of data collected for statistical analysis.

School	Louisville elementary	London middle
New Building Type	LEED Gold	LEED Platinum
Occupied	2012	2011
Square Footage	128,778	74,823
Indoor Environmental Quality	12 credit(s)	14 credit(s)
Indoor Air Quality	3 credit(s)	7 credit(s)
Thermal Comfort	3 credit(s)	3 credit(s)
Daylighting	2 credit(s)	1 credit(s)
Performance Index 2011	103.3	86.6
Performance Index 2012	103.9	91.8
Performance Index 2013	104.5	90.8
Performance Index 2014	105.6	89.4
Rate of Change in Student Performance (PI points/yr)	(+) 0.8	(+) 0.7

The data shown in the examples above was available for 115 schools matching the selection criteria. After collecting the data a statistical analysis was completed.

2.2 *Applying the statistical model*

Two primary indoor environmental design typologies emerged from the sample of 115 green schools.

The first design typology (Green Schools Type I) included nondaylit green schools designed to be both highly thermal comfortable and for high indoor air quality. Type I schools were awarded 2 or 3 credits for thermal comfort design and between 5 and 10 credits for indoor air quality design. There were 53 schools of this type. As shown in Figure 10, most of Ohio's green schools were designed to be highly thermally comfortable.

As shown in Figure 11, most of Ohio's green schools were also designed for high indoor air quality.

As shown in Figure 12, most of Ohio's green schools were not designed for daylighting. However, there

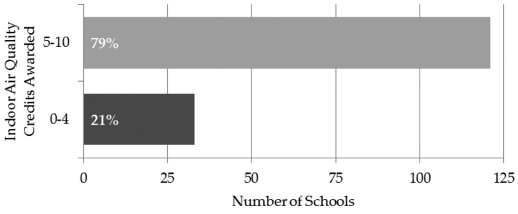


Figure 10. Thermal comfort design in Ohio's LEED schools.

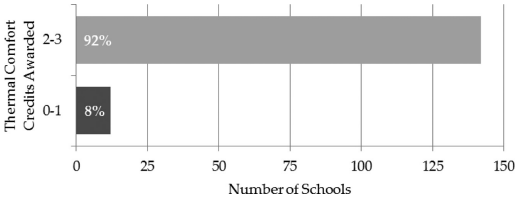


Figure 11. Indoor air quality design in Ohio's LEED schools.

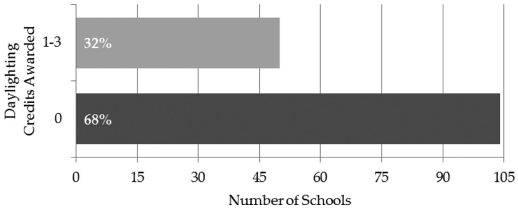


Figure 12. Daylighting design in Ohio's LEED schools.

were enough daylit schools to allow for a meaningful comparison between daylit schools and non-daylit schools.

Therefore, the second design typology (Green Schools Type II) included all daylit green schools. Type II schools were awarded 1 to 3 credits for daylighting design. There were 40 schools of this type. The unique nature of the design priorities at work in Ohio allowed for a statistical analysis focused on daylighting.

An independent sample T-test was used to analyze change in student performance for the two green school design typologies. One of the assumptions of this statistical test is the two groups are unrelated. Unrelated groups do not share defining characteristics. In this study both Type I and Type II schools were LEED certified. Also most of the Type II daylit schools were designed to be highly thermally comfortable and for high indoor air quality like the Type I schools. Therefore, a third group of schools was established as a baseline for comparison. This group included traditional Ohio schools that were not LEED certified. The traditional schools were not designed for daylighting and were not designed to be highly thermally comfortable or for high indoor air quality. Therefore the independent sample T-test could be applied when comparing Type I schools to traditional schools and when comparing Type II schools to traditional schools.

Table 2. T-test for equality of means for traditional schools and green schools type I.

		Equal Variances Assumed	Equal Variances Not Assumed
Levene's Test for Equality of Variances	F	12.711	
	Sig.	0.000	
	t	-0.120	-0.190
	df	3059	56.854
	Sig. (2-tailed)	0.904	0.850
	Mean Difference	-0.053390	-0.053390
	Std. Error Difference	0.443448	0.280737
95% Confidence Interval of the Difference	Lower	-0.922877	-0.615588
	Upper	0.816096	0.508808

Table 3. T-test for equality of means for traditional schools and green schools type II.

		Equal Variances Assumed	Equal Variances Not Assumed
Levene's Test for Equality of Variances	F	10.514	
	Sig.	0.001	
	t	1.042	2.038
	df	3046	43.278
	Sig. (2-tailed)	0.298	0.048
	Mean Difference	0.530781	0.530781
	Std. Error Difference	0.509573	0.260431
95% Confidence Interval of the Difference	Lower	-0.46836	0.00567
	Upper	1.529923	1.055893

The null hypothesis for the first independent T-test was the mean change in student performance for Type I schools was equal to the mean change in student performance for traditional schools. Table 2 presents the results of the test.

According to Levene's test for equality of variance equal variance should not be assumed for this data set. Therefore the significance ρ was 0.850. Since ρ was greater than the standard significance level α ($0.850 > 0.050$) there was not a statistically significant difference in the change in student performance between Type I schools and traditional schools. While the mean change in student performance for Type I schools was slightly higher than the mean change for traditional schools the difference was not great enough to be statistically significant. This means that indoor air quality and thermal comfort did not have a statistically significant impact on student performance over the study period.

The null hypothesis for the second independent T-test was the mean change in student performance for Type II schools was equal to the mean change in student performance for traditional schools. Table 3 presents the results of the test.

Again, according to Levene's test for equality of variance equal variance should not be assumed for this data set. Therefore the significance ρ was 0.048. Since ρ was less than the standard significance level α ($0.048 < 0.050$) there was a statistically significant difference in the change in student performance between Type II schools and traditional schools. This means that the addition of daylighting in Ohio's LEED schools had a statistically significant impact on student performance over the study period.

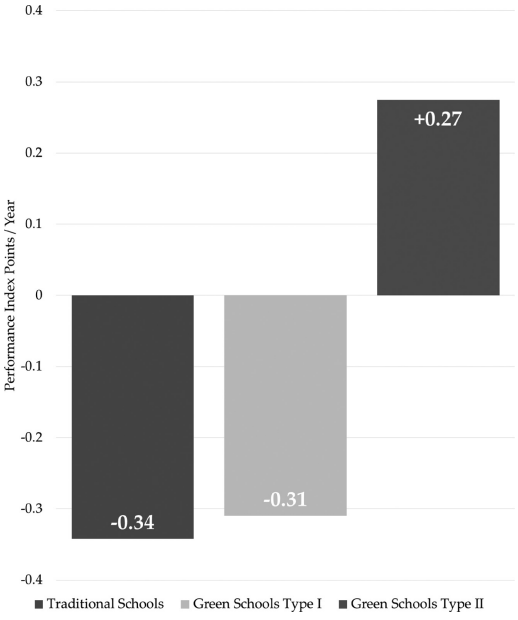


Figure 13. Median change in academic performance.

3 CONCLUSIONS

3.1 *The significance of daylighting*

Figure 13 presents the median change in academic performance for the two green school design typologies as compared to the baseline of change in traditional schools.

As shown in Figure 13, Type I green schools designed to be highly thermally comfortable and for high indoor air quality slightly outperformed traditional schools for the study period (2011–2014). However, this difference was not statistically significant. In other words, the rate of change in student performance between Type I schools and traditional schools was similar. Figure 13 also shows that Type II green schools designed for daylighting outperformed traditional schools for the study period. The difference between daylit schools and traditional schools was 0.61 performance index points per year. The analysis found that this difference was statistically significant. This means the addition of daylighting in Ohio schools has had a significant impact on academic performance. Additionally, daylit schools have outperformed all other green schools.

As shown in Figure 13, academic performance in Ohio's daylit schools improved while performance declined in all other schools. As previously discussed there are many socioeconomic factors that influence student performance. The socioeconomic climate in Ohio over the study period was such that most Ohio

schools were experiencing a decline in student performance. However, the influence of daylighting was significant enough to overcome the net negative influence of other socioeconomic factors.

These results indicate that over the short term daylighting was the leading influencer of academic performance in Ohio's green schools. The results also indicate that the impact of high indoor air quality and thermal comfort design was minimal over the short term. This does not mean that there is not value in high indoor air quality and thermal comfort design. It's possible that there are benefits to academic performance which only manifest over a longer term. It's also possible that high indoor air quality and thermal comfort design has other benefits in the short term, such as improved attendance, which were not addressed by this study. Additional research may answer these questions.

3.2 *Rethinking design priorities*

The results of this study challenge the design priorities at work in Ohio's green schools and beyond. The analysis showed that among indoor environmental quality elements known to impact human performance, daylighting was the leading influencer of academic performance. This is a unique contribution to the growing body of evidence linking improved indoor environmental quality and human performance.

Given the significance of daylighting established in this study it is unfortunate that nearly 70% of Ohio's LEED schools are not daylit. However, the public, the government and the design community all stand to benefit from studying these schools. The lessons learned from studying the performance of existing green schools may inform the design of future schools.

For example, the results of this study may prompt green building programs like LEED to consider modifying indoor environmental quality guidelines. A shown in Figure 1, there are 19 indoor environmental quality credits in LEED for Schools 2009. Of the 19 credits available, 13 are for indoor air quality and thermal comfort, 3 are for daylighting and 3 are for other items (USGBC, 2008). Currently, there are no prerequisite items in any version of LEED related to daylighting. Restructuring design guidelines may help decision makers understand the significance of daylighting.

More importantly, studies like this one prompt further research and discussion of green design priorities in schools. This is especially important in the United States right now where educational infrastructure has a D+ rating (ASCE, 2013). The American Society of Civil Engineers (ASCE) estimates that $3.6 trillion dollars is needed to overhaul educational infrastructure before 2020 (ASCE, 2013). Figure 14 presents the investment needed state by state in relation to Ohio.

There will be thousands of new schools constructed across the United States over the next decade. How many of these school buildings will be designed to improve student performance? How many will perform as designed? Coherent design priorities will help maximize America's return on future investments in green schools.

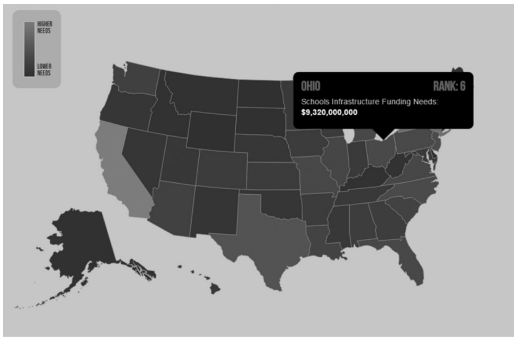


Figure 14. National educational infrastructure need courtesy of the ASCE infrastructure report card (2013).

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A framework for commissioning and energy performance measurement and verification in buildings

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ABSTRACT: Building practitioners work diligently to develop more energy efficient buildings while not compromising human comfort. Building Automation System (BAS) has gained popularity as one of the key information sources for building Commissioning (Cx) and Performance measurement and verification (PM&V), which are typical practices for energy efficiency improvements. However, the BAS installed in buildings itself cannot estimate performance level relative to the design intent. It does not inform the building manager of how much energy could be saved from implementing Energy Efficiency Measures (EEMs) after the Cx processes either. This paper presents a framework of integrating Cx and PM&V with BAS and Energy Management & Control System (EMCS) in existing commercial buildings. This framework has been conceptualized based on the Cx and International Performance Measurement & Verification Protocol (IPMVP) Option-C and D. The framework was tested in a case study using a building located in the Research Triangle Park (RTP), North Carolina. The proposed framework takes advantage of both simulation modeling and regression analysis in its process to provide the information about potential energy savings and energy efficiency improvements in buildings.

1 INTRODUCTION

1.1 *Background*

The topic of high performance buildings has gained popularity along with energy efficiency, green buildings, and sustainable buildings. In this regard, building practitioners are persistently trying to develop more energy efficient buildings while maintaining and/or improving the human comfort to achieve the Architecture 2030, 2025 Commercial Buildings Initiative, and the Net-Zero Commercial Building goals. However, building energy systems often represent more (about 20%) energy consumption than they were expected compared to the building design intent.

According to the Bailey et al. (2011), HVAC systems, mainly air distribution systems, and common control systems are the main sources of flaw in the building. Although identifying the specific sources and root causes of energy waste in particular buildings can be challenging, but it is possible to achieve more than 20% of energy savings by conducting existing building commissioning (Mills, 2010). Therefore, most of the buildings go through the commissioning processes during their life to maintain the high building performance level.

According to ASHRAE guideline for the commissioning process, Cx is a precise documentation process whose purpose is to ensure that building systems are designed, installed, and functionally tested, and that they are able to be maintained and operated for performance that is in line with design intent (ASHRAE 2005). Through a wide range of research in the scope of building commissioning, several different terms have been created to describe the time and process of commissioning such as Re-Cx, retro-Cx, existing building Cx, new building Cx, continuous Cx, ongoing Cx, and persistence Cx. After and during the Cx process, some building owners or managers invest in implementing the suggested EEMs in the building, and they want to know how much they have saved and how long their savings will last. The determination of energy savings requires both accurate measurement and replicable methodology, known as Measurement and Verification (M&V) protocol (IPMVP 2001).

Nowadays, traditional PM&V approaches can also be too complicated or expensive. Building managers desire to reduce time, cost, and complexity of PM&V. Moreover, access to data via smart meters, devices, and analytics tools has been increased and building managers are showing more interests in multi-measure whole-building programs that can generate deeper savings (Granderson et al. 2015).

In general, the Cx and PM&V process requires hiring Cx engineers and takes a long time and hard work to achieve, verify, and document the performance of facilities, systems, and assemblies in buildings.

It is also an expensive process which should be repeated several times during the building life cycle. A critical obstacle in the Cx process is the lack of data or information at sufficient detail due to lack of measurement systems or difficulty in acquiring such data in most of the small and medium size existing commercial buildings. Most of them have not been equipped with required sensors and BAS to isolate abnormal changes in load conditions or irregular operations (Bailey et al. 2011).

Although, a systematic building management system has the potential to save energy by estimated range of 5% to 30% (Pérez-Lombard e al. 2008), but these systems cannot estimate performance reduction relative to the design intent and are not able to inform the building manager of how much energy has been saved by implementing the EEMs in the building after the Cx process (Bailey et al. 2011). Therefore, it is not sufficient to just rely on the BAS in the building.

To avoid the costly Cx process and facilitate the PM&V process after installing the EEMs in the building, a standardized framework, both cost- and time-effective, is required to help building managers identify any change in building performance, recognize type of that fault and make decision how to fix that problem. This framework (Cx and PM&V) integrates the data from existing BASs or installed meters.

This research aims to develop a new Cx and PM&V framework, which can maintain or improve the energy performance level of buildings. This new advanced framework utilizes the building data (BAS database, utility bills, and installed meters data) to detect and recommend ways to fix the problems with minimal human interventions. This framework is intended to significantly improve the efficiency of both Cx and PM&V processes for continuous energy savings through the life of small and medium size existing commercial buildings with minimal costs. The previously mentioned framework uses some key parameters (among thousands of data points in BAS) which affects the building energy performance the most to achieve higher energy savings.

This conceptual framework is intended to serve as a support or guide for the development of Mini-Building Energy Management System (Mini-BEMS) that expands this framework into something useful. Mini-BEMS is the name of the tool that will be developed over the Cx and PM&V framework. The tool is called Mini-BEMS since some key factors have been selected among a pool of parameter and building data to analyze and control the building performance.

The framework integrates the Cx process and IPMVP Option C and D. It uses building simulation and machine learning techniques to calculate and predict the building energy consumption and savings after implementing EEMs. This framework uses the EnergyPlus reference model (calibrated building model) which is built based on the building description, geometry and materials, internal heat gains, schedules, and characteristics of building's HVAC system. This framework enables building energy managers to compare alternative corrective actions using whole building metrics after detecting the faults, and finally to validate enhanced performance when corrective actions and required Energy Efficiency Measures (EEMs) have been implemented.

The anomaly detection, building energy savings, and performance will be visualized in a graphical user interface to facilitate the building management process.

1.2 *Precedence*

There are several researches conducted in the scope of automated and real-time commissioning to develop tools and methodologies to address the complex problem of building energy performance management and to help reduce the energy waste in buildings with various approaches.

A new integrated toolkit which is using building performance objectives has been developed by Costa et al. (2013). This tool allows building manager defines new key factors such as temperature set points or lighting level set points for any different operation strategy and runs the simulation again. The comparison between previous results of the calibrated base case building with the results of the building with different key factors enables the manager to evaluate the thermal comfort and energy consumption of the building. One more tool has been introduced by Bynum et al. (2012), in the study conducted by Energy System Laboratory (ESL) at Texas A&M. The Automated Building Commissioning Analysis Tool (ABCAT) is a prototype fault detection and diagnostic tool which is tailored for Cx services in order to extend the benefits of Cx and to aid in reducing excess energy consumption in buildings. Two of the previous Fault Detection and Diagnosis (FDD) tools are Performance and Continuous Re-Commissioning Analysis Tool (PACRAT) by Facility Dynamic Engineering, and The Whole Building Diagnostician (WBD) which is guided by Pacific Northwest National Laboratory (PNNL).

Similar to previous literatures, Automated Building Commissioning Analysis Tool (ABCAT) also utilizes a calibrated mathematical model to predict energy consumption for given weather conditions. ABCAT is a Microsoft Excel based tool that uses three different sensors to get its required data, whole building electricity, whole building heating, and whole building cooling. The predicted energy consumption is compared to the measured consumption, and faults are detected based on statistically significant deviations between the two data sets (Bynum et al. 2012).

Automated Measurement and Verification (M&V) 2.0 module, recently developed by LBNL is beginning to be introduced to the energy management and information systems. Baselines (building energy consumption profile) are atomically created using historic interval meter data (machine learning techniques) and weather data feeds. User enters the date of EEM implementation and savings will atomically be calculated (Granderson et al. 2015).

Some of these researches only focus on the Cx part, and some of them are concentrated on the measurement and verification part after adding EEMs to the building. Most of the tools mentioned above use a mathematical calibrated model (using machine learning techniques) as a baseline model to predict energy consumption and compare it to the measured consumption to detect the faults based on statistically significant deviations between the two data sets. This approach is similar to IPMVP Option C. According to IPMVP Vol. 1, Option C is using modeling technologies such as regression modeling and inverse modeling for the baseline development. The option-C process requires several steps such as pre-retrofit data process, post-retrofit data analysis, and data quality control procedure. IPMVP Option D is using computer simulation software to predict facility energy use for one or both of the energy use term(s). Simulation model must be "calibrated" so that it predicts an energy use and demands pattern that reasonably matches with the actual utility consumption and demand data from the real building. Option D is not considered a popular technique, since accurate computer modeling and calibration to measured data are the major challenges associated with option-D. To control the costs of this method while maintaining reasonable accuracy, the simulation analysis needs to be conducted by trained personnel who are experienced with the particular software and calibration techniques. Therefore, there is not many Cx and PM&V tools to use the IPMVP Option D approach.

The Cx and PM&V framework in this study (Mini-BEMS) has been conceptualized based on the Cx and IPMVP option C and D. This framework takes advantages of both approaches to facilitate the process of Cx and PM&V.

2 CX AND PM&V FRAMEWORK

2.1 *Framework structure*

Figure 1 illustrates the framework structure and data flow. The Cx and PM&V framework (Mini-BEMS) includes three main subdivisions.

- BEM development and calibration process using EnergyPlus (IPMVP Option D).
- Building energy consumption profile development (IPMVP Option C)
- Energy Savings calculation

These three phases are explained more in detail by using a case study building for better understanding.

The case study building is located at the Research Triangle Park (RTP) area in North Carolina. According to climatic analysis, this area is a humid subtropical climate.

Advanced metering at the facility, including submetering for electrical and water use helps building facility managers identify and fix any power drains and water leaks. This feature of case study building also facilitate the process of this research since the advance metering system installed in the building provide us with enough data to use for the calibration and commissioning purpose.

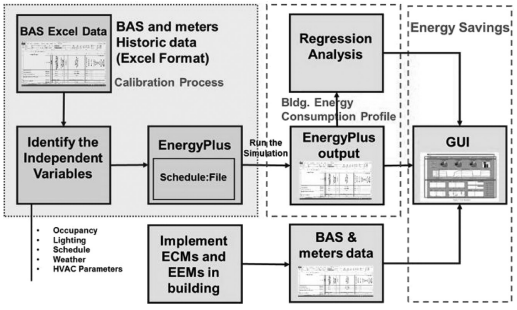


Figure 1. Cx and PM&V Framework (Mini-BEMS) data flow.

3 BEM DEVELOPMENT AND CALIBRATION PROCESS

3.1 *Geometry and HVAC modeling*

The case study building (Fig. 2) is an office building with varying types of office occupancy built in 2014. The building has three occupied floors and a floor space of 4,273 m^2 (46,000 ft^2). The building has rooms of many different purposes being served with two types of HVAC system. The heating and cooling are provided by Air Handling Units through VAV boxes for each zone. Three zones are being served by split systems for heating and cooling. This building also is equipped with an Energy Recovery Unit (ERU). The energy recovery process is the process of exchanging the energy contained in normally exhausted building or space air and using it to treat (precondition) the incoming outdoor ventilation air in residential and commercial HVAC systems.

The case study building has been modeled using SketchUp and OpenStudio plugin based on each floor's HVAC zoning diagram. In the next step, the geometry file has been imported into the EnergyPlus tool to add the internal heat gains (people, light, and equipment), and HVAC systems to the model and develop the base case model based on the ASHRAE Standard 90.1 2004.

The building is assumed to follow typical office occupancy patterns with peak occupancy occurring from 8 AM to 5 PM weekdays with limited occupancy beginning at 7 AM and extending until 6 PM for janitorial functions. For the medium office, Saturday, Sunday and holiday occupancy are modeled at 10–50% of peak. Schedules for lighting and miscellaneous equipment were matched to occupancy schedules with additional limited usage during unoccupied times. HVAC system schedules were matched to the occupancy schedules, and allowed for earlier startup times

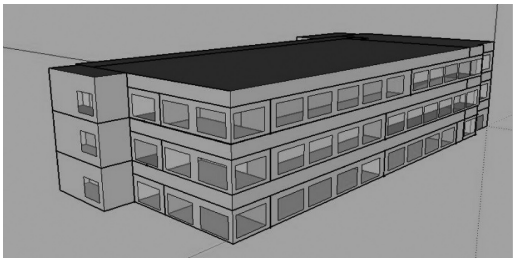


Figure 2. Case study building west Façade.

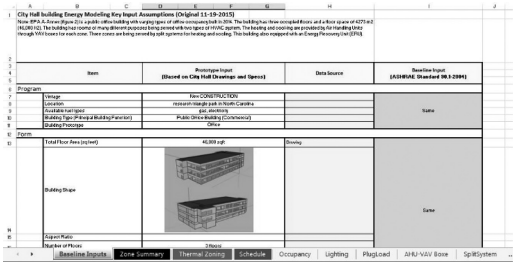


Figure 3. Cx and PM&V framework Excel interface. Geometry and HVAC modeling.

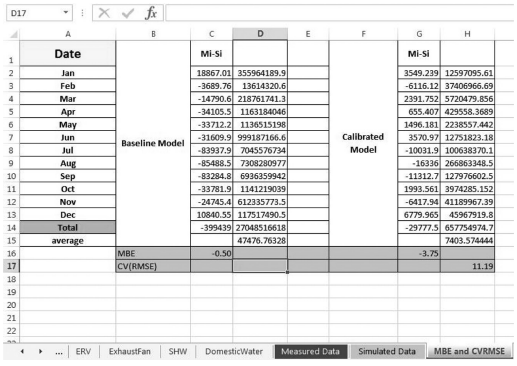
to bring the space to the desired temperature at the beginning of normal occupancy.

The Cx and PM&V framework (Mini-BEMS) is a Microsoft Excel based framework that collects all building information such as baseline inputs, zone summary, thermal zoning, schedule, internal loads, and HVAC systems characteristics in different tabs. Figure 3 shows a screenshot from the first page of the Excel file.

3.2 *Calibration*

Calibration process is divided into two parts. In the first step, the main independent variables have to be identified and modified in the baseline model. For this building, the main independent variables are weather data, envelope characteristics, Lighting/Equipment Power Density (LPD/EPD), lighting/equipment schedule, occupancy schedule and HVAC operation hours.

A manual and iterative calibration approach has been used to calibrate the building model based on the independent variables collected from the case study building. After several iteration between the baseline and calibrated model, the measured data (building energy consumption) obtained from BAS or extra meters are used to calculate the calibration acceptance criterion which are MBE<5% and CVRMSE<15% for monthly data calibration, and MBE<10% and CVRMSE<30% for hourly data calibration, respectively (Lam et al. 2014). This process has been shown in the second sets of tabs in the Cx and PM&V framework Excel file. Figure 4 shows the Excel interface for this phase.



	A	B	C	D	E	F	G	H
1	Date		Mi-Si				Mi-Si	
2	Jan		18867.01	355964189.9			3549.239	12597095.61
3	Feb		-3689.76	13614320.6			-6116.12	37406966.69
4	Mar		-14790.6	218761741.3			2391.752	5720479.856
5	Apr		-34105.5	1163184046			655.407	429558.3689
6	May	Baseline Model	-33712.2	1136515198		Calibrated Model	1496.181	2238557.442
7	Jun		-31609.9	999187166.6			3570.97	12751823.18
8	Jul		-83937.9	7045576734			-10031.9	100638370.1
9	Aug		-85488.5	7308280977			-16336	266863448.5
10	Sep		-83284.8	6936359942			-11312.7	127976602.5
11	Oct		-33781.9	1141219039			1993.561	3974285.152
12	Nov		-24745.4	612335773.5			-6417.94	41189967.39
13	Dec		10840.55	117517490.5			6779.965	45967919.8
14	Total		-399439	27048516618			-29777.5	657754974.7
15	average			47476.76328				7403.574444
16		MBE	-0.50				-3.75	
17		CV(RMSE)						11.19

Figure 4. Cx and PM&V framework Excel interface, calibration process.

4 BUILDING ENERGY CONSUMPTION PROFILE

The evaluation of building energy consumption during a specific time interval usually requires building energy profiles (baseline model) on an hourly basis. Building energy profiles can be developed by using the historical monthly electricity bills in buildings without BAS (similar to most of the automated Cx tools that were mentioned before) or by using the BAS data stored in an Excel file in buildings with advanced BASs. However, a serious challenge is the lack of sufficient data due to lack of measurement systems or difficulty in acquiring such data in small or medium size office buildings. Most of the buildings have not been equipped with required sensors and BAS to observe the hourly key factors to develop the building energy profile (Bailey et al. 2011).

Now this question may come up that why has calibrated building energy model been added to this framework to obtain the building energy profile. The Cx and PM&V framework has to be applicable among general building types rather than buildings with unique function. This feature enhances the applicability and popularity of the framework among building owners/managers in the future. Among different commercial building types, office buildings in different sizes make up the major building stock. According to Commercial Building Energy Consumption Survey (CBECS), the majority of office buildings consist of small and medium size offices (1,000 to 5,000 sq-ft for a small size office, 5,000 to 50,000 sq-ft) that are rarely equipped with BAS. Using this framework in such buildings will be more cost effective and appropriate for the building owner than an expensive complete package of BAS.

Therefore, after calculating the MBE and CVRMSE for monthly data calibration, now it is time to use the calibrated model to develop the building energy consumption profile on an hourly basis. The calibrated EnergyPlus model has this ability to provide the hourly required outputs or key factors that may affect the building energy consumption the most, to generate the

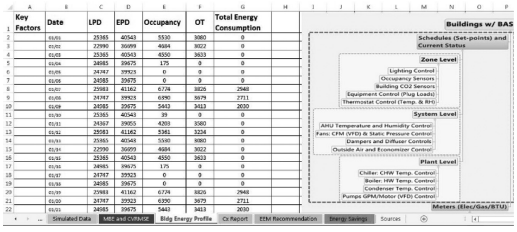


Figure 5. Cx and PM&V framework Excel interface. Key factors and building energy profile.

building energy profile without using and installing extra sensors and meters in the building.

According to Fumo et al. (2010) weather data can play an important role on predicting energy consumption in buildings. Parameters such as solar radiation, air velocity, and dry-bulb temperature are the most important factors on energy consumption since they have the most deviation during the day. However, there are other key factors that may affect the building energy consumption profile. Those key factors can be different for each case study building based on its location, type, and characteristics.

Therefore, the building energy profile in Cx and PM&V framework (Mini-BEMS) is a multivariable regression model based on the outputs from the calibrated EnergyPlus model. In this study, the number of occupants and LPD/EPD are selected as the main key factors. Weather parameters already are considered in the calibrated model for the specific interval (year 2015).

5 ENERGY SAVINGS CALCULATION

5.1 *Cx report*

As mentioned before, the Cx process requires hiring Cx engineers and takes a long time and hard work to achieve, verify, and document the performance of facilities, systems, and assemblies in the building. Existing building Cx is an expensive process which has to be repeated several time during the building life cycle and may or may not bring the building to its original design intent (Hensen & Lamberts 2012). The Cx and PM&V framework aims to turn the traditional Cx process to an ongoing process which optimizes energy use. This framework (Mini-BEMS) will be embedded in the existing Energy Management and Control System (EMCS). In case of small and medium size office buildings which are not equipped with advanced EMCSs or several meters, this framework will be added to the building management interface and serves as an alarm any time consumption deviates beyond the limits.

This framework utilizes the building energy consumption profiles (linear regression or multivariate regression model) for each specified key factor (outdoor air temperature, LPD/EPD) to compare the predicted building energy consumption with the measured building energy consumption (utility bills data) for a specific time interval. If the comparison shows a deviation in building energy consumption which is beyond the limit, it indicates an anomalous event. Based on the owner's determination, several meters can be installed in the building rather than using utility bills to repeat this process for the HVAC components such as AHU, chillers and hot water system.

The building energy consumption deviation from the design intent is evaluated based on the statistical methods which rely on the assumption that the characteristics of the data variations are relatively unchanged unless a fault occurs in the system. This implies that the mean and variance, at a particular operating point are repeatable, even though the individual values may show significant fluctuations. This repeatability allows thresholds for certain measures that indicate anomalous operation to be determined automatically. This is the core of the fundamental standard used in the Cx phase of this framework.

The anomaly score is computed when the system is in operation and building manager requests to observe the building performance for a specific time interval.

In case of having several meters in the building, this process will be completed for each component. Therefore, it is easier to assess each component in order to detect the fault's origin. But if there is just utility bills or whole building electricity meter available, this framework will provide building manager with several common problems/faults in commercial buildings which being summarized of a rigorous literature review and interviews with Cx engineers at NCSU campus. Figure 6 shows the main typical faults in commercial buildings. However, there are two groups, BAS problems and physical problems which are different than other groups. The physical problems are not related to the data points extracted from the BAS. Also, the BAS systems have their own issues such as improper installations and the program itself malfunctioning.

5.2 *EEM recommendation*

This framework integrates Cx and IPMVP Option C and D processes. It uses the calibrated building simulation model to calculate and predict the intended building energy consumption (design intent) and savings. The Cx and PM&V framework enables building energy managers to compare alternative corrective actions after detecting the faults, and finally to validate enhanced performance when corrective actions and required EEMs have been implemented.

In the last phase of this framework, building energy manager is being provided with a list of different EEMs which can be used in the existing office building after the Cx process. The EEMs list which is added to this framework has previously gathered from different sources such as AEDG-2004-2006-2008, ASHRAE 90.1–2010, and High performance building database (HPBD). Building manager selects a proper EEM from

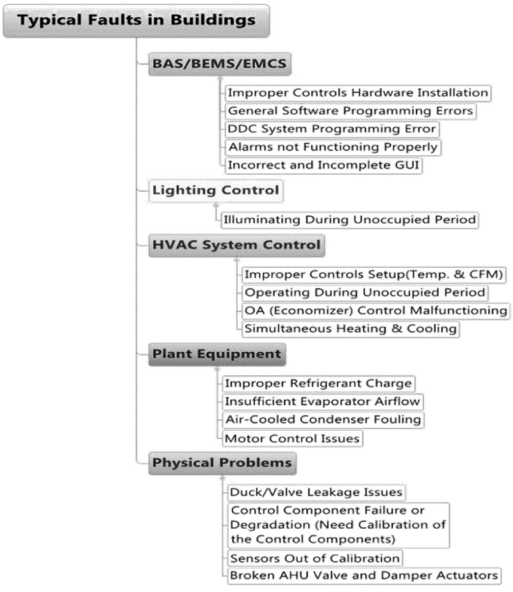


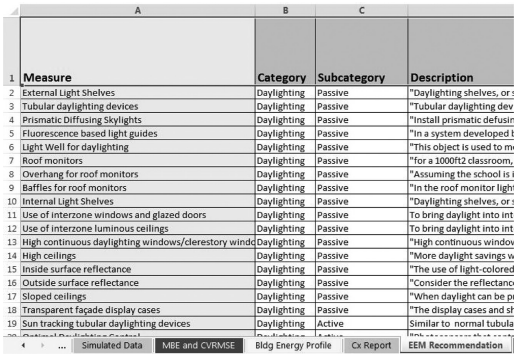
Figure 6. Typical faults in commercial buildings.

the list of EEMs to implement in the existing building according to building size, shape, age and the owner' budget. The future research will focus on the techniques (partly atomization methods by categorizing the EEMs) to facilitate the decision making process for the building manager. Figure 7 shows the Cx and PM&V framework Excel interface for the Cx report and EEMs Recommendation section.

5.3 *Final energy savings results*

According to IPMVP, Option C uses the utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of EEM, but not individually if more than one is applied to an energy meter (IPMVP, 2001). Based on this explanation, the savings are calculated from the subtraction of predicted building energy consumption (using the building energy consumption profile) from measured building energy consumption (using utility bills or meter data) after Cx process and implementing the desired EEMs to the building for a specific time interval (it may be a week or a month).

The Cx and PM&V framework has this ability to develop and use the building energy consumption profile (Baseline) by using IPMVP Option D techniques such as simulation modeling and calibration process, and regression methods. Therefore, it is the building manager's role to collect the measured data for a specific time interval after Cx and implementing EEMs, insert them to the framework' Excel interface and let the framework to calculate the final amount of energy savings.



	A	B	C	
1	Measure	Category	Subcategory	Description
2	External Light Shelves	Daylighting	Passive	"Daylighting shelves, or s
3	Tubular daylighting devices	Daylighting	Passive	"Tubular daylighting dev
4	Prismatic Diffusing Skylights	Daylighting	Passive	"Install prismatic defusin
5	Fluorescence based light guides	Daylighting	Passive	"In a system developed b
6	Light Well for daylighting	Daylighting	Passive	"This object is used to m
7	Roof monitors	Daylighting	Passive	"for a 1000ft2 classroom,
8	Overhang for roof monitors	Daylighting	Passive	"Assuming the school is i
9	Baffles for roof monitors	Daylighting	Passive	"In the roof monitor light
10	Internal Light Shelves	Daylighting	Passive	"Daylighting shelves, or s
11	Use of interzone windows and glazed doors	Daylighting	Passive	To bring daylight into int
12	Use of interzone luminous ceilings	Daylighting	Passive	To bring daylight into int
13	High continuous daylighting windows/clerestory windo	Daylighting	Passive	"High continuous window
14	High ceilings	Daylighting	Passive	"More daylight savings w
15	Inside surface reflectance	Daylighting	Passive	"The use of light-colored
16	Outside surface reflectance	Daylighting	Passive	"Consider the reflectanc
17	Sloped ceilings	Daylighting	Passive	"When daylight can be pr
18	Transparent façade display cases	Daylighting	Passive	"The display cases and sh
19	Sun tracking tubular daylighting devices	Daylighting	Active	Similar to normal tubula

Simulated Data | MBE and CVRMSE | Bldg Energy Profile | Cx Report | EEM Recommendation

Figure 7. Cx and PM&V framework Excel interface. Cx report and EEMs Recommendation.

6 RESULTS AND DISCUSSION

The Cx and PM&V framework can be used for new and existing buildings. In case of using it for a newly constructed building, the result may not show a significant deviation from the design intent. The case study building was built in 2014 and the measured building electricity consumption for 2015 show a relatively good match with the building energy profile. In this situation, this framework is very useful in predicting the heating and cooling performance of the building. Moreover, this framework can be used to test any new control code in the building and its energy impact before implementation.

It is always a challenging task to develop an acceptable and reasonable building energy profile (baseline model) for the energy savings calculation. However, the Cx and PM&V framework facilitates the process by decomposing it to several sections. Adding this framework (Mini-BEMS) to the EMCS will be able to enhance the building management role and bring the ongoing commissioning to the field. This framework can also be improved or manipulated based on the owner's need and applied as an advanced tool by having the capability of assessing the real-time data points from BAS and weather data.

7 CONCLUSION

This paper introduced a new Cx and PM&V framework, which has capabilities to continuously maintain and/or improve the energy performance level of buildings during the entire building life with minimal costs associated with operation and maintenance. A systematic approach for the development of the framework and its application was presented. The ultimate goal of this research was to achieve energy savings in buildings through smart building management system.

The framework consists of key parameters and key data points from BAS and EMCS that mainly affect the building energy performance the most. As a result, it focuses on energy related issues for maximum energy

savings in the buildings. The Mini-BEMS concept was introduced to include the intended functions of Cx and PM&V. The potential benefits of Mini-BEMS were also addressed.

ACKNOWLEDGMENT

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Design and praxis in the post-digital era

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ABSTRACT: Like similar revolutions transpiring in science, engineering, and industry, the future of building design will be driven by the power of structured data and the development of new computational tools, frameworks, and methodologies capable of bringing heterogeneous design data and information together in order to make it more accessible, reliable, and effective in modern practice. And like these associated disciplines, leveraging the full body of data, knowledge, and expertise in our discipline – including that which is already embedded in the built environment – will require new structures to propagate critical cross-disciplinary virtual communities and collaborative networks, new tools to facilitate the use, reuse, and sharing of knowledge, and new platforms to grow and sustain new networks of information. Authors will describe current research efforts to advance building design in the Post-Digital Era, specifically: multi-criteria decision support tools and web-based strategies to streamline the creation and discovery of building information and design data.

1 INTRODUCTION

1.1 *Motivations and background*

The advent of ubiquitous information catalyzed by the development of the World Wide Web (WWW) and by extension the Semantic Web (Hendler & Berners-Lee 2010) has transformed the way humans work, socialize, and interpret the world. As a consequence, humans are becoming increasingly dependent on data in nearly every aspect of life. Practically speaking, this immense influx of data and information, coupled with the rapid rate of change in all disciplines, means that it is getting more and more difficult to synthesize and apply the state-of-the-art knowledge in one's own field, in closely allied fields, and even in one's own sub-disciplines. Indeed, Design Knowledge and Practice are more distributed now than ever, due in large part to vast amounts of heterogeneous data related to the design, construction, and ecological impact of the built environment that span the currently incompatible levels of open access, proprietary, and other types of special interest databases.

Meanwhile, new knowledge in allied fields and disciplines is influencing architecture in major and conceivably unprecedented ways, i.e., in digital technology and material science; in energy production and consumption by buildings; and systems innovation.

Consistent with past revolutions in discovery (Hey Tansley, & Tolle 2009), technology is once again transforming the way disciplines observe and describe the world, generate new knowledge, communicate with one another, and ultimately make impactful decisions. The instruments that are used to support design-learning and advance both the scholarship of design and the physical execution of design have evolved far beyond traditional modes. Society, at large, produces and digests information by vastly different mechanisms than just 50 years ago.

1.2 *What does this mean for architecture?*

Whereas the greatest shifts in general discovery were previously achieved by innovation in empirical and theoretical models and later, by harnessing the power of advanced computational modelling (Hey Tansley, & Tolle 2009), the new paradigm for discovery in this era – that is the post-digital era and the era of "Big Data" – will be marked by newfound abilities to access and consider large amounts of disassociated data in order to make discoveries that would not be possible in a single view of the data or from a single data set. The future of discovery in our discipline, as in others, is in the development of new tools, frameworks, and methodologies capable of bringing design data and information currently compartmentalized across areas of expertise, databases, and sources back together, in order to make the data and information more accessible, reliable, and useful in building design, construction, and operation.

Gaining access to building design data and related information presents new challenges as well as a myriad of timely opportunities that will influence the future conception and execution of the built environment, particularly as concern over the impact of the

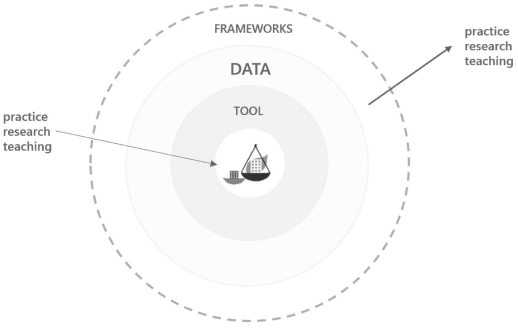


Figure 1. Integrating data into the design process.

built environment on the natural environment continues to grow. When up to 90% of a building's lifetime energy use potential can be determined in the earliest stages of the design process (Keolien, Menery & Curran 1993), expanded access to reliable and useful data is essential.

The first step is to add structure to the data with formal, machine readable, conceptual models (Janowicz, Harmelen, Hendler, & Hitzler 2014), capable of facilitating more complex decision-support (Ishizaka & Nemery 2013) for architects. In order to guide the design of impact-aware buildings, methods and tools must, at minimum, be capable of assessing up-front energy costs alongside operating energy costs, repair and replacement life-cycle costs, and potential repair or replacement costs related to hazard mitigation or loss. However, current tools are not yet capable of generating this full picture – or rather, the data that is needed to achieve this type of robust, holistic analysis is not in a format that is well structured, reliable, or readily accessible.

These circumstances are changing, in light of the sheer quantity of building-related information that exists in digitally fabricated design documents, material and manufacturer databases, and even the "experiential data" in the minds of the design professionals. These developments mean that distinctly new tools and methods are needed to facilitate the use, reuse, and sharing of design data and knowledge (Gruber 1995) over distributed localities and processing components. However, in order for data to effectively influence – or inform – the design process, mechanisms that are capable of harnessing data effectively must be developed and then overlaid by frameworks capable of integrating data into the design process (Fig. 1).

2 METHODOLOGY

2.1 *Background*

Recognizing the need for enhanced tools and methods capable of weighing the broader ecological impacts of building design decisions from the outset of design is essential if the goal is to achieve the greatest possible influence over design outcome. Enhanced decision-support by these computational tools will be enabled by harnessing building design data and information in new and powerful ways. The GreenScale Research Project (The Green Scale 2014), an interdisciplinary team with expertise in architecture, computer science, and knowledge engineering, has been working along three related workflows: the development of a new multi-criteria design tool called the GreenScale Tool, theory plus use-case based approaches for Linked Open Data (LOD) methodologies that are beneficial for generating the data structures and translations required, and the creation of modern computational architecture infrastructures capable of intelligent processing in our world of distributed data processing for Decision Support System consumption.

Simultaneously, our work considers other non-trivial challenges surrounding ubiquitous data in the age of data-driven design. For example, we strive to answer questions including:

- Beyond harnessing the data itself in a structured manner, what are the threats to authorship and intellectual property?
- What are the barriers to reliable, validated data, both computational and psychological?
- What are the opportunities within these same challenges?
- How might the built world adapt to reflect our data-driven society?
- And how might unprecedented – or unfettered – access to building information and design data change the process of design, the practice of architecture, & pedagogy?

Our research commenced with a study and rigorous testing of existing analysis methods and tools in 2009. This study revealed the short-comings of many current design analysis and support tools in the face of a Big Data driven world, and meanwhile inspired the development of a novel tool and analytical data models that we discovered to be essential for advancing the testing and validation of existing tools (discussed in detail in the following section). Development of the novel tool also enabled the research of methods for expanded data discovery by tools and the development of novel strategies for achieving enhanced decision-support beyond what is currently possible with the tools tested and most-widely used in AEC (Ferguson, Buccellato, Vardeman II 2015). The tool we created, the GreenScale Tool (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016), underwent thorough testing and validation, which led to the realization and subsequent hypothesis: prevailing tools and methods are only one part of a much larger set of challenges for our built environment. We believe that data is, in fact, the more critical – and non-trivial – barrier to achieving higher resolution and reliability in building performance and impact analysis simulations.

In response, in 2013, the research team launched the Sustainability Data Initiative which brought together experts across the academic, industrial, governmental,

and technology research domains to discuss the challenge of data and information related to the construction of buildings and cities, and to find opportunities to leverage existing knowledge, tools, technologies, and data to overcome the status quo. These conversations led to a series of workshop events (Geospatial Semantics Workshop and GeoVoCampDC, 2013 and GeoVoCamp, 2014) sponsored by the Spatial Ontology Community of Practice – or SOCoP (SOCoP 2013) – a community of spatial knowledge experts who develop spatial ontologies (Ontology Design Patterns.org 2010) or data pattern languages for use on the semantic web (Berners-Lee, Hendler, & Lassila 2001). The initial workshop (GeoVoCamp, 2013) was held at the National Science Foundation and lead to sustained collaborations with experts in semantic web frameworks and decision theory focused on finding practical ways to structure building design information and data and advance frameworks capable of bringing the data back to the user in new and more meaningful ways.

2.2 *A study of tools and methods*

Prevailing computational tools available to and used by architecture and engineering professionals purport to gather and present thorough and accurate perspectives of the environmental impacts associated with their contributions to the built environment. Research of building modeling and analysis software used by the Architecture, Engineering, Construction, and Operations (AECO) industry reveals that many of the most heavily relied-upon industry tools are isolated in functionality, utilize incomplete models and data, and are, in fact, disruptive to normative design and building optimization workflows (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016).

At the outset of this research and as mentioned above, a study of current architectural design tools revealed large gaps in the capabilities to advance the design and execution of both data-aware and impact-intelligent buildings. A review of primary functions and limitations of prevailing tools (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016) led to a series of case studies to further evaluate the current state-of-the-art in tools and building energy analysis, followed by the development of more advanced models (Ferguson, Vardeman II, Buccellato 2015) to assess, among various factors, lifetime building energy consumption alongside operating energy use. The novel GreenScale Tool was developed in response to the functional comparison of tools and the need for this specific functionality. The fundamental goals of this particular effort, as well as some of the goals of our research, in general, are to a) better understand the efficacy of tools used by architects and engineers to influence the design process and b) to increase the use and efficacy of building impact studies conducted during the building design process.

An analysis of the current state of AECO modeling and analysis platforms (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016) revealed a number of tools that endeavor to process one type of energy analysis or another, whereas they either have limited – or no – capacity to evaluate material variations against overall building energy impact, including pre-construction material energy costs. Additionally, many of the tools are not able to operate beyond a narrow set of functions within each application, and are almost always limited to single-metric calculations, meaning that no comparative analysis can be completed without extensive manual intervention. For example, there are individual tools that are able to produce an embodied energy simulation that categorizes total energy summations into specific categories, such as transportation impacts, construction processes, and manufacturing impacts; however, if only one type of analysis is possible, separate analysis is required to anticipate lifetime building energy impact, including operating energy.

Other, distinct tools used frequently in industry can consider isolated metrics like daylighting potential, carbon emission totals, water usage, and ventilation capabilities, conduct performed carbon emission analysis and thermal calculations that include daylight and shadow. However, many of these tools function in a non-iterative manner, making it difficult to meaningfully analyze – or respond to – how changes made during the design process might ultimately influence a building's overall performance. There are also tools, such as SuAT ®, that will separate analyses into distinct categories, such as thermal flux, zoning, and climatology, and while these calculations are important, all are based on thermal calculations, which is what we refer to as single-metric. The multi-metric comparative analysis that we are referring to exists where broader and more disparate types of simulation comparisons can be made and enhanced by decision support. For example, the multi-metric analysis required by the modern industry would be able to take these thermal results and dynamically compare them to embodied energy data types, material shipping information, market costs for parts, and other data sets that are currently not compatible – but need to be.

In addition to these function-based comparisons, several experiments were conducted to gain an understanding of prevailing industry tools' relative strengths and weaknesses, focused in two key areas: capacity for estimating key metrics of building energy use in operation and initial (embodied) energy consumption. To accomplish this, simulations were conducted with a consistent set of architectural models using a select set of prevailing, commercially-available analysis tools (Fig. 2) and a control model, the GreenScale Tool (GST) (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016).

The results of the experiments revealed large differences in calculated results for the same architectural building models. This was due, in part, to differing levels of precision and accuracy in the settings and calculation methods between the tools. Further investigation, including verification by manual calculation methods, revealed that the majority of the numerical

Existing Sustainability Tool Comparisons								
	GreenScale Tool ®	Tally ®	SUaT ®	Ecotect ®	Athena ®	GB Studio ®	DOE/BEES ®	GaBi ®
Automated and Iterative Model/Tool Interaction	x							
Zoning	x		x					
Thermal Heatflux	x		x	x			x	
Embodied Energy	x	x			x			
Embodied Water	x					x		
LCA	x	x			x			x
Global Warming Potential		x				x		x
Environmental Potentials		x				x		
Carbon Emmissions				x		x		x
Other Energy Analysis						x		
System Types			x					
Daylighting						x		
Heating/Ventilation			x					
Shadow Calculations	x		x	x		x		
Statistical Data Analysis			x					
Climatology	x						x	
Energy Star and LEED Support						x		

Figure 2. Standard AEC Tools and respective functions.

Preliminary Industry Tool Comparisons			
	Embodied Energy	Operating Energy/Year	Total (100 Years)
Revit Energy Analysis	N/A	1.478e9 BTU	N/A
OpenStudio/EnergyPlus	N/A	2.743e9 BTU	N/A
Athena Impact Estimator	2.501e9 BTU	N/A	N/A
GreenScale Tool	2.369e9 BTU	6.044e7 BTU	8.413e9 BTU

Figure 3. Industry standard tool experiment results.

differences (Fig. 3) resulted from discrepancies originating in the raw data values and the associated material properties that the commercial tools were using to tabulate the results. For example, prevailing analysis tools may use significantly different density values for the same material, yielding significantly different results when aggregated over an entire building. Furthermore, observations of the outputs of these tools (i.e. aggregated energy use totals, for example) demonstrate that building simulation programs used by architects today lack uniform data and processes to facilitate the consistent and reliable evaluation of both customary and novel building practices, meaning that there is a high degree of uncertainty behind the critical decisions that architects are making using these tools. At minimum, this suggests that the decision-support tools that are currently available in the marketplace may vary widely in accuracy.

Specifically, there are differences in numerical values due to rounding and approximation techniques as well as issues with the semantics of the naming system for materials, among other properties, leading to comparisons being a best guess in a lot of cases. For example, certain databases will record material data (assume for pine), but the values can also differ for the exact same pine because of unit translation precision or because they are referring to two different types of the same pine but from different geographical regions that yield slightly different wood due to different soil, rainfall, or mineral availability. As expected, the potential propagation of these differing values can make building simulations vary drastically to say the least.

The study of the existing tools, the results of the experiments conducted with them, and industry case studies allied with these concerns (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016) reveal the following:

- Single-metric analysis tools are not capable of evaluating the full energy impact of a building over its lifespan; a single view of data, or a series of independent views, is less efficient – and potentially less effective – than multi-metric analysis tied to consistent, uniform data sources.
- Whether single or parametric utilities, data and processes that are utilized by prevailing analysis tools are currently non-standard and embody too much uncertainty (in the data sourcing and thus in the outputs). Uncertainty is also not adequately considered in the decision-making process.
- Regardless of the capability of a tool (GST or otherwise), data reliability and consistency is critical to achieve a complete picture of environmental impacts, and ultimately, data is the central factor for advancing the use of simulation in architecture.

3 DATA

3.1 *Confronting the data challenge in architecture*

Gaps in data – whether in provenance, reliability, accuracy, etc. – increase uncertainty in the results handed to the user by the tool and meanwhile contribute to widening gap between intended, simulated, and achieved building performance. In the data-rich disciplines, like the life sciences, or even in more closely-allied disciplines, like engineering, gaps in data are mitigated as these disciplines turn to current computational and Big Data analytics technologies to enable broader access to and reliability of their data. When compared to other disciplines, like automotive and aerospace design, or even closely allied industries, like civil engineering, architecture is currently underutilizing these potentially very powerful technologies; our data remains largely siloed, fragmented across areas of expertise, allied in sub-disciplines, or tied up in proprietary databases.

Our discipline's relatively restricted use of advanced computational models in conjunction with limitations of the data it is currently using, means that decisions are being made by humans considering a smaller, and often skewed, scope of parameters and criteria than could be possible by utilizing Big Data practices and

modern computing power applied to that data. If such methodologies could be harnessed by the building professions – by the architects and engineers who will determine the future of the built environment – we could achieve a much greater understanding and practical ability to affect the way that the built environment is conceived, how resources are consumed or conserved, and the effect of design choices today on the future.

3.2 *Here's how: LOD principles for architecture*

The WWW with which we are all familiar – and dependent upon – has evolved from a network of documents into a Semantic Web of intelligent data that enables access to a volume of information previously unimaginable. However, in order for humans to make sense and proper use of the vast amount of data available on the web, strategies that have been developed to support data interoperability and contextualization need to be fully implemented. Machine-readable data formats based on the web standard Resource Description Framework (RDF) (Resource Description Framework 2014) computationally appropriate data structures (Ontology Design Patterns 2010) can all be enlisted for use in modern Decision Support Systems. However, for this to be successful, we must be able to correctly describe, classify, and relate cross-domain data. The aforementioned formalizations of data enable computations to "understand" human conceptualizations and link – or connect – the data that matters to that conceptualization or specific human effort (like design).

Because ontologies have the capability to capture complex logical relationships, frameworks for promoting data sharing, discovery, and interoperability via the semantic web are being widely adopted, from the scientific research community (Kandil, Hastak, Bridges 2014) to the US government (DATA.GOV 2016) to the private sector (Samwald, Coulet, Huerga & others 2012).

There is significant ongoing research aimed at developing tools and techniques to lower the barrier to adopting semantic technologies, including several on-going efforts in architecture and allied professions to create extensive controlled vocabularies, like the Industry Foundation Classes (IFC) (Building Smart 2014), a commonly-used data model designed to facilitate interoperability within the AEC communities.

In fact, the origin of pattern languages is not remote from architecture. It was Christopher Alexander who first introduced the concept of pattern languages to describe problems and specify potential solutions in his A Pattern Language (Alexander, Ishikawa, & Silverstein), which describes design patterns for architectural design, building, and planning. The goal of Alexander's patterns for architecture is to enable people to describe their own conceptualization of design at different scales: for houses, streets, and cities. Inspired by this work, the software engineering community began to adopt software design patterns that

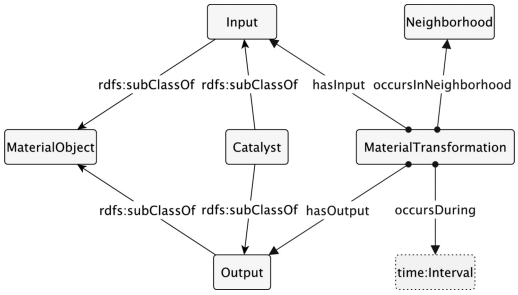


Figure 4. Material transformation pattern data model.

created reusable, successful solutions to commonly-occurring programming problems. (Gamma, Helm, Johnson, Vlissides 1995). Ontology Design Patterns (ODPs) share a similar goal: to enable communities to describe their domain and domain-specific data using (their) natural vocabularies and meanwhile provide additional guidance to the data and formalization of the process.

To this end, our research group recognizes the data challenge in architecture and also the capability of ontology design patterns to tie together these data schema with varying degrees of formal specification in conjunction with existing controlled vocabularies used by the AECO community. Our research team, in collaboration with experts in ontology, developed a formal Material Transformation Pattern (MTP) (Vardeman, Krisnadhi, Cheatham & others 2014) to contextualize necessary data and provide automated reasoning support for Life Cycle Inventory analysis related to construction materials (Janowicz, Krisnadhi, HU & others 2015).

Briefly, the MTP (Fig. 4) "tells" a computer there exists a class of things in the world called a MaterialTransformation that has inputs (hasInput) and has outputs (hasOutput) that these both refer to MaterialObjects. It also tells the computer that a MaterialTransformation has some spatial extent, a Neighborhood, in which the transformation must occur and some specific time interval associated with the transformation. Lastly, we specify a class of MaterialObjects that are necessary for the transformation (manufacturing equipment, tools, etc) and that are necessary for the process to proceed, but are not part of the transformation. These we call Catalyst. Behind these logic classes are a set of machine readable axioms in formal logic, the most interesting of which expresses that a MaterialTransformation has at least one input that is not part of the output and at least one output that is not part of the input, which is the crux of the notion of transformation.

The MTP is designed to work in conjunction with other ontology design patterns, such as the semantic trajectory pattern (Hu, Janowicz, Carral & others 2013) that defines "a path through space on which a moving object travels over time". An example of the most basic use case would be to GPS tag an object as

it traverses some path through space and time resulting in a GPS data output that is a Semantic Trajectory. Such a pattern might also be applied to material supply chains to describe the path that objects take during their life cycle. MTP lets us then describe the situation in the data where one object may stop, be transformed, and continue its journey with a new identity. When a computer detects this situation in the data, it may "infer" that a transformation has occurred.

Other patterns such as "a Minimal Ontology Pattern for Life Cycle Assessment Data" provide a conceptual model for Life Cycle Assessment and Life Cycle Inventory at a higher domain specific level. This pattern can be formally "aligned" against lower level patterns, such as the trajectory and transformation patterns, to give domain practitioners a natural conceptual "view" to consume the data and ask questions of the data.

Assuming that material and material supply chain data were published as Linked Open Data using these design patterns, it is conceivable that machines could automatically discover relationships in data atoms using probabilistic machine learning algorithms, such as the multiway neural network approach that Google (Dong, Gabrilovich, Heitz & others 2014) has developed as part of its Knowledge Vault effort. Methods such as these add new information to a knowledge graph along with the probability that the relationship represented in the graph is a true relationship. This form of algorithm may hold advantages over traditional reasoning algorithms which are strictly coupled to the definitions expressed in mathematical logic.

4 FRAMEWORKS: ALIGNING DATA & TOOLS

4.1 *Rules engine layer*

As indicated by our initial study, many simulation tools in use today perform data analysis on a single design metric, but in the era of Big Data, tools will need the capacity to run efficiently through several metrics simultaneously and over a large quantity of design choices. To reach an optimal level of usefulness and efficacy, modern multi-criteria decision tools must be capable of performing routine calculations efficiently, considering a much broader range of data and information, including, as we propose, data harvested from heterogeneous sources linked to all aspects architectural material manufacturing, construction, and usage.

In response, Green Scale Research aims to discover more efficient methods to both aggregate and process data. This work is further motivated by our understanding that within certain existing simulation tool databases, there is syntactical and semantic ambiguity that is not adequately addressed by the application of regular expressions or even in generating the correct nominal values for material data. By extension, adjustments in energy calculations are often overlooked due to these misinterpretations because of the structural nature of Open Green Building XML-based (gbXML) (Green Building XML 2016) schemas, which are commonly implemented in architectural design tools. Additionally, the capacity of current tools to interpret XML tag-structured data is limited. However, by using the PyKE (Python Knowledge Engine 2016) rules engine, rules can be adaptively constructed to fix these discrepancies and can be extrapolated for use across other rules engines and applications.

PyKE is a knowledge-based inference engine inspired by Prolog11 (Logic Programming 2016) but implemented completely in a programming language, called Python. It is a type of logic programming allowing customized, domain-specific system rules. Incorporating rule sets with existing simulation processes means that there is an extra set of knowledge: in addition to a set of instructions, the model now has an additional set of information describing what those pieces of information mean as well as how to proceed in special cases. It also means that originally missing schema data, imperfections in schema layout, and capturing human-implicit "rules of thumb" can all be resolved computationally instead of manually.

In our own Tool study, we specifically focus on the incorporation of construction material data into a multi-metric application and develop ways to access additional data without harming the performance of a multi-metric application. Next, studies were completed to explore how these methods could communicate beneficially with the larger Semantic Web. One of the avenues of research included developing a PyKE Rules Engine (Ferguson, Vardeman, Buccellato 2015). A rules engine is a part of a computing infrastructure that captures categories of scenarios and the associated set of actions or computations that need to happen when a certain schema instance is encountered.

For example, a rule might be to use the T-by-2T "rule of thumb" for describing spread footings. This piece of knowledge about a building structure is translated into computer code and stored electronically in what is called a Knowledge Base, so that the machine knows how to process something of this category each time certain types of building footings are encountered in computational representations. Layers of computations, such as these, lead to more accurate results than would be generated without knowing the rule(s). The ultimate goal is to seek machine-assisted solutions that will positively impact the way that the built environment is conceived and executed.

For this portion of the study, we implemented the previously developed GS Tool (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016) with sets of rules as they were needed to fill in information that is not explicit in the schema file that is handed to the tool itself. To explore experimental methods of rules communication used for handling the types and quantities of data that we anticipate means that we will need to collectively work toward bridging the gap between our tools, the larger semantic web, and decision support, all

using linked open data principles (Janowicz, Hitzler, Adams & others 2012). The Green Scale (GS) Tool (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016) itself was built to seamlessly integrate with the normative workflow of the architect and to provide a broader perspective of the potential ecological impacts of design decision-making through a multi-criteria, comparative analysis including BEAM thermal heat flux model and Embodied Energy life cycle inventory model (Ferguson, Buccellato, Paolucci, Yu, & Vardeman II 2016).

4.2 *What does the horizon look like*

This above instance of a PyKE implementation builds on the GS Tool by adding a flexible framework for mapping regular expressions to normative conditions and by linking regular expressions to an associated action for several types of architectural design decisions (material choice, geometry discrepancies, and architectural best-practice rules).

However effective, this is only one set of solutions to a much larger problem. These rule sets and tools need to become more accessible and eventually need to be part of a larger cyberinfrastructure that can handle distributed processing. Currently the efforts of the research still function within a closed computational environment often a single machine. Some organizations are beginning to move data stores to cloud-based locations and are providing their tools as a service via the internet. Similarly, the computational components we are researching and developing need to have access to many other elements, such as reasoners, triple stores, and other computational models (The Digital Manufacturing and Design Innovation Institute 2016). Upon further development of a Linked Data Platform (W3C: Linked Data Platform 2015) used for distributed computing, the rules layers we develop, the tools we create, and the resulting knowledge bases generated can all be moved to the Cloud and subsequently enhanced and improved upon by Machine Learning [10]. Additionally, light weight (W3C: SPIN 2015) rules can be integrated with query mechanisms like the web standard (W3C: SPARQL 2015) for generating inference based connections with relevant methods in the expanding knowledge base. Additionally, SPIN could provide mechanisms for data consistency and integrity checks within the knowledge base.

Using a framework such as this, varying architectural perspectives and experience can be leveraged to generate a broader set of accessible and reliable data. Using specific types of interfacing and web services such as REST APIs (Fielding 2000), the accessibility of our data can be expanded and the framework can be made effective for cloud-computing environments. This means that advanced implementations of our research could enable wireless and web-based applications to communicate with other applications and more usefully connect a series of elements, tools, sensors, etc., within the same system or for the same simulation purposes.

5 CONCLUSION

By virtue of the mechanisms that we use to observe and describe the world, generate new knowledge, and communicate with one another, we arguably "know" more than has ever been known to civilization, but consequently – due to this proliferation of information – there is that much more to know. Yet, in many disciplines, like architecture, this abundance of information has made the design and execution of the built world more complicated – not less – and the utilization of design related data and information more challenging, due to the sheer quantity of data, the myriad places where the data "lives", and the limitations of the tools that we depend on to use the data effectively. And this is just the data that already exists. What about the future, and the data that is generated daily, in BIM, in simulations, and by our buildings?

Given the predominant use of digital design and analysis tools in building design today, a building's lifespan now begins in computer simulation. Therefore, the consequences of consistency and reliability – of both the tools and the data – impact the environment from the commencement of the design process throughout each iterative step thereafter, including the selection of materials, the methods of their assembly, and the myriad long-term implications of a building's design on the environment. And yet, without a more efficient way to discover data, we will never become more effective in harnessing it, understanding it, or, perhaps most importantly, in applying the data.

While concerns about the proprietary nature of building design – and by extension, the data "created" in the process of design – will persist, by recognizing the opportunity of utilizing existing Big Data practices along with modern computing power applied to that data, it would be possible, in this post-digital era, to advance beyond the status quo, in tools and in data, to achieve greater understanding about the impact of our design decisions and enhanced practical ability to affect the way that the built environment is conceived and how resources are consumed or conserved.

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Refund Brunelleschi: The redefined role of representation for an integrated building process

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ABSTRACT: A design architect working today may have access to a range of software applications designed for a number of different sectors: this may bring them into contact with the disciplines to which the programmes belong; what at first glance appears to be a technological opportunity fast becomes a professional challenge. But to what degree is it possible to expect architects to step outside their comfort zone and address questions that come from other disciplines? To answer the question, we look at the broader construction process, in particular the separation between the conception stage and design development. At the regard, it is very close to Brunelleschi's design process and the manner of his research, connected with the act of making in concert with others. The thinking will be developed by addressing to topic issues such as the role of the use of digital technologies, arguing about theoretical knowledge and some examples of teaching experiences.

1 INTRODUCTION

"What is really disturbing is not that world could turn into a complete kingdom of technology. Much more disturbing is that men are not prepared at all for such a radical change. Much more disturbing is that we are not capable yet – through mediative thinking- to an adequate deal with what we are really facing in our time"
(Heidegger, 1959)

A design architect working today may have at his disposal a wide range of different software each one designed for a specific sector and this may, as a consequence, may bring into contact with the disciplines to which the software are addressed – e.g. structural analysis, environmental analysis, cost estimating, services installations, structural engineering etc. Young designers in particular may use a whole host of software tools which eases to achieve photorealistic representations with a degree of precision taken from the world of cinema and together encourage the construction of digital models for technical simulation needed to construct a building. So what at first glance appears to be a technological opportunity fast becomes a professional challenge. Architecture, though, if it is to survive, must react to the constraints imposed on it, since the penalty for not doing so is flimsy, insubstantial design and the banal symmetry of pure construction.

But to what degree is it fair or even possible to expect architects to step outside their comfort zone and address questions that, while influencing and interacting with design, come from other disciplines? The recent scenario has shown the development of systems to produce design strictly related to the possibilities offered by digital instruments. They do support the formal expression developing new design paradigms but the proposed organic forms are far from a traditional conception of space.

The major potential of digital instruments lies where technology becomes "transparent" to its own aims. A goal that is sometimes blurred by other kinds of digital simulation, that have very little relationship with the real aim of every project, that is its final construction. Guadet stated: "*Architecture conceives, then studies, then builds. But construction is the final aim of conception and study: we conceive, we study, only to be allowed to build. Construction must be the constant thinking of the architect. It gives him his arsenal of resources and bounds his field of action. Every attempt for architecture that's not built makes no sense; and every form in architecture that breaks or fakes the rules of construction is vicious*" (Guadet, 1984).

2 THE COMPARISON WITH THE MASTER OF THE PAST

In order to better understand the issue, a broader look at the construction process and the actors involved is due, focusing in particular on the separation between the design conception phase and the design development stage, on the relationship between small architectural firms and large multidisciplinary engineering companies, on the role that consultants and specialists employed in the building process have and on their relationship with the figure of the designer which seems to be gradually relegated to a concept designer role.

Referring to the Masters of the past it is interesting to compare the added value provided by new



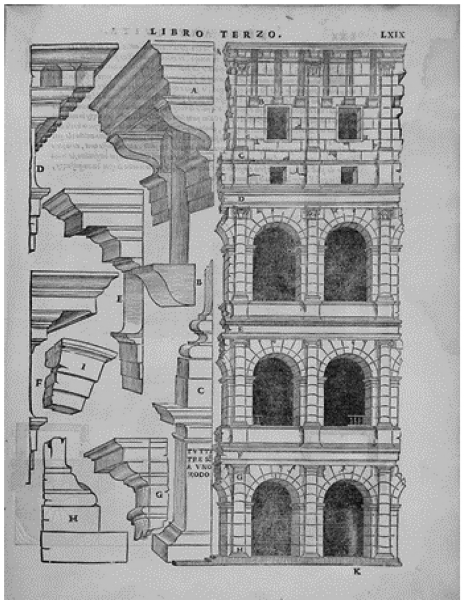


Figure 1. Sebastiano Serlio Bolognese: the cover of the Third Book, which is part of his treatise in Seven Books, seems to be the manifesto of the method used to represent and describe the antiquities of Rome. The method of decomposing and recomposing is completed by particular three-dimensional details related with the assembly drawings. Cover and Table LXIX, on Colosseo orders, drawn by the Venetian edition of 1544.

digital tools (that consent a multidisciplinary design knowledge) and the design process conceived by Filippo Brunelleschi, born of a mind firmly engaged in the totality of building, and Leon Battista Alberti's delight in a more two-dimensional and façade-based architecture deeply rooted in conceptual thinking and writing about beauty, proportion and composition. Brunelleschi's design process and the manner of his research were fundamentally and inextricably connected with the act of making in concert with others. He had technical discourse with tradesmen, held their contracts, sketched with stone masons, had complementary collaborators in Arnolfo di Cambio and Antonio Manetti, and understood that it was not enough to dream something up: the dream itself had to include the methods for its own realization; in his opinion, design and making were indistinguishable. In the same years, Alberti fathered a new lineage of architect –heroic, elevated from the primacy of making, focused on conceptual thinking and concerned with architecture as a system unto itself and with the refinement of its own terms as the central purpose and pursuit of the individual genius of the architectural mind.

It is interesting to compare what nowadays graphical representation is and how it was in the past. It's evident its role of interpreter, and often of protagonist, in activities of analysis, investigation and design of architectural and landscape heritage. It is considered a language aimed to describe, expose thesis, and demonstrate hypotheses.

As known, the three-dimensional space described in the Italian architectural treaties of the fifteenth and sixteenth century[1] is firstly revealed through analytical descriptions, but soon enriched with graphical interpretations that become more and more used by the authors of the texts (not always the same authors of the illustrations) with expressive qualities and very different outcomes depending on the author and the production techniques.

In the various Renaissance treaties, drawings and graphical representations, either more or less sophisticated in the treatment of surfaces and volumes (plans, elevations, sections, perspectives, pseudo axonometries) are the visual means through which static, functional and aesthetic needs are illustrated, issues that are then widely explained in the texts.

3 BRUNELLESCHI'S UPDATED APPROACH

Comparing the past graphical representation processes with the current digital modeling procedures, used today within the design phase, it's evident that behind

[1] Leon Battista Alberti printed his *De re aedificatoria* in 1452 (in 1550, the vernacular version of Cosimo Bartoli), Filarete was the first to draw up a vernacular architectural Treatise, between 1461 and 1464; Francesco di Giorgio Martini in 1480 wrote the *Trattato di architettura civile e militare* Sebastiano Serlio published since 1537 the *I Sette libri dell'architettura*. In 1562 Giacomo Barozzi da Vignola published the *Regola delli cinque ordini dell'architettura*, in 1570 were printed *I quattro libri di architettura* by Andrea Palladio. The lack of illustrations in the original version of the *De re aedificatoria* in ten books of Leon Battista Alberti, written between 1443 and 1452 and printed in 1485, joins this treatise to the *De Architectura* of Vitruvius, but there are more or less over fourteen centuries between these two authors. The Alberti's vision, entrusted to only textual description, will soon be overcome, thanks also to developments in printing techniques.

similar images there is a complete different graphical approach. In the past the three-dimensional representation were considered as the complementarily part of several representations; in recent digital environment, the 3D model is the source from which new drawings are generated.

In the past, as well as today, the architect has been considered an all-round professional, with good design, craft and management skills all together. Thus within the construction process the architect is the person that leads the design, deals with the digital models, manages the administrative issues and follows the construction phase. Nowadays, within this scenario, software applications have not a "linking role" though: each actor have specific software to address its specific purpose and most of the software have their own proprietary formats tending not to facilitate dialogue with other software.

Thus now new professionals, experts in producing rigorous rule-based digital models, are becoming crucial within design and engineering firms in order to introduce process innovations supported by complex software. Such innovations are for the most part deployed on projects with complex forms or architectural configurations and that require dedicated systems of representation and analysis or, at the very least, customizations based on existing standard platforms.

The innovations in question are for the most part deployed on projects involving complex forms or configurations that require dedicated systems of representation and analysis or, at the very least, customizations based on existing standard platforms. In these cases, dialogue between disciplines is a requisite if standard solutions are not being used. A common terrain is required in which interrelation and conflict can take place between the ideal solutions and configurations of each of the various disciplines involved in the construction process. Exchange and conflict always occur and generally lead to unwelcome cost increases or the scaling down and simplification of solutions, but in the case of complex forms they are often absolutely indispensable.

This is what led to the emergence of new professional forms such as the first computational geometry groups created to handle and optimize geometry using high-precision digital modelling, which include the Specialist Modelling Group at Foster & Partners and the Advanced Geometry Unit created at Arup by Cecil Balmond, an engineer famous for his collaborations with architects (including Rem Koolhaas and Toyo Ito to name but a few) in which the engineering aspect is always closely connected to the architectural conception.

In Italy, where authoritative endorsements of the adoption of the new technologies are few and far between, their impact has simply been postponed for a few years. We must therefore wait for a process of emulation to emerge and generate a rapid growth in parametric design products and the requisite shared parametric design culture, which in turn will facilitate the adoption of new forms of work management, employing the sort of collaborative working environments still rarely seen in this country.

At present, in Italy, the acquisition of know-how is still strongly disregarded and having a software it doesn't mean to be able to use it effectively. Time, resources and energy: all need to be invested in training.

In this current period of transition are precious and crucial professional figures that in addition to their specific professional skills are also capable of acting as a point of reference for the adoption of new teamwork organization procedures and strategies.

There is, therefore, an increasingly high demand for new professional figures capable of providing support for short periods of time at design and architectural firms, and delivering advanced level training through the development of one or more pilot projects. This approach enable to transfer the needed know-how through training activities designed to teach how to manage the complexity defining efficient controls over the working methods.

This is the area in which the distinction between professional practice and research is blurred almost unrecognizably: the architects and engineers working for the software houses need to possess technical skills and an understanding of professional practices in order to be able to correctly coordinate the production of new functions. They may also work as consultants, because the software houses provide resources and services to design firms, who advise on the adoption of procedures and technologies.

At a very advanced level, these procedures enable the customization of certain functionalities and the creation of others, meaning that there is a shift in the role of the professional from mere software user to full-blown software developer and into a role which is an embodiment of the work that up until now was done within the computational geometry groups set up in large design and engineering companies.

Because of their interoperability, digital models have the capacity to act as recipients for information related to geometry, the physical characteristics of materials, construction cost estimates, material and component performance evaluations, energy performance analyses, structural behavior, information regarding contracts and tender procedures, and much more besides. The question is therefore what know-how and exercises to present to students and how to present them within the learning environment, that will translate into an improvement in their skills and into the abilities they will need in the professional world of the future.

4 OPEN ITEMS: THE IMPORTANCE OF TRAINING OPPORTUNITIES

It is therefore clear the active role of the academic teaching staff: they must keep themselves abreast of the continuous technological and procedural developments, with particular regard both of the progress in

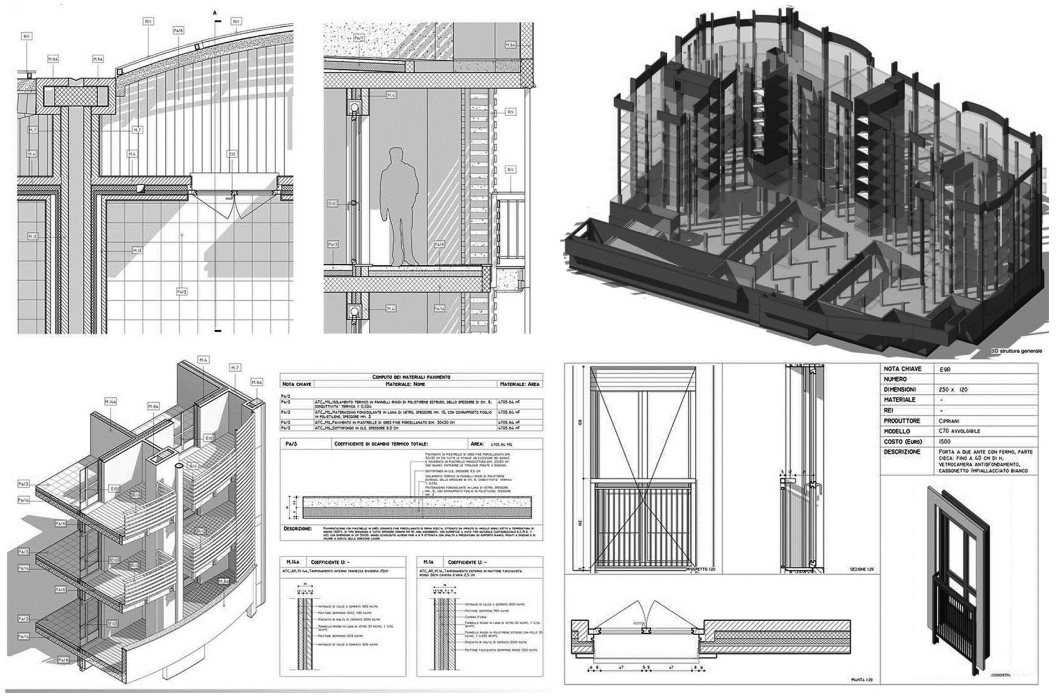


Figure 2. Orthogonal projections, space views, thematic views and details of the same building. 78 residential apartments for ATC in Spina 4, Turin. Source: Alberti, A. (2014). *L'evoluzione infografica del processo edilizio: dalla progettazione integrata in ambiente BIM alla gestione del cantiere 4D e 5D*. Master Degree in Architecture-Construction and City, supervisor: Prof. eng. M. Lo Turco, Department of Architecture and Design, Politecnico di Torino.

the various sectors of the construction industry and of the implementation of such improvements by professionals. The constant updating of the teaching content as an immediate by-product of experimentation in research is therefore crucial in a sector that is constantly evolving, as is the case of all fields of digital technology.

So, what represents an opportunity in terms of digital technology needs to be turned into a professional challenge within the world of architecture (both in the theory and in practice) in order to break down the barriers between design and technology, or at the very least to help bringing together two disciplines which are currently too far apart. Thus a network of teaching courses are being created for establishing closer links between disciplines, for introducing a greater degree of continuity in work with students and for implementing a semi-professional approach.

The educational intent is to show to the students the operating tools, exploring the potential of the new tools in terms of their capacity to provide access to an information system for supporting the construction process, including management and maintenance, in a scenario in which time is the determining factor in the various decision-making processes and operating phases.

Particular attention is paid on the role of the BIM Manager, who has the delicate task of coordinating and optimising those procedures which constitute the core of a multidisciplinary approach, such as:

- the creation of templates for different three dimensional parametric models according to the purpose;
- the definition of standards for the design phase and for the inbound and outbound data exchange;
- the implementation of graphical representation standards for models (architectural, structural, systems, building site, etc.) compliant with the applicable laws;
- the setting of modelling procedures and strategies geared towards achieving interoperable workflows;
- the management and the use of multidisciplinary information contained in relational databases.

The Master of Science degree program in Architecture Construction and City of the Politecnico di Torino is structured into Design units, Subject laboratories and courses. In the course of Building Information Modeling students are first of all asked to create a model of a modern or contemporary architecture and to study different collaborative working approaches in order to provide students with the necessary tools for the further design activity. In fact the students will measure the level of learning achieved through the Design Unit, a multidisciplinary activity that requires the involvement of different disciplines,



Figure 3. Proposals to help students to manage unusual forms and complex interventions. Virtual reconstruction in the BIM environment of the Cayan Tower (Khatib & Alami, Skidmore, Owings & Merill), a building of helical shape, obtained by rotating each floor of 1.2 degrees clockwise from the lower level, giving the tower a distinctive shape. On the left, the actual image of the building, on the right and down some virtual simulations. Course work of Digital Parametric Modelling in the Master Degree in Architecture-Construction-City of the Politecnico di Torino. (Lecture prof. M. Lo Turco. Students: D. Cordani, M. Corallo).

such as technology, structural engineering, building physics, economics and design organization.

We see great hope in the design schools refocused on maker culture and cultivating collaborative modes of teaching, learning and designing. Here we find inspiration and look for our future collaborators. We also notice that in University design units, individual leadership is essential to move forward a critical design culture only if it is based on collaboration. Individual vision is necessary, but it may be most productive when

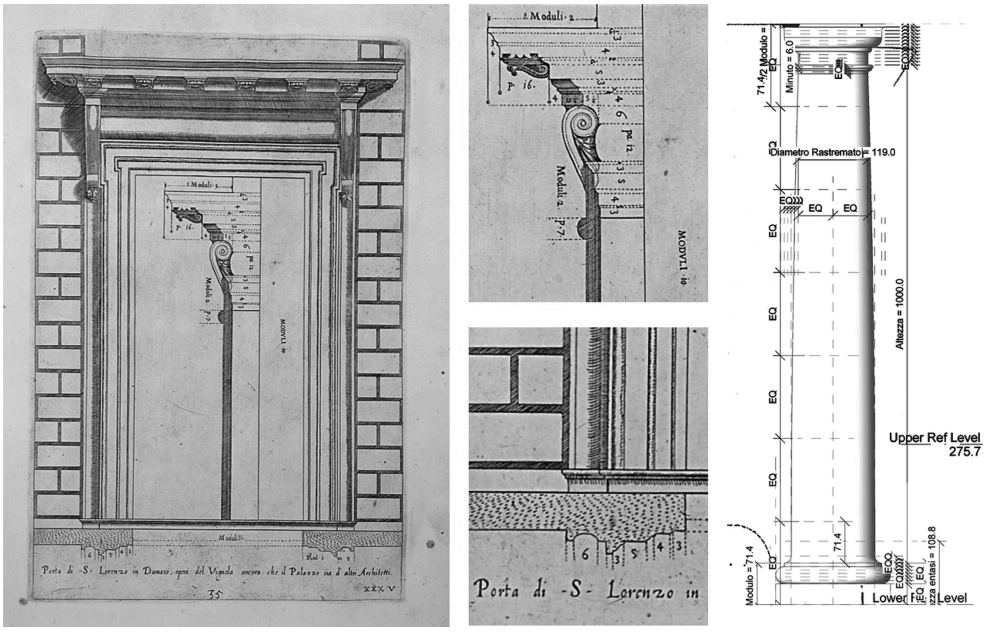


Figure 4. Jacopo Barozzi da Vignola, in the drawing for the *Porta di San Lorenzo in Damaso* in Rome, uses the spatial shadow to render his architectural idea for the elevation view; then, he associates the horizontal section, treated with modules, a side view, overlapping elements belonging to different plans, using hidden lines and hatches. Table XXXV published in the Roman edition of Fausto Amidei (1754). On the right, the Tuscan order of Vignola updated in a parametric environment, according to the rule of successive partitions through a control of rules and constraints between the parties.

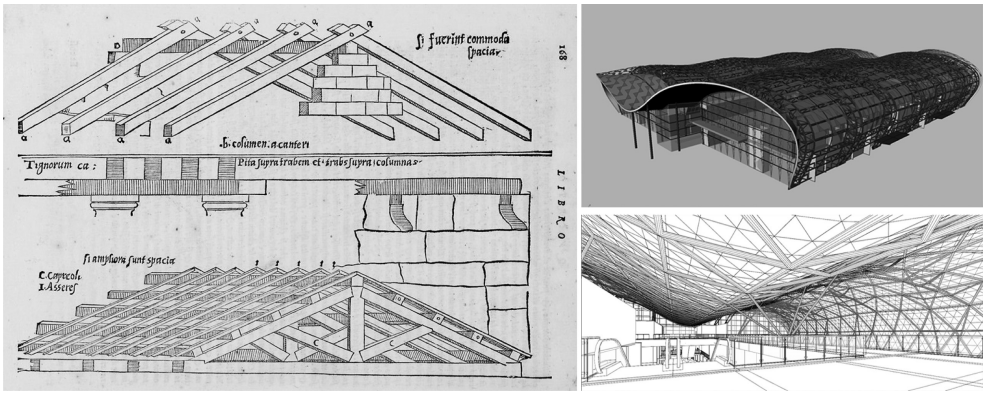


Figure 5. The solutions of wooden structures supporting roofing of small and large areas are outlined in a spatial representation, reproduced not to alter the geometry of the principal beams; in order to keep the visibility of the whole, the other parts are only hinted at and drawing is suspended. Figure taken on page 168 of *Libro Quarto*, Venetian edition of 1567 of the translation of the *Dieci libri dell'architettura* by Vitruvius M., commented and with addition of some illustrations by Daniele Barbaro, (on the left). On the right, spatial perspective representation resulting from the virtual model, not in true form, but essential to simulate complex shapes, such as organic forms and double-curved surfaces. Taiwan Exhibition Center, Cox Architects (2010).

it is altered and nuanced by dialogue within a collective culture.

In the not-too-distant future, information flows will become increasingly like the process employed by parametric software applications. This is why teachers are required to prepare students for a new cultural revolution in which they will be the heirs and standard bearers of a new methodology that that soon will become firmly established within the construction industry. Traditional teaching methods linked to construction need to be updated, to evolve and to adapt to the new information systems. If we understand innovation as the act of introducing new ideas, new technologies products or processes to solve problems,

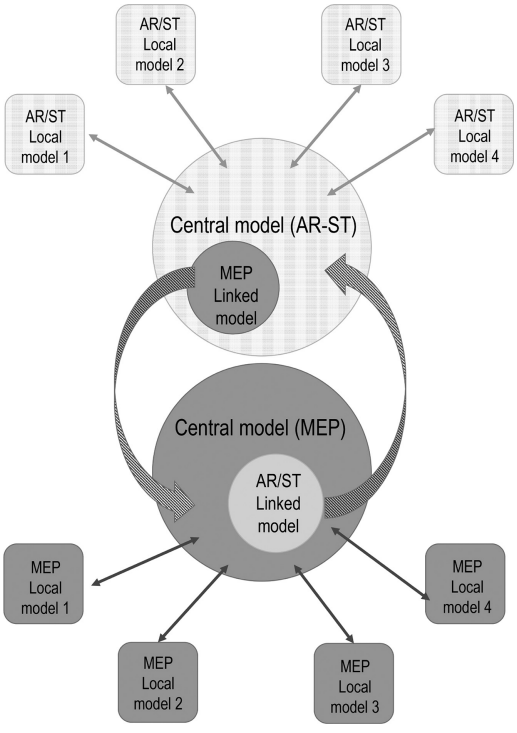


Figure 6. Work organization chart sample for the complex projects developed using a BIM approach: two central models, divided based on disciplines, constantly related to each other and each one divided into several local-models.

employing differentiated approaches, then it is clearly fundamental to ensure a close relationship between research and teaching.

At this regard, the representation plays a dynamic role; it stimulates actions and collects instances; it works to produce ideas that must be responsibly evaluated and verified through a series of checks that, to better operate, need more and more information, in terms of quality and quantity, upon which achievement of performance and successful service life of the implemented work rely: it therefore claims an increasingly strong cognitive value as an active medium throughout the whole investigation process, since its inception, according to the modus operandi advanced by Brunelleschi. So, the term "representation" is referred to a selected recording of the elements that constitute the essence of the object identity and the importance of the relations between the system and its components.

A change in professional practice will not probably have a strong impact on the average structure of offices or in common workflows but it will make the awareness and appropriateness of technology use – so distracted today- an increasingly crucial topic, in a society based on cultural inhomogeneity, fragmentation of material culture, and great availability of technology and highlight, therefore, the need for a "mediative thinking" (Converso, 2009).

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Model as machine/machine as model: Emerging representational devices in stereotomic practice

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ABSTRACT: This paper will discuss the origins of the architectural model as a representational device in the design and construction of vaulted structures. Through the study of historic precedents exploring shell structures, techniques in modelling will be investigated based on the relationship to scale and material properties. Assessing the need for physical models in contemporary practice and whether advances in emerging technologies are influenced by material properties and scale. Situated within the art of cutting solids (stereotomy) and the evolution of machine tools; this paper will examine stereotomic based practices, their modelling techniques and how they are fundamentally shifting the role of the architect. It will explore the relationships between the architects, the models, the machines and the design outcomes.

1 INTRODUCTION

Since antiquity, the architectural model has enjoyed a great popularity amongst architects as a source of inspiration and tool for designing buildings. In its earliest form, history tells us that the first humans used nature as a didactic model for imagining the spatial and tectonic attributes of the first architecture — the primitive hut. Despite a handful of examples for the fabrication of proportionally accurate three-dimensional representations of proposed structures in ancient Mediterranean cultures (Egypt, Greece and Rome), it was not until the 15th century that the model received its theoretical framework in Leon Battista Alberti's architectural treatise *De aedificatoria*. However, in Alberti's proposal the model was not something found or constructed as a mechanism for imagining new designs but a tool to visualize preconceived architectural ideas in three-dimensions. By relieving the model of its role as a thinking mechanism, Alberti initiated a major change in the use of materials for modelling architectural form. It was not until the 17th century that the role of the model was revived as a mechanical device for projecting architecture in three dimensions.

Our contemporary understanding of a machine is inherited from ancient philosophers such as Archimedes who also created complex devices — a water screw — to complete difficult tasks. Certainly architects were involved in the design and fabrication of tools and machinery to construct architecture. The sublimation of this mechanistic imagination into architectural design practice finds its beginning during the end of the 17th century with, most famously, Giovani Poleni and later Antoni Gaudi who both employed hanging chain models to study the effects of gravity on arched, vaulted and dome structures. More recent explorations with this approach towards form finding include architect Jorn Utzon's Sydney Opera House based on shell structures and emerging researchers such as the Block Research Group in Zurich and New Fundamentals Research Group in Italy who are investigating various modelling methods towards the construction of freeform masonry structures. Compared to an emphasis on architectural form, what these examples demonstrate is a use of the physical model for analogical simulation that invites material and mechanistic speculation.

Today, the use of digital simulation as a modelling method for constructing freeform masonry structures is confounding our traditional concepts of model and machine. With the development of increasingly complex computer programs the architect is now free to simulate the effects of forces on different constructive materials in absentia. Without any recourse to material as a medium for design, the machine is now the model. Nevertheless, despite its advantages, one factor still remains — the need for a thinking mind to make analogical associations between the model and the projected structure it represents. This paper seeks to explore the changing role of model as a machine by challenging our assumptions about material, model and machine as interchangeable and exchangeable factors in design.

2 THE MODEL

2.1 *Model, paradigm and prototype*

The word 'model' is derived from the Latin term '*modus*' meaning 'basic measure' in early Greek and

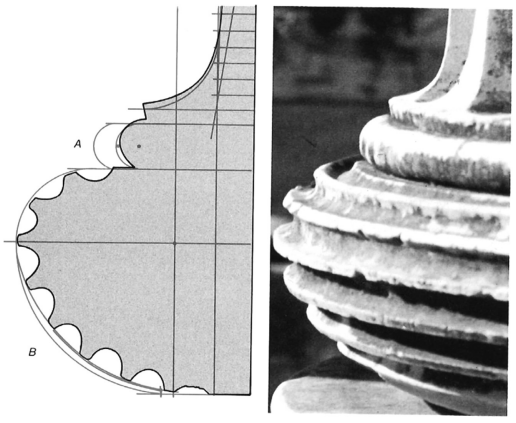


Figure 1. Lothar Haselberger, Planned and Actual Column Base. The inscribed lines on the inner wall are reconstructed by extending visible lines.

Roman Temple designs. With the exception of an often-cited story about the presentation of miniature scale military models in Vitruvius first century BCE treatise on architecture there are very few examples for the use of three dimensional representations of architecture as a design tool before the Renaissance. Rather ancient architects relied upon simple drawings to describe the distribution of the modus in different architectural elements. It was the meaning and purpose of these early architectural drawings that gave the model its name and define its role of the design practices of digital architects today.

Until recently, it was believed that little design work was involved in planning Greek temples that instead relied on specifications for directing the work of others. Indeed, at the Temple of Apollo at Didyma Lothar Haselberger discovered that the construction of large temples concerned the use of not only chalk but also the inscription of construction lines or drawings onto the actual building material. Inscribed on the smooth lower walls of the adytum (inner sanctum) Haselberger found full- scale plans for the components of the temple that dictated their precise and strict geometric relations. For example, the construction and layout of the column bases were established upon 'perfect' torus profiles in a process involving inscribing circular centres on a horizontal axis and projecting them vertically (Figure 1).

What Haselberger's discovery suggests is the presence of a 'master builder' who would be involved in making decisions about the application of geometry and selection of material. As Haselberger explains:

> Geometrically pure paradigms were drawn first, but the architects did not hesitate to alter them to suit their refined sensibilities. . .. The construction plans must have been drawn before the individual components pictured were fashioned but after the stone "drawing boards" were smoothed. (Haselberger, p. 119)

Haselberger's diagrammatic paradigms should not be confused with the Greek *paradigma* – full-scale examples of architectural elements to be copied. By contrast, the drawings at Didyma are prototypes in the sense of Greek *protopon*, (primitive form), the neutral form of *protopos* (original, primitive), from *protos* (first, foremost) and *typos*, (impression). In contemporary practice, prototypes usually involve the extra factors of consideration such as materialisation. They are systems of modules that describe an object or larger system in material form. Although a prototype is similar to a paradigm (pattern or model), by visualising an idea or thought process the architectural *paradigma* is an evolved scale paradigm to be imitated or copied. This is the meaning typically ascribed to an architectural model today.

The familiar image of an architect constructing scale three-dimensional models to study or workout their designs only came into practice during the second half of the 14th century. One finds the earliest records of the use of models by architects in the practice of building around the construction of the Florence cathedral. In 1366 there is a modelling explosion when the Opera del Duomo ordered designs for the completion of the cathedral to be presented in drawings and models. The drawings ran under "*desingum seu modellum*" and a large brick model of Neri di Fioravanti's design referred to as "*chiesa piccola*" had to meet a double similarity: on the one hand it had to be similar to the drawings, on the other hand the church had to be built similar to the model (Guasti, p. 192ff, Doc. 175 & 214). However, the construction of Neri's ambitious dome project, a double shell using no buttressing and only wooden or stone chains to prevent buckling was never realized for the lack of technical skill and knowledge how to accomplish it (Grote, p. 229). The discussion to solve these difficulties began 50 years later in 1417 when another model competition was offered in 1418 and won by Fillipo Brunelleschi (Guasti, p. 15ff, Doc. 11-14; Fabriczy, p. 67). Here, one can find in the payment receipts for the 11 other competition models that they are referred to for the first time as '*modello*' (Guasti, p. 22–25; Saalman, p. 250).

In 1485 a friend of Brunelleschi, Leon Battista Alberti became one of the first individuals since Vitruvius to define the importance of models for the development of architectural ideas. Herein architects are encouraged to follow a time-honoured custom to not only prepare drawings but also '*modello*' to study and develop their ideas in order to avoid making faults. Alberti argues this point by suggesting in Book I of his treatise on architecture that architects have immaterial architectural ideas called lineaments to define the surfaces of the enclosure:

> All the intent and purpose of lineaments lies in finding the correct, infallible way of joining and fitting together those lines and angles which define and enclose the surfaces of the building. (Alberti, p. 7)

As Alberti suggests, it is quite possible to project these lineaments in the mind without any recourse

to material, by designating and determining a fixed orientation and conjunction for the various lines and angles (Alberti, p. 7). However, in Book II Alberti observes how the lineament as formed in the mind was imperfect and could only be given its consequent form through the examination, exercise of judgment, and modification of it through drawings (Alberti, p. 34).

The model, then, for Alberti, was not a vehicle to present an idea to a client, but a means to study and realize their ideas in three dimensions. Because lewdly dressed or painted models can distract from the study and appreciation of these lineaments, Alberti argued that architects should construct plain and simple three-dimensional forms. These models whose lines and angles had a scale and measure embodying the proportions and distribution of a modulus are likened to the diagrammatic paradigms Hasselberger discovered at Didyma.

2.2 *Analogue and digital prototypes*

The development of architectural science in the 16th and 17th century was made possible because of a growing number of technical innovations and the dissemination of scientific ideas to the construction workforce. These developments gave craftsmen and model makers access to up to date knowledge. Scientific achievements from the publication of 'thought experiments' from across the industries of manufacturing to astronomy "raised people's confidence that all subjects would benefit from such methodical study, both intellectual and practical" (Addis, 2007, p. 191). This included the study of the strength of materials.

Physicist Galileo Galilei (1564–1642) was perhaps the earliest to propose non-linear scaling based on what is currently known as the Square Cubed law (Addis, 2007, pp. 191–192). This is based on the area increase with the square of the scale factor, volume and mass that will increase as the cube of the scale. As shown in Figure 2,

> [h]e used this observation to explain that the finite strength of bone material means the size of animals cannot be scaled up indefinitely. (Addis, 2014, p. 35)

Ancient builders in this case would perhaps not have known the distinction between the two categories of models, where one is independent of the structural properties of a material and the other is dependent on them.

Because of his observations with material performance, Galileo was very critical of Alberti's proposed use of models he believed could only provide visual information, regardless of scale (Di Pasquale, p. 665).

Those models based on proportional forces and vector systems verses material qualities are scale independent. For example hanging chain models based on Hooke's Law were both physically modelled and digitally re-interpreted. Giovanni Poleni (1683–1761) made use of Hooke's Law in the 1740s to

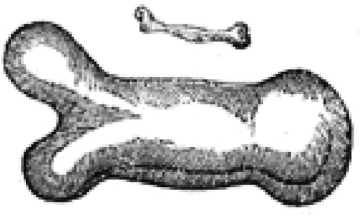


Figure 2. Drawings of Galileo's representation using bone strength of the square cube law.

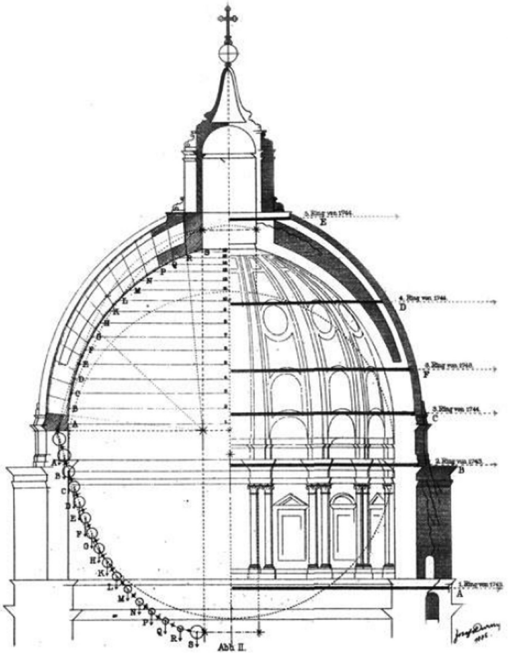


Figure 3. Giovanni Poleni St Peter's Cathedral, Rome, 1506–1626 Superimposed sketch showing Poleni's hanging model on the section of the dome.

> [a]ssess the safety of the hundred-year-old 41.9 m diameter dome of St Peter's Cathedral in Rome, which had developed a number of alarming radial cracks. (Addis, 2014, p. 36)

According to Poleni's report of 1748

> [h]e knew of Hooke's hanging chain, and he has an astonishing preperception of the safe theorem by his explicit statement that stability of a structure is assured if it can be established that the line of thrust lies completely within the masonry. (Heyman, p. 751)

As illustrated by Poleni's drawing of a catenary arch over the section of Michelangelo's dome of St Peter's Cathedral, the paradigm, in this case a mathematical principle is used as the basis for the creation of a modelling system or prototype to assess the safety of domed masonry structures (Figure 3). These mathematical principles based on forces are directly

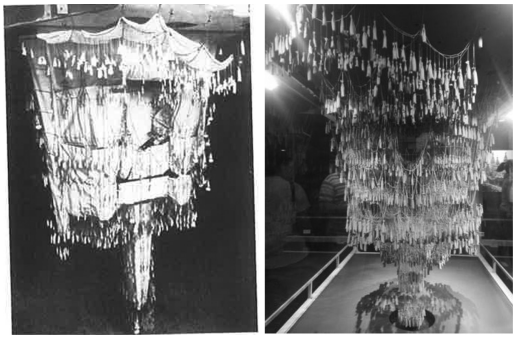


Figure 4. Left: Funicular model by for the chapel of Santa Coloma near Colonia Guell, Barcelona 1898 (Sardo, 2004) Right: Hanging chain model currently exhibited inside the Bascilica La Sagrada Familiar (Fernando, 2015).



Figure 5. Variety of historic models and machines on display at the Sagrada Familiar workshop museum, Barcelona, Spain (Fernando, 2015).

applied to contemporary computational models that can simulate and analyse forces in more than two dimensions.

Antoni Gaudi (1852–1899) used Poleni's chains as a design tool for modelling the shape that the Sagrada Familiar structure would take in response to the loads and thrusts acting on it (Figure 4). To this end, Gaudi hung chains upside down adding weights to distort the parabolic catenary arches into funicular polygons by attaching weights where sculptural elements would be placed. Using these chain models as a tool to investigate structural integrity of arched and vaulted spaces was an effective modelling method for form finding.

A more recent example of a scale dependant model was the 1:60 scale thin shell test version of Danish architect Jørn Utzon's (1918–2008) design for the Sydney Opera House (Addis, 2014, p. 39). Ove Arup & Partners' were appointed as consulting engineer in 1957 and utilized a team of researchers at Southampton University. Due to the complex initial geometry they adopted a solution based on using thin parabolic concrete shells. The complexity of concrete shell structures make the use of material model tests



Figure 6. Left: timber scaled model of roof of Sydney Opera House for wind tunnel testing. Right 1:60 scaled model of a thin shell version of the Sydney Opera House roof being tested at the University of Southampton in 1958 Source: (Morice, 1958).
Source: http://www.engineering-timelines.com/who/Rice_P/ricePeter3.asp.

at various scales useful for many designers to analyse the performance of a structure.

What began as understanding of elasticity and stiffness in the eighteenth century became a paradigm for design in the 1:60 scaled model of the Sydney Opera House (Figure 6). Similarly the chain models used by Gaudi to test structural forces can be seen as machines because they employ a series of mechanisms which are responsible for the transfer for forces and energy.

3 THE MACHINE

A machine is a tool that uses a series of parts to transfer energy in order to perform an action. The word machine is derived from the Latin word '*machina*' derived from the Greek word *makhana*, and *mekhane* meaning (machine). The contemporary definition of a machine implies the use of electricity as a generator to complete complex tasks. However, with the printing of three-dimensional models, the machine becomes a generator of the tool itself, confounding our traditional assumptions about the definition of a machine as a tool.

Historically craftsman in Western culture controlled the skills necessary for creating the devices that greatly affected the daily rituals of humankind. Already during the fourth century BCE the philosopher Plato was concerned that craftsman sustained the skill to create illusions of reality. His student Aristotle however states that mechanical skills were necessary for overcoming problems caused by nature. Vitruvius devotes his entire final chapter to the discussion of the machine. He believed the method of creating improved architecture was with educated craftsman who understood both the theory and practice of mechanisms (Vitruvius, p. 5–6).

Herein, Vitruvius defines a machine as "a combination of timbers fastened together, chiefly efficacious in moving great weights" (Vitruvius, p. 283). This definition implies that a machine uses mechanisms in order to achieve a function or effect. The relationship between the two mechanisms is what differentiates the desired outcome thus making the machine a tool.

For the construction of the Florence Duomo Filippo Brunelleschi solved the issue of lifting and manoeuvring heavy materials such as blocks of stone

by inventing lifting mechanisms. His sketches of machines for lifting heavy loads including hoists, castellos and cranes, were published in manuscripts as drawings of machines (Addis, 2007, p. 131) Another example is Leonardo da Vinci (1452–1519) who employed and communicated structural analysis tools through sketches of mathematical forces in order to solve practical problems such as cracks in masonry structures (Addis, 2007, p. 143).

Today there are more various types of tools and desired outcomes for which machines are employed. The advent of a 'machine age,' which was formed through the industrial revolution in mid to late 19th century, saw the rise of new building techniques. With the development of early twentieth century Modernism, architects began to explore new materials and methods for creating models of architecture as machines for generating and imagining architecture (Mindrup, *The Merz Mill* 2013). Today, increasingly complex computer modelling software and fabrication tools, are beginning to blur our traditional concepts of the model and machine.

4 THE DIGITAL MODEL AS THINKING MACHINE

A tool for architects and designers the machine has been widely accepted as a generator of design outcome regardless of its type. Mario Carpo makes the distinction between "a mechanical machine (for example, a press) that makes objects and a digital machine (for example a computer) that makes a sequence of numbers- a digital file" (Carpo, p. 5). However the content of this digital file and the resultant outcome is dependant on the initial setup and whether it is a 'performative' device meaning that it relies on its execution of instructions. For example, in the case of a structural model that can be further distinguished as a 'behavioural model' which is "designed to demonstrate clearly some particular structural behaviour or principle" (H.J. Cowan, 1968, p. 66). This structural model is ideal as a teaching device as it demonstrates concepts and feasibility of various scenarios. In this case the model is a thinking machine.

Advances in computational power make visualisation, analysis and simulation more accessible to a wider audience have redefined the process and outcome of the 'model' and 'prototype.' Parametric models which are set up to define certain relationships between elements of the scheme have enabled designers to quickly generate and iterate various scenarios and possible outcomes. In this way the parametric model is not only a tool but a thinking machine. It is made up of parts that can be modified, regenerated and replicated based on the code provided by a reflective modeller. Machines such as 3D printers now have the ability to re-produce parts for themselves based on the program defined by humans further distorting the boundaries between the use of the machine and model as a thinking machine.

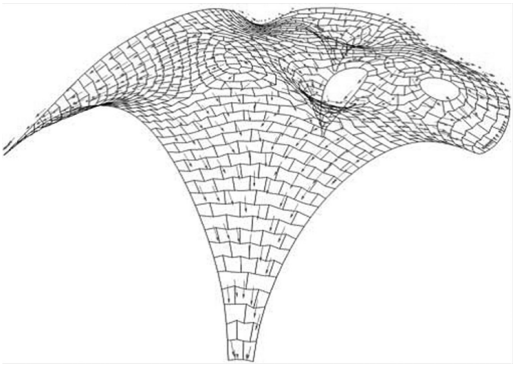


Figure 7. The Digital Model showing magnitude and direction of forces on each module Source: (Philippe Block, 2013).

5 EMERGING STEREOTOMIC PRACTICE

Contemporary architectural practice and research is often subject to emerging trends and advances in technology. As these technologies have developed the capabilities of modelling complex geometry, this has caused a revival of historic methods of modelling and crafting. Stereotomy or the art of cutting solids emerged in the 1500s as a process of calculating the geometry of complex:

> [n]on-uniform stones and making drawings of them so the masons could work on many stones simultaneously, and the stones can be placed in situ as soon as they were needed (Addis, 2007, p. 153).

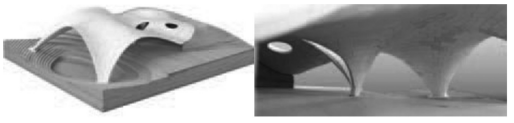
This highly mathematical process emerged due to advances in computational power which speeds up the process and makes the model more accessible to a wider audience.

5.1 *Structural analysis and form finding tools*

The use of the model as a machine can be seen in the work of practices engaging with structural analysis models. A contemporary example of stereotomic practice using structural models is from the Block Research Group in Zurich. Here a digital structural model is produced and is used as a behavioural model to analysis various structural issues as it simulates load conditions of a masonry vaulted form (Figure 7).

The form finding which occurs as a result of the optimization of the structural model is 'machine' generated. Smaller scale test models are produced of the vaulted surface to test connections between each of the modules and overall relationship to the context.

Another example created by the New Fundamentals Research Group in Bari, Italy as shown in Figure 9 is the Osteomorphing Catenary Marble vault in which a model prototype was recently produced at full scale working directly with the material properties. Here a combination of computational and traditional stereotomic techniques was adopted to test and manufacture the structure. The final model outcome is also



(a) (b)



(c)

Figure 8. 3D printed models for structural testing of models of a shell structure (a), (b) 3D-printed structural model, consisting of separate voussoir pieces, of the MLK Jr Park Vault Project (scale1:33); (c) partial collapse of the structural model Source (Philippe Block, 2013).
Source: http://www.block.arch.ethz.ch/brg/files/2013_ICE-COMA_Rippmann-Block.pdf.

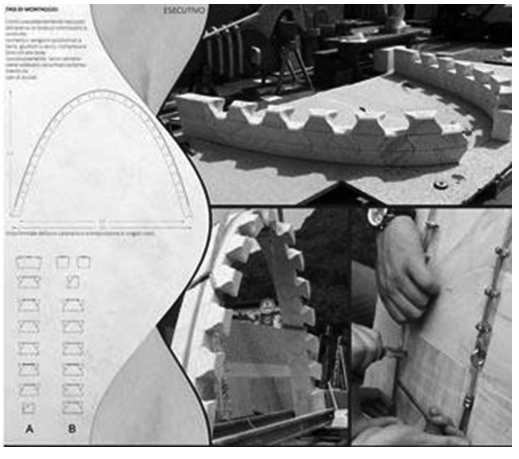


Figure 9. Osteomorphing Catenary Marble Vault by G. Fallacara with Generelli SA (Fallacara, 2015)
Source: http://www.atelierfallacara.it/prototipi.html.

a prototype which can be used to base further iterations of various materials. Here the model produced is a thinking machine similar to a 'behavioural' model to demonstrate and test a particular concept or idea.

5.2 *Robotic technologies in stereotomic practice*

The utilization of industrial robotics originally developed in the automotive industry as a method for cutting complex stone modules expands the concept of the machine as model. This development is due in part to the combination of the instructional properties provided by software with precision of a robotic arm (Fernando et al 2015 p. 395). In these instances, the use of sensors to create a feedback loop between code and manufacture elevates the digital model to the level of a thinking machine enabling the provision of direct feedback from material outcomes.

A recent project adopting stereotomic practices using robotic crafting tools is the Stereotomy of Wave Jointed Blocks (Weir et al 2016 p284) project, exploring the 6 axis wire cutting of interlocking blocks. A custom hot wire cutter end effector was developed as part of the fabrication system utilizing an industrial robot arm to cut foam blocks to prototype a construction method. This single tool cutting system maximises the proficiency of the cutting process and returns the once technical factors of robotic construction back to the designer. This research explores a variety of outcomes and engages the architect with the machine as a thinking tool in the early stages of the design process. Here it is important that the architect has an understanding of structural and material properties which are investigated through structural analysis tools as well as experimentation with the material itself.

6 CONCLUSION

As a thinking tool the use of a model for generating and imagining new architecture has begun to blur. The recent rapid rise of 3D modelling software and sophisticated digitally controlled tooling permits more complex structural investigation and modelling techniques. The use of manufacturing machines can enhance the precision and accuracy of cutting materials such as stone. Because the model has now become a thinking machine, it can be optimized specifically to the type of material used. This changes the way an architect uses the model contributing to a shift in the manufacturing and use of the architectural scale model as thinking machine.

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Additive architecture: 3D printed architecture

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ABSTRACT: 3D printed architecture is rapidly developing globally, with new projects and techniques promising to revolutionize the building industry. This emerging movement within digital fabrication, called additive architecture, will no doubt play a role in how architecture is built in the future, and therefore it is important to provide a comprehensive study and documentation of this quickly-evolving topic. The paper will provide an overview of 3D printed architecture projects around the world, identifying the emerging means and methods of this movement by categorizing the different approaches and trajectories.

1 INTRODUCTION

The idea of 3D printing a building seemed like a futurist's dream until engineer Behrokh Khoshnevi introduced the Contour Crafting project in 2006 (Khoshnevi et al. 2006); demonstrating the possibility of 3D printing at a large scale and taking this dream into reality. Since then, the number of projects pursuing this goal has expanded exponentially, leading to several architects simultaneously racing to 3D print a full-scale building. These projects, and others, are located worldwide and utilize various printing processes, materials, scales, and machines. They are also promising to revolutionize the building industry, with complex components that are materially efficient, tailored for specific structural applications, and fabricated on-site using local, bio-based or recycled materials. While there are many questions and broad implications to consider with 3D printing, the focus of this paper is on the many approaches people are taking to additive architecture.

2 BACKGROUND

3D printing is a fabrication process that stacks thin, two-dimensional layers (x, and y-dimensions) on top of each other vertically (z-dimension) to create a three-dimensional object. Historically, this technique was used by architects as a prototyping tool to produce scale models of building or details. However, this small-scale prototyping tool has quickly evolved into a full-scale production tool for architectural building components and structures. There are several widely accepted benefits of 3D printing in comparison to traditional manufacturing, which are outlined in the book Fabricate (Lipson 2005). From this list there are four principles that highlight these benefits, or new opportunities. They are the reduction of material waste, increase in geometric complexity, portability of manufacturing, and custom material blends.

3D printed architecture uses an additive manufacturing method, which is relatively new to the field of digital fabrication in architecture. Therefore it is important to understand where this technique fits within the digital fabrication movement, and compare it to the standard tools, techniques, and machines that have traditionally been used.

Since its inception, digital fabrication or CAM (computer aided manufacturing) has revolved around a given set of standards that have been widely adopted and utilized. First, the primary machines are three-axis CNC (computer numerically controlled) tables or gantry systems. Secondly, the tools or end effectors are most often based on standard, industrial, hand tools, such as routers, welders and plasma cutters, which are simply attached to the 3-axis CNC milling machine. Third, the production has relied on off-the-shelf or stock materials, which are prefabricated and sold in standard sizes, densities, and finishes, such as wood, foam, plastic, and metal. The typical machine is built to accommodate the most common building material size, a 1220 mm by 2440 mm sheet. Lastly, and most importantly, the fabrication techniques have relied on subtractive methods, where the machine and end effectors are used to remove or subtract material, such as milling, routing, cutting operations.

However, over the past few years, many of these widely held standards are being challenged. With the recent proliferation of multi-axis machines, or robot arms, into professional and academic research labs, as well as open source hardware and software platforms that have made these machines more accessible to architects and designers, there has been greater experimentation. Architects and designers have also begun building and customizing their own machines that perform specific functions, which has helped the development of additive architecture projects.

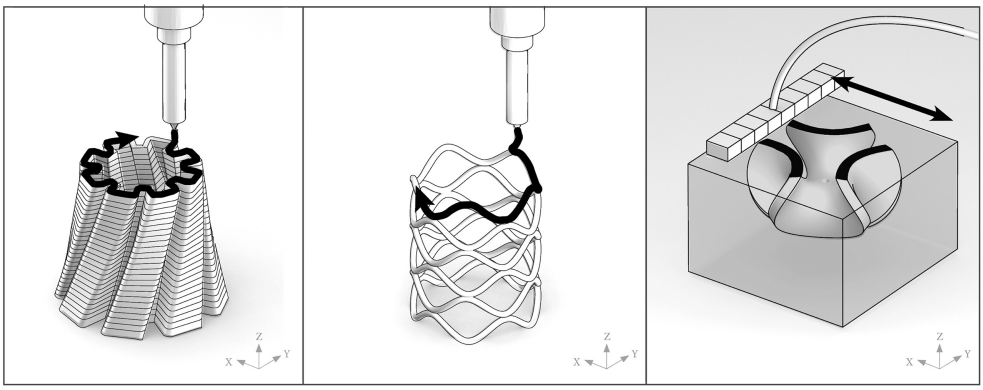


Figure 1. 3D Printing techniques: (*a*) fused deposition modeling (*b*) anti-gravity printing (*c*) stereoligraphy.

3 ANALYSIS

The data set analyzed consists of current and past projects that have pursued 3D printing at the scale of architecture. The project list was compiled by Erno Langenberg (2015) and provides the project name, location and material used for approximately the first forty additive architecture projects in the world. Using this list as starting point, we created a more comprehensive comparison between the projects by also categorizing their printing techniques, mechanics, extruders or print heads, and fabrication approaches. The intent is to use this data to identify the emerging methods of this movement.

3.1 *Materials*

There are a wide variety of materials being used to 3D print building components. They range from traditional building materials, such as concrete and ceramics, to experimental materials such as bio-based polymers or composites. One of the most popular materials currently being researched and used for 3D printing in architecture is concrete, (Buswell 2006, Rael et al. 2011, Stampler 2015) with over a third of the projects pursing it as the main printing material. It is typically printed using a FDM style printer with either a gantry system or multi-axis machine. There are several projects that have used large machines to 3D print large sections of buildings or walls in concrete, however the industry still has concerns about how structural reinforcing, such as rebar, is included during the printing process. Ceramics is another popular material being explored (Peters 2013); however one of the limitations of the material is that it needs to be fired. This is simple to accomplish at a small scale, however at a large scale, the size of kilns becomes a barrier to printing large components. There have also been experiments with the use of local materials, such as adobe, however the results of their structural tests have not been released. To date, there have been no large-scale, 3D printed architecture projects that use wood, which is otherwise a typical building material. Other traditional building materials that are harder to 3D print and were not included in the project list, such as glass (Klein et al. 2015) and metal (Crolla et al. 2014) have been proven to work at small scales.

Less traditional building materials being used include plastic (Peters 2016, Wainwright 2014) and artificial stone (Fixsen 2015), which have their advantages. For example, plastics can easily be recycled by grinding 3D prints into pellets, re-extruding filament and then reprinted the material again. There have also been experiments with a bio-based plastic material, which alleviates some environmental concerns. Artificial stone has been used in one project and promises the durability and strength of the natural stone, while being able to use recycled or local material.

It is important to note that all the projects listed are mono-material systems, where only one material is printed at a time. One of the largest hurdles in advancing the use of 3D printing in architecture is multi-material printing, where metal, concrete, and glass can be combined simultaneously. This opens up many possibilities in terms of environmental and structural performance.

3.2 *Printing techniques*

There are three main types of 3D printing techniques being utilized at the scale of architecture (Figure 1). The first, and most popular (60% of the projects surveyed use this technique) is fused deposition modeling (FDM) printing. This style involves extruding a liquid-based material on top of the layer below, typically without a support material. The FDM style is easy to visually identify, since the prints always reveal the printing process and the layers that were used to fabricate the system. The resulting ribbed texture can be minimized by reducing the layer height, however this will greatly increase the overall print time. Since this style of printing relies on the layer below, it is problematic to stop and start the printing process and print failures may occur when layers don't properly adhere to one another.

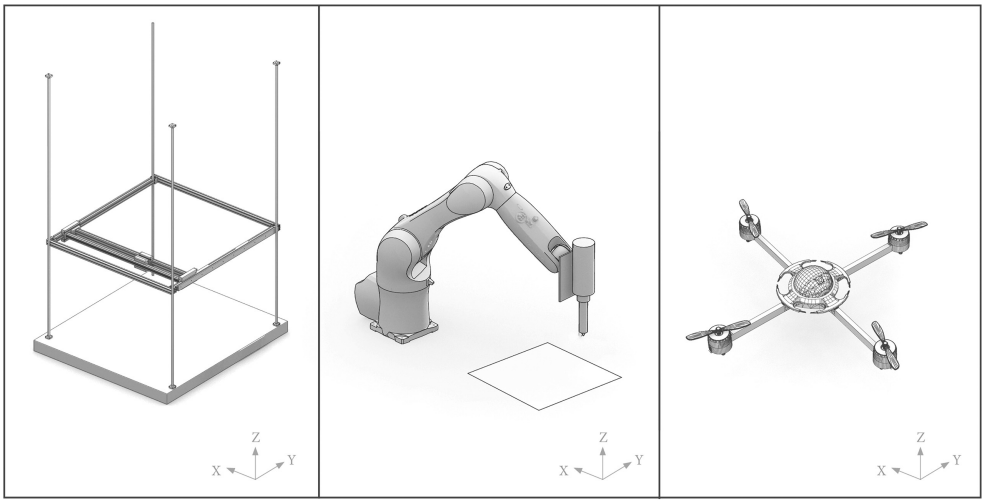


Figure 2. Machine typologies: (*a*) gantry (*b*) multi-axis (*c*) mobile.

The second most-often used technique in additive architecture is stereoligraphy (SLA). This involves printing objects in a bed of material (powder or liquid), thereby having the objects suspended in that surrounding material during the printing process. After the print is complete, the support material is meticulously removed. The projects using this technique have shown greater geometric flexibility because there is a support material; however the process is more time intensive and usually requires manual labor to remove the print after it is complete.

The third technique that is being utilized is an approach called anti-gravity printing, which is a version of FDM style printing that is done in midair. There are a small, but quickly growing, number of projects that have experimented with this technique (Hack et al. 2014, Laarman et al. 2014). The printing material does not rely on the layer below for stability, but rather dries immediately upon exiting the print head. This technique provides exciting geometric possibilities and can be highly material efficient, however it can only be achieved with materials that dry and harden almost instantaneously, such as composites, polymers, and metal. The applications currently experimented with include lightweight lattice structures and support material for a secondary process, such as reinforcing for concrete casting.

3.3 *Mechanics*

There are a wide range of machines being used to fabricate architectural components, however they can grouped into three typologies (Figure 2). The first and most commonly used typology is the gantry style, which is typically a three-axis machine. It is widely utilized because the system can be constructed out of off-the-shelf components, such as extrusions, rails, motors and electronics, allowing the system to be easily customized for various scales or applications. Of the thirty gantry projects, the largest is 12 m^3 and the smallest is 200 cm^3.

The ten most recent projects have utilized the second typology: a multi-axis machine, such as a 6-axis robot arm. These machines allow for more geometric freedom compared to a three-axis gantry system, but are less accessible in terms of modifying the mechanics. They may also be popular because there are a variety of robot arm sizes that can carry a wide array of loads and stresses.

The final typology is a mobile machine, such as an unmanned aerial vehicle (UAV) or quadcopter. These machines are far less prevalent and suffer from limitations relating to weight loads and precision. Their inclusion is based on speculative projects and their application in additive architecture is still yet to be seen.

3.4 *Extruders or print heads*

There are two primary types of extruders being utilized for FDM style 3D printing of additive architecture. The first is an auger or screw-type mechanism that takes material from an input and slowly feeds the material through the system. The second type of extruder is a piston-based mechanism, which uses a mechanical device or air pressure to force a plunger down a cylinder, pushing the material out of the extruder. The benefit of using an auger-based extruder is that the material can be continuously fed into a hopper, however it is difficult to cleanly stop and start the extruder during the printing process. The benefit of piston-based extruder is that the operator has more control over the speed of the extrusion. The limitation is that the cartridge needs to be refilled, which hampers the printing of large components.

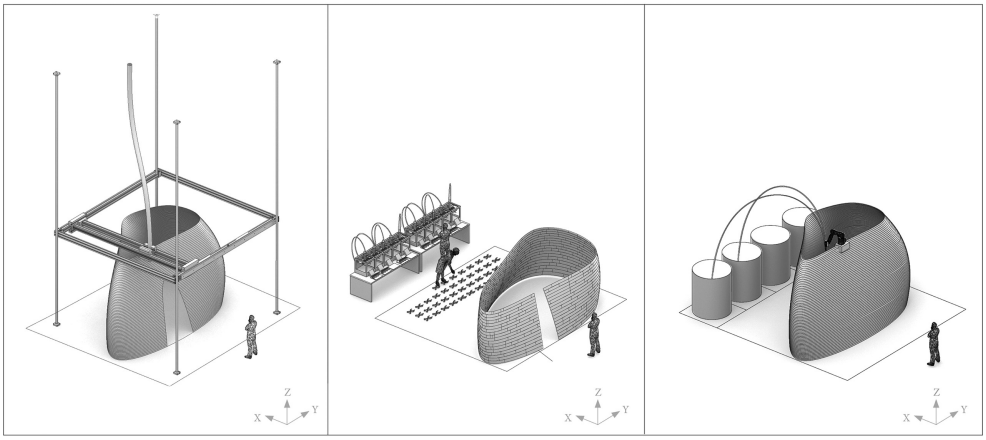


Figure 3. Fabrication approaches: (*a*) large scale machine on-site (*b*) small scale machines on-site (*c*) small mobile machine in-situ.

3.5 *Fabrication approaches*

While there are several fabrication approaches to additive architecture projects (Figure 3), including pre-fabricating components, one of the exciting advantages of 3D printing is the potential to fabricate on site, utilizing a mobile printing lab. To date nearly half of the projects have used on-site 3D printers to fabricate building components, though there are two different approaches. The first is printing on site, or even in-situ, with very large-scale machines. At the other end of the spectrum, there are several projects that have utilized small desktop 3D printers to fabricate small components that come together to form a larger structure. This approach uses small, easily transportable printers that are relatively inexpensive. While they can offer a high resolution of detail compared to larger printing machines, the number of components required to be printed in order to assemble a full scale structure can take much longer to fabricate. The final approach is to use a series of small mobile machines to print a large structure on site (Jokic et al. 2014).

3.6 *Mold printing*

While the majority of the excitement and energy of the architectural community is focused on directly 3D printing building components, there are a growing number of projects investigating instead 3D printing molds and formwork for casting building components (Gardiner 2014, Peters 2014, Sun et al. 2014). While 3D printing molds does not take advantage of all the design benefits of 3D printing, it does alleviate some of the problems associated with traditional casting by reducing fabrication steps, which in turn reduces the material waste and fabrication time. 3D printing molds can also sometimes produce more high definition and geometrically intricate designs then large-scale FDM style 3D printers because of the resolution of the printing process. These projects are utilizing a typical molding material (flexible, wax, etc.) to either recycle and reuse the material from each subsequent mold, or reuse and reconfigure the molds repeatedly.

3.7 *Custom machine fabrication*

With the recent proliferation of 3D printing projects into professional and academic research labs, there has been an increase in the development of custom attachments (end effectors) for these machines. This has been aided by open source hardware and software platforms that have made these machines more accessible to architects and designers. For example, through projects such as the RepRap (Gershenfeld 2005), which is an open source 3D printer kit, the knowledge for how to assemble, modify, and customize a 3D printer has greatly increased. Additionally, in combination with other open source hardware projects, such as Arduino, it has become relatively easy to learn how to program and prototype small electronic projects. This new knowledge is empowering those who would typically not able to do so, such as architects or designers, to build new digital fabrication devices, tools and end effectors. The results range from custom additive fabrication processes, such as 3D printing, to hybrid systems that combine various techniques, such as a carbon fiber spinning attachments to stacking devices.

Of the projects researched, a majority (almost two-thirds) used off the shelf machines, such as multi-axis robot arms, and built custom extruders or print heads that were attached to the robot arm. The rest actually built custom machines and extruders for their projects. How are architects developing custom machines, and not simply accepting or relying on machines that are given? While architects may not feel they have the expertise for such work, collaboration with various experts, such as mechanical and electrical engineers, is the solution for these complex problems. Those that are currently exploring these possibilities are producing new and exciting design ideas for architecture and

demonstrating how architects can be directly involved in the fabrication process.

4 CASE STUDIES

The following two case studies demonstrate how the role of architects in fabrication is evolving and adapting; highlighting architects' involvement in the development of fabrication tools and machines.

4.1 *3D print canal house*

An example of a professional project where architects are leading a team in the development of a large-scale, custom-built, 3D printer for architectural production is the 3D Print Canal House by DUS Architects. The project, located in Amsterdam, Netherlands, was started in 2012 and continues today. The concept was to build a large 3D printer that could easily be transported from site to site, and therefore it was built inside of an existing shipping container. The complex project necessitated collaborating with several companies, including a desktop 3D printing manufacturer, extrusion system manufacturer, and material engineers; however architects were at the helm. Since being built, the custom 3D printer, which prints with pellets of bio-plastic, is being used to 3D print a full-scale house on a public site in Amsterdam. The project was innovative due to its scale of FDM style printing, its use of bio-based materials, as well as its portability.

4.2 *Building bytes*

A personal project that highlights this growing trend of architects building their own small-scale, custom 3D printers is Building Bytes (Figure 4). This project combines a traditional building material (ceramics) with a new fabrication technique (3D printing) to re-think an ancient building component (bricks) and demonstrate how 3D printers will become portable brick factories for large-scale construction. Bricks have been a standard building material for centuries, and while their manufacturing has undergone changes, this project seeks to update this building component to suit architects' needs using this new fabrication tool. The intent is for architects to be able to design each individual brick in their projects, bringing them into the fabrication process. The project was realized by customizing an existing 3D printer to print in ceramics and focuses on producing bricks quickly, efficiently and within a limited budget.

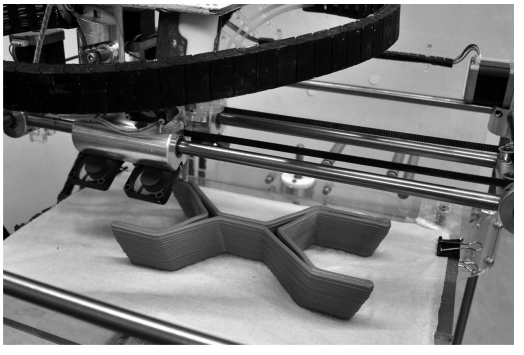


Figure 4. 3D printing ceramic brick.

5 CONCLUSION

3D printing in architecture is driving architects to become more involved in building fabrication. As a result, they are customizing machines, developing new approaches to fabrication and using new materials. Additive architecture is therefore taking many forms, but its full impact on the building industry is yet to be seen.

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Laser scanning: The transformation of architectural practice through 3D imaging

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ABSTRACT: 3D imaging technologies like laser scanning are shaping architectural practice, especially when projects involve the existing built environment. Laser scanning helps rapidly produce highly accurate digital representations of existing buildings, spaces, and details. Architects are increasingly utilizing the technology to quickly capture places and spaces. The resultant large sets of data can then be easily accessed from remote locations. The research presented in this paper investigates how laser scanning can advance the field of architecture and allied disciplines, especially in respect to extant buildings and sites. First, the paper explores the growing trend towards reusing existing buildings and the growing use of laser scanning for architecture. Second, through case study analyses, this paper examines what products can be generated from laser scan data and how they can help with distinct issues at varying scales ranging from the recording of existing interior details to the mapping of topographic information. Case studies include Steinway Hall, New York City, United States and Shwe-Nandaw Kyaung, Mandalay, Myanmar.

1 INTRODUCTION

Laser scanning and other 3D imaging technologies are changing how architects and allied professionals document, perceive, and interact with existing buildings and the built environment. With ongoing improvements in hardware and software, laser scanning and 3D imaging will become an integral part of the documentation and design process. Rapid and highly accurate, terrestrial laser scanning captures large quantities of 3D data that result in digital models of spaces, buildings, entire neighborhoods, and cities. These digital models–referred to as point clouds for laser scanning–can be accessed by architects and others from their office or elsewhere to aid in continually studying the building or environment.

The purpose of this study is to investigate how 3D digital imaging and laser scanning help change and advance the field of architecture. Therefore, this paper explores laser scanning for existing and historic structures and the built environment through the review of architectural projects and literature and examines case studies where 3D imaging was used to document the context and details of building. To be specific, this paper discusses what products can be generated from laser scan data and how they help with a variety of architectural practice.

2 ARCHITECTURAL PROJECTS REUSING EXISTING BUILDINGS

Today, demands for reusing existing buildings are increasing as a part of global efforts for preserving cultural heritage and reducing energy consumption caused by new construction and demolition (Bennett 2009). Further, architects have increasingly retained and incorporated existing building elements and features as part of a design strategy. *ArchDaily*, a popular online architecture newspaper, has annually announced the *Building of the Year Award* voted by the public based on 14 categories, one of which is "refurbishment" (Stott 2016). A 2016 winner House in Guimarães, Portugal, designed by Elisabete de Oliveira Saldanha, has modern additions simultaneously preserving, restoring, and sometimes replicating historic elements of the existing building (ArchDaily 2015).

The utilization of existing buildings and sites often requires careful historical and physical analysis. Depending on cultural significance or deformation of existing buildings, architects collaborate with heritage specialists. For instance, Musée Unterlinden Extension in Colmar, France, designed by Herzog & de Meuron, involved a close collaboration with architects of the French national heritage department to adaptively reuse a medieval convent complex (ArchDaily 2016). However, in many cases, architects themselves make decisions when encountering challenges. One example is the interior intervention project for Stedelijk Museum Schiedam that adaptively reused a listed building–the 1787 Neoclassical chapel in Schiedam, The Netherlands. With this project, architects had to cope with substantial deformation of the floors and ceilings, according to Nathalie de Vries of MVRDV (Dezeen 2015). Thus, accurate as-built data is critical for designers and engineers to deal with existing conditions as well as new interventions.

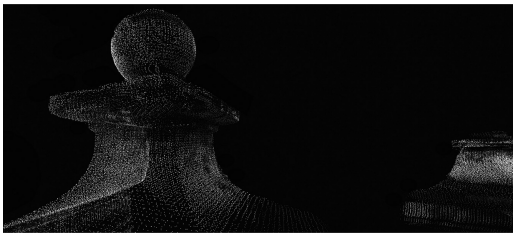


Figure 1. Point cloud. Parapet detail of Shwe-Nandaw Kyaung, Mandalay, Myanmar. Laser scanning by the authors, 2014.

However, many old buildings and sites have no digital design records or have never been inspected after construction (Bennett 2009).

3D digital models from laser scanning can provide accurate information of complex existing buildings and sites and their conditions. This information can help with design and construction for restoration, retrofit, interior renovation, architectural expansion, landscape addition, and urban rehabilitation. For instance, a construction firm Beck Group employed laser scanning to repurpose 1939 Hinman Research Building at Georgia Institute of Technology, Atlanta, USA. Not only did this provide an accurate digital model of the existing space but also reduced time and cost required to go back to the field and undertake onsite work (Turner 2011).

3 LASER SCANNING

English Heritage defines 3D scanning (often referred to as laser scanning) as "the act of using a laser device that collects 3D coordinates of a given region of a surface automatically and in a systematic pattern at a high rate [as much as a million points per second] achieving the results in (near) real time" (Jones 2011, 19). There are numerous systems and types of scanners for recording a variety of object scales, range, and accuracy (Boehler & Marbs 2004). The principal product of laser scanning is a point cloud. Point clouds are generated through the registration and alignment of individual scans (Jones 2011). Depending on size and density, point clouds can contain millions to billions of points establishing the xyz coordinates of the surface of a building including its details and context (Fig. 1). Products that can be generated from point clouds include, among others, two-dimensional, black-and-white line drawings in AutoCAD or another program, surface or solid models, and video animations (Boehler & Marbs 2004).

4 APPLICATION OF LASER SCANNING IN LITERATURE

4.1 *Use of point clouds for monitoring*

Some research addresses the use of point clouds generated from laser scanning for monitoring of not only existing structures but also new constructions. Point clouds can be used for mapping historic masonry building walls to inspect overall surface changes, cracks, and structural issues (Pesci et al. 2011, 2012). For the maintenance of concrete structures, the point clouds can help detect and measure spalling by calculating the depth of sectional changes on a wall surface (Mizoguchi et al. 2013). In addition, the progress of building construction can be estimated by matching a point cloud of a construction site with a designed CAD model (Zhang & Arditi 2013). This concept can also be applied to monitoring MEP projects by matching circular cross sections of pipes' point clouds to determine how accurately a structure was built as designed (Bosché et al. 2015). Monitoring elevational change of a 3D laser scanning model can help with seismic damage testing for structural engineering (Takhirov 2010).

4.2 *Surface or solid modeling from points*

A point cloud is literally composed of points, and this unique format may limit its architectural use by many architects and engineers who do not typically use it despite highly accurate information. The usability of point data can increase when it is converted to 3D digital models with surfaces or parametric components, which are more widely used. Using modeling software capable of housing a point cloud, a surface or solid model can be built directly over a point cloud by using sectional profiles traced on the point model (Leonov et al. 2015). If a historic building has a repeated classical language, knowledge from archival sources, like pattern books or historic drawings, can be added to develop a library of building components for a parametric model (Murphy et al. 2013). For other irregular or non-classical buildings, however, starting from point clouds by laser scanning can generate more accurate results than modeling upon two-dimensional information (Quattrini et al. 2015). Furthermore, laser scanning attic spaces can significantly enhance understanding of complex structures inside historic vaults and domes, which are often hard to measure by hands and different from original drawings (Balletti et al. 2014, Herráez 2014).

4.3 *Development of HBIM*

As Building Information Modeling (BIM) has become an important part of architectural practice, recent research examines developing so called Historic Building Information Modeling (HBIM) using geometric information from point clouds by laser scanning. Most research discusses modeling strategies and appropriate levels of detail, since standardized BIM assemblies and objects are hard to use for many historic buildings with complex shapes and variations (Fai & Rafeiro 2014). Challenges are the representation of historic elements avoiding excessive simplification and at the same time, development of a model that different experts can use together (Oreni et al. 2014).

Although existing buildings with relatively simple shapes can be modeled using original or surveyed 2D drawings (Fai et al. 2013), most research on HBIM development shows the use of spatial data from laser scanning or other 3D imaging (Quattrini et al. 2015). While literature mostly focuses on modeling, some recent projects, like the 3D documentation of George Washington's Mount Vernon, Virginia, USA, show a more comprehensive approach in terms of integrating survey and archival data into a 3D digital model and 3D GIS application (Benson et al. 2015, Fink 2015).

4.4 *Lack of research on architectural practice*

There is a limited amount of research and examples of architects' active use of point clouds by laser scanning. HBIM projects often require time-consuming modeling work, and in previous literature, the direct use of point clouds is mostly for surveyors' monitoring such things as cracks and deformation. Professional architects and engineers, however, often have a limited amount of time and budget, and a point cloud by laser scanning itself can convey a substantial amount of information of existing architecture. Therefore, designers who plan interventions for existing buildings and sites need to directly use a point cloud. This practice can be aided by recent improvement of software, such as Autodesk products and ArchiCAD, in capability of handling large point data. Designers can combine and render their new design components with the as-built virtual space without additional modeling.

An important benefit of laser scan data is that designers and engineers can virtually visit the site whenever they want from their offices and collect specific, detailed information for documentation, analysis, and creative design. Another advantage of laser scanning, distinguished from typical manual modeling, is that one-time scanning can capture not only buildings but also contexts. When dealing with existing buildings, the surrounding environment is often an important part to study, but most research on 3D imaging focuses on buildings and structures as single objects. Therefore, this study incorporates a comparative case study of laser scanning for historic interiors and a monastery complex representing some products and information from scan data for consideration in architectural practice.

5 COMPARATIVE CASE STUDY

5.1 *Steinway Hall, New York City, USA*

The Steinway Hall on 57th Street, New York City, is a sixteen-story masonry building constructed in 1925 by the Steinway & Sons piano company. The building had recital rooms on the ground floor where professional and amateur pianists tested new pianos before purchase. The building also had its own recording studio to broadcast music on the radio. Recently, a developer purchased the building and an adjacent property and is building what will be, for a while, the tallest residential

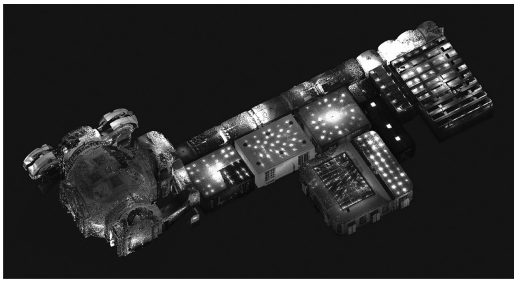


Figure 2. Point cloud. Interiors of Steinway Hall, New York City, USA. Laser scanning by the authors, 2014.

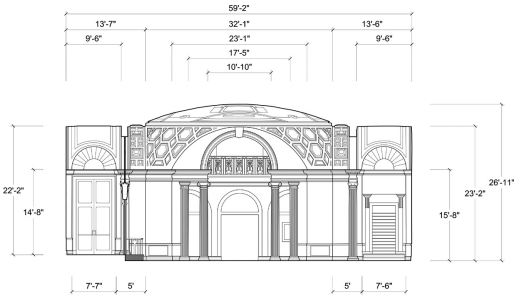


Figure 3. Interior elevation. Steinway Hall, New York City, USA. Drawing by the authors, 2015.

tower in New York City. SHoP Architects (2016) plan to adaptively reuse the historic building for an entry hall and community space for the new adjacent tower. Although the Steinway Hall's exterior and its grand hall are listed as landmarks and protected, other interior spaces, including the recital rooms with ornate plaster ceilings, were demolished in 2014. Before the selective demolition, the interiors were digitally recorded using laser scanning (Fig. 2).

The initial purpose of laser scanning was to document the historic interiors that were selectively demolished. Only a few hours were allowed for scanning due to urgency of the construction, thus medium resolution scanning, which took shorter time, was undertaken. 29 scans were taken to cover the approximately 9500 ft^2 (883 m^2) ground floor interior with one grand rotunda, five recital rooms, and one hallway. A point cloud of the 29 scans helped with creating detailed interior elevation drawings for each individual space and a simple mass model of the area to be renovated. For potential replication for design purposes, partial surface models of the ornate plaster ceilings were created from the point cloud. In collaboration with the University of Florida Envision Heritage, American College of the Building Arts created rubber molds based on measurements taken from the 3D digital models to recreate the lost plaster ceilings.

Highly accurate two-dimensional drawings of the historic interior elevations were created by tracing over scalable orthographic images of walls, floors, and ceilings taken from the point cloud (Fig. 3). These black and white line drawings, including spaces remaining

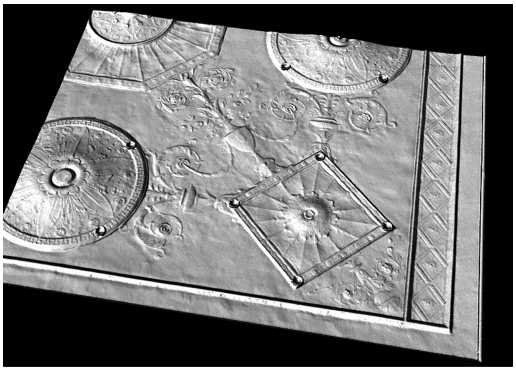


Figure 4. Mesh surface model. Interior ceiling of Steinway Hall, New York City, USA. Modeling by the authors, 2015.

and gone, are critical records of what existed. According to Dodsworth (2009), if creating interiors within an existing building, the designer should understand what formed the character of the building. At the same time, a simple 3D mass model was quickly created by putting and trimming flat surfaces on planes of the walls, floors, and ceilings. Despite lack of details, this simple model provided designers with the sense of proportions, volumes, circulations, and opening positions of the existing spaces. Both products are basic, but fundamental resources for any interior rehabilitation project, and no extensive hand measurement is required if laser scanning, which guarantees quick, accurate 3D documentation, is conducted.

Surface models of the decorative historic plaster ceilings were created to examine the possibility of using the scan data for recreating historic elements for new design or potential later restoration (Fig. 4). Partial mesh models composed of triangle surfaces, smaller than a quarter inch (6 mm), were built by automatically connecting individual points of the scan data. These rough mesh polygons were smoothened for better representation. The software Rhinoceros 5 and its plugin RhinoResurf helped with modeling. The surface models increased the visibility of small details that were hard to look closely on the point cloud because points disappeared when zooming in. The mesh models exactly trace the point cloud and make computer-aided fabrication, like 3D printing or CNC routing, possible. Moreover, high quality handcraft was experimented by artisans taking measurements from both point cloud and mesh models. While computer fabrication physically copies a digital model whether it is good or not, hand fabrication allows artisans to make the decisions for parts weathered or lacking sufficient scan data.

5.2 *Shwe-Nandaw Kyaung, Mandalay, Myanmar*

Shwe-Nandaw Kyaung is a nineteenth-century Buddhist monastery in Mandalay, Myanmar. The main building, constructed in the traditional Burmese style with ornately carved teak wood, has two connected

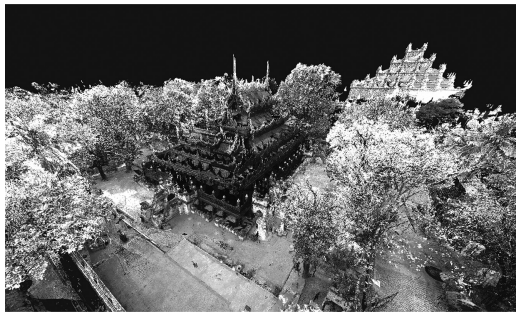


Figure 5. Point cloud. Shwe-Nandaw Kyaung, Mandalay, Myanmar. Laser scanning by the authors, 2014.

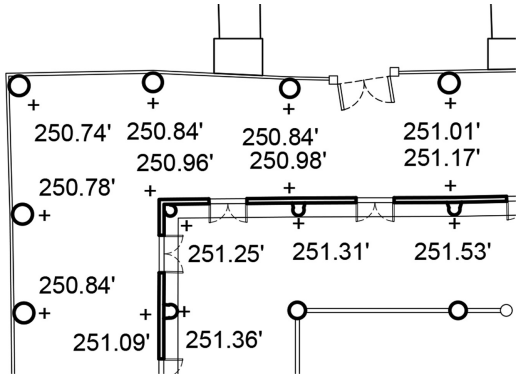


Figure 6. Floor elevation mapping. Shwe-Nandaw Kyaung, Mandalay, Myanmar. Drawing by the authors, 2016.

interiors surrounded by a veranda and stands in a garden with other smaller structures. This historic place has been threatened by seasonal flooding that is exacerbated by the lack of appropriate drainage maintenance in the site and surrounding urban context.

To help with rehabilitation of this place, a total of 217 scans recorded the main building's exterior and interior, garden, neighboring properties, adjacent canal, and surroundings (Fig. 5). It was challenging to secure scanner stations and complete field work in a busy tourist place and changing weather conditions.

The point cloud covers an about 5.2 acre (21,000 m^2) area, including the 1.7 acre (6900 m^2) monastery site. The point cloud helped with creating a complete drawing set of the building and site and some mappings with specific information, such as floor elevations and ground topography. Using these products, a water management plan, as a part of a comprehensive rehabilitation effort, is being prepared including redesigning the existing garden and improving the drainage system of the building.

After two-dimensional drawings were created by tracing over orthographic images from the point cloud, accurate three-dimensional information was added. For instance, a floor plan with detailed spot elevations of the floors of the veranda and interior helped with renovation planning for the 336-foot-long (102 m) veranda to improve drainage of the building (Fig. 6).

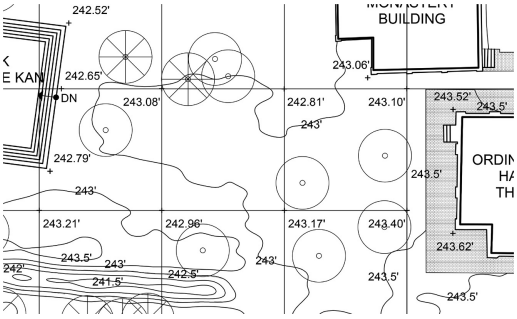


Figure 7. Topographic mapping. Shwe-Nandaw Kyaung, Mandalay, Myanmar. Drawing by the authors, 2015.

This information helped figure out irregular inclination of the historic structure. After defining GPS information of a fixed benchmark that was in place during scanning, spot elevations were documented by measuring vertical differences between the floors and benchmark. Since the point cloud virtually represents reality with millions to billions of xyz coordinates, highly accurate elevation information can be collected from the laser scan data. This is a significant advantage of laser scanning, and the benefit increases when the point cloud is used for landscape mapping.

For the landscape design intervention incorporating a water management strategy, a two-dimensional base map of the site was integrated with accurate topographic contour lines with 6 inch (0.15 m) interval, elevation grids for every 30 feet (9 m), and spot levels at the corners of buildings (Fig. 7). These are crucial survey resources for landscape design especially for a site with water issues (DesignWorkshop 2016). The contours were created from NURBS (Non-Uniform Rational Basis Spline) surfaces that were draped over the point cloud using the software Rhinoceros 5 and its plugin RhinoResurf. NURBS surfaces are often used for modeling organic-shaped architecture due to their smooth curves. The nature of this mathematical structure can benefit landscape modeling. Like a thin cloth covering an object, NURBS surfaces that were draped over the point cloud accurately depicted the topography of the ground. Once the surface model is done, it is possible to automatically create sectional contours with any benchmark and interval. The grid and spot elevations were added in the same way that the floor elevations were collected.

6 CONCLUSION

Steinway Hall and Shwe-Nandaw Kyaung represent different types of architectural heritage from western and eastern cultures and demonstrate two varying approaches to the treatment of existing and historic architecture. Due to the unique form and features of each structure, the challenges of each site context, and the time and other limitations placed on field work, accurate documentation and analyses of both properties proved difficult. Despite these difficulties, the two cases demonstrate that a laser scanning survey can create an accurate as-built digital model (a point cloud) of a building and its context. The three-dimensional data serves as a powerful repository of information that designers and engineers can refer to and use remotely as they continually assess and understand existing and historic buildings and their sites.

The Steinway Hall and Shwe-Nandaw Kyaung demonstrate that a point cloud produced by one-time laser scanning can generate a variety of information for different experts and purposes without physically revisiting the site. The Steinway Hall case shows that a point cloud helps with not only drawings and digital models for the new design intervention, but can also inform the reconstruction of lost elements and even whole resources. The Shwe-Nandaw Kyaung demonstrates that the same type of digital data gathered to record the architecture and built environment can also provide a highly accurate topographic mapping for water management planning, as a part of a comprehensive rehabilitation effort. Both projects also relay the ability to collect and analyze information from the point cloud, significantly reducing time for surveying and field work. For example, the Shwe-Nandaw Kyaung topographic mapping was continually updated using the digital documentation and information provided by the project manager and other experts working from varying locations. Architectural practice, especially focused on the built and historic environment, will continue to transform as laser scanning and 3D imaging technologies advance and become more common place.

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Japan, from modernity to today



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Study on Japanese Art Museums since the Second World War: Graphic analysis and typology

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ABSTRACT: After The Second World War, Japan has built many public facilities, including art museums. To nowadays, museum buildings have been characterized for having freer shape due to the program exhibition requirements, so architects are encourage testing how far they can push the limits of their abilities in architectural design. In this investigation, art museums are taken as an effective sample of architectonical design processes of the last 65 years. First, through the analysis of the architectural elements' cases and compositions, a typology classification had been made. This study tries not only to identify some of the elements and characteristics of the Contemporary Japanese Architecture, but also to establish the relationships between the formal composition and the interior organization that define them. The goal is to establish a classification of Japanese Contemporary Museum, describing the characteristics of the new types that have emerged over the past years.

1 INTRODUCTION

1.1 *Background and research question*

Since the beginnings of the Architecture there have been authors who tried to summarize architectural principles and theorized about them. In architectural composition, the classification of buildings attending to their intrinsic characteristics is one way of summarizing concepts as types. This study aims to continue previous studies classifications and adapt them to a contemporary way of thinking architecture.

As for Contemporary Japanese Architecture, at the beginning of the 1930s, at the same time when Japan adopted Western modernism in architecture, an identification of Japan-ness (Isozaki, 2011) to an external gaze began. Since then, the debate of the "Japanese taste" in architectural design reminds when studying Japanese conformed architecture. In that sense, it is relevant to talk about Japanese architecture as an example of a particular way of thinking architecture because the social and historical context in which is formed.

After The Second World War Japan has built many public facilities, including art museums. During the bubble-era (1989-1995) (Daniel, 2008), many buildings were demolished and replaced with new ones. Because of the economic and social circumstances of Japan at that time, buildings started to acquire new roles. In some cases, various projects, particularly museums and cultural centers, "were completed mainly for reasons of rapid investment, prestige, their image value, or even political pressure or rivalry" (Bognar, 2008). To nowadays, museum buildings have been characterized for having freer shape due to the program exhibition requirements, and most of them have a larger budget than other public buildings, so architects are encourage testing how far they can push the limits of their abilities in architectural design.

This investigation takes art museums as an effective sample of architectonical design processes of the last 65 years in Japan. This study tries to identify some of the elements and characteristics of the Contemporary Japanese Architecture, and also to establish the relationships between the formal composition and the interior organization that define it. The goal is to establish a classification of Japanese Contemporary Museums, describing the characteristics of the new types that have emerged over the past years.

1.2 *Methodology and sources*

Due to the complexity of architecture, graphic analysis is a method used to express architectural form, concepts and systems in a reduced way. Many architects theorized about architectural concepts by using this analytical method. Alexander Klein (1980) established a graphic method to study typology classification and make comparison and validations between different buildings. Another architects such as Peter Eisenman (1982), John Hejduk (1984) or Christopher Alexander (1977) used graphic analysis and architectural diagrams to express concepts and architectural systems.

In order to a better understanding of the study cases and their design concepts, this study is focused on museums form analysis for being more objective than intangible qualities. The investigation method is based on form analysis to provide an appropriate model to describe architectural concept formation. The analysis of the geometry of the building plan, and the creation

Table 1. Cases list and code.

No.	Year	Architecture Name	Architect	Code
1	1959	ISHIKAWA PREFECTURAL MUSEUM OF ART	Yoshiro Taniguchi	111–DLpe
2	1964	OKAYAMA PREFECTURAL MUSEUM OF ART	Kunio Maekawa	111–DLpee
3	1966	NAGANO PREFECTURAL SHINANO ART MUSEUM	Nikken sekkei	111–ERpeL
4	1973	TOCHIGI PREFECTURAL MUSEUM OF FINE ART	Kiyoshi Kawasaki	101–DLpee
5	1973	TOTTORI PREFECTURAL MUSEUM	Nikken sekkei	111–ERpeV
6	1973	NARA NATIONAL MUSEUM	Zyuzo Yoshimura	111–ERpel
7	1975	KITAKYUSHU MUNICIPAL MUSEUM OF ART	Arata Isozaki	110–ERpeL
8	1975	THE MUSEUM OF MODERN ART GUNMA	Arata Isozaki	111–DLpe
9	1975	IKEDA 20TH CENTURY MUSEUM	Takevoshi Inoue	101–DLpee
10	1974	CHIBA PREFECTURAL MUSEUM OF ART	Ootaka Masato	111–ERpel
11	1977	TOKYO METROPOLITAN ART MUSEUM	Kunio Maukawa	111–DRpe2
12	1977	HOKKAIDO MUSEUM OF MODERN ART	Minoru Ota	111–ERpel
13	1978	KUMAMOTO PREFECTURAL MUSEUM OF ART	Kunio Maukawa	111–DRpe2
14	1978	IWASAKI ART MUSEUM	Maki and associates	111–ERpeL
15	1979	SHISEIDO ART HOUSE	Yoshio Taniguchi	100–DLpee
16	1981	THE SHOTO MUSEUM OF ART	Seichi Shirai	100–DLpee
17	1981	SHIZUOKA MUNICIPAL SERIZAWA KEISUKE ART MUSEUM	Seichi Shirai	101–DLppee
18	1982	JAPANESE UKIYO E MUSEUM	Kazuo Shinohara	110–DLpe
19	1982	THE MIYAGI MUSEUM OF ART	Kunio Maukawa	111–DLpe
20	1983	THE MUSEUM OF MODERN ART, SAITAMA	Kisho Kurokawa	0M–ERpeV
21	1984	IZUNOCHOHACHI MUSEUM	Osamu Ishiyama	100–ERpeV
22	1984	TANIMURA MUSEUM	Murano Mori associate	100–ERpeS
23	1984	FUKUSIMA PREFECTURAL MUSEUM OF ART	Ootaka arc	100–DLpee
24	1984	SHIGA PREFECTURAL MUSEUM	Nikken sekkei	110–ERpeS
25	1985	OKANOYAMA GRAPHIC ART MUSEUM, NISHIWAKI	Arata Isozaki	0M0–ELpeee
26	1986	SETAGAYA ART MUSEUM	Syozo Uchiʻ	111–ERpeL
27	1986	THE TASAKI MUSEUM OF ART	Koji Hara	101–ELpe.e
28	1985	SHIZUOKA PREFECTURAL MUSEUM OF ART	Shizuoka Sekkei Renqou	111–DLppe
29	1986	THE NATIONAL MUSEUM OF MODERN ART, KYOTO	Fumihiko Maki	111–DLpe
30	1987	NAGOYA CITY ART MUSEUM	Kisho Kurokawa	0M–DLppee
31	1989	IIDA CITY MUSEUM	Koji Hara	101–DRpe2
32	1989	NAKAGAWA KAZUMA ART MUSEUM	TAK Architects INC.	111–ERpeS
33	1989	INFORMEL NAKAGAWAMURA MUSEUM	Kikou Mozuna	100–DLpe
34	1989	HIROSHIMA CITY MUSEUM OF CONTEMPORARY ART	Kisho Kurokawa	100–ERpel
35	1989	YOKOHAMA MUSEUM OF ART	Kenzo Tange	100–ERpeV
36	1990	NAGANO PREFECTURAL SHINANO ART MUSEUM, HIGASHIYAMA KAII GALLERY	Yoshio Taniguchi	111–ERpeL
37	1990	KAWAMURA MEMORIAL DIC MUSEUM OF ART	Ichiro Ebihara	100–ERpeL
38	1989	IMAIZUMI MUSEUM	Hisao Kouyama	100–DLpe
39	1991	AUTOPOLIS ART MUSEUM	Hiroshi Naito	111–ERpel
40	1992	NAOSHIMA CONTEMPORARY ART MUSEUM	Tadao Ando	100–DLppe
41	1992	KORIYAMA CITY MUSEUM OF ART	Takahiko Ynagisawa	111–DRpe2
42	1992	SHINSYU TAKATO MUSEUM OF ART	Tadanaga Miyamoto	100–DLpee
43	1993	SHIMA ART MUSEUM	Hiroshi Naito	111–DLppe
44	1993	JINGU MUSEUM OF FINE ARTS	Hiroshi Ohe	111–ELpe.e
45	1994	RIAS ARK MUSEUM	Osamu Ishiyama	0M–ERpeV
46	1994	NAGI MUSEUM OF CONTEMPORARY ART	Arata Isozaki	100–ERpel
47	1994	GARDEN OF FINE ART, KYORO	Tadao Ando	101–A
48	1995	MUSEUM OF CONTEMPORARY ART TOKYO	Yanagisawa Takahiko+TAK	111–ERpel
49	1995	EHIME MUSEUM OF SCIENCE	Kurokawa Kisho	100–DLppe
50	1995	SUNTORY MUSEUM	Ando Tadao	100–DLppe
51	1995	MIYAZAKI PREFECTURAL ART MUSEUM	S.Okada+.Sekkei	100–ERpel
52	1995	SHOJI UEDA MUSEUM OF PHOTOGRAPHY	Takamatsu Shin	100–DLppe
53	1995	NARIWA MUNICIPAL MUSEUM	Ando Tadao	110–DLpe
54	1996	TOYOTA MUNICIPAL MUSEUM OF ART	Taniguchi Yoshio	111–ERpeS
55	1996	ANPANMAN MUSEUM	Furuya Nobuaki	110–DLpe
56	1996	KAMPO MUSEUM IN SHIGA	Team ZOO	100–DLppee
57	1996	FIN/NIUIMA GLASS ART MUSEUM	Katsuhisa Hashimoto	100–DLpe
58	1996	HAMADA CHILDREN'S MUSEUM OF ART	Shin Takamatsu	111–DLpep
59	1996	OKAZAKI CITY ART MUSEUM	Kuryu Akira	111–C2
60	1997	SAKATA CITY MUSEUM OF ART	Ikehara Yoshiro	111–ERpeS
61	1997	KUMANO KODO NAKAHECHI MUSEUM	SANAA	100–C2
62	1997	CHIHIIRO ART MUSEUM AZUMINO	Naito Hiroshi	111–ERpeS
63	1997	KYOTO HOSOMI MUSEUM	Tadasu Ohe	111–DLppe
64	1998	AKINO FUKU MUSEUM	F. Terunobu+U. Yoshio	110–DLppe
65	1998	TENSHIN MEMORIAL MUSEUM OF ART	Naito Hiroshi	111–ERpeS
66	1998	SAGAWA ART MUSEUM	Takenaka corporation	111–DRpe2
67	1998	DAYLIGHT MUSEUM	Tadao Ando	100–DLpep
68	1999	SHIMANE ART MUSEUM	Kikutake Kiyonori	0M–ERpel
69	1999	NEMUNOKI ART MUSEUM	Shigeru Ban	101–A
70	1999	UNIVERSITY ART MUSEUM, TOKYO NATIONAL UNIVERSITY OF FINE ARTS AND MUSIC	Rokkaku+Nihon Sekkei	111–ELpepe
71	1999	KIRISHIMA ART HALL	Kunihiko Hayakawa	111–DLpee
72	2000	BATO MACHI HIROSHIGE MUSEUM	Kuma Kengo	111–DLpee
73	2001	TOKYO NATIONAL MUSEUM THE GALLERY OF HORYUJI TREASURES	Taniguchi Aichi	111–DLpee
74	2001	HYOGO PREFECTURAL MUSEUM OF ART	Tadao Ando	111–DRpe2
75	2002	GUNMA MUSEUM OF ART, TATEBAYASHI	T. Takahashi+D.-Kobo	100–ERpeS
76	2002	POLA MUSEUM OF ART	Nikken Sekkei	100–C1
77	2003	THE MUSEUM OF MODERN ART HAYAMA	AXS SATO INC	111–ERpeL
78	2004	21ST CENTURY MUSEUM OF CONTEMPORARY ART	SANAA	100–B
79	2004	CHICHU ART MUSEUM	Ando Tadao	110–DLppee
80	2004	KAGAWA PREFECTURAL HIGASHIYAMA KAII SETOUCHI ART MUSEUM	Yoshio Taniguchi	111–DLpe
81	2004	EHON MUSEUM	Tadao Ando	110–C2
82	2005	TOMIHIRO ART MUSEUM	Yokomizo Makoto	111–DRpe2
83	2005	NAGASAKI PREFECTURAL MUSEUM	K. Kengo+Nihon Sekkei	111–ERpeV
84	2005	KANNO MUSEUM	Hitoshi Abe	111–C1
85	2006	AOMORI MUSEUM OF ART	Aoki Jun	100–C1
86	2006	SAKANOUENOKUMO MUSEUM	Tadao Ando	101–C2
87	2007	KEYFOREST871228 KEITH HARING MUSEUM	Kitagawara Atsushi	101–DLppee
88	2007	YOKOSUKA MUSEUM OF ART	Yamamoto Riken	111–ERpeL
89	2007	OKINAWA PREFECTURAL MUSEUM & ART MUSEUM	Ishimoto+Niki	111–ERpeV
90	2007	THE NATIONAL ART CENTER, TOKYO	Kurokawa Kishou	0M–DRpe2
91	2007	SUNTORY MUSEUM OF ART	Kengo Kuma	111–DLpee
92	2007	NEMUNOKI CHILDREN MUSEUM	Terunobu Fujimori	0M–ELppee
93	2008	TOWADA ART CENTRE	Nishizawa Ryue	0M–ERpeS
94	2008	HARA MUSEUM ARC	Arata Isozaki	110–ERpeV
95	2009	NEZU MUSEUM	Kuma Kengo	111–DLppe
96	2010	TESHIMA ART MUSEUM	Nishizawa Ryue	0P–A
97	2010	LEE UFAN MUSEUM	Ando Tadao	101–ERpeS
98	2010	HOKI MUSEUM	Nikken Sekkei	100–DLpee
99	2010	MUSEUM OF THE LIGHT	Tadao Ando	111–DLppe
100	2011	HIROSHI SENJU MUSEUM KARUIZAWA	Nishizawa Ryue	0P–A
101	2011	KEN IWATA MOTHER AND CHILD MUSEUM	Toyo Ito	0P–A
102	2012	AKITA MUSEUM OF ART	Tadao Ando	101–DLpep

of conceptual diagrams, is one way to show how new architectural concepts can be derived.

In most of the cases the plan conveys the central organizing strategy of a building. It is full of clues about the designer's values and attitudes toward theories of order, methods of construction and so on. The idea is not to use the plan just as a set of data, but also of values, ideas and analogies that had shaped the building in a particular way.

The conceptual diagrams are created from every case like a parti diagram, in order to delineate the dominant organizational and formal concepts governing an architectural scheme for the subsequent analysis. The purpose of this study in plan is not to demonstrate the abstract perfection of ideal form itself but a schematic design process through which the creative intention can embody the complex relation between concept and form, and the internal organization.

1.3 *Object of study*

102 samples (Table 1) had been selected from the period after the Second World War. These buildings are published in the periodical Shinkenchiku Nenmatsu from 1950 to 1990, and in Japanese Architecture Yearbooks and GA Publication from 1990 to 2015. This study uses these sources because their consistent review-oriented approach and the precision of its data. The information is based on architectural drawings and pictures found in those sources.

The purpose of the buildings is art museum, dismissing other purpose museums such as natural museums or science museums. Small pavilions and galleries annexed to other buildings different from art museum are not considered. Renovations and temporary buildings are also excluded. In the cases that museum program is mixed with other uses such as library or auditorium, only the examples where the main public access area is intended for exhibition use are considered.

1.4 *Previous studies*

After the Second World War, the socio-economical context where Japan was immersed allowed architects to develop new ways of experimentation in architectural concepts. In this way, museums are able to show the architectural thinking evolution, and very often they are open to public debate. There are several studies on Japanese Contemporary Architecture and museum typology that show a relation with this paper. The studies of Nakai, Moriyama and Sakamoto (2006) show an approach to museum elements composition. In the case of Koike and Nakagawa (2011), they focus their research on public museums' spatial configuration.

This paper aims to identify issues that could be of broader relevance in architectural design analysis, the study of museum architecture, and research about Japanese Contemporary Architecture.

2 CONCEPTS' DEFINITIONS

Two descriptive levels are defined. On one hand, cases are analyzed in terms of boundary conditions. On the other, the relationship between internal elements is defined.

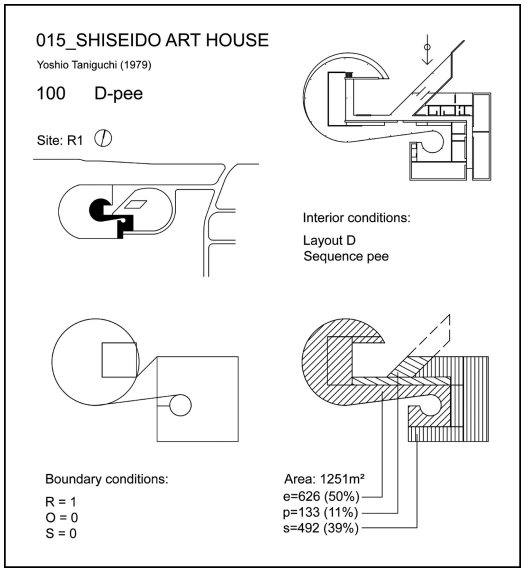


Figure 1. Analysis example.

Table 2. Concepts for boundary conditions.

REGULARITY = 1				REGULARITY = 0	
ORTHOGONALITY = 1		ORTHOGONALITY = 0		MIX	PURE
AXIALITY = 1	AXIALITY = 0	STRAIGHTNESS=1	STRAIGTNESS=0		

The entire samples are diagrammed according to these levels of study, and defined by a code (Table 1). For example, the analysis of Example 1 (Fig. 1) is defined by "100 D-pee" code. The first part of the code defines the case in terms of boundary conditions; the second part describes the layout and the sequence pattern. There is also an approach to the surrounding conditions and the usage areas of the program.

2.1 *Boundary conditions*

For the boundary conditions the interior space information is systematically dismissed in order to emphasize the idea of the shape, as a figure-ground diagram. For the creation of these diagrams, secondary elements such as exterior open galleries or small walkways are not considered.

The selection of the concepts is made with cautious consideration: Regularity, orthogonality, axiality and straightness (Table 2). These concepts have representativeness mainly in the description of the shape of the boundary diagrams and are applicable to architecture as an object, enabling to explain some issues of museum's architecture in terms of space composition.

A system for Boolean analysis is used, where data type has only two possible values: true (1) or false (0).

Regularity

"Regular forms (R = 1) refer to those whose parts relate to each other in a consistent and orderly manner. They are generally stable in nature and symmetrical about one or more axes. (…) From our experiences with similar forms, we can construct a mental model of the original whole even when fragment is missing or another part is added.

Irregular forms (R = 0) are those whose parts are dissimilar in nature and related to one another in an inconsistent manner." (Ching, 2007) They are usually form by organic shapes and more dynamic than the regular forms. They are called "mix irregular forms" if they are composed of a regular form with some irregular element or organic shape part. On the other hand, the ones that are totally irregular are called "pure irregular forms".

Orthogonality

Two types of regular forms can be distinguished: The cases where the reconstruction of the whole form is made of combination of rectangular shapes (O = 1) are defined as orthogonal examples. Non-orthogonal examples (O = 0) are defined for being regular forms with subtracted items, forms created from a regular shape irregular composition, such as trapeziums, and regular curve forms as made with circles or ovals.

Axiality

Regularity and orthogonality are two important concepts to understand the shape of the elements in a plan, but there's still one more concept needed to define the relation between the pieces. In this way, axiality defines the turns of elements and a main axial direction. For the group of cases which elements are defined as regular and orthogonal there are some of them where axiality value is true (A = 1) and others where the elements interact with turns, and then the value is false (A = 0).

Straightness

For non-orthogonal forms, there's still one more characteristic to be consider and that it's especially important for architecture: The presence of curved elements. When talking about boundary configuration, straightness is related to the geometry of the whole regarding to the segments taken one by one. The construction methods and most common structural systems nowadays consist of geometrical and rectilinear elements. However, there are many attempts to find new ways of architectonic expression by using curved shapes in their buildings. In this way, it is interesting to subdivide this group into two categories: The forms witch boundary is composed by straight sections (S = 1) against the ones that include curved parts (S = 0).

2.2 *Interior conditions*

For the interior conditions, not only the shape and size of the spaces is relevant, but also the program and the connections between them. In the programmatic diagrams, three different areas are distinguished: areas for

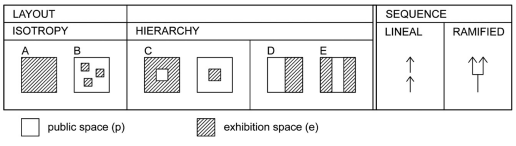
private use restricted to public access, such as office or storage (r); areas for public services, such as cafeteria, auditorium or library (p); and areas for exhibition spaces or expositive galleries (e) (Table 3).

In terms of sequence, the space is diagrammed according to the layout and the circulation. Comparing the layout, five different groups are defined. The fist two ones (A and B) are differentiated for been isotropic spaces. Isotropy is uniformity in all orientations. When talking about architecture, isotropy is related to the perception of space and it's connections. In this case, the parameter of isotropy wants to qualify the connections between spaces through the sequence of the visitor.

So isotropic cases (A and B) are related to non-delimitated exhibition spaces and non-hierarchical space connections. By contrast, anisotropy cases (C, D and E) are those in which space properties are directionally dependent. Layout C has a central distribution. D and E have a hierarchical distribution for the areas depending on the use. In D cases the distribution attends to the program separating exhibition spaces from public spaces. For E cases, the public space act as a link between exhibition spaces.

Interior conditions in terms of shape and position is defined by the terms above. But there's still one more parameter to consider, the connections between spaces. Besides the sequence of the building depends basically on the layout, the circulations order through the building it's also needed. In this way, cases are also classified attending to the circulation sequence from the main entrance to the exhibition space. The building sequence is diagrammed base on the analysis of the space divided in phases, attending to the use of the areas and it relative position, dismissing shape and size.

Table 3. Concepts for interior conditions.



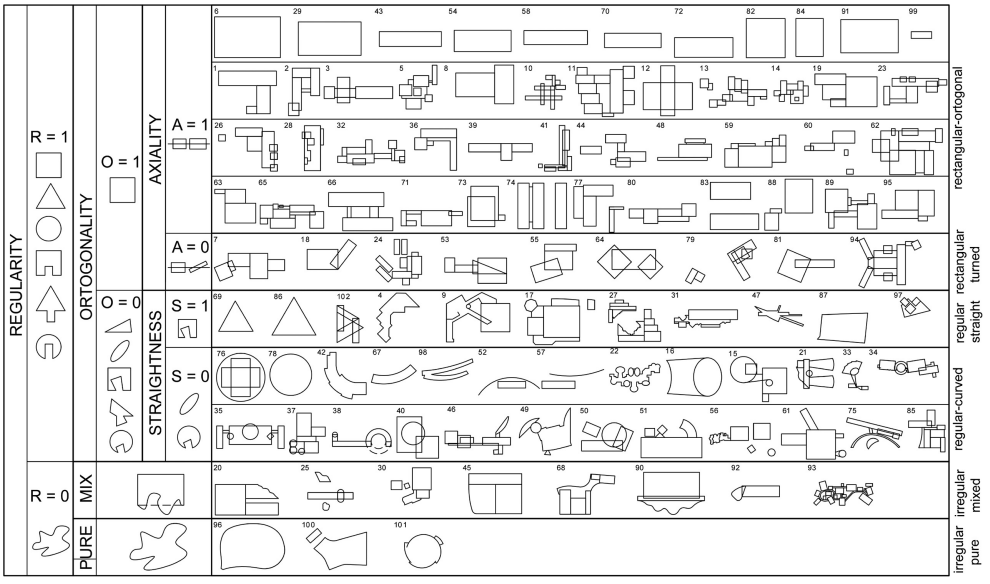
3 ARRANGEMENT

3.1 *Compositional diagrams. Typologies based on boundary conditions*

In order to understand the external boundary, cases are divided according to their specific qualities and similar arrangement in terms of formal composition. In Table 4, concepts are shown in the left column and the result of the classification in the right column, distinguishing the following six different types:

- Rectangular-orthogonal type (code 111) is defined by their regularity, orthogonality and axiality and it represents the simplest shape boundary condition. The rectangular shapes are combined to create the whole composition of the plan (46 cases out of 102). Sometimes (11 out of 46) just one shape is enough to conform the whole building plan.
- Rectangular-rotated type (code 110) whose composition in plan is also based in rectangular forms, but the axiality is lost (9 cases out of 102).
- Regular-straight type (code 101) is formed by regular but non-orthogonal cases formed with rectilinear boundary composition (11 cases out of 102).
- Regular-curved type (code 100) is formed by regular but non-orthogonal cases including curved boundary elements (25 cases out of 102).

Table 4. Boundary conditions types.



- Irregular-mixed type (code 0M) present cases formed by irregular forms, including some organic-shaped elements combined with regular parts (8 cases out of 102).
- Irregular-pure type (code 0P) is composed by cases with organic form along the entire boundary (3 cases out of 11).

3.2 *Sequence diagrams. Typologies based on interior conditions*

As for the internal organization of the museums, cases are divided according to their specific qualities and similar arrangement in terms of interior layout and sequence. Concepts are shown in the left column of the Table 5 distinguishing two main groups:

Isotropy group (6 cases out of 102) is formed by cases where the layout presents an isotropy space configuration. Two different types are consider in this group:

- Type A (5 cases out of 102) is formed by unitary small spaces.
- Type B (1 out of 102) is formed by multiple exhibition spaces connected in a non-hierarchical way.

Phased group (96 cases out of 102) includes cases related to phased architecture sequence with a hierarchical formation layout. Three types are included in this group (C, D, E). In D and E layout types, the classification in terms of sequence is specified within two subgroups: Lineal sequence and ramified sequence.

- Type C (7 cases out of 102) is formed by central layout cases. In this type, the direction of the movement is described when talking about sequence. In this way, there are centrifugal cases (C1, 3 cases out of 7) and centripetal cases (C2, 4 cases out of 7).
- Type D (49 cases out of 102) is formed by cases with hierarchical layout, where the use of the areas is divided clearly in exhibition space and public space.

Table 5. Interior conditions types.

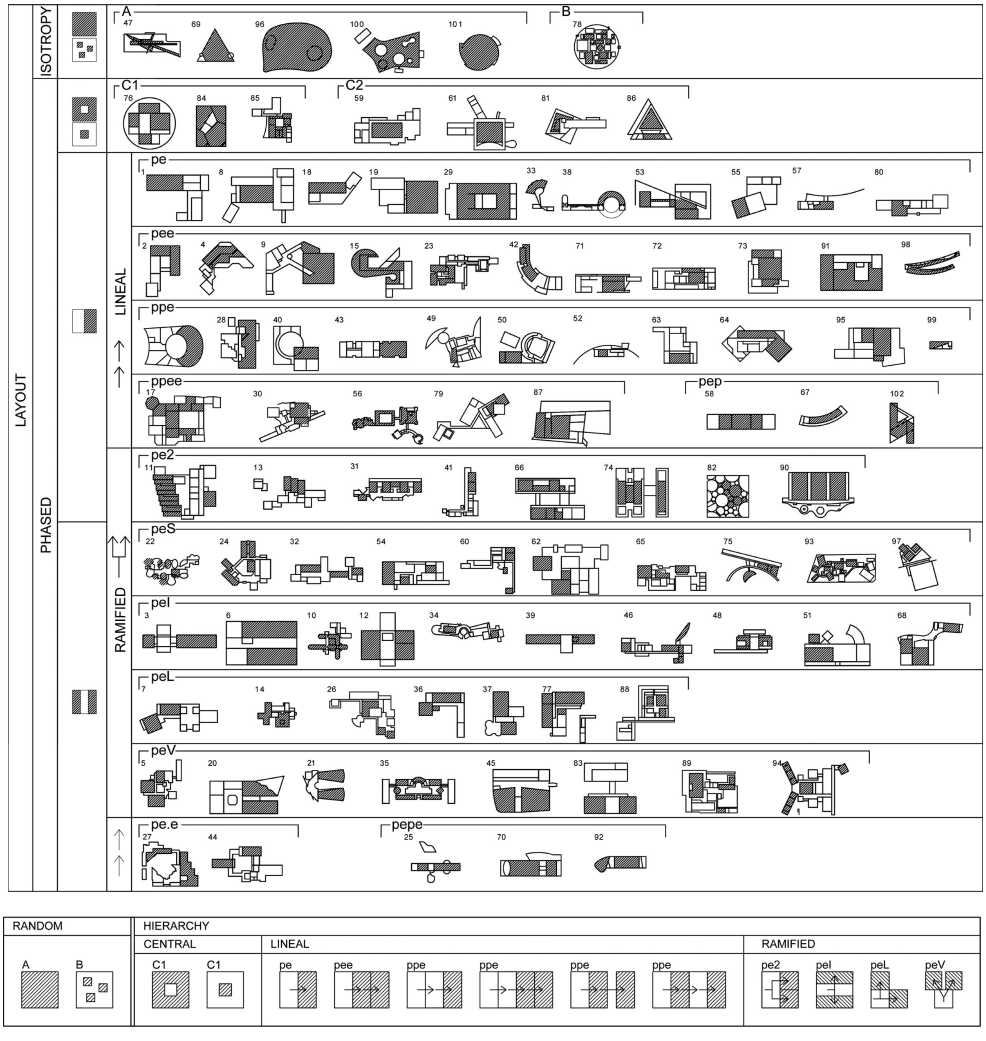
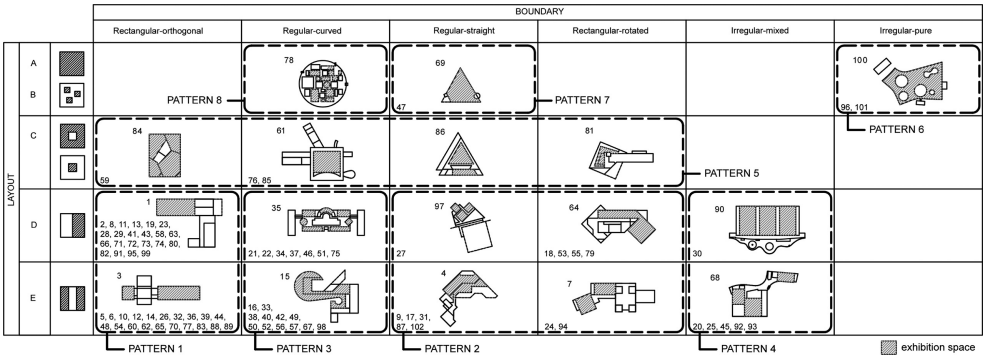


Table 6. Boundary-Interior connections patterns.



- Type E (40 cases out of 102) is formed by cases with hierarchical layout, where the exhibition space areas are divided in two or more areas and connected by public space areas.

3.3 *Boundary-interior connections*

Once cases have been analyzed and classified based on their external boundary and interior conditions, the resulting typologies are combined and eight patterns are created and defined as shown on Table 6.

- Pattern 1 (44 cases out of 102) is formed by cases with a rectangular-orthogonal external boundary and D or E layout.
- Pattern 2 (16 cases out of 102) 2 is formed according cases regularity and straightness (regular-rotated and regular-straight boundary types). This group presents D or E layout.
- Pattern 3 (21 cases out of 102) is formed by cases with a regular-curved external boundary and D or E layout.
- Pattern 4 (8 cases out of 102) is formed by cases that present an irregular-mixed external boundary type. This group also presents D or E layout.
- Pattern 5 (7 cases out of 102) is formed by central layout cases. The clarity of the central space organization and the regular shape of the boundary characterize this pattern, so the group is classified according to the interior distribution, presenting several different external boundary type compositions (rectangular-orthogonal, regular-curved, regular-straight and rectangular-rotated).
- Pattern 6 (3 cases out of 102) is formed by irregular-pure cases. They present a non-hierarchical layout organization type A, composed by a single exhibition space.
- Pattern 7 (2 cases out of 102) is formed by regular-straight cases. They also present a non-hierarchical layout organization type A, and composed by a unitary space.
- Pattern 8 (1 case out of 102) is formed by a single case (case 78, 21st Century Museum of Contemporary Art) and is consider an exception for been composed by multiple exhibition spaces. This case has regular-curved external boundary type.

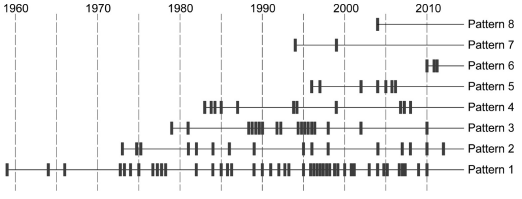


Figure 2. Timeline groups distribution.

3.4 *Timeline*

Finally, groups are analyzed in terms of time (Fig. 2). Cases are plotted along their group timeline according to the year when they where built. A progression in the timeline from pattern1 to pattern 7 can be noted, giving some clues about concepts evolution. As an overview, results suggest a tendency for the use of organic shapes in the boundary conditions and the preference for non-hierarchical plan layouts, allowing museums design became more dynamic.

The comparison between patterns 1 to 4 indicates that, within the same static and phased layout (D or E), an evolution through time from regular to irregular shapes can be noted. Whereas pattern 1 rectangular-orthogonal boundary type characteristics continues over time, cases with irregular boundary conditions are appearing during the last analysis years. This means that some cases, even if they follow the tendency on external boundary for including organic shapes, the layout configuration remains static according to the previous years patterns. For example, case 20 (The Museum of Modern Art of Saitama, 1983) presents a irregular-mixed external boundary and E type layout (code 0M-ERpeV). By contrast, some of the regular boundary type museums that had been built in the last two decades (Patterns 5, 6 and 7) show a significant change with regard to the layout configuration, having more dynamic compositions (A, B and C layout types). For example, case 84 (Kanno Museum, 2005)

has a regular-orthogonal external boundary and a C1 layout type.

4 DISCUSSION

From the typology viewpoint, a clear grouping is shown: Cases related to classical architecture understanding are characterized for having a regular boundary and hierarchical formation layout (Patterns 1, 2 and 3). Pattern 4 also shows a hierarchical layout (D or E), but with different external boundary (irregular-mixed). Central layout (Pattern 5) is related to changes at the external boundary composition, but with a strong involvement with the interior conditions. For patterns 6, 7 and 8, cases have an isotropic layout, but the big differences in their external boundary conditions give us the need of split them in tree different groups. Patterns 6 and 7 cases have a common characteristic: To be formed by a unitary exhibition space. Pattern 8 composed by case 78 (21st Century Museum of Contemporary Art) must be underline for being a singular case formed by several exhibition spaces, presenting a regular-curved plan boundary and, at the same time, having a layout composition that suggest the release of hierarchical order.

From the timeline viewpoint, the result show that regular-orthogonal boundary type with static phased layout type (Pattern 1) prevails over time. For the next groups (Patterns 2, 3 and 4), the changes in the external boundary had been included gradually through time. There are also some regular boundary type museums that have been built in the last two decades (Patterns 5, 6 and 7) showing a significant change with regard to the layout configuration, having more dynamic compositions (A, B and C layout types). The timeline analysis suggests some tendencies with special emphasis on the use of organic shapes in formal design and the intention of finding non-hierarchical plan layouts, so architects are trying to develop new ways of designing compared with the previous years conception of art museum. This can be interpreted as an attempt to design according to the new social reality where art is observed according to the user mood and freedom of movement.

5 CONCLUSIONS

The characteristics of contemporary Japanese art museums in terms of external boundary and interior layout have been examined. First, cases plan configuration was defined as parti diagrams, as a way to find formative ideas and architects intention. Second, diagrams where analyzed according to the different concepts definitions. Third, classification in terms of external boundary and interior conditions was made. Finally, applying comparisons and connections of these typologies, patterns had been clarified and some tendencies outcome from the timeline analysis.

As an interpretation, we can find there's a change from more regular to more irregular forms in the external boundary analysis of Japanese art museums. There's also a tendency from more stable to more dynamic interior plan layout, attending to the new way of enjoying art.

Additionally, the results show some possibilities for plan design and program distribution, and also give a clue for establishing connections between them. This study provides a basis for further work to deepen on other architectural Japanese art museums elements and concepts, such as daylight, materials or environmental analysis.

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Japanese spirituality, flexibility and design: Influences and impacts on agile architecture + open building

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ABSTRACT: Contemporary times can be characterized as turbulent, shifting and uncertain. Rapid urbanization and dramatic intensification are coupled with technological leaps and a call for sustainability. Conventional architecture was typically purpose-built with limited concerns about adapting downstream to new users, different purposes and altering conditions. Today however, with climate change, different demographics, resource depletion and affordability challenges, it is argued that building plasticity is urgently needed (Sinclair, 2015a). Rather than having people adjust to static spaces and places, next generation architecture must be dynamic, responsive and adaptive to needs, circumstances, culture and context.

Japan is a country that has historically approached extreme demands on space in unique, innovative and successful ways (Sinclair, 2015b). In this island nation with inadequate resources, large population and limited legroom, environmental design has assumed directions that explore and overlap inside with outside, pragmatics and poetics, and the sacred with the profane. Spirituality is pervasive in many dimensions of everyday living, including in the design, construction and occupation of architecture. Powerful Buddhist concepts such as emphemerality, impermanence and non-attachment have had demonstrable consequences on the theories and practices of design. Traditional Japanese housing, for example, deploys tatami mats and shoji screens to afford infinite degrees of mutability, plasticity and change. Spaces shift in size and function. Borders blur between interiors and landscapes. Proportions swing, walls move and movement becomes fluid. The architecture accommodates fluctuations in need, intention and experience.

For a wealth of reasons it is argued that architecture of the 21st century must approach similar levels of flexibility and adaptability. Rather than demolishing buildings to bulk up landfills, our architecture should be developed for disassembly, redesign, reassembly and reuse. The present research, following from focused literature reviews in Architecture and Spirituality realms, examines housing & commercial (both historic and modern) case studies from Japan. Included in the methodology is a critical examination of Japan's open building movement, undeniably a leading edge strategy for introducing greater choice and freedom in design, delivery and dwelling. A series of qualities, variables and approaches are delineated that hold relevance, and provide lessons, for agile architecture more broadly considered. Building upon the analytical aspects of the present research, a model is then synthesized and presented, suggesting a novel path for next-generation architecture.

At the present juncture architectural theory, education and practice needs to grapple with unprecedented demands, unforeseen complexity and a call for much greater responsibility. Within this milieu agile architecture stands as one viable route to meeting such charges. The author contends that Japan's proven methods for environmental flexibility hold tremendous value beyond Japan as we struggle to make our cities, blocks, buildings and interiors more mutable, adaptable, responsive and responsible. The present paper draws unique connections between agility (e.g., Open Building) and spirituality (especially Buddhism), while concurrently expressing the need for other nations to learn from the design accomplishments of Japan. Emphemerality, impermanence and non-attachment prove highly pertinent notions in the new millennium as we strive to reposition architecture from static to dynamic and from fixed to flexible.

Keywords: open building, agility, architecture, Japan, Buddhism, change, society, sustainability, design

1 INTRODUCTION

> *"The spaces of the contemporary city are characterized by fluidity, multiple layers and phenomenality; these also happen to be the characteristics of microchips.*
>
> *(Toyo Ito, 1994)*

Modern society is intensely complex, both at the local level and on the global stage. Rules and regulations, while often established for safety and security reasons, commonly spin out of control as one face of daunting bureaucracy. Depletion of resources, rapid urbanization and a collective call for greater environmental accountability introduce wicked problems into realms

of design and planning. Technology proves a blessing and a bane, with many contemporary crises fueled by state-of-the-art products and processes yet frequently solvable only via deployment of these same systems. While a century ago many problems were comprehensible and localized, today many problems are incomprehensible and universal. Without question the facets to be considered, and the variables to be managed, have exponentially cascaded to the point where we often are uncertain how best to begin and confused regarding where best to intervene.

Within this milieu architecture is routinely viewed as progressive and leading. While there are undeniably moments of innovation and edginess, the author argues that in general the profession is more conservative than it could, should and must be, especially considering the high stakes presented in today's ethos. A major concern of the present paper is the static nature of design and planning outcomes, and in particular the general inability of our products to shift, morph and mutate based on quickly changing requirements and demands (e.g., human needs, environmental conditions, financial forces, etc.). Today's buildings, for example, deploy approaches (e.g., development, organization, production, operation, etc.) that are in many ways similar to those utilized over the past century. Despite remarkable advancements in material science, information technology, and systems performance, many projects are designed and constructed in old-fashioned ways, with antiquated means and with permanence in mind.

The rigid nature of design and construction translates into architecture that is not easy to change, into interiors that can't readily adapt, and to the burden of responsibility for accommodation placed on users of environments rather than the environments themselves. Such conventional posturing is especially seen in North America where the design, development and construction industries are intensely fragmented, fractured and arguably less than optimized. However, in some global jurisdictions, such as the Netherlands and Japan, great strides have been made in both theory and practice concerning models for more flexible and mutable interiors, buildings, blocks and cities. Falling under a series of monikers, most notably Open Building (OB), such approaches consider building systems that cooperate (interoperability) together yet which retain separate identity and component integrity. The sub-systems or components differentially respond to such factors as anticipated life-span, ease of change, levels of complexity and shifting use.

Japan is the main focus of the present paper, which looks at how spiritual and philosophical tenets have informed and influenced a societal embrace and a move to more flexible design and agile architecture. In particular the presence and principles of Buddhism are critically examined in light of Open Building strategies. Qualities of spiritual practice, such as the illusory nature of reality and our perceptions of solidity versus fluidity, have shaped both Japanese designers and the consumers/end-users of the resultant designs.



Figure 1. Modern 'Traditional' Room in Japan.

There are many lessons to be learned by Western architects, developers and builders, and especially so given the dramatic pressures to be more responsible, more accountable and more sustainable. Design needs to respond to the ever-changing needs of users and communities, versus having these users adjust to arguably inappropriate and ineffective static and staid environments. Interiors, buildings, blocks and cities need to be far more dynamic and accommodating, in many ways responding sensitively and sensibly to the volatile, uncertain and constantly fluctuating features of modern societies.

2 JAPAN + DESIGN

> *"If there is to be any order of beauty in the age of life principle, it will be in a dynamic balance that maintains its order, while always moving, roaming and changing."*
>
> *(Kisho Kurokawa, 1995)*

Space in Japanese culture is fundamental to design, dwelling, working and living – the nation assumes very different ways of understanding and approaching space compared to the West. As an island society with limited resources and large population, space is particularly precious and valued. Many families in Tokyo live in a fraction of the residential space that counterparts in North America might enjoy. Japanese society lives with high density and crowding as a simple fact of coping with a significant population on a less significant land base. The metropolitan area of Tokyo is home to more residents than the entire country of Canada. In Japan psychological, cultural and social norms have developed that permit so many people to live in such close proximity. Personal space is tight and crowding is commonplace. Expectations for resources are relatively low while conservation and reuse is unquestionably high. Architecture and design support the need to live in confined spaces and tight places, and mechanisms of design work hard to make the tight feel more expansive and the small seem larger. Vehicles such as choreography of path and control of view (including the so-called 'Zen view') are vital in the quest for promoting comfort, pursuing beauty and seeking harmony (e.g., between people and environment; between the built and the natural, etc.).

Form and materials are important in Japanese design, interplaying in balance with the significance and meaning of space. On the material side, Japan is known as a 'wood' culture due to the historical access to timber as a primary building material. The structural qualities of wood, with its limited spans, gave way to a post and beam construction system. The manner of building homes and temples, with complex joinery and regular grid layouts, fostered the rectilinear geometry that is so prevalent in historic Japanese architecture. From this building approach arose many aspects of Japanese design that are now well known in the West, including perhaps most significantly the interconnection and mutability of spaces, the use of infill panels (most notably the shoji screens), and the creative control of perspective to shape perceptions. Nishi and Hozumi (1983) describe qualities of architecture arising through reliance on post and beam construction: "There is, moreover, a fluidity in Japanese architecture between inside and out. Though fixed walls are frequently used, the distinction between wall and door is very elastic, and whole facades in both temples and residences can be opened to the elements at will by folding open or swinging up the panels between posts or by sliding open, or even removing entirely, the wooden or paper screens." Such historically embedded understanding of space has had demonstrable impacts on modern architecture in Japan, including on designers' willingness to pursue agility.

In Japan there is an important concept known as *shibumi*, which in essence translates as an unassuming elegance and conscious reserve. When shibumi is elevated it invokes what is called the beauty of *wabi sabi*. *Wabi* is about the wretched, forgotten and forlorn while *Sabi* is about the 'rust' of age. It is arguably in the union of *wabi* and *sabi* where Japanese design becomes most compelling and aesthetics most remarkable – where the simple, the unaffected and the elegant coexist. We find this search for beauty, and the invocation of *wabi sabi*, deeply rooted in the traditional Japanese arts of *ikebana* (flower arranging), *bushido* (the way of the sword), and perhaps most notably *sado* (also referred to as *chado* or the way of tea). For the purposes of this paper, each of these 'arts' include strong temporal, and ephemeral, qualities. While preparations and reflections are inherent and valuable, it is the moment that proves especially critical. Certainly such concepts loom large in the efforts of Japanese architects and landscape architects, especially in their search to impart beauty, tranquility, mutability and meaning in an ever-escalating modern milieu of technology, urbanity and uncertainty.

One critical aspect of Japan, that informs and inspires design, is the deeply rooted spiritual history that underpins the culture. Shintoism and Buddhism are inextricably intertwined in the society, with ramifications witnessed over a spectrum of endeavours from business and the arts, to education and politics. The Zen notion of *mushin*, or 'no mind', is a good example. Without a mind one is rendered without a self. Without a self one is afforded great freedom from the many trappings and seductions of common existence – inching ever closer to escape from the vicious cycle of suffering Buddhists call *samsara*. Ideas around and implications of 'non-attachment' loom large. Japanese design and architecture often seeks such release from trappings and clutter, electing instead for the simple, the austere and the unadorned. The Japanese term *kanso* acknowledges the importance of simplicity of design, akin perhaps to German modernist architect Mies van der Rohe's famous dictum "less is more".

Modern Japanese architecture, perhaps most notably in the work of the Metabolists and inspired by deeply-rooted philosophies (Kurokawa, 1995), pursued ideas of reconfigurable form and space in a new era of technological, material and societal revolution. Coupling simplicity of design and economy of means with the need for fluidity and mutability in environments, Japanese architecture has historically, and continues to, acknowledge and respond to the need for users and their built realm to exist synergistically, to transform as conditions shift, and to be less about solidity and more about fitness.

3 FUNDAMENTAL CONSIDERATIONS

> *"People are very open-minded about new things – as long as they're exactly like the old ones."*
>
> *(Charles Kettering)*

The central topic that this research paper explores is the connections and relationships between the tenets, philosophies and features of Buddhism in Japan and their influences and impacts on flexible architecture and planning. To address the central curiosities of this paper, the author critically reviewed the literature on both Buddhism & Open Building (OB), and visited/studied numerous agile projects (e.g., Kikou Skeleton Infill [KSI], Next 21, Muji, Sekisui & Toyota housing, prefabricated housing + others) with a view to establish some links and connections.

While previous studies have explored the role of Buddhism in shaping Japanese design more broadly, the present paper is particularly concerned with implications on more mutable (i.e., agile) contemporary architecture. Without question historical design approaches have been influenced by spiritual and philosophical views of humankind's place in the cosmos, including the illusory nature and transitory character of existence. We see in the traditional Japanese dwellings many connections to such viewpoints, including for example, the blurring of boundaries of realms (e.g., inside versus outside) and the infinite permutations (e.g., a meeting room transforms to a bedroom). Limited study has been focused on the role of the spiritual underpinning of Japanese culture on the development of agile approaches to modern buildings.

Present research underscores that such design is undeniably an outcome of prevailing world and self

views. It is important to stress that while designers and architects have pioneered this agility in buildings, the broader societal acceptance of the approach has permitted it to grow and flourish. It is quite difficult for architects in the West to easily understand the motivations and forces shaping this agile architecture, especially given the West's subscription to science and technology at the expense of other ways of seeing, thinking and acting. However, the author contends that being open to this approach, and grasping some of the drivers behind greater agility, could translate into more responsible, responsive and sustainable projects beyond Japan. Some serious shifts in mindsets and methods are, of course, fundamental in this regard.

4 OPEN BUILDING

Modern architecture can arguably be seen as conventionally generating buildings of rigidity, and inflexibility, with designs unable to adapt to changing needs and with limited integration of inherent systems. Such buildings, unable to be effectively retrofitted and easily renovated, have all too often seen demolition only to become one of the most significant contributors to our landfills. Open Building, as an evolving architectural methodology, allows our buildings, similar to ecological systems, to shift and adjust over time. Embedded flexibility enables such buildings to adapt to different circumstances and be mutable in terms of systems upgrades and ongoing maintenance (Kendall & Teicher, 2000) – hence, in the larger picture, they prove more resilient and less wasteful.

The adaptability in OB has become possible through separating the structure or 'support' from the interior or 'infill' – in essence ensuring that the systems in a building are independent yet inter-related (Habraken, 1999). This innovative approach challenges the typical 'entangled' systems in conventional buildings and provides much greater degrees of flexibility. John Habraken (1994) introduced 'support' and 'infill' as new categories among existing levels in his theory of "decision-making levels in the built field". In this theory, Habraken divides the built environment into different aspects that have varying lifespans and across which the decision-making and control is delegated to different parties. In these various 'environmental' levels, users have the ultimate control over the 'flexible' interior or infill level to adapt it to their own needs and desires. In this system, 'support' is the continuation of urban fabric in the third dimension (Habraken, 2008) – its longer life-span and relative permanence supports stability with respect to long term community interests while 'infill' accommodates change in respect to individual preferences in the shorter, more immediate, term.

Debatably Open Building's century-old history has been more dedicated to the technical development of 'support and infill'; while the discussion over the design, character and aesthetics of these buildings have been largely overlooked. In a previous paper,



Figure 2. Next 21 Open Building Project, Osaka Japan.

the current researcher introduced the notion of 'aesthetic flexibility' (Safarzadeh, Mousazadeh & Sinclair, 2011) as a complementary concept to already established notions of 'spatial flexibility' and 'functional flexibility'. The notion of 'aesthetic flexibility', as a novel dimension in OB theory, holds promise to celebrate 'identity', foster 'customization' within the OB design equation, and strengthen built outcomes. The idea of 'aesthetic flexibility', in the author's sense, applies to two different levels in the theory of "decision-making levels". First, it applies to the 'infill', which allows the users to adjust their interior environment according to their changing spatial needs but also modify it to reflect their personal character, culture and aesthetic preferences. Second, it applies to the façade of the building, which interestingly lies between the domain of community interest and individual preference. Consideration of such duality is arguably a crucial and innovative step in the evolution of Open Building. The concept of 'aesthetic flexibility' further positions itself within a broader understanding of the design & construction milieu, including a significant resonance with the notions of and frameworks for Agile Architecture and Holistic Design + Planning (Sinclair 2009, 2010, 2012).

5 BUDDHISM

In Buddhism there is strong awareness of the illusion of permanence – that is, we construct and perceive our lives in a manner that suggests solidity, stability and predictability. All of this understanding of permanence however is mere folly, for the world and our lives are in constant change. What we accept now as reality is merely our best interpretation based on available knowledge, stimuli, past experiences and guesswork. Japanese culture accepts that life is ever-changing, and that a path that acknowledges the frailty & vulnerability of our journey, and the uncertainty of our path, is wise and reasonable. Zen teaches that in the midst of unpredictability, disorder and delusion one is well

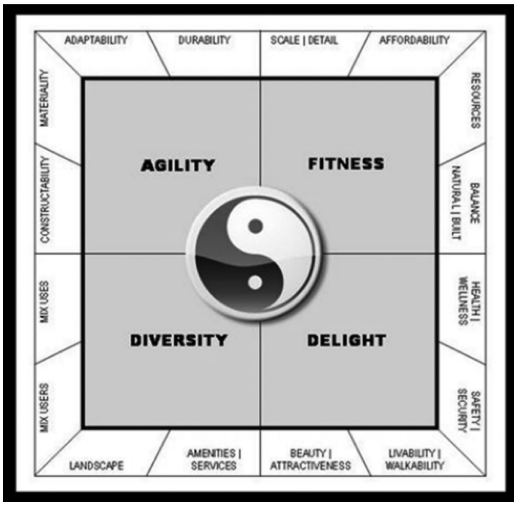


Figure 3. Sinclair Holistic Framework for Design + Planning.

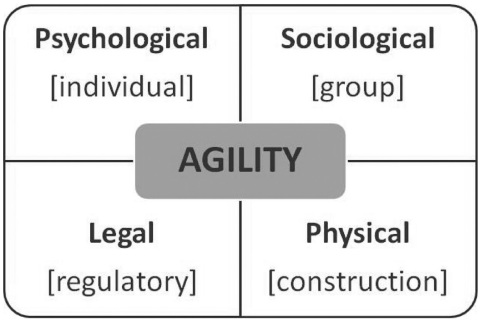


Figure 4. Sinclair Agility Framework.

advised to make things as simple as possible. The goal of reducing one's environment down to its basics, to limit exuberance and seek the most minimal essence, is indeed noble.

While we see this search for simplicity, austerity and restraint in contemporary Japanese design, from Tadao Ando's awe-inspiring concrete churches to Kengo Kuma's masterful collages of glass, steel and wood, it is also clearly evident in far more modest fabrications, including the constructions of the homeless. The author has previously written about Japan's informal sector, delineating the 'temporary' housing of the day-labor class. Such 'architecture' is unquestionably accepting of uncertainty, mutable in nature, light on the land, efficient in operations, and effective in the provision of shelter that protects, nurtures and provides a rightful sense of dignity.

Japanese architecture, from both historical and contemporary perspectives, has encountered strong inspiration & influence from Buddhist thought. Spiritual notions of impermanence & ephemerality (*mujo*) impart a sensibility into design. Such impact is seen in the employment of cardboard and paper as building materials in the projects of contemporary architect Shigeru Ban. Concepts of layering, lightness, change, transience and the transitory can also been seen in the work of Arata Isozaki, Rei Kawakubo, and Metabolist master Kisho Kurokawa (notably his Nakagin Capsule Tower in Ginza). Taro Igarashi (2005), in his article "Kisho Kurokawa: Buddhism and Metabolism", noted that the architect's "…global view that creation and destruction run fluidly into one another has its roots in Buddhist doctrine." He adds that, "In the original language of Buddhism, *samsara* means 'to flow', and also means the combination of various states, expressed through the process of reincarnation." It is clear that the work of numerous modern Japanese architects celebrates many dimensions of Buddhist thought, including demonstrably the inevitability of change, a lightness of being, and the cycle of suffering common to all sentient beings.

6 CONNECTIONS + RELATIONSHIPS

> *"An empty space is marked off with plain wood and plain walls, so that the light drawn into it forms dim shadows within emptiness. There is nothing more. And yet, when we gaze into the darkness that gathers behind the crossbeam, around the flower vase, beneath the shelves, though we know perfectly well it is mere shadow, we are overcome with the feeling that in this small corner of the atmosphere there reigns complete and utter silence; that here in the darkness immutable tranquility holds sway."*
>
> *(Junichiro Tanizaki, 1933)*

Architectural and urban design in our modern ethos is ever more complex, driven in part through remarkable advancements in technology, in part through escalating regulatory demands, and in part by dramatic shifts in demographics, expectations and needs. Designers and developers of projects, across a range of scales, struggle to ensure relevancy, viability, potency and sustainability. To achieve such ends the exploration and application of Open Building theories and practices proves increasingly important. In reaction to static and immutable conventional environments (e.g., interiors, buildings, landscapes, etc.) Open Building and Agile Architecture methods foster a milieu of flexibility, modularity, adaptability and change. This vital notion of change has numerous dimensions, including key qualities that take account of the technical and the social. While the vast majority of research efforts have focused on scientific, technical and quantitative characteristics of Open Building, the present paper argues that the human, social and spiritual attributes are equally critical. Included in this latter set of pursuits is Buddhist philosophy that is richly infused and subconsciously pervasive in daily life in Japan.

In our quest for heightened mutability and adaptability of environments it is essential to consider

change in a broader fashion. While the technical capabilities of change in an environment can be developed and realized, such possibilities prove moot if the users of the resultant space(s) are resistant to adjustment, unwilling to take action, and reluctant to transform. In other words, the provision of flexibility in environments does not, de facto, translate into environments that will be modified by users. Key to the equation of greater mutability is not merely the ability of a user to effect change, but more importantly the willingness and desire to effect change. In the West change has not been a common part of many design equations nor of many constructed environments. In this way an embrace and adoption of more flexible and agile architecture in North America is an uphill climb. There are many fundamental ways of operating that need massaging and transforming if the design and development sectors in North America are to move towards greater mutability of our spaces and places.

The following Buddhist principles are worth considering in more detail when exploring agile architecture and open building:

6.1 *Ephemerality*

Ephemerality is in some ways the opposite of being concrete, being fixed and being set. It implies a lightness of existence and an ethereal quality. In the West our architecture often aims at being grounded, at conveying stability and communicating certainty. In Architecture schools we often witness the intense pursuit of iconic, monumental and over-bearing structures. Seldom in such settings do we see students encouraged to include changeability, to foster user-driven design roles, and to relinquish the architect's 'divine authority' to create and control. In contrast Open Building, in the eyes of the author, strives to address all of these qualities. Hence, especially in the West, the movement towards Open Building and Agile Architecture is viewed with suspicion, concern or even outright denial/dismissal.

6.2 *Impermanence*

Impermanence is a core principle of Buddhism, which holds that all of reality is in constant flux. To assume that any circumstance, object or being is truly fixed is truly folly. Life is a journey of constant motion and ever-changing situations. Each moment is distinct from those preceding and those proceeding. Uncertainty is a certainty. In Western approaches to design and architecture we are most comfortable, on many counts, with total predictability. Financing models, for example, are aimed at costing out projects at a fixed moment in time based on a set bill of materials. In many cases project capital costs exclude less rigid components such as moveable walls and furniture. Such narrow views then serve to limit any embrace of uncertainty and tend to preclude more agile, flexible models of development (including, for example, modularity and sometimes prefabrication). With skepticism abundant, and the role of architects and architecture rather entrenched in notions of permanence, it is easy to understand how the environment in North America has proven hostile to more mutable buildings. The author argues, in light of an urgent call for greater sustainability, that a deeper understanding of impermanence is important. Approaches aimed at a design for disassembly, deployment of modular building systems, and empowering users to modify their spaces and places, seems timely and worthwhile.

6.3 *Non-attachment*

Non-attachment involves our ability to distance ourselves from the material world in an effort to more fully understand ourselves and our reality. In the West our obsession with consumption and consumerism (albeit now growing rapidly in the East) make non-attachment an ellusive concept. North American marketing efforts tell us that "We are what we own". In design this translates into the role of buildings as status symbols, of products as instruments of power, and of Architecture as object. Non-attachment, as a concept of Buddhism in Japan, serves to weaken the link between the object as precious, as unchangeable and as primary. With space seen as ultimately changeable and the material world viewed as transient and detached (or detachable), architects and end-users are far more willing to accept buildings that might morph, shift, subside, reform and resurface.

7 SUSTAINABLE RESPONSIBLE DESIGN

> *Sustainability is a term commonplace in contemporary culture. The idea that we do no harm, and even that we might leave the world in better condition than when we found it, seems reasonable in principle yet incredibly difficult in practice. Globally, our populations are growing, our cities expanding, our technologies developing, our environments decaying, and our cultures destabilizing. Buildings are placed everywhere yet belong nowhere. Literacy increases. Yet crime spreads. Indifference grows. While compassion dissolves, internationalization advances. However, fragmentation proliferates.*
>
> *(Brian R. Sinclair, 2015)*

While few would question the environmental challenges confronting designers and facing civilization more broadly, it is remarkable that contemporary architecture and urban design remains so entrenched in conventional practices. Our landfills are ripe with construction waste, primarily with products of demolition. As cities change and grow, the built environments struggle to keep pace. The need for more and better space frequently translates into renewal, revitalization and redevelopment, which usually involves removing the old and building the new. Given the dynamic



Figure 5. Nakagin Capsule Tower Unit.

character of our cities it seems logical, and imperative, to conceive of and construct spaces and places that can twist and turn, adapt and adjust to shifting needs. Rather than building environments that are glued, wired and welded into single aggregations it seems wiser to assemble worlds that can readily be dismantled, reconsidered and reconfigured. We need a next generation of walls that morph as needed, floors that travel as required, ceilings that alter as called for, facades that flex, and systems that exist independently while operating collectively. If environmental design professions are serious about responsibility, accountability and sustainability, the author argues a dramatic change in design strategy is needed. If educators are to prepare graduates for more effective contributions, then studio pedagogy needs to jump from an obsession with the creator and his/her iconic creations to models that focus on the users of buildings and on environments that are quick to respond. If governments are keen to see optimization of resources and better management of finances then far greater attention must be paid to the way that environments age, accommodate, amend and repurpose. Agile Architecture, Open Building and Resilient Environments seem prudent directions to pursue given the tremendous pressures at play and the certainty of uncertainty in our complex, turbulent and often unstable world.

8 CONCLUSION

"What is called the spirit of the void is where there is nothing. It is not included in man's knowledge. Of course the void is nothingness. By knowing things that exist, you can know that which does not exist. That is the void."

(Miyamoto Musashi, 1645)

The present paper has considered the largely unknown intersection of, and relationships between, aspects of Japanese spirituality with key traits of Open Building. While previous research has exposed connections between Buddhism and traditional design in Japan, little consideration has been afforded to links between the country's leadership in agile architecture and Buddhist principles. The author argues that a number of over-arching tenets of Buddhism have played roles in facilitating and catalyzing such dramatic innovation in the design and development of spaces and places.

Fundamental spiritual principles, including ephemerality, impermanence and non-attachment influence daily life in Japan, albeit in often subdued and unconscious ways. Over many centuries a rich mix of Shinto and Buddhist practices have inspired and shaped culture. The conduct, and indeed the consumption, of design in Japan have likewise seen significant influence and impacts via such deeply embedded spiritual guide posts. With dramatic advancements of Japan after the Second World War, and given pressures to accommodate growth while addressing intense change, it is understandable how innovations in design were so aggressively pursued. With a bright yet unknown future in mind, many emerging architects in the 1960s and 1970s pioneered novel ways of crafting space, meeting needs, and addressing uncertainty. Subsequent designers pushed notions of flexibility even further, beginning to consider (e.g., Next 21) how the full development, including facades, might mutate to tackle shifting needs and emerging demands. Over recent years many efforts by Japanese practitioners, researchers, and government agencies have actively explored Open Building and experimented with agile architecture. Throughout this post-WW2 period it is argued that the intertwining of the spiritual and secular realms has had demonstrable influences upon architecture and design, including most notably on the ingenious and brave approaches of Open Building. The author contends that while the West has operated under very different circumstances, there are valuable lessons to be learned that could make architecture more responsive, responsible, accountable and sustainable. Spiritual notions of ephemerality, impermanence and non-attachment can be reconsidered and applied, in a secular manner, within design principles, pedagogy and practice beyond Japan. In an era and ethos of environmental urgency, the design world has much to learn and much to gain by migrating from the static to the mobile, from the fixed to the flexible, and from the rigid to the dynamic.

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The urban persistences and social traditions in the (re)creation of the Japanese urban modernity

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ABSTRACT: In a time of a constant urban and cultural transformation is imperative that traditions remain in use by society as a link between the past and the present. The problem is that the continuity of the traditions it isn't always a fluid and authentic process. But still it's possible to find in the present city values and routines that persist form the previous social layers.

So, the main goal of the study its to identify traditional scenarios and rituals that persist from Edo era to the present social experiences of Tokyo, her successor. The idea is to show different forms of appropriation of the public and private spaces that continue to be used as before in the local beliefs and culture of today. This hypothesis integrated in urban traditions can be shown, for example, in the relationship between the Shrines and Temples with the local communities through religious rituals, festivals and ceremonies.

1 TRANSITIONS AND PERSISTENCES FROM EDO TO TOKYO ERA

Since the late nineteenth century that Japan is in the process of building a new identity with the production of hybrid forms of heritage, based on precise values of the past that are adapted and reproduced in building a "Japanese Cultural and National Identity". In this context, spaces are lived in the image of an "authentic" identity of the past, returning to an origin that is intended to value and lived by today society.

The profound changes occurred in the Meiji period (1868–1912) and after the 2nd World War (1945–1952) have introduced in Japan new ideas and concepts that imposed a forced redefinition of a culture that defines itself according to traditional values. That is, Japan lives since then the dichotomy between modernization and the preservation of his past, or between the innovation and the safeguard of the traditions. The sequent Japanese societies over time have created and idealized the past traditions, "as an ideological for present conceptions" of a Japanese way of life (Scheiner, 1998).

In Tokyo, the complexity between the old and the new it's a constant characteristic that determines the diversity in a very homogeneous urban texture. The previous layer of the city appears in small spaces between the current urban fabrics. In this confrontation, lies sometimes the construction and reproduction of elements that redefined the relationship between society and their history. This interaction allows the invention of traditional spaces that society embraces as heritage in our days (Hobsbawn, 1983).

For Eric Hobsbawm the "historical continuity" results from the invention of the traditions as a creative process of adaptation to a new cultural environment. The creation, the invention of traditions, emerges in time in fast social transformations that destroy the patterns of the traditions, producing automatically new ways to adjust the inadaptability of the society to its previous meaning and use.

The creative process of remaking the traditions may involve: the break with the past to claim new a tradition; the construction of a new element fully copied from a past shape, creating a "false historic"; or through the repetition of past characteristics and shapes in a new environment.

The "invented traditions" are imposed formally in the present as rituals of a lived past. A past adapted to current uses or that serve as examples to new identity and cultural perspectives (Hobsbawm, 1983).

The reuse of the traditions that haven't been "relived" or "invented", if they aren't deliberately adapted may represent a resistance to innovation. Traditions are often (re)invented from a "routine" or a "convention" of the common sense and not from an ideological meaning. Hobsbawm points them as a social resistance to the transformation of the cultural habitat by new concepts and rules. But, in practice when an object "symbolic" or "ritual" reaches its uselessness by saturation, it can't be re-used or transformed.

For example the invention of the "traditional" Japanese castles in the 80s representing architectural models of a feudal period from the seventeenth and nineteenth centuries; or the gardens that are no more than reinventions that copy different forms like places, artefacts and buildings to sustained the Japanese memory and history.

So, how does the Japanese society adapts to the evolution and modernization of the city, especially in a period of globalization, keeping intact its cultural and architectural traditions and identity? How does the "traditional" city adapt to the twenty-first century keeping the past intact?

The urban landscape of the contemporary city can be considered as a scenario of close relations between the monuments and the people, a urban framing made from the reciprocal relationship between the history built and society.

The urban landscape is understood here as a process of contextualization of collective memory, relationship of the observer with the built environment (buildings, public spaces and monuments), which affirm concepts corresponding to the identity of the place time.

The cities of Edo and Tokyo were made between hills and rivers, urban spaces created in communion with nature. The first was build as a castle town, extremely ruled by a hierarchical system, organized in different districts: the "upper town" created as a "green city" for the high samurai class and the "down Town" in a relation with the water front, populated by a lower-class samurai and common people.

Tokyo, in turn, grew on top of the urban fabric produced by the old system, keeping it largely intact. What have changed in this new city were the political systems, the war destructions and the cultural external influences that affected the social experiences, the design and the materiality of urban space.

Beyond the urban structure, hills, rivers and green landscape it's still possible to find a few reinterpretations of the old social habits like the yokocho-streets in Shinjuku or Ueno district areas (Fig. 1–2). The streets are filled with markets, "Sake" drinking establishments, yakitori restaurants and karaoke bars that transform Tokyo social behaviour from a day business life to a human city by night. But some times this is seen, as a "stain in the grime of history" as Hidenobu Jinnai says in is work "Ethnic Tokyo" (Jinnai, 1991).

The vernacular traditions have been used to provide the present with traditional images, long after the transformation caused by the modernization of the nineteenth century, including wooden-houses and spiritual buildings, even clothing and social identity (Sorensen, 2002).

2 INFLUENCES AND URBAN REFORMS: OUTLINE OF JAPANESE HISTORY

The multiple influences of the West cultural societies allowed the establishment of architectural and urban values that are recognized as identities of the historical image of Japan. Among others it can be highlighted the influences of the Chinese culture between centuries VI and XII in the production of urban and local arts as well as in the definition of spiritual values, for example the introduction of the Buddhism in the Japanese religious culture.



Figure 1. Shinjuku Omoide Yokocho. Surrounded by a big cosmopolitan city exists within the urban blocks narrow and winding old streets, part of a network of alleyways with small bars and restaurants.

According to Hideto Kishida[1] the inclusion of the "foreign arts" in the Japanese society allowed the improvement of what he entitles as "beauty of proportion" and exemplifies with the Buddhist temples Shitenno-ji, Hōryū-ji and Hoko-ji (Kishida, 1935). Another example of this influence are the cities of Nara (Heijō-Kyō) and Kyoto (Heian-kyō), two old imperial capitals that were planned according to a Chinese urban system characterized by a regular orthogonal

[1] Hideto Kishida in his book "Japanese Architecture" makes a characterization of the Japanese architecture organised in a "chronological classification of architecture in Japan". The chronology is divided into three major periods: the first period (660 BC – 551 AD) is the introduction of Buddhism in Japan by the Chinese. According to the author there was no specific style that features buildings or urban ensembles; the second period (552 AD – 1867 AD) extends from the introduction of Buddhism to the Tokugawa Shogunate, corresponding to the "Buddhist style" period; and the third and final period (1868 –... AD) extends to the present the one corresponding to a period of profound influence of the West in the production of the arts and the city itself in Japan. Simultaneously he makes a characterization of the different architectural typologies of the Shinto Shrines, Buddhist Temples and Japanese architecture in general.



Figure 2. The Ameyokocho Market was built after the Second World War and was used by the American soldiers as a black-market. The market is located under and beside the Yamanote rail line at Ueno.

mesh structured from the Imperial Palace in the centre.[2] On the other hand, comparing with this strait Chinese system, the Japanese "Castle-town" demonstrates an asymmetric and irregular urban growth.

The "Castle-Towns" are a typical Japanese urban settlement, originated in the Tokugawa period and its major examples are the cities of Edo (Tokyo), Osaka and Nagoya. This method is the result of the establishment and affirmation of the Samurai class from the twelfth century to the beginning of the seventeenth century.

The organization of these type of urban layout, corresponded to a extremely hierarchical and military system organized into three segments: the "Inner Castle" represents the power with the houses of the feudal lord (Daimyo or Shogunate) and the most important Samurais in the society; the "Outer Castle" for the second-class samurai surrounded by areas of common people (peasants, artisans, merchants); and, the third, in the peripheral areas existed the monks with the Temples and Shrines.

While the interior it was highly organized its urban and peripherical context grew without planning, with an asymmetric growth. During the XVII century the "Castle Towns" overlapped existing fortified structures, taking advantage of easy defence sites that already contained some business functions, population, agriculture and communica-tion areas such as rivers and roads (Jinnai, 1995).

In this sense, it was in the Tokugawa period (1603–1867) that were made the firsts urban reforms of Edo. In the year 1600, with the Shōgun Tokugawa Ie-yasu (1543–1616), were changed river courses, built new communication routes between the center and the outline prefectures, urban expansion to north with the earthmoving of the Mount Kanda and to south with landfills in the city's bay, and the reconstruction of the castle using part of the existing functional structure.

A second renovation took place in 1657, after Meireki fire, involving the rebuilding and the displacement of shrines and temples from the downtown area for the uptown of the city. This process permitted the constructions of "major highways" that connect the center of the city with the peripheral areas. The approach streets to temples and shrines began to be built between the houses (Jinnai, 1995).

With the end of the hierarchical feudal system in the Meiji period (1868-1912) it happened a new reform of urban space. The new "Imperial restorations" were the beginning of a deep restructuring of the political, social and territorial system. The physical process of modernization of this "new" imperial city, Tokyo, was designed based on western guidelines but with the necessary adaptation to the Japanese culture. For example the downtown was reorganized as a Central Business District according to projects developed by German architects, English and Japanese. This reorganization involved the dismantling of parts of the castle fortifications to use stone in the construction of bridges, the occupation of the south land that were before in daimyo control for installation of government infrastructure and the construction of the first public park in western style Kasumigaseki, Hibya Park (Cybriwsky, 1991).

Between 1872 and 1923 the city is marked by a series of catastrophic events, fires and earthquakes, imposing a new transformation of the urban image of the city. However, these events and changings also represent the addition of new architectural and urban concepts that allowed a gradual modernization of the city's infrastructure.[3] During this period was developed the "Archi of Japanese Taste" joining a certain revivalism influenced by the Renaissance and Gothic architecture in Europe and the symmetric clearance of the modern movement. Among other examples was built the Nihon-Ginko (Bank of Japan) in 1896 and the Tokyo Station in 1914, both designed by the architect Kingo Tatsuno, and The Imperial Hotel, design by Frank Lloyd Wright in 1915.

In the city's reconstruction process after the 2nd World War (1939-1945) was introduced the memory as a mark of the recent past, a symbolic idea of the national commitment to the reconstruction of their own identity. For example, were built new memorials, valued the ruins as physical memories of an past

[2] With the ascension of the capital Nara in the VII century the influence of the Chinese arts resulted in the development of the Japanese "arts and crafts" and the in the introduction of a new urban system by coping the Imperial style of the "Changan Palace" in China. In the sequential dynasties the Chinese arts influence the architecture and landscape of the temples, especially in the Heian period, like the Kongō-Buji and Enryakuji on the Hiyei Mount; in the Kamakura period it was introduce the Zen Buddhism as a spirit and concept to the conception of architecture, the Shari-den of the Engaku-ji temple its an example; or the temples built in the Momoyama period as a Kamakura revivalism, rich in colour and carved decorations, as exemplified by the Zuigan-ji near Sendai.

[3] Among other events, the 1872 fire preceded the urban plan "the Tokyo city ordinance improvement" and the construction of the "Ginza Brick Quarter" designed by the architect Thomas Waters.

event and built new cultural symbols, as exemplified in the memorial A-Bomb Dome[4] in Hiroshima and, in a sense, the 1964 Olympic Games.

From the 80s was reintroduced the "revival" style in the architecture with the construction of neo-classical elements or neo-mannerist such as the Tsukuba Civ-ic Center, designed by Japanese architect, Arata Isozaki. The project is a reproduction of Michelangelo's Piazza del Campidoglio in Rome and shows somehow the appetite for the past forms rejected by the modern movement.

Currently the transformation processes of the city are related with the active super real-estate market that keeps the urban spaces in constant revolution. The curiosity of this process is the ability of the urban fabric to blend in a rhythm of advances and retreats between the public and private space.

Despite the approach and influences of the West in the production of the Japanese heritage or in the continuous globalization and transformation of the cities today, some culture practices still prevail in a local level. These events are connected in many cases with their spiritual believes that keep alive the culture identity in the relationship between the society with the shrines and temples.

3 SHRINES AND TEMPLES IN THEIR URBAN AND SOCIAL CONTEXT

The cultural significance of the shrines and temples and their importance in the organization of the urban space and local life experiences imposes a brief morphological analysis to their relationship with the urban and social context.

In the Edo period these spiritual spaces were located in the peripheral areas and along the main axes of the city's output, mixing the urban space between religion and the profane, promoting urban expansions and, above all, military defence. These areas were organized in a close relationship with their neighbourhood, according to their nature and usefulness. They were build in wood, some times in a agriculture environments, placed outside of the settlement and on top of small hills surrounded by forests as costume of the "Japan's ancient community structure (Fig. 3–4). The mountain shrine, plain shrine, village and field shrine, as models of developing farm villages spaces, were transferred to the structure of the shrine grounds, formal approach, gate and surrounding neighbourhood in the urban context" (Jinnai, 1991:61).

Before the opening of Japan to the West culture these sacred spaces were also consider as "green parks" in a near concept to the public space of a Western garden. But, none of them corresponds to a true concept of public space because they are private and without influence of uses and public administration. In the Meiji period some private gardens belonging to daimyo residences or sanctuaries were transformed into public spaces. Unfortunately, some of these areas have been reduced with the urban growth since then.

The particularity of these spiritual spaces before the Meiji period is that as the city grew they were successively displaced to the new areas of expansion. However the action is not synonymous with a physical displacement of the original building but the change of the religious community from the old building to the new one (Jinnai, 1995).

Despite the continue transformation of the urban fabric and landscape of Tokyo, the structure and organization of the shrines in the Edo period are still preserved in the present days. Despite being integrated within the urban blocks they are still evolved in the mythical relation between man and nature (mountain/forest), symbolic representation of the ancient sacred spaces. But, in many cases this relation it was produce or fabricated by man him self, as demonstrate by the inner-precinct forest of the Meiji Shrine in Tokyo built in 1920 to emphasize a political symbol with an idea of a national, traditional and sacred space (Imazumi, 2013).

Their relationship with the urban environment is in many cases made through a long and thin avenue that connects the city to the religious complex, passing the main entry (Torii) in the direction of the deity building. This element is the sandō. These walking paths are sacred spaces to prepare people before they reach the shrines and main temples, symbolize the way to achieve divinity. In the case of shrines the sandō is preceded and punctuated by a *Torii* or the *Tōrō* (stone, wood or metal lanterns) as demonstrated by the approach in side of the Meiji Jingu (Fig.5) and the Omotesando in Tokyo (Fig.6). And, in the case of the temples, the way can be started, or not, by a Temple Gate (Monzen-machi) as exemplified by the Senso-ji Temple in Tokyo (Fig. 7).

The days of festivity around the Shinto religion mark the space and social livings in the local context of the shrines, surviving from the Edo era to the present (Fig. 8). The inner-precincts and the surrounding streets of the shrines are absorbed by people who seeks to participate both in the ambience created by the food stalls (Fig. 9), located in the sandō, as well with the shrine deity's palaquin, the mikoshi[5] (Fig.10).

[4] The A-Bomb Dome (Genbaku Dome) it is located in the Hiroshima Peace Memorial Park, in Hiroshima, and was one of the few standing structures after the explosion of the atomic bomb in 1945. The preservation of the remaining's of the Hiroshima Prefectural Industrial Promotional Hall constructed in 1914 symbolises the war destruction and is an expresses of the hope for world permanent peace. The ruin had three conservation projects (1967, 1990 and 2003) and received a structural reinforcement to secured its integrity but lost part of its autentecity with the replacement of the steel structure of the dome (the original is in the Peace Memorial Park).

[5] The most traditional and important *mikoshi* event was held in a annual festival around the Edo Castle, connecting him to the Kanda Myojin Shrine at north and the Hie Shrine in the south of the city.

These social and cultural events are a very similar to the religious Catholic processions. The mikoshi symbolizes the deity, attempts to approximate the shrine to the community and delimit the neighbourhood area with the path created, a method to define his influence by affection to a specific sanctuary[6].

On the other hand, the temples are built integrated into the urban fabric and are mostly surrounded by cemeteries[7], may also include periodic fairs that encourage the habits and memories of the inhabitants of that community, give meaning to the locus. After the political transition the relocation or construction of new temples in consolidated urban areas were made in the public patios (Kaishi), interstitial areas of the urban blocks that served in Edo era as open spaces for deposit of wastes (Kochi, 2013).

Over time many areas with temples were developed in popular centres (Sakariba) joining the economic aspect to the religious celebrations. These leisure areas could contain theatres, teahouses, food stalls, and located along the Temple Gates (Monzen-machi). The urban context was developed in a similar system to the current Senso-ji and Gokoku-ji in Tokyo or Zenko-ji in Nagano, becoming an important part of the urban sprawl of Edo and partly of Tokyo (Cybriwsky, 1991).

4 FINAL REMARKS

The traditional persistences are forms of culture that result from the will of the society to return to their origins, at least to understand their utility in the production of social and historic identity.

These processes of cultural affirmation trough cultural traditions are in both western and Japanese culture a condition of the modern society; both of them are being transformed by a global point of view. The difference is that in Europe the traditions born, in part, from the sedimentation of time. So, it is to believe they will continue to be produced and created as before. In the Japanese case, traditions were kept for centuries almost intact in a closed society. Now the new traditions are the result of the influence of other cultures, and the old traditions just reflexes of actions reproduced or reinvented trying to keep unspoiled the "Japanese way" of the past in the present.

Thus, the continuity of the traditions is only possible with the peculiar relationship between modernity and time. In the Japanese case, as elsewhere, the residues of traditions are taken by nostalgic feelings of actions vanished from time, "fetishized" many times as functions of special events, religious practices or in the rebuilding of heritage scenarios. "We have seen, for example, how Japanese nativist ethnology, in its attempts to rescue disappearing words of narrative and practice from oblivion, rehabilitated them in the guise of the folkloric" (Ivy, 1995:242).

The places and acts of worship have tried to keep the old representations and habits of the traditional way. Even realizing that the processes of conservation or entrepreneurship sometimes loses some feature in

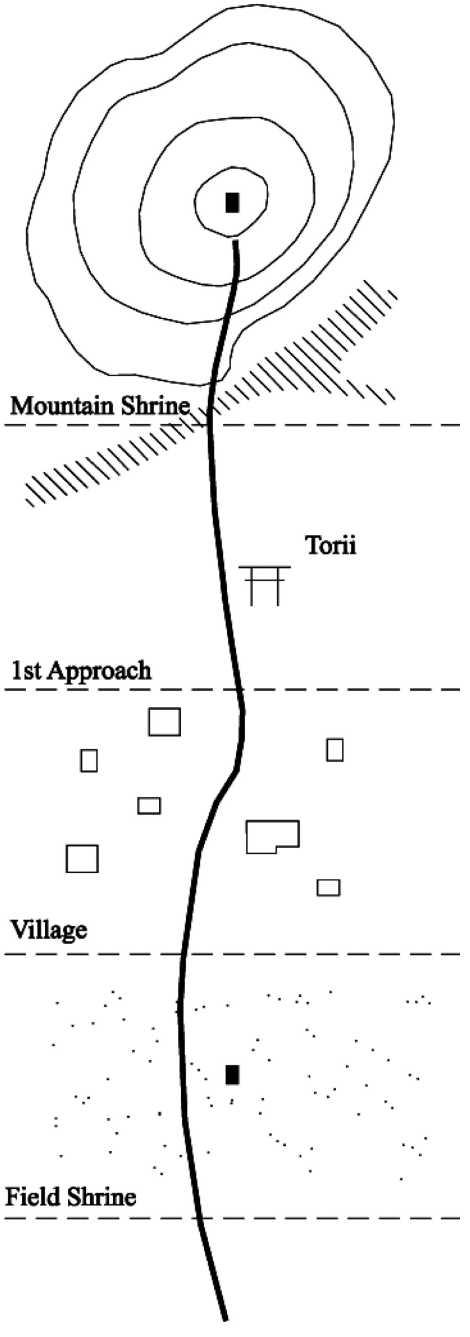


Figure 3. Hypothesis of a shrine approach (sandō) in his primitive urban settlement form.

[6] A special event is the festival that takes place in the Asakusa Sanja Gongen Shrine, where the mikoshi route simultaneously integrates a path by land and another by water, aboard a boat along the Sumida River.

[7] In some case it's possible to find temples fully integrated in a forest like the Eiheiji Temple in Fukui.

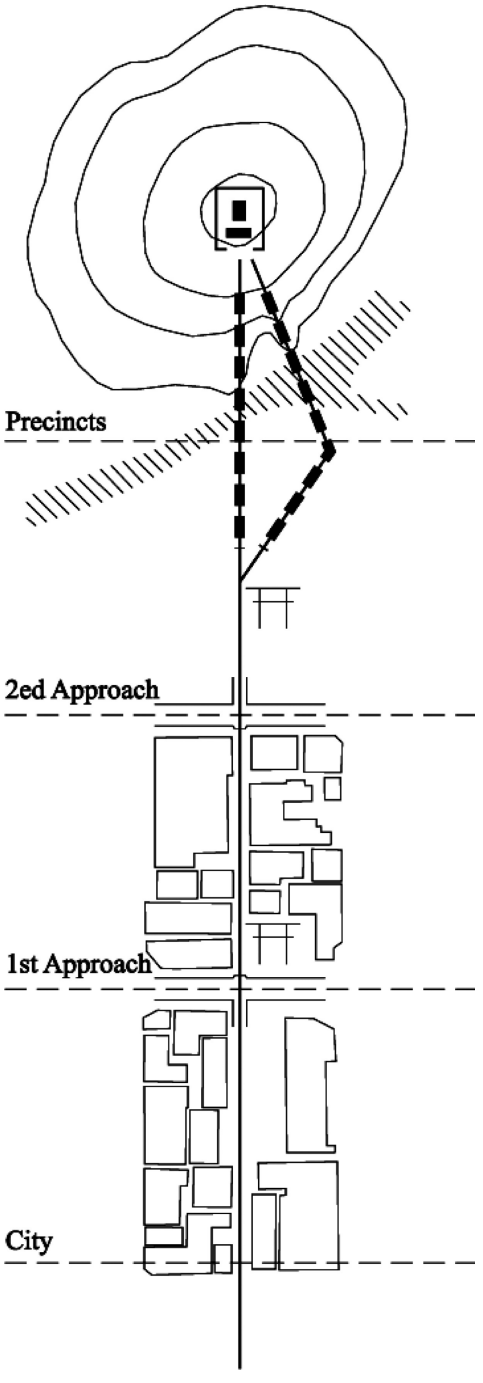


Figure 4. Hypothesis of a shrine approach (sandō) in its current urban form.

the translation of time, it's still possible to see an old lady wearing the traditional kimono on a Noh play, a traditional wedding procession in a shrine, an almost extinct tea ceremony or the rituals of purification and prayers performed over the deity in a shrine or temple.



Figure 5. The Sandō of the Meiji Shrine is an example of a path completely surrounded by a man made forest and marked by two Torii.



Figure 6. The Omotesandō is considered as the first approach to the Meiji Shrine and it's fully integrated in the urban fabric. The beginning of path it's marked by two stone lanterns (tōrō), decorative Shinto symbols that represent the sun and the moon.



Figure 7. The Senso-ji Temple, Asakusa, is fully integrated in the urban block and the Sandō exemplifies the commercial use that some times they have.

For example these expressions of the traditions can also be found in the Senso-ji Temple in Asakusa area. The temple was a popular and worship space even before the emperor Tokugawa establish the capital in Edo at the beginning of the seventeenth century, and remains as a important place for the spirituality of the Japanese people. As evidenced by the large attendance every day or in special celebrations, such as the



Figure 8. Spring Grand Festival ceremony at Meiji Shrine, Harajuku.



Figure 9. Food stalls aligned with the Benten-do Temple and the Kiyomizu Kannon-do Temple at Ueno Park.



Figure 10. Mikoshi at the Namiyoke Inari Shrine, Tsukiji.

Asakusa Sanja Matsuri, a spring festival in May, and the New Year's Day when thousands of Japanese traditionally pay their first prayers to the several deities inside of the temple precinct.

Another peculiarity of this temple is the market located along the Nakamise-dori and next to the temple gate remembering the relationship of these worship sites had in Edo era to the local religious and economic dynamics. The street-market is aligned axially



Figure 11. The Harajuku Girls is a youth phenomenon started at the beginning of the XXI century that quickly gained fame and tradition in Japan. The costumes differ from the cartoon characters to rock idols.

with the Kannon Hall, the main building of the religious ensemble reconstructed in concrete in 1925 and 1950.

So, it's recognizable that the Japan of today contains a vast cultural tradition, present in the vernacular and spiritual buildings and spaces, even in the way of life, as shown by this reconstruction forms and images of a sense of historical authenticity.

But, social traditions are a heterogeneous facts and layers that resist or are recovered, even reinvented, to delight and connect the modern society to there historical identity. The problem is that the modern and postmodern societies are producing new traditions in a blinding speed that imposes a wedge between the present and past traditions, in Japan as elsewhere (Fig. 11). "Perhaps his not quite obsolete vision of modernity is taking its place as one more instance of the vanishing, along with its [traditional and new] objects" (Ivy, 1995:246).

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Top-down and bottom-up approaches in Tokyo's recent urban re-development projects

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ABSTRACT: In the last thirty years, Tokyo went through consistent re-development projects. In big top-down plans, new visions were explored and created. But, nothing was done in order to keep or to enhance local identity and lifestyle. Case studies, such as Roppongi Hills, Tokyo MidTown and OMY analyze the top-down approach for the creation of high-dense urban settlements, with mix-use of functions in "vertical cities". In Tokyo, some other areas have been testifying a slower re-development, which happened piece-by-piece in fragmented and traditional urban fabrics, where a strong sense of identity is felt by citizen. Areas such as Komagome, Ura-Harajuku, Shimokitazawa show up the strength and characteristics of the bottom-up approach. Nevertheless, in order to avoid banal building speculation in gentrified areas new models for re-developments are needed. Otherwise, the lost is enormous: from the identity of place to the social encounters and structures, to the traditional liveliness and vitality in different parts of the city.

1 TOKYO AS GLOBALISED METROPOLIS

1.1 *Urban policies to revitalize the economy*

In recent years Tokyo has undergone huge urban transformations. Different areas in the metropolis have completely changed their image and identity. By doing it the original urban fabric has been altered. This is specifically evident when huge top-down developments are compared with the existing urban fabric surrounding them. Nevertheless each development was pursued based on a specific vision, much connected with notions of Tokyo' s attractiveness to the globalised world.

Following the bursting of so-called "economic bubble" in the 1980s, Tokyo and Japan suffered a decade of economic recession, now seen as the lost decade for the failure to take positive action against the economic downturn.

The recession in the 1990s brought to question the Tokyo status as global city of virtual command post in the networks of twenty first century capitalism (Sassen 1991). In fact, Tokyo was challenged by other Asian cities emerged at global level, such as Shanghai, Hong Kong, and Singapore (Saito and Thornley 2003).

Several issues in the economy were pushing for a change: depressed property market, banking sector in crisis, non performing loans (Katz 2002) and lack of money flow. Companies in the corporate sector could not recover from the investments they made in the 1980s in Tokyo's property market. (Kantor 2012).

Starting in 1986 Nakasone launched the Urban Renaissance Policy, which implemented projects and ideas of large scale redevelopment projects. But, due to the big economic crisis, it was not consistently applied.

In 2002 the government led by Junichiro Koizumi set up a committee called "Headquarters for the Urban Renaissance of Cities" chaired by Koizumi himself, with the aim of promoting 21st century urban and environmental re-vitalization projects and internationalization while at the same time ensuring disaster prevention measures. The Act was aiming to enhance the attraction of the cities and their international competitiveness; to stimulate economic recovery and reinvigorate the land market. (Urban Renaissance Special Measure Law, 2002).

A clear indication on the creation of more compact, dense and unified urban structure was given, willing to limit the urban sprawl and expansion of cities; defining a safer urban life in regards of earthquakes, traffic congestion; promoting a higher quality of urban life in beautiful, secure cities realizing a sustainable society; and the evaluation of accumulated assets in urban areas making use of them in conjunction with a new arrangement of facilities. (Basic Policies for Urban Renaissance, URHQs).

The urban regeneration strategy presented three main programs: urban regeneration project by state initiative, urban development by private investment, and urban regeneration project in nationwide to be carried out by local government and NPO or voluntary sector, being the private sector the key element of regeneration.

The Special Law on Urban Renaissance designates the priority urban redevelopment areas, relaxing the existing planning regulations, giving private developers the opportunity to propose projects, and providing various incentives, such as financial aid, tax relief, and a simplified approval process. Controls and

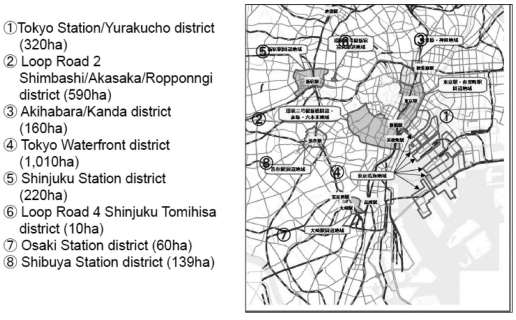


Figure 1. Priority Urban Development Areas.
(source: Prime Minister of Japan and His Cabinet).

restrictions have been further loosened, with a series of measures that have significantly increased Floor Area Ratios (FARs) (Sorensen 2003, Waley 2007). Thus, by giving cabinet authority to designate regeneration areas, the central government made much easier and faster the projects' approval for redevelopments of inner city sites.

Among the first targeted areas for urgent improvements, on a total of 3,515 hectares, 2,370 hectares where in Tokyo.

Until 1990s Tokyo was characterized by a vast and fast growing sprawl thanks to private companies developing along new rail way lines the urban residential settlements. Political and economic interests created those strong centripetal forces (Cybriwsky 1998). In fact, until then Tokyo's vast infrastructure had been constantly enhanced to allow decentralization and urban development in outlying districts beyond the Yamanote inner ring. As a result, the metropolis spread inexorably west and east.

But not only the Urban Renassaince Headquarters were looking for a strong re-development of some central areas in Tokyo, but also the Tokyo Metropolitan Government. In 2000 TMG in the White Paper recognized that Tokyo was losing its role at global level as the main Asian metropolis of attractiveness level. TMG's urban policies proposed an important turning point abolishing the sub centers policies in favor of centre of Tokyo. Specifically, it came up with the decision to create a "central business district", the CBD, covering the centre of Tokyo and neighbouring areas. Moreover, thanks to the fact that the usual height of 31 meters could be overcome, TMG encourage the realization of high-rise buildings to maximize the density in the city, and offering FAR bonus when creating at the high-rises bases open public areas. The aim was to encourage international companies, financial institutions and media companies to set up in an area that also offered medium to top-end residential accommodation. The main focus now became centralization, bringing people back into the centre to work but also for living. Central areas underwent radical new development. Several small plots were combined to create large development areas, and large state-owned properties were reallocated in compliance with the government's new urban plan to drive economic recovery.

1.2 *Re-conceptualization of urban condition. A prototypes for top-down approach. Roppongi Hills*

Roppongi Hills developed by Mori Corporation is one of the first mixed use re-developments. It proved to be successful in term of uses and property investment.

It is needed to affirm that the previous Ark Hills project provided to Mori Corporation the needed know-how that brought Roppongi Hills into realization. In fact, Ark Hills was characterized by an area of 5.6 ha, with a main property owned by Mori, but other parts owned by many people living in the area. The involvement of all the residents into the project required several years of negotiations. It was a process of development that started in 1967 and ended in 1986. One of the critic that followed the realization was the fact that almost all the previous owners changed areas for living.

In 1986 Tokyo Metropolitan Government designated Roppongi 6-chome as a Redevelopment Inducement Area, where redevelopment should be induced through cooperation between the public and the private sector. In Roppongi 6-chome more than 500 residents were living, on an area of re-development of 11,6 ha.

Being interested in the development, Mori Building with TV Asahi started to involve the residents setting up councils to create an agreement for the re-development.

The latter was reached only in 1998 with 94% of the residents' participation. The Union was founded and between 2000 and 2003 the mixed-use development was constructed.

The development included a main office tower, residential towers, hotels, a high-end commercial gallery, a cinema complex and restaurants. It combined culture into a private re-development with the realization of a contemporary art museum.

The development allowed the insertion of large floor areas for offices. It stimulated people to live in the center offering a new life-style in apartments, where people could be close to the central areas of Tokyo, and close to work. Roppongi Hills became also a prototype for the creation of public spaces managed by the private sector: plazas, park, incorporating contemporary art.

Roppongi Hills urban development completely altered the urban frame of the area, enhancing the process of gentrification of the area. Looking up at map in Figure 2, it is clear the difference of scale between the new project and the surrounding urban fabric.

Which was the vision to re-conceptualize the urban condition? The inspiration was taken from European cities, where mixed use facilities keep cities alive 24 hours a day, as "Artelligent City". And, attention to creation of public spaces were given, recalling Western approach to the making of the city. "66 Plaza" with its "Maman" by Louise Bourgeois immediately became



Figure 2. Roppongi Hills.(source: Google map).

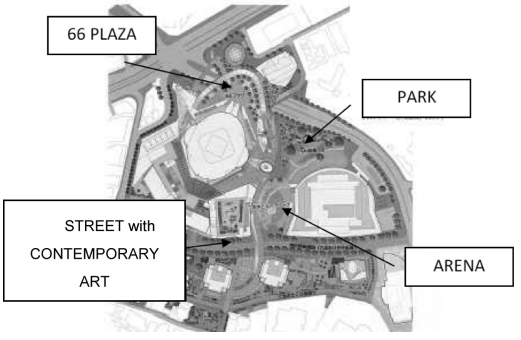


Figure 3. Roppongi Hills. Plan.
(source: http://www.mori.co.jp/en/projects/roppongi/).



Figure 4. Roppongi Hills. Garden. Art Pieces in Urban Design.
(source: Photograph by the Author).

a place for gathering and moving to restaurants, contemporary art museum, cinema complex, events.

Because of the development's high density, public spaces can be found at different levels.

66 Plaza itself is located at the entrance of Roppongi Tower but not at the street level, while at street level we can find an arena and a garden.

Roppongi Hills is one of the first cases in which a street was characterized by interventions of urban design with contemporary art pieces.

Clearly, Roppongi Hills constitutes the model that inspired others developers willing to revitalize huge central areas in Tokyo. Thus, each new project needs to get a new unique vision, able to compete and attract people during different moment of the day and for various activities.

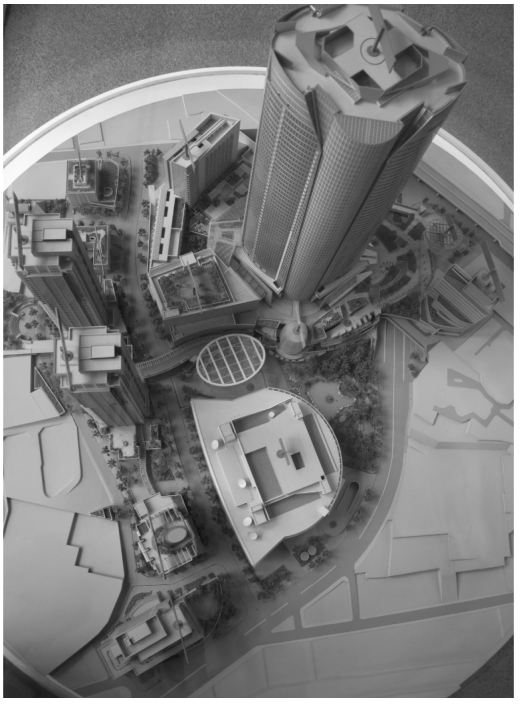


Figure 5. Roppongi Hills. Model.
(source: Photograph by the Author).



Figure 6. Roppongi Hills. 66 Plaza and Mamam.
(source: Photograph by the Author).



Figure 7. Tokyo MidTown.
(source: Google map).

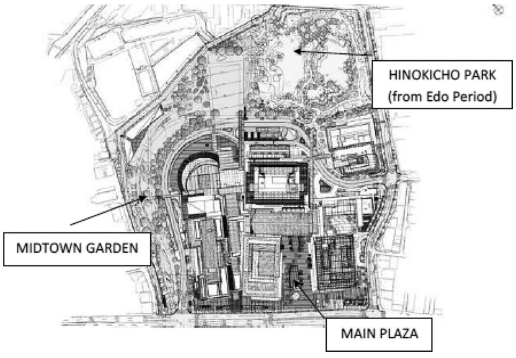


Figure 8. Tokyo MidTown. Plan.
(source: http://www.tokyo-midtown.com/en/facilities/).



Figure 9. Tokyo MidTown. Garden.
(source: Photograph by the Author).

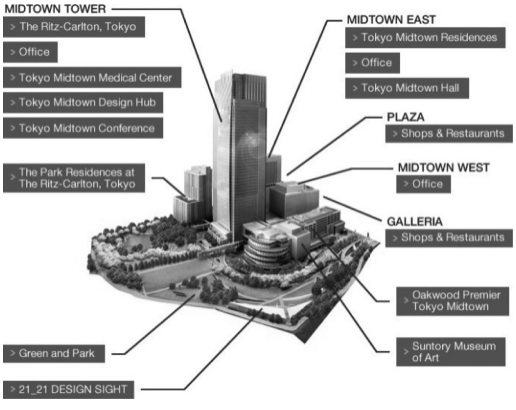


Figure 10. Tokyo MidTown. 3d model.
(source: http://www.tokyo-midtown.com/en/facilities/).

2 PRIORITY URBAN DESIGN AREAS – TWO CASES

Among the Priority Urban Development Areas established by the Urban Renaissance Act, we find Tokyo Midtown and the area of OMY. The two sites have been developed respectively by Mitsui Fudosan and Mitsubishi, based on different concepts and approaches.

2.1 *Tokyo midtown*

In order to re-develop central unused or under-used settlements TMG promoted the so-called Land Use Transition District Plan, aiming to revitalize the city

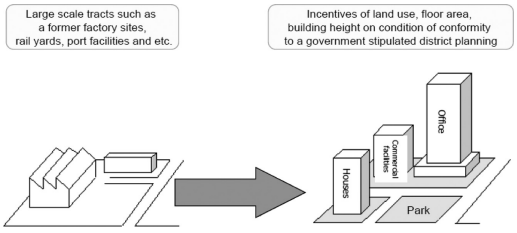


Figure 11. TMG – District Planning.
(source: http://www.asianhumannet.org/db/datas/9_transport/udt_reference_en.pdf).

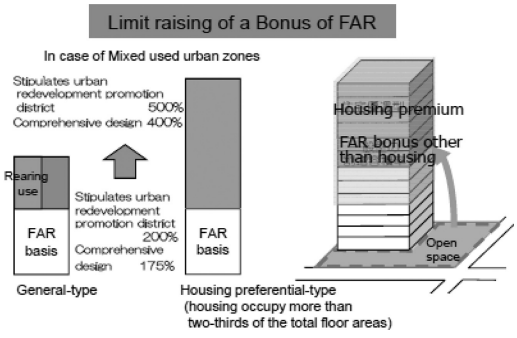


Figure 12. TMG – Mixed used urban zones – Bonus FAR.
(source: http://www.asianhumannet.org/db/datas/9_transport/udt_reference_en.pdf).

with an effective use of land providing urban functions, houses and offices.Tokyo Midtown was developed as a transition district plan on a vacant area owned by Defense Agency. It is a consistent site of 7.8 ha. The project promoted by Mitsui Fudosan defined a mixed use facilities plan, which was realized from 1988 to 2007. It was based on a vision that expressly wanted to be something “new”. Still nowadays, the area is branded as a place where people could find a new part of city expressing a new vision and unique image. A place where people could work, dwell, play and relax. The intention was to define new values and lifestyle that could be share at international level. Compared to Roppongi Hills, Tokyo Midtown is composed by a compact group of buildings surrounded by public open spaces. Those spaces are all located at ground floor, isolating the new development from the existing surrounding buildings through a garden, a park and a plaza. The park is a historical landmark of a previous feudal villa. All the development is a very high-end settlement, comprising a very elegant commercial gallery, museum, hotel, offices, residences. While in Roppongi Hills the museum is located at the top floor of the office tower and it became a very important facility in the contemporary art field, here the museum in inside the main shopping gallery and offers small refined exhibition on traditional Japanese arts. Temporary exhibitions find place in another structure connected to the open garden.

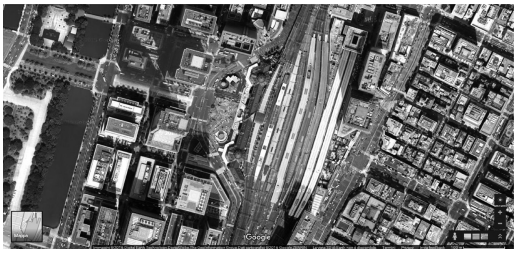


Figure 13. OMY Area.
(source: Google map).

2.2 *OMY*

Otemachi-Marunouchi-Yurakucho (OMY) is the district situated in Chiyoda city and is the hearth of metropolitan Tokyo. It has always been known as the center of international business in Japan. Its redevelopment has been considered essential to reinforce globally its centrality. The Otemachi-Marunouchi-Yurakucho District Redevelopment Project Council was founded by landowners of the area in 1988. Only in 1996 Tokyo Metropolitan Government (TMG) set up an Advisory Committee on OMY Area Development and few years later defined the Central (Ward) Area Development Guidelines, and the Landowners' Council was organized "as a forum for discussing specific city renewal plans for the 21st century" (OMY District Redevelopment Project Council, April 2008).

The Council is composed by 70 landowners, 17 observers, 9 special members with a totality of 96 members.

The Council defined the vision for re-development as "ABLE CITY: A City of New Opportunities. Amenity, Business, Life, Environment". The Council proposed to plan an urban landscape based on three-layers. The one, with the existing 31-meter building heights, to create human scale and pedestrian comfort at Hibiya street (dori) and Marunouchi Station Plaza. The second height up to approximately 150-meter in the city center, with the possibility of achieving 200-meter buildings around major railway and subway stations, in spite of the legal limit up to 260 meters. The height could be reached thanks to FAR bonus system, as in Figure 13 and 17. Public spaces are part of a comprehensive urban design strategy characterized by an unprecedented public-private cooperation. Today, thanks to the different activities it offers, the area attracts the contemporary *flaneur* (Dinner 2012).

The development started in 2000, and it is still going on.

3 BOTTOM-UP APPROACH

In other areas of Tokyo, we assist to very interesting processes of small scale development. The three chosen sites present a very strong identity and sense of community felt by its residents and users. They present different characters and targets, but they share a common issues for future developments.

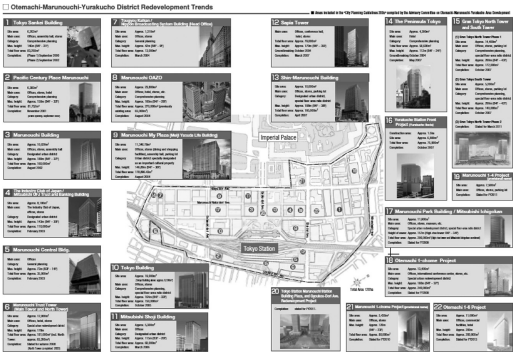


Figure 14. OMY Plan and Schedule.
(source: http://www.otemachi-marunouchi-yurakucho.jp/images/engreport200804.pdf).



Figure 15. OMY – Aerial View at 2008.
(source: http://www.otemachi-marunouchi-yurakucho.jp/images/engreport200804.pdf).

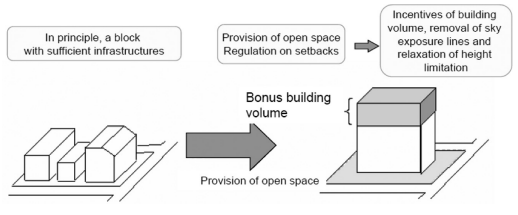


Figure 16. TMG – FAR – Bonus System.
(source: http://www.asianhumannet.org/db/datas/9_transport/udt_reference_en.pdf).

3.1 *Komagome*

Situated in the north-west part of Tokyo, still inside the central JR line-system, in Komagome is possible to find the ancient urban structure. Komagome is a neighborhood counting around 10,000 inhabitants in its central core. Strolling around the district of Komagome, the sensation in entering in this neighborhood is to enter in a sort of village. Houses are single detached houses of one or two stories high, generally in wood; every dwellings is differently decorated by a small independent entrance or a narrow private street of entrance shared by four or five houses. The actual situation of Komagome is very charming from the point of view of external visitors, but instead very critical for the community living. First, some dwellings



Figure 17. Komagome Area.
(source: Google map).



Figure 18. Komagome Plan.
(source: http://www.arigalab.arch.waseda.ac.jp/you_he_long_yan_jiu_shi/212ju_purojekuto.html).

are obsolete facing tiny streets which make very difficult to prevent a natural disaster or fire explosion. Therefore, new building standards define the maximum buildable in an area of 60% of the GFA (gross floor area), however, for the actual situation, one plot is almost built for the 100%, leaving just a small passage for entering in a house in the one besides. Second the aging population in Komagome area requires new public facilities. Third, being the area very central it is very valuable and investors try to buy plot of land from the elderly for building speculation.

How to solve problems of disaster prevention, growing elderly population and urban redevelopment keeping an identity of space? The City of Toshima, helped by Waseda University, is trying to collaborate with the community by means of participative workshop, in order to reclaim the most critical areas. The University in synergy with the community is trying to progress is the reconstruction and the restoration of Komagome, keeping the special human scale dimension of the building, the everyday activities and the familiar connotation of outdoor spaces.

3.2 *Ura-Harajuku*

Ura-Harajuku has a very distinctive character. It keeps the feeling of human scale. Being located at the back of Omotesando and its high-end fashion shops, it developed as one of the best place for unusual attractive shops. It is place known for subculture and very popular among young people.



Figure 19. Komagome Street Views, playground and garden.
(source: Photograph by the Author).



Figure 20. Omotesando and Ura-Harajuku.
(source: Google map).



Figure 21. Ura-Harajuku – Street View.
(source: left- http://www.travelience.com/blog/top-10-places-to-shop-in-shibuya-area-tokyo/
right- Photograph by the Author).

Visually, facades are continuously changing and adapting themselves to the small commercial business that buildings host.

The area is recognized as an area of creativity and originality both for the shops and for the people strolling in it, that define their personality by creating a personal mode of consumption. Smallness and fragmentation of urban fabrics and buildings match with the peculiarity of the shops characterized by individual contributions and creativity in reusing existing buildings.

Places of meanders and surprise are welcome. Thus, urban fragmentation and irregularity, small mainly pedestrian streets are preserved as a value.

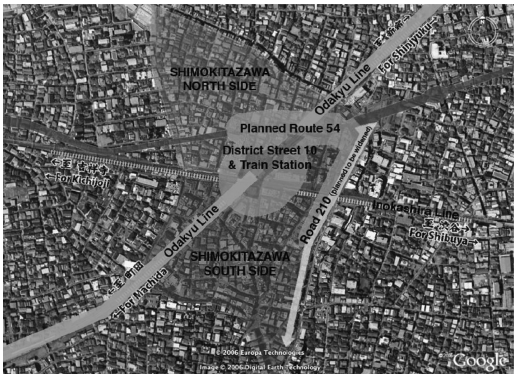


Figure 22. Shimokitazawa Plan. (www.koba-lab.com/masami/research/Shimokitazawa_Icomos.pdf).

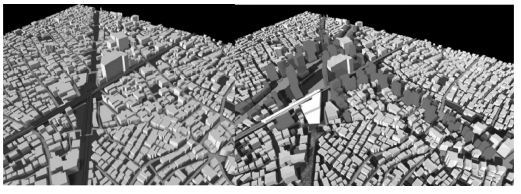


Figure 23. CG Simulation of the Future image of Shimokitazawa with Government's Plan – left: Existing condition; right: In 30 years. (www.koba-lab.com/masami/research/Shimokitazawa_Icomos.pdf).

3.3 *Shimokitazawa*

Shimokitazawa is located at around 2–3 km from Shinjuku and Shibuya, West side of Tokyo. Historically, it is not very old, but it is a friendly pedestrian compact city with narrow streets. This is due to the fact that it grew as depending on rail system, more than cars. It is a neighborhood very much loved by young people, a vital area with many theaters and music clubs. It is also considered a comfortable are where to live with its 20,000 residents.

Almost 60 years ago, Tokyo Metropolitan Government planned the realization of Route 54, to become 26 meters wide crossing Shimokitazawa. And, the actual station of Odakyu Line is now under re-construction with an underground station.

Those two big infrastructures' interventions are going to completely modify the actual urban fabric in Shimokitawaza. Moreover, according to Japanese building regulations the height of buildings depends on street's wideness. Therefore streetscape of the neighborhood is going to change in the near future close to the wider street. Building relaxation rules would even make the case worse. Until then, the urban redevelopment of the area worked out through small interventions, operated by local owners. The urban fabric has been kept using existing building or inserting new ones in the original context, enhancing the atmosphere and the identity of the neighborhood. When the two over mentioned projects became public, the reaction of local residents, shopkeepers, professionals and young visitors was strong. Several movements to protest against the project started. Three major citizens' groups were risen. "Save Shimokitazawa", volunteer group of young people spending their time in the area. They spread up news and awareness about Shimokitazawa and in 2003 started a signature campaign. A second group, the "Shimokitazawa Forum" is composed by local professionals, architects and urban planners, journalists represented by Prof. Masami Kobayashi from Meiji University. They have developed inquires, workshops, comparative studies, lectures and symposiums. The Forum proposed alternative plans.

The third group is "Shimokitazawa Shopkeeper's Council" which consists of 500 shopkeepers, mostly tenants. They made many petitions against the Government's plan. Nevertheless, TMG progressed with the plans and Shimokitazawa will be changing in the next five to ten years.

4 BIGNESS AND SMALLNESS

4.1 *Tokyo and identity of place*

Tokyo has always had many identities. Being a multinodal city, it is composed by towns with different insights. While differences among some nodes tend to disappear, Tokyo has accepted and created new identities with the aim to open the metropolis to the world. "Gaijin (foreigner) friendly" I would say. TMG is always looking for new visions which could bring Tokyo to become the world's best city (Masuzoe 2015). Until now, top-down approaches to urban development in Tokyo defined new visions for the city. While doing it, local identities were substituted by new ones, more homogenous, organized and controlled. Visions which took inspirations from the Western cities and lifestyle. They defined new ways of the making of the city. These are cases in which big stakeholders through agreements with public sector develop big areas with high rising building offering to the market new type of mixed use facilities with big floor areas of office buildings, commercial areas and central apartments. The new mixed use developments brought people back to the center for living. Life in apartments was enhanced as a new type of lifestyle, matching with the new trend of female entering and staying in the labor market. While defining new urban models, the concept of public space also changed. Plazas, arenas and open public spaces were created, while traditionally not existing in Japanese cities, characterized by completely different urban settlements.

On the other hand, other areas of Tokyo still present highly fragmented urban fabrics, due to a vast number of ownerships and small building types. Those areas host a socially strong environment and specific atmosphere. Many times the urban fabric is particularly dense and characterized by small streets (roji) turning

around small buildings. In some ways, Tokyo presents the big size and the small–very small size, but not a medium one.

Nowadays, small size is brought into question both by standard building regulation for disaster's prevention. For instance, actual building regulations do not allow to re-built single building in front of small streets, because of risk prevention issues. Setbacks rules have been defined, reducing plots land already very small. Moreover, many areas are suffering building speculation. The risk of banal gentrification still exists (Boontharm 2012). Models of reuse and development proposed by the public are lacking of creativity. On the other hand, participatory projects see citizen working with university's labs on town-planning and urban design to clarify approaches and methodologies to solve local issues of future developments without losing the specificity of the places. Bottom up approaches recall for uniqueness and intimacy of space. Some developers are looking for new ways to approach urban development incorporating those local needs. But, in order to avoid empty stylish exercises, an interdisciplinary approach is needed. It is about having experienced and analyzed the city from many view points, studying the existing situations. It is important to look for the importance of keeping variety and flexibility to assure users' personalization through life and time.

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Research on architectural education

Tendencies



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New schools of thought – an investigation on tendencies in architectural education

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ABSTRACT: This paper elaborates on the first findings of the ongoing research project NeST (New Schools of Thought), which investigates reactions to academic homogenisation within European architectural education. NeST defines a New School of Thought as a set of ideas and new approaches on methods of knowledge creation and forms of knowledge transfer, which a group of people who are dedicated to architectural design and spatial planning share about architectural education. Schools are no longer the only privileged place for thinking. New sites of knowledge production and reflection have arisen, giving way to new types of schools of thought. Through a multiple case study situated at the level of secondary education, higher education, and public mediation, this paper analyses the inherent concepts of new schools of thought and reveals their alternative routes as responses to tendencies in architectural education. This framework gives indications of potential impacts on models of architectural education.

1 INTRODUCTION

Architecture reflects, shapes, and enriches society and its culture. At the same time, it seems increasingly incapable to be influential in determining 'the course of things in space' (Eisinger 2008). At the most, it can be considered as 'a singular way of thinking about anything', being 'a diagram of everything' (Koolhaas & McGetrick, in: Eisinger 2008). It is exactly in this encompassing and indecisive way of 'being in the world' that architecture 'manifests itself as an instrument for exploring the world' (Eisinger 2008). Latour values architecture as a unique practical and visualizing tool that political language does not have (Ghosn *et al.* 2008). In its "singular way of thinking about anything", architecture – as a tool and an instrument – provides a unique lens which "preserves a view of the total" (Eisinger 2008).

Architecture is embedded in culture. With its traditions, it is inseparable from education. In architectural education, architecture is the pathway for self-formation. Teaching architecture is not solely teaching *about* the role of architecture in society. Its pedagogy consists mainly of *learning from* architecture and *educating via* architecture. In essence, it is teaching *in* and *through* the moment in which society manifests itself through architecture. What then is it that is taught? Or – as formulated by the Swiss architect and teacher Andrea Deplazes with an exhibition in the Schweizerisches Architekturmuseum in Basel in 2006 – "was studieren sie wenn sie Architektur studieren?" Indeed, architectural education cannot be considered as mere vocational training towards professional proficiency. Given architecture's inherent responsiveness and sensitivity to societal change, its capacity to critically conceive new futures as creative responses to current conditions, and since architecture acts as a unique *practical and visualizing tool* and as an *instrument* for *exploring the world*, *preserving a view of the total*, architectural education provides rich grounds both for self-formation of the individual student and for critical reflection and transformation of society as a whole. In times of rapid changes and societal challenges which lead to uncertainty and complexity, one could argue that architectural education is providing society with schools which feature a certain "cunning of uncertainty" (Nowotny 2015) while embracing contingency and complexity.

Architectural education has many roots. Apprenticeship on the building site, pupillage in the office, Beaux-Arts training in the academy, engineering lessons in the polytechnic school, and – more recently, owing to the ascent of cultural studies and critical theory – a master's degree at the university. Each of these approaches has been challenged. Europe's recent higher education reform has tended to advocate

the university as the ultimate place for higher education. But is the university the optimal biotope for architectural education to flourish?

1.1 *The university as a place for architectural education*

The university is a particular institution in that it hosts both research and education. Its legitimation to provide academic higher education consists of this proximity to research. This idea originates from the beginning of the nineteenth century, with the foundation of the University of Berlin as an icon for the modern European university. Since then, the public role of the university has been fundamentally questioned several times. Two centuries after the founding of the first university, at the turn of the twenty-first century, there is a widespread consensus in academia and society that the mutual relationships between science and society (including economy and politics) have drastically changed (see e.g. among many others Delanty 2003, Simons et al. 2007). The evolution towards mass higher education and the rise of the knowledge society, accompanied by the emergence of a knowledge economy, have transformed the relationship between science and society, the role of research, and the identity of the university as a place where research and teaching coexist. Higher education no longer addresses an intellectual elite. Since the university is *democratised*, it has not only delivered many cohorts of graduates, it also has delivered cohorts of knowledge producers, generating and exchanging knowledge in a variety of sites and contexts. The university has lost its privileged position as knowledge producer. The university gradually becomes acknowledged as a place typified by its limitations and restrictions in the conduct of research – narrowed to emphatic interpretations of scientific research – rather than pictured as the place par excellence where teaching is embedded in the most thriving and intensive research environments available. This is particularly the case for architecture and architectural education.

Architecture is connected to many disciplines and knowledge fields – it is "boundary work" (Kurath 2015). This boundary condition manifests itself at least in three ways. (1) Being in a margin of the scientific environment of the university, merely contributing to the academic body of scientific knowledge, architectural education takes a defensive stance. Academisation makes architectural education operate in a climate of confusion and pressure (Gisler and Kurath 2015). (2) In this boundary condition, architecture acts as a connector. It connects many disciplines, and it gets many actors involved (both human and non-human) (Yaneva 2012). (3) Given the fact that new knowledge is created at many sites and in many contexts, given that architecture is connected to many fields and many types of knowledge, and given the specificities of the type of research conduct actually fostered by the university, it is hard to assert that the university – as it operates today – would provide the most appropriate conditions for architectural education.

1.2 *Architectural education in times of homogenisation*

In 1988 the *Magna Charta Universitatum* was proclaimed by the rectors of European universities. It referred to the coming abolition of boundaries within the European Community in the next four years. In 1999 the European Union's Bologna Declaration was defined "in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education" (European Ministers of Education 1999). Together with both European qualifications frameworks – the QF-EHEA, or *Bologna Qualifications Framework*, and the EQF-LLL, or *European Qualifications Framework for Lifelong Learning* – and European Directive 2013/55/EU, it was a milestone towards comparability of European education. However, it is also seen as the starting point for academic standardisation which, from an academic point of view, could potentially result in "Verschulung" and "didatticizzazione", "rigid and compressed curricula", "with less space for creativity and innovation", less time for "independent research or study, critical reflection, fostering of an independent mind" but instead "greater efficiency and delivery" (Froment *et al.* 2006).

Reichert & Tauch (2005) designate the added value of the Bologna reforms as the "internationalisation of study programmes", "increased mobility", and the "improvement of international communication. This reform takes place in circumstances of increased competitiveness, contributing to it at the same time. Academic institutions are required to become more self-sufficient and thus entrepreneurial, raising more third party money, particularly for research (Smith 2010). As a result, private academic institutions and excellence clusters within public academic institutions develop as an alternative and open up "the economic discourse about the value of education" (Verwoert 2007,Hochmuth and Mangold 2012).

Architectural education in Europe has been a kaleidoscopic landscape, reflecting differing roots and cultures. The higher education reform, which started in the 1980s, contained strong preconditions for homogenisation. These processes have reached their full development and maturity today. Learning outcomes, subject-specific competences, institutional evaluations, professional accreditations/ regulations, research assessments, etc. have developed a strong grip on all higher education, including architectural education.

1.3 *New schools of thought*

The Bologna process is not to be seen only as an educational reform. It has to be understood as a response to a changing world. Delanty (2003) concludes that the post-industrial knowledge society – consisting of

services rather than of production – is increasingly driven by communication and information technology. The post-industrial knowledge society is not a European but a global society, in which the separation between knowledge and economy has blurred, giving way to the "scientisation" of society (Delanty 2003). Facilitated by the Bologna process, knowledge production and education are turned into globally marketable products (Kurath 2015). Since the late twentieth century, architectural education in Europe has been reshaped by these conditions of digitalisation and internationalisation, which have brought forth tendencies of *scientification* and *commercialisation*. Within these circumstances, architectural institutions have undergone changes in content and in methods of knowledge creation and transfer, as well as shifts in organisational structure.

How much these processes have effectively homogenised architectural education and to what extent formal adaptations to superimposed structures are simply masking submersed resilience of pedagogical traditions is not clear. It can be observed, however, that several initiatives have emerged as alternative routes of education, all of which comply with what we identified as *New Schools of Thought* – a set of ideas and new approaches on methods of knowledge creation and on forms of knowledge transfer, which a group of people who are dedicated to architectural design and spatial planning share about architectural education. These initiatives illustrate that there is an urge to expand the current scope of architectural education. They operate under a diversity of circumstances, address other audiences, involve other disciplines, and adopt a variety of methods for sharing insights and disseminating knowledge.

The research project NeST investigates these alternative routes, which – like Derrida's (2001) "university without condition" operate as battlefields of theoretical discourse with academic and unconditional freedom, sovereignty, democracy, and resistance.

2 RESEARCH INTEREST

Jenson (2014) criticises "the conventional educational structure of design and architecture schools" and suggest that "the global changes to education demand the necessity for the emergence of a new type of reflexive educational space" apart from the mind-bordering classroom. In accordance with Jenson's argumentation, NeST will investigate such new types of *reflexive educational space*. Studies on architectural education focus mostly on formal higher education at the university or at a school of architecture. This focus does not allow for grasping the many initiatives which emerge elsewhere, and which – deliberately and with great enthusiasm and conviction – present architecture as a means to explore the world, for the personal development of their audience and as an "offer being made to society" (Eisinger 2008). Therefore, NeST takes a comprehensive stance, open to include a diversity of initiatives which address architecture as a medium for learning (about the world). It widens the term "school of thought" in terms of scope, place, and audience. In addition to universities and schools of architecture, it includes institutional think tanks, networks, and platforms (both physical and digital), etc.; it includes *formal* as well as *non-formal* learning, and it includes all stages of learning, from childhood education to lifelong learning. The research project NeST views these schools as possible social and cultural innovators. It aims at uncovering the motivations, goals, innovative approaches, and ranges of these schools of thought. By including these schools of thought, NeST aims at broadening the debate on architectural education by expanding the scope of approaches taken to address the challenges of societal and environmental change – through architecture.

3 RESEARCH DESIGN

This paper reports the first findings of an early stage of the project, which rely on an empirical study consisting of the analysis of multiple cases (Yin 1994).

The study concentrates on the European context. Within this limitation, cases were selected based on three parameters: (1) the chosen case had to be understood under the definition of a *new school of thought*, (2) the initiative must have arisen after the educational turn in Europe in the 1980s, and (3) the initiative has to provide new approaches for knowledge creation and for sharing insights to a public audience, in and through the field of architecture and spatial planning.

Cases were found, either through their prominent appearance in the media, or through the networks of the partners of the NeST-consortium. Twenty-one initiatives have been designated for further investigation, of which eleven have responded. After a concise screening of the documentation available online, a qualitative online survey has formed the study's most substantial body of information to date. The aim of this survey is ideosynchratic: it is not looking for generalisations, but aims to reveal a rich pallet of diverse characteristics, approaches, and stances of innovative and thought-provoking approaches with regard to architectural education. Representatives of the chosen initiatives have responded to three thematic clusters, which were based on a review of the literature. The first set of questions asks about the reasons behind the creation of the initiative, its main characteristics and the challenges faced in running it. The second part of the survey maps the target audience and the scope of disciplines which are involved, as well as the methods and techniques used for knowledge creation and mediating the work to the public. The third and last section explores how and to what extent the school of thought positions itself towards the tendencies of *commercialisation* and *scientification* – tendencies which emerged from the literature review as determinants of the current educational landscape. The aim of this third part was not so much to confirm or estimate the

significance of the tendency, but to map the diversity of routes that have been taken in relation to this tendency as a factual condition, identifying the particularity of each approach while giving special attention to the context in which the initiative operates and to which it responds (Mortelmans 2011).

Responses have been received for the following eleven cases, which have been designated for further investigation: Architecture Workroom Brussels (AWB); ADAPT-r; aut. Architektur und Tirol (aut); bink; Bundesstiftung Baukultur (BB); Estonian Academy of Arts, Faculty of Architecture (EAA); Spacespot; TRANSark; University of Sheffield, School of Architecture (UoS); University of Reading, School of Architecture (UoR); Vorarlberger Architektur Institut (vai).

4 FINDINGS

The following section will firstly explain the mind-sets within the typological framework of the cases in order to then elaborate on their responses and alternative routes set out in response to tendencies in architectural education. When examining the aims rooted in the mind-sets of the different cases, it becomes obvious that within architectural education, certain types have evolved which can be clustered by their target groups: secondary education, higher education, and public mediation. Within those three types, one can clearly identify coherent (meaning homogeneous and logical in its system of thought) and at the same time distinctive (when comparing with other traditions or entities of thought) mind-sets. It is important to note that individual cases are not necessarily bound to one typology; they may be comprised of a mix. For instance, vai operates in the realms of secondary education and public mediation. The aim of this section is to present the inherent concepts of the three different typologies. This will form the basis for understanding their reactions to the multiple tendencies within architectural education, which are presented afterwards.

4.1 *Mind-set within the topological framework of architectural education*

Within secondary education, the NeSTs participating in the survey intend to create a network which links architects and schools. Another aim is to implement architecture as a subject in the school's curriculum. This shows that architecture is not yet established as a teaching subject. Hence, the initiatives have to fight for their existence. Nevertheless, they emphasise the positive feedback they get from architects, teachers, and children for their approaches. They are aware of the importance of their work: "young people are the decision-makers of the future. They will contribute to our built environment as politicians, clients, or the like" (Spacespot). Therefore they emphasise the importance of increasing sensitivity for the built environment among students, teachers, and parents.

Within higher education, the NeSTs participating in the survey have aims which vary in *content*, *method*, and *attitude*. Concerning content, issues such as climatic change, economic crises, and large-scale environmental crises all challenge our planet and "call for a rethink in architectural education" (TRANSark). Concerning methods, there is a desire to "close the gap between academia and practice while creating space for reflection on both" (UoS). One can identify the intention to bring back "critical thinking, reflection, and an evolutionary approach" (UoS). Furthermore, the University of Reading intends to "make it a multi- and interdisciplinary environment around understanding, designing, and managing the process of buildings". However, the applied methods of knowledge creation and forms of knowledge transfer vary significantly among the different schools of thought and will be elaborated upon further. Concerning attitude, one can make out a strong social ethos that links the initiatives within higher education.

Within initiatives of public mediation of the NeSTs participating in the survey, the general assumption is that sufficient discussion and action is lacking on the built environment, building culture, and the building process. Hence, the general aims within this typology are (1) to raise political and interdisciplinary discussion about the built environment, building culture, and the building process, (2) to create a broad network, and (3) to develop pertinent and meaningful responses to crucial societal challenges.

The different approaches are nevertheless distinct when looking at their point of departure. Aut intends "to develop a societal and legal basis in order to improve the living environment". In contrast, Bundesstiftung Baukultur already fought for their political influence: In October 2014, the German Federal Cabinet dealt with the first Building Culture Report 2014/15 developed by the Bundesstiftung Baukultur (2015). This report had then been forwarded to the German Parliament and Bundesrat as basis for legislative draft.

Through literature and the answers given to the survey, certain tendencies in architectural education have been identified. The following paragrpahs will elaborate on the NeSTs' responses and the alternative routes they have set out in response to those tendencies outlined here as sub-chapters.

4.2 *Responses to tendencies within architectural education*

4.2.1 *Several gaps in architectural education*

There is a common need to close several gaps between (1) academia and practice, (2) public awareness and financial support for the initiatives, and (3) architecture and pedagogy.

In order to close the gap between academia and practice, the situation calls for, on the one hand, "the development of a new level of pedagogical practice which requires dual-role professionals, that is, professionals who are as skilled in their discipline as

they are with academic teaching abilities" in order to confront societal challenges (TRANSark). On the other hand, new forms of knowledge creation and transfer have been tested by the initiatives. University of Sheffield School of Architecture, who is the initiator of the Live Projects programme and the Live Works initiative in the UK, emphasises collaboration and participation between the civic community and students: "The motivation behind setting up Live Projects was to give students an opportunity to learn through doing – to actively experience the connection between theory, practice and community engagement. We were aware of the disconnection between our teaching, via studio work and lectures, and the socially-engaged ethos we promote. Live Projects close the gap between academia and practice while creating space for reflection on both" (UoS).

This approach can also help in closing the gap between public awareness and financial support for the initiatives. By simply including sponsors in the creative process and at the same time widening their audience, the new schools of thought achieve acceptance and financial support.

In order to close the gap between architecture and pedagogy, pedagogues (being professionals in mediation) and pedagogical theories and methodology should inform educational programmes for architecture (Spacespot, bink, TRANSark). Additionally, TRANSark uses a limited set of courses as "testbeds for didactic experimentation" which are later being internally discussed through seminars and evaluation.

4.2.2 *Inability to find a language for architecture*

There is an inability to communicate design strategies and to find a language for architecture in spoken words, images, and spaces in order to mediate to people outside the discipline and to support the profession. "The 'architect' has contributed to her own marginalisation for many years by allowing other disciplines to take over large and vital parts of the processes producing architecture. Even for core aspects of our profession, such as creativity, other disciplines such as design have developed a much stronger rhetoric and narrative, placing designers in a more potent position with *design thinking* than architects with *XXXX*. There is a strong need for research, development and formulation of our contribution in society" (TRANSark).

As a reaction to this tendency, the initiatives increasingly make their work public in order to mediate to a wider audience outside the discipline and to support the profession. Their methods of inquiry vary widely. They establish a constructive dialogue through internal and public "dialectic debates" (aut), a public "atelier" (AWB), or "excursions" (vai, bink). Bundesstiftung Baukultur conducts polls to find out what public authorities and private persons think about building and planning. This is incorporated into a bi-annual report about the state of building culture in Germany (Bundesstiftung Baukultur 2015). Vorarlberger Architektur Institut emphasises "communication at eye level" as a general means of architectural mediation. Certainly, many of the initiatives also conduct marketing in various media, such as journals, magazines, or radio, yet aut uses *space* as a common language to mediate to the public. The institute designs exhibitions "developed as specially conceived architectural projects synaesthetically designed so as to directly convey what is involved in the work of the exhibiting artists". This reaction can also be understood as an alternative route to counteract the following tendency.

4.2.3 *Scientification and digitalisation weakening the quality of architecture as physical and embodied matter*

Scientification and "increased digitalisation may influence the understanding and quality of architecture as a physical and embodied matter" (TRANSark) leading towards a shift in the content studied and the tools used.

As a reaction, aut implemented the project "bilding" (bilding 2016), an art and architecture school for children built by 27 architecture students over two semesters. Through this hands-on project, students got insights into "dirty reality" (aut) and craftsmanly topics. Furthermore, the initiatives recommend to promote interdisciplinary dialogue, providing building and planning as a culture of general interest (BB), and to introduce the socio-political focus of basic architectural themes in the debate against "digital formalisation and pseudo-sciences" (aut).

4.2.4 *Scientification*

Scientification of architectural education has led to (1) an ongoing discussion about knowledge production in architectural research, (2) the demand for appropriate evaluation and validation techniques for architectural research, and (3) competition in regard to research outputs. Controversies regarding these issues have impacted education.

The increasing emphasis on research in higher education has provoked architectural education to stimulate more staff to do research, and to put a greater focus on knowledge production. The ADAPT-r project can be understood as a result of such a process. This tendency has also led to an increasing variety of teaching and learning formats. In order to inform architectural education with "good quality research" (UoR), new methods such as research-led studios (EAA, TRANSark, ADAPT-r, UoR) were introduced, which combine the techniques and content of research and studio designs. This potentially develops into architecture-specific research methods like research by design. In the long term, this can lead to "a consistent theoretical and methodological framework for pushing our didactic development further" (TRANSark), and hence it can help overcome the necessity of boundary work (Kurath 2014). The Faculty of Architecture at the Estonian Academy of Arts, however, warns that design-based research models need to be accepted by the responsible

institutions and not be subordinated to pure academic writing.

Consequently, there is a demand for useful evaluation and validation techniques in architectural research and teaching. Since "architectural research is still a young research field and has provisionally to lean on other disciplines for methodology and funding" (TRANSark), the initiatives use synergies coming from the cooperation and discussions with other disciplines: "Architectural production has become increasingly regulated from the side of legislation and demanding from the expectations of both the technological and financial performance as well as the cultural and intellectual adaptability to the changing needs of the society. These increasing demands cannot be faced by one professional nor addressed by one single curriculum, but signal a need for a wider interdisciplinary collaboration" (EAA).

In order to keep pace with the competition in regard to research outputs, the initiatives increase credibility by mediating to an academic audience (through papers, conferences, etc.) as well as to a practice-based one (through lectures, exhibitions, journals, and magazines). Additionally, they aim to gain resonance through discussions with invited practitioners and others (UoS, UoR). As a result, the initiatives become interesting for young, experimental practitioners (EAA).

4.2.5 *Commercialisation*

Commercialisation in architectural education has led to (1) a shift from the qualitative value of creativity to an economic one, (2) greater dependency on financial supporters, (3) pressure on the organisational and administrative management of institutions, and (4) a decrease of critical thinking, reflection, and innovation.

Marketing is used as an answer not only to increasing competition in regard to research outputs but also to commercialisation leading to a shift from the qualitative value of creativity to an economic one. The initiatives need to be understandable for and communicative to a wider public, and hence they are challenged by an "increasing pressure for simple messages and nice pictures for the media" (EAA). In order "to highlight the creative role that universities can play in the development of their home cities", the University of Sheffield School of Architecture created the Live Projects programme. Naturally, this has led to increased collaboration with and hence funding by external partners, and turned their dependency on financial supporters into an interrelationship with external partners. Real live projects have the potential to turn commercialisation from a pressure and a threat into an opportunity for learning: "In our education we approach commercialisation by involving the students in real live projects in the framework of 'live pedagogies', allowing the student to 'learn the game' in small scaled 1:1 deliveries. We are also developing platforms for entrepreneurship competences enabling the students to engage with stakeholders in society" (TRANSark).

As a reaction to commercialisation leading to pressure on the organisational and administrative management of institutions, the initiatives within higher education are pushed to decrease student contact in order to create more time for research, to cut back on space and resources allocated to teaching, and to increase fee incomes and student numbers.

"The core values of architectural education as a generator of innovation and critique of the discipline and profession are being eroded. Design skills cannot thrive within an environment of commercialisation where efficiencies of space and resourcing are prioritised over quality of the creative environment. It is very difficult for students and staff to make time and space for risk-taking, experimentation and reflection in the design process. Outputs are becoming more homogenous and predictable because of this – innovation is being squeezed" (UoS). As a reaction to this tendency, the initiatives foster different methods of learning. University of Sheffield School of Architecture introduces mutual learning between students and an interdisciplinary community (clients and the public) in order to offer "an opportunity for critical thinking, reflection and an evolutionary approach to project and design development" (UoS). TRANSark "investigates the transformative aspects of the learning experience when students, exposed to extreme complexity of aesthetical, ethical, technical, economical, and functional challenges as they become architects." (TRANSark 2016). Additionally, the initiatives stress interdisciplinarity as a source for complex, lateral, and creative thinking: "This can't be replicated within the institution – students need a public audience to be able to gain feedback and critically reflect upon their skills, their role and how they can make a difference to society in meaningful ways" (UoS).

5 CONCLUSIONS

5.1 *Tendencies*

This first approach to identify tendencies within NeSTs has been done in a heuristic way. The study of the cases served to expose their main driving forces, objectives, attitudes, and target groups in architectural education. These have been explored further within five tendencies and ways of handling them. (1) There seems to be a breach between architectural academia and practice as well as a mismatch between financial support and public awareness. These circumstances which ask for new instructional approaches and skills. (2) The lack of a common architectural language (spoken words, images, and spaces) makes communication with a wider public difficult and leads to misunderstandings about the architecture profession. In response to this lack, work results are increasingly expected to be formatted and mediated to an audience outside the discipline of architecture. (3) Moreover, the value of architecture as physical presence

appears to be repressed by an augmented scientification and digitalisation. This has a direct impact on the topics studied and the tools used. (4) Scientification of architectural education has further led to ongoing discussions about knowledge production, demanding appropriate evaluation and validation procedures for architectural research. It also has contributed to a growing competiveness in regard to research outputs. (5) Commercialisation is increasingly leaving aside the qualitative and formative value of architectural education, focusing instead on the economic one. Academic institutions compete against each other through the amount of research they produce. The quantity of research done by the universities is also used to recruit students. Frankly speaking: the better the research and the higher the ranking of the university, the more students enrol (UoR). This provokes ongoing pressure on the organisational and administrative management of institutions, leading to financial dependencies and decreasing the possibility of critical thinking, reflection, and innovation. Responses to these challenges include decreased student contact time, cutbacks on spaces and resources allocated to teaching, higher fee incomes and student numbers, and an emphasis on different methods of learning, including an interdisciplinary community. Hence, the initiatives do not only include other sciences, such as the social sciences (architecture and planning, media and communication, economics and business, geography, sociology, psychology etc.), the humanities (arts, cultural studies, literature, archaeology, philosophy, religion, etc.), and the technical sciences (engineering, software and hardware developers), but also medical and health sciences (medicine, neurosciences etc.) in order to provide deeper insight into the interrelations between perception, thinking, and action.

Although the findings of the tendencies contribute to a first understanding of NeSTs, additional in-depth studies of the correlations between the tendencies are planned.

5.2 *Research in architectural education*

As a consequence of the Bologna reform, and the academisation process which it induced, architectural education was expected to strengthen its research orientation. An ongoing tension has arisen between research in architecture, drawing on methods and ontologies borrowed from other disciplines – research into architecture – and attempts to develop design research and practice-based research up to the levels of a recognised academic methodology – architectural research (Crysler *et al.* 2012). Architectural research is a contested concept. In order to give exposure to its existence and to advocate its potentials, the European Association for Architectural Education [EAAE], felt a need to write a Charter on Architectural Research (EAAE 2012). Our future investigations will expand the scope of typologies to include research-oriented NeSTs and focus on tendencies within research in architectural education.

5.3 *The role of space in architectural education*

Finally, the spatial component of NeSTs will be a subject of future research. The sprawl of knowledge sites makes teaching through and learning from architecture now appear in a variety of places, ranging from the typical classroom over exhibition floor, discussion platforms, think-tanks and transdisciplinary networks, to virtual spaces as blogs and websites.

In times of digitalisation, an educational space may no longer be confined to physical walls but may expand into digital space, where a set of rules for the regulation of pedagogical interactions and communications forms an alternative learning environment. As Latour (1983) explains, the whole society is turned into a laboratory, "there is no outside of science but there are long, narrow networks that make possible the circulation of scientific facts."

NeST is a research project conducted in collaboration with the following research partners: the Institute for Architecture and Planning at the University of Liechtenstein, the Architectural Association School of Architecture in London (AA), the Institute for Art and Architecture of the Academy of Fine Arts Vienna, the Faculty of Design Sciences of the University of Antwerp, and Umeå University School of Architecture.

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Ancient architecture and new meaning in the New World. Current tendencies in the USA

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ABSTRACT: The question concerning the relationship between ancient and new in architecture is still relevant, even though it has been debated for over sixty years. The research starts with an analysis of some words, such as restoration, preservation and conservation, in the USA, compared with their European meanings. On this basis, theoretical approaches and practical outcomes are illustrated with reference to the United States of America. Specifically, the aim is to understand how design/restoration/conservation/adaptive reuse projects of historical buildings are oriented.

Through the analysis of some projects, it was possible to evaluate whether the compatibility and reversibility criteria were observed and if and how they were able to create a dialogue between the past and the present, enhancing cultural/material values and at the same time giving relevant answers to contemporary necessities.

1 THE MEANING OF WORDS AND CULTURAL POSITIONS

This study aims to focus on the way interventions on historical architecture are carried out in the United States. The project began because of the awareness that internationally, also in terms of terminology, there are substantial differences due to varied cultural habits. For example, leaving aside the technical literature and referring to the meanings described in dictionaries, we realize how true this is, and how it reflects the history and culture of each country.

The word "restoration" in the English-speaking world means "the act of restoring or state of being restored, as to a former or original condition, place". It is, moreover, interpreted in a negative sense by the academia, certainly influenced by Ruskin thought. Furthermore, "The action of building up again or reconstructing; the process of carrying out alterations and repairs with the idea of restoring a building to something like its original form; a general renovation" (Oxford English Dictionary).

In its place we more commonly use the term "conservation", i.e. "the act or an instance of conserving or keeping from change, loss, injury, etc." (Collins English Dictionary); "the preservation or restoration of archaeological artifacts, historical sites, works of art, etc., by means of specialized techniques" (Oxford English Dictionary).

In France "restauration" means "restitution", translated as "Ensemble des actions visant à interrompre le processus de destruction d'une œuvre d'art ou d'un objet quelconque témoignant de l'histoire humaine, à consolider cette œuvre, cet objet afin de le conserver et, éventuellement, à le rétablir plus ou moins dans son aspect originel" (Dictionnaire Larousse de Français). In other words, it is an act of stylistic restoration, evidently influenced by Viollet-le-Duc's approach since the second half of the 19th century.

In Italy the term "restauro" has followed the criteria of the critical restoration theory since the end of the Second World War. Therefore, it has little to do with re-establishing the former shape of a building. The Treccani dictionary, for instance, explains the lemma as "qualsiasi intervento volto a rimettere in buono stato e in condizioni di funzionalità (...) un edificio o alcune sue parti, oppure altro manufatto", that is "any operation to put in good functional condition (...) a building or some parts of it, or another artifact"). On the contrary the term "ripristino", is "l'operazione di restituire l'aspetto e la consistenza che [un monumento, un edificio] aveva a una data epoca, per lo più fra le più antiche della sua storia, e che aveva perduto in seguito a opere successive di trasformazione e adattamento", that is to say the task of restoring the appearance and texture that a monument or a building had in a specific previous moment of its existence – most commonly the oldest one – and which it lost because of transformation and adaptive reuse. Thus, from place to place the terms listed above assume very different meanings. Matero remarks: "It should be mentioned that translations of the Italian *restauro* as "restoration" are an inaccurate use of the English word. At least from the time of the late nineteenth century debates to the present, the word 'restoration' has come to mean "the process of returning the artifact to the physical condition in which it would have been at some previous stage of its morphological development"



Figure 1. Chicago, downtown landscape (Photo: C. Giannattasio 2015).

(Matero 2007: 55). In Brandi's opinion, "restauro" is "any operation that aims to put back into effective order a product of human activity" as opposed to "preservation" which is "preventive restoration". In this regard, a better translation of "restauro" would be "conservation" which "describes any physical intervention in the actual fabric (...) to ensure its continued integrity" (Fitch 1990: 46).

Another difference is the American context, where "restoration" means "reinstatement in a former position, rank, etc.; restitution for loss, damage, etc; a putting or bringing back into a former, normal, or unimpaired state or condition, a representation or reconstruction of the original form or structure, as of a building, fossil animal, etc.". "Conservation" means "1. the act or practice of conserving; 2. protection from loss, waste, etc.; preservation; 3. the official care, protection, or management of natural resources; 4. the preservation, reconditioning, and restoration of works of art" (Collins American English Dictionary). "Preservation" is often used as a synonym of the term.

Referring to the United States (Fig. 1), the issues of preservation of historical heritage, debated for over two centuries in Europe, have been addressed over time in different ways. In a country characterized by a strong spirit of innovation and given the dominant position of economics in public and private choices, the transformation of the building heritage had less to do with scrupulous attitudes than in the Old World. Nevertheless recently we can notice a growing awareness, demonstrated by greater integration between environmental protection and urban planning (Mugayar Kühl 2007: 139), also in terms of sustainable development (Stubbs & Makaš 2011: 473–74). We can clearly see that the results of preservation are strongly conditioned by the intense connection between the private and public sectors (Rosina & Corbin Murphy 2002: 55).

Reflections on architectural history and on historical heritage preservation were at a crucial point in the 1960's and 1970's, also illustrated by the birth of the National Historic Preservation Act in 1966 and the successive territorial conservation registers and commissions (Longstreth 1999: 326). During this period scholars and American professionals looked at the European experiences (Figs. 2–3), as demonstrated by the Getty Conservation Institute's effort to publicize European ideas in the USA (Mugayar Kühl 2007: 139).

With regards to the different context and architecture, attitudes differ: in America, aspects like national identification, symbolism and historical narration, as well as economic interest are more important than the authenticity or the historical value of the building. In American culture a restored and preserved building has no intrinsic value as layering of history, and it is 'disconnected' from the flow of time. Architecture is seen "as a tool for illustrating history" (Fiorani 2013: 17); at the same time, a historical building which does not have a symbolic and patriotic value, is susceptible to transformation, replacement or demolition.

American thought has long been influenced by a rigid idea of preservation, basing the classification and evaluation of cultural heritage only on style, function and symbolism. Nevertheless, it should be pointed out that recently a new focus on the issue of preservation of existing buildings is emerging. Indeed, "today increasing numbers of high-caliber students in doctoral as well as master's programs are giving serious consideration to the field" (Longstreth 1999: 332). The recent awareness in dealing with the theme of preservation and restoration is indeed evident in the university programs of the main American schools of architecture, analysis of which highlights how students are faced with the issues of authenticity and testimonial value of historical heritage, with a more critical attitude towards preserving historical buildings than in the past.



Figure 2. Boston, Berkeley Building, listed by the Boston Landmarks Commission as Boston's City Landmark in 1975 (Photo: C. Giannattasio 2015).

The sensitiveness towards the past can be seen by the active participation in international conventions (such as UNESCO's World Heritage Convention in 1991), the commitment of many research centers (such as the Getty Conservation Institute in Los Angeles) and the growing number of cultural associations and charities supporting the preservation of heritage.

2 THE PRACTICE OF PRESERVATION

In the United States the practice of restoration and conservation has recently been strongly linked to the themes of patriotism and national identity, as well as to economic and marketing issues. The approach towards the historical and architectural heritage varies, depending on the subject of the project. It ranges from restoration projects to partial or total replacements of the pre-existing building. Some emblematic cases highlight this attitude.

The restoration act to reinstate a former or original condition represents the first approach – also in chronological terms – to the theme of the commemoration of a past to remember and maintain. This theme is often present in the history of architecture. It influences projects and preserves the architecture which is the expression of national identity. What we are talking about is not an exclusive attitude, but rather a direction followed over and over again in the American experience. A classic example concerns the sites and cities where the main historical events took place,



Figure 3. Boston, Old State House (1713). In 1776, from the balcony of the city's oldest building, the Declaration of Independence was read to the citizens (Photo: C. Giannattasio 2015).



Figure 4. Chicago, Crown Hall, IIT, Mies Van Der Rohe (1952–56). An iconic building of the Modern Movement (Photo: C. Giannattasio 2015).

such as the American War of Independence (1775–83) and the American Civil War (1861–65). In this sense Williamsburg is a typical case. In fact from the early years of the 20th century it was decided to 'reconstruct' a precise moment of the city's history. Consequently, all the structures built after the War of Independence were demolished, and a stylistic reconstruction of the destroyed Capitol and Government Houses was created, based on written descriptions and illustrations. The commemorative framework was completed with the staging of the period events, introducing costumed characters that simulate the lifestyle of the second half of the 18th century (Fiorani 2013: 16). Similar projects

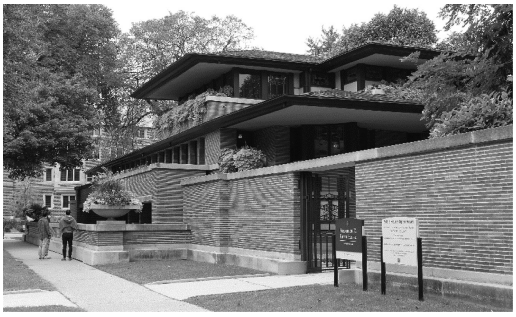


Figure 5. Chicago, Robie House, Frank Lloyd Wright (1908–1909). At the beginning of the 21st century it was restored to its former state (Photo: C. Giannattasio 2015).



Figure 6. Chicago, Art Institute, the Modern Wing opened in 2009, designed by the Renzo Piano Building Workshop (Photo: C. Giannattasio 2015).

are carried out today: an effective example is the demolition of the Visitor Center at Gettysburg National Military Park, designed by Richard Neutra and Robert Alexander between 1959 and 1962. This important example of architecture from the post-war period was intended to serve as a bridge between past and present, introducing visitors to the site of the bloodiest conflict of the Civil War, and where Abraham Lincoln proclaimed his famous speech. Despite the significant value of this modernist work and the opinion of preservationists, the Visitor Center was demolished by order of the Park Superintendent, the National Trust and the Advisory Council on Historical Preservation, in order to restore the landscape skyline of the Civil War period. The operation was completed in 2009.

Therefore, the tendency is to treat architecture and its history as a tool of communication and storytelling: unbound by time, it is considered to represent an elective period or the identity values of the nation. The great respect shown to other modernist buildings, in contrast to that manifested by the last example, confirms this position, leading to operations of reinstatement of the original condition (Docomomo 1991). This is especially true regarding architects enhanced by contemporary American historiography, such as the architects of the School of Chicago and of the Modern Movement, like Frank Lloyd Wright, Walter Gropius, Mies Van der Rohe and Louis Kahn (Figs. 4–5); that is American architects, native or naturalized, who have been able to produce architecture representative of the national identity. An effective example of this approach, certainly not respectful of the modern principles of authenticity and minimal intervention, is the restoration of the Monadnock Block in Chicago, started in 1979 after the acquisition by a partnership headed by William S. Donnell (Miller 1991: 140). Designed by the famous architects Daniel Burnham and John Wellborn Root, School of Chicago, and begun in 1891, this skyscraper is one of the most interesting examples of the pre-modernist movement. It was the subject of several renewal projects carried out in the 20th century, which had compromised its former design. Therefore, Donnell restored the building to its original condition, taking care of every detail and reproducing furnishings, doors and the lighting system (Miller 1991: 145).

Following a similar approach, some of Frank Lloyd Wright's masterpieces such as the Fallingwater House in Bear Run, Pennsylvania (1936–39) and the Robie House in Chicago (1908–10) have been restored.

The latter was adapted to a student center for the university in the 1970's, with consequent modifications and replacement of furnishings. Recently, it was restored and transformed into a museum. It is considered representative of the national architectural identity and so it must be preserved and transmitted to the future, not simply for its historical and material values, but mainly for its intrinsic identity meanings. In accordance with this point of view, at the beginning of the 21st century the Frank Lloyd Wright Preservation Trust undertook the restoration project, both re-establishing the original architectural configuration of the house and reproducing the furnishings, decorations, etc.

Another current and common tendency in the US, in contrast to those described above, regards historic architecture which is not considered representative of the aforementioned symbolic or identity values. Even though they are listed in the National Registers or in Preservation Lists, usually economic and marketing factors prevail on conservation or restoration issues. Consequently the design project focuses on the creation of invasive contemporary structures in order to extend or renovate pre-existing architecture, without considering its peculiarities and meanings. In this sense, many adaptive reuse projects are carried out, recently influencing also the European context, where this practice is becoming more and more widespread. Therefore, the delicate relationship between old and new, which has been widely debated in Europe since the end of the Second World War, is not really considered in the US. The recent demolition of the Takashimaya Department Store façade in New York, designed by Philip Johnson and John Burgee, is a clear demonstration of the loss of attention shown towards some buildings. In 1993 David Chipperfield was asked to design a new façade. The English architect justified his invasive project saying that it was an attempt to

reproduce architecture like that created by Mies Van Der Rohe, specifically inspired by the famous Seagram Building. Chipperfield's work, even though it is of high quality, reflects the American innovative spirit, distant from European, and especially Italian, culture.

In extreme cases, the economic and functional needs lead to the complete demolition or replacement of the pre-existing building, a fact accepted even by preservationists. These actions are done "irrespective of their intrinsic physical qualities or their role in the development of the community" (Longstreth 1999: 330). Façadism seems to be the compromise widely used in the United States, and in Europe as well. Following this kind of practice, the structure and material of the architecture are considered as separate entities, giving more importance to the former. A representative example is the Penn Mutual Building in Philadelphia (1971–75), reinforced concrete and glass skyscraper built to replace the Pennsylvania Fire Insurance Company Building, by the neoclassical architect John Haviland in 1838. Nowadays only a portion of the former marble façade survives, conserved as a reminder of the past.

When the design project is conceived by architects deeply involved in the cultural debate concerning the union between old and new, sensitive to the conservation and valorization of historical buildings, the outcomes are highly remarkable. For example, Renzo Piano's works in the United States, often consisting of the extension and renovation of existing buildings, are strongly marked by respect for the relationship between old and new (Fig. 6). Some significant examples are his plans for museums and libraries in Atlanta, Chicago and Boston. A very notable case is the renewal and extension of the Morgan Library & Museum in Manhattan, New York, designed by the Renzo Piano Building Workshop. He describes the project as "three new pavilions connected to the historic buildings, leaving a large open 'plaza' at the center of the Morgan complex that could be used for public functions and as a metaphorical breathing space for visitors. The three historic buildings, the plaza and the new pavilions meet under a transparent steel and glass roof" (http://www.rpbw.com/).

Regarding adaptive reuse, cases of transformation of existing buildings are numerous and often interesting, although it appears that functional motives could prevail over conservation aims. In other words, contrary to modern principles of preservation, the function becomes the 'aim' and not the 'tool' of the project.

One of the first large scale urban rehabilitation and reuse projects was the preservation of the Quincy Market-Faneuil Hall Marketplace in Boston and its three-year conversion into a contemporary shopping center in 1976, through which the revitalization of the area was achieved (Stubbs & Makaš 2011: 452–53). Inspired by Anglo-Saxon urban strategies, this operation was later reproduced in several other cities in the United States (Fig. 7).

A more recent project, on the architectural scale, again in Boston, involved the Liberty Hotel (Fig. 8).



Figure 7. Boston, Quincy Market-Faneuil Hall Market-place. Converted into a shopping centre in the 1970's (Photo: C. Giannattasio 2015).



Figure 8. Boston, Liberty Hotel. An example of adaptive reuse designed by the Cambridge Seven Associates & Ann Beha Architects in 2007 (Photo: C. Giannattasio 2015).

Inaugurated in 1851, the building was originally the Charles Street Jail, designed by John Fox Grigley Briant, exponent of the so-called Boston Granite Style. When it opened, this prison was considered exemplary, but the lack of investment and increasing overcrowding lead to its closure in 1990. Recognized as a National Historical Landmark building, it was acquired and used for a while by the Massachusetts General Hospital; after it was transformed into a luxury hotel, redesigned by the Cambridge Seven Associates and by Ann Beha Architects. The *rotunda* was transformed into the hotel lobby, and balconies once used by guards and prisoners now connect guest rooms to conference spaces. At the same time many significant historic features were restored.

Reuse also involves structures and infrastructures that have completely lost their function, in the presence of which transformation can obviously be more audacious. For instance, the New York High Line (Fig. 9) is an example of urban regeneration through the reuse of an abandoned railway. It successfully renovated the entire area which it crosses, from a social and economic point of view. Furthermore, even though it is too early to make an efficient evaluation, the High Line seems to be a good example of participatory planning



Figure 9. New York, High Line, designed by James Corner Field Operations and architects Diller Scofidio + Renfro in 2002 (Photo: C. Giannattasio 2012).

and of a new gentrification process: "A neighborhood that had already been greatly impacted by sweeping gentrification since the late 80s may have experienced an increase in gentrification since the installment of the High Line, as the area is over-run by new real-estate developments of high-end condominiums, hotels, and loft conversions in expensive new residential spaces" (Alvarez 2012: 10). Thus, in New York the High Line is a significant project in terms of urban regeneration, which seems to reflect the usual American approach linked to the need to have economic benefits.

Another interesting example, connected to a much rarer operational tendency, which reflects a coherence with the critical restoration approach, is the Franklin Court in Philadelphia. Former home of Benjamin Franklin, situated in the Independence National Historical Park, in 1976 it was the subject of a significant redevelopment project: "a team of designers, engineers, and archaeologists offered a revolutionary solution by revealing the site's historical and aesthetic authenticities through real and exaggerated elements" (Matero 2010: 1). The team, including Robert Venturi, elaborated a project which allowed visitors to rediscover archaeological spaces and reinterpreted the original space of the former house, by means of a ghost structure made of white-painted metal frame reproducing the outline of the demolished main residence of Benjamin Franklin. The concept of Venturi's project is close to European culture and to the principles of the 1964 Venice Charter, although this document has never really been taken into consideration in the United States (Fiorani 2013: 29). Actually, in the American, and in the Anglo-Saxon world in general, "Brandi's words and concepts have been largely absent, due to the lack of an English version of his 1963 Teoria del Restauro until the first excerpts were published in 1996" (Matero 2007: 45; Brandi 1996).

3 TEACHING PRESERVATION

After seeing the projects carried out in America, it is useful to examine ongoing university research and educational programs there. The aim is to identify and emphasize the relationship between the cultural/academic world and the professional world. The tendency among preservationists to prefer typological reinstatement (which considers historical architecture from a stylistic point of view, combined with other factors, such as function, symbolism and structure) is no longer prevalent in the academia. Actually other factors are considered in preservation projects, such as revitalization and sustainability and giving architectural heritage new purpose and vitality (Longstreth 1999: 332). This new way of thinking can be seen by analyzing a few educational programs of the main American universities.

Even though history and culture are the basic topics for preservation courses as well as for design and architecture teaching, one can see that these two subjects are studied in depth in some specialized courses specifically dedicated to heritage. For instance, if, on the one hand, important institutions like MIT in Boston or Yale University in New Haven provide a few specific courses on heritage preservation within the architecture programs, on the other hand, more and more universities offer graduate programs in Historic Preservation. This is the case with the George Washington University in Washington, the University of Pennsylvania in Philadelphia, Columbia University in New York, the University of Southern California in Los Angeles, just to mention a few. In these courses the study of history and culture is not limited only to the US territory, but expands its interest overseas. The course "Urban Conservation Seminar: Heritage and Urbanism in China", held by Randall Mason at the University of Pennsylvania, is an interesting example of this trend. Manson compares the slow evolution of the European cities with the explosion of Asian ones. Moreover, many aspects of American architectural history are explored in greater depth, including issues such as vernacular architecture, rural systems, etc. This connects the American and European cultures as they both move towards a more wide-ranging knowledge of historic buildings.

Similarly, preservation theory and history are taught, for example, "Historic Preservation Principles and Methods" at the George Washington University, "Theories of Historic Preservation" at the Pennsylvania University, "Architectural and Social History" at the School of the Art Institute of Chicago and "Preservation theory and history" at the Pratt Institute in New York. Also in this case the American teaching moves towards the European one: the evolution of the concept of preservation over time is at the base of the Historic Preservation courses, and increasingly in conservation design projects the typological tendencies are giving way to critical design positions.

Even the technical aspects do not differ particularly from the European school, ranging from the study of the properties of materials and construction techniques to the diagnosis of degradation and conservation of buildings. For example, "Conservation Methods and Materials" at the University of Southern California, "Physical Conservation" at the School of

Art Institute of Chicago and "Building Technology" at Pratt Institute look more closely at the themes regarding historical building materials, building pathologies affecting materials and construction elements, as well as actions and methodologies used to preserve and protect the architectural heritage.

An interesting point to be highlighted, and which characterizes the American school, not only academically, but also in the practice of conservation and reuse, is the importance acquired by one of the fields, which has significantly impacted on the preservation of buildings in American culture, namely economics. It exercised a considerable influence even before the enactment of a specific law on heritage preservation (1966) and the birth of the first educational program concerning historic preservation. Currently, schools are planning more and more classes in economics and management applied to the field of conservation and cultural heritage. At the George Washington University "Economics of Preservation" is taught, where, in addition to economic techniques, costs and benefits in the practice of preservation are considered. "Managing Heritage Sites" concerns the management of cultural sites and how to make them more pleasing to the public as well as how to manage budgets, staff and resources.

The Historic Preservation programs of the University of Pennsylvania include "Historic Site Management", "with topics like conservation policy, interpretation, tourism or economic development strategies", and "Preservation Economics" which, as described in the Donovan Rypkema's course program (Spring 2016: 2), "prepare the student, as a practicing preservationist, to understand the language of the development community, why a preservation project should be undertaken, and to be able to quantify the need for public/non-profit intervention in the development process, and also to acquaint the student with measurements of the economic impact of historic preservation".

In summary, in the universities examined the academic teaching of themes closer to the conservation and protection of historical and cultural heritage is frequently overlooked. The specialized educational programs mentioned above represent an exception, particularly those in Historic Preservation at George Washington University, at the University of Pennsylvania and at Columbia University. In these universities all areas are investigated that positively and negatively affect the conservation of cultural heritage at the same time as focusing on related topics such as "the legal framework, the nature and dynamics of preservation organizations, economic factors in rehabilitation, long-range planning and management techniques, the role of community activism, the opportunities of adaptive use and community revitalization, the management of historic sites, and the theoretical bases for current practices". The aim is to seize "the opportunity to deepen one's understanding of the richness and complexity of the built environment as a cultural landscape and the historical significance of its varied parts and relationships; to develop skills in documenting, assessing, and protecting this legacy; and to recognizing the design and planning issues that are central to managing the forces of growth and change within a historic context" (Graduate Program in Historic Preservation at George Washington University).

4 CONCLUSIONS

Ultimately, in the US, as often happens in other international contexts, both European and non-European, we currently have two parallel tendencies. On the one hand, projects are not really sensitive to the historical and material values of a building, and priority is given to economic factors, which justify the reconstruction or replacement of entire old sections. On the other hand, projects are linked to commemorative issues and their aim is to reinstate the original aspect of a building, erasing the signs attesting the passage of time.

This trend comes both from a critical analysis of the main projects, and also from examination of the teaching programs of the leading US universities focusing on historic preservation. First of all, we have to highlight that only some universities in the US include these kinds of courses. When this happens, the cultural reference is the Anglo-Saxon environment, that is to say, preservation is taught paying great attention to technological and conservation topics, as well as to marketing and the economic feasibility of the project.

It consistently emerged that the "critical restoration" principles do not succeed here.

Nevertheless, reflection on cultural heritage as a material sign of the past, also of the recent past, is nowadays more and more the focus of some American conservation specialists. Unlike some professionals and preservationists, they do not look at historical architecture as something to associate with typological building categories, representative of a particular historical period, and selected according to comparable processes of the classification of biological species. Despite the fact that typological conservation is still the main *modus operandi*, there is a certain optimism among those specialists who approach the preservation of cultural heritage with more vitality and a critical spirit.

Finally, we think that a dialogue between Europe and the US, from an academic and professional point of view, could be very useful for the growth of the conservation and restoration sector. If we do this, we will manage to create a common way of thinking and working which at the same time respects each country's differences. Specifically, this will allow us to enhance conservation and design projects based on a careful balance of old and new, once and for all stopping false "in style" projects.

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Future studio: Preparing students for practice in the global context

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ABSTRACT: How is the institution of the architectural design studio evolving in the twenty-first century in response to external pressures from the profession and society? How might current professional trends and societal challenges further transform the design studio? The architectural design studio is an educational setting that has evolved in North America from the late nineteenth century to the present day. Originally modeled on architectural practice, early studios grew in a variety of supporting institutions including architectural clubs, firms, schools, and universities. Through a process akin to natural selection, the university emerged, in the early twentieth century, as the predominant locus for design education. Henceforward the design studio developed into its present form as a result of influences from both academia and the profession. As with biological evolution, the development of the studio is an ongoing process with variations emerging in response to practice trends. The present research, part of a study of the evolution of architectural design education in North America, examines one particular practice trend, increasing globalization of society and professional services, and the various responses of architecture schools and allied institutions in the design of studio experiences preparing students for their future roles in globalized practice.

1 INTRODUCTION

The architectural design studio is an educational setting that has evolved in North America from the late nineteenth century to the present day. Originally modeled on architectural practice, early studios grew in a variety of supporting institutions including architectural clubs, firms, schools, and universities. Through a process akin to natural selection, the university emerged, in the early twentieth century, as the predominant locus for design education. Henceforward the design studio developed into its present form as a result of influences from both academia and the profession. As with biological evolution, the development of the studio is an ongoing process. Variations have emerged in response to emerging trends in practice. The present research, part of a study of the evolution of architectural design education in North America, examines one particular practice trend, increasing globalization of professional services, and the various responses of architecture schools in the design of studio experiences to prepare students for their future roles in globalized practice.

Studio experiences that bring architecture students into contact with international cultures have their intellectual roots in the Grand Tour. Beginning in the late 16th century, young aristocratic men traveled to France and Italy to learn about art and architecture (Sorabella, 2003). Aspiring American architects who traveled to Paris to study at the Ecole des Beaux Arts followed this intellectual tradition. As American architectural education developed largely based upon the educational model of the Ecole brought back by those early students, the value of international experience was fundamental to the system.

In the early days of American architectural education, the purpose of the international experience was to prepare American architects for domestic practice by giving them educational opportunities unavailable at home. It was not until the late twentieth century that international practice became an important factor in the development of the American architectural profession. International clients began to seek out American architects and firms for their expertise and American practices came to depend upon international markets for services to maintain their profitability through the vicissitudes of the United States economy. With time, international practice evolved into global practice, as American firms with commissions in other countries evolved into multi-national firms with worldwide strategic plans. Travel improvements enabled international practice to develop, and advances in communications technologies continue to spur the evolution of global practice.

This study first examines variations on the spectrum of international to global practice. Next, it identifies a set of models for architectural education preparing students for engagement in increasingly global architectural practice. Finally, it concludes with speculation about the future of studio in the preparation of students for practice in an increasingly interdisciplinary,

multi-cultural, global setting. professional models for globalized practice.

2 PROFESSIONAL MODELS FOR GLOBALIZED PRACTICE

Although the globalization process has its roots in early travel, key turning points have been identified as 1) the separation of communication from transportation with the invention of the electric telegraph in 1830-1850, and 2) the invention of the micro-processor, leading to the establishment of the first global networks in 1971. Economic, political, technological, cultural, and environmental factors all influence the process of globalization (Rennen and Martens 2003). Innovations in transportation and communications have spurred the globalization of architectural practice. American architecture firms have adopted several models for practicing internationally and for engaging in truly global practice. Major models include: 1) the traveling architect model, 2) the strategic alliances model, 3) the outsourcing model, 4) the field office model, and 5) the virtual team model.

2.1 *Traveling architects model*

In the traveling architects model, key project personnel fly to an international site for meetings and information-gathering, then return back to the firm's US office and inform the team that executes the work.

An example of the traveling architects model was the way Skidmore, Owings & Merrill organized to execute the Hajj Terminal at the King Abdulaziz International Airport in Jeddah, Saudi Arabia, completed in 1981. The airport work was executed in the New York and Chicago offices of SOM, with firm principals traveling for project meetings and bringing information back to the project team executing the work in the US offices. (Simon, 1979–1983)

An innovation in air travel at the beginning of the fourth quarter of the twentieth century, supersonic flight, ushered in with the beginning of Concorde service in 1976, cut flight times dramatically. Concorde service, although short-lived, launched faster air travel and an accompanying sense that international destinations were closer. In the late twentieth century, documents traveled by airplane as well. FedEx, a pioneer of air delivery, was founded in 1971, and by 1977 was delivering around the world, enabling next-day transfer of project documents. These innovations in travel for people and documents facilitated international practice. (Simon)

2.2 *Strategic alliances model*

In the strategic alliance model, the US firm forms an association or joint venture with a local firm. The terms of the association or joint venture agreement set forth the respective roles of the two firms. While the association model preserves the separate legal status of the two firms, the joint venture model unites the two firms into a single legal entity for the duration of the relationship. (McNeill 2009) In a simple strategic alliance, the US firm might execute the design, while the local firm, familiar with local construction methods and materials and constructors, might prepare construction documents and perform contract administration.

An example of a strategic alliance is the 2010 formation of a joint venture between Callison and HAYA Architects, uniting Callison's "global design expertise and experience" with HAYA's "local insight and strong delivery systems." (Callison, 2010)

2.3 *Outsourcing model*

The US firm outsources the preparation of construction documents to an overseas firm in a labor market, such as India, where the cost of services is substantially lower than in the United States. The international education of Indian architects in the United States facilitated their founding of architecture firms back in their home country prepared to interface with American practices. Another key factor enabling outsourcing is improvements in the technology of documents transfer. The ftp protocol came online in the 1980's, providing secure document sharing over the internet.

2.4 *Field office model*

In the field office model, US firm sends key personnel to establish an office at the location of an international project. The field office principal maintains communications with the firm's US office(s). The field office may be temporary for the course of a single project or may establish a long-term relationship, serving to develop new clients for the firm as well as executing local projects.

Developments in communications technology, such as email, becoming prevalent in the 1990's, facilitated the growth of international offices of US firms and the development of multi-national firms.

2.5 *Virtual team model*

In the virtual team model, the firm maintains offices in international locations, staffing the offices with local personnel, and manages projects as collaborative efforts among members of the geographically dispersed team.

An example of the virtual team practice model is the master plan and selected buildings for New Songdo City in South Korea, designed by KPF in their New York and Seoul offices at the beginning of the twenty-first century. Personnel in the New York office relied upon their counterparts in Seoul for information about urban culture in Korea (Nemeth, 2014).

A version of the virtual team model is the round-the-clock practice model, where a firm realizes economies of time by passing projects back and forth across time zones to team members in two or more geographic locations.

Virtual practice was enabled by the development of communications technologies and collaborative tools. Not only do architects pass documents back and forth among geographically dispersed team members by ftp protocol, but since the beginning of the twenty first century, they can collaborate in real time on an intelligent three-dimensional model with building information modeling (BIM). Whereas in the early days of international practice, architects and consultants would work separately, meet physically, and exchange physical documents, integrated project delivery now creates an interactive environment where virtual teams collaborate through the building information model. A rapidly expanding array of project management and communication tools facilitates easy exchange among team members.

3 EDUCATIONAL MODELS FOR LEARNING TO PRACTICE GLOBALLY

The American tradition of well-to-do young men (and one woman, Julia Morgan) traveling to France for study at the Ecole des Beaux Arts continued into the second half of the twentieth century. And, for those who could not afford to study abroad, a group of alumni of the Ecole banded together to form the Society of Beaux-Arts Architects, later becoming the Beaux-Arts Institute of Design (BAID), which promulgated a system of design education spurring the creation of American ateliers that emulated the Parisian ateliers of the Ecole. (Simon, 2012) In these ateliers associated with clubs, firms, schools, and universities, aspiring American architects were steeped in the French culture of architectural education, even learning the French vocabulary of architectural practice. (Simon, 2002) Of course, these experiences were not intended to prepare American architects to practice in France; instead they were intended to prepare American architects to practice in the United States as if they had studied in France. These were not study abroad studios, but rather studios that transferred a foreign culture to the United States.

The opportunity to study abroad in Paris, long a custom of the wealthy elite, was extended to all students in the American ateliers when in 1904 the Beaux-Arts Institute of Design (BAID) began offering a competition, the Paris Prize, which funded one American student each year for study at the Ecole. The BAID, renamed National Institute for Architectural Education (NIAE) continued the Paris Prize until 1963 (Schwartzman, 1964).

Another important American institution, the Rotch Traveling Scholarship, grew out of one family's experiences with the tradition of studying abroad in Paris. The scholarship, initially offering funding to an individual for two years of travel and study abroad, was founded in 1883.

These early opportunities for aspiring American architects to study abroad – or to study at home as if they were abroad – laid the foundation for the development of a variety of educational models introducing architecture studies to international cultures. Initially inspired by the animating concept of the Grand Tour, self-improvement through exposure to the monuments of the past, the mission of many of these educational experiences broadened and evolved over time in response to changes in educational institutions, in society, and in architectural practice. The education of architects moved from a diversity of early settings into the universities. As increasing globalization of drove the development of study abroad programs in universities, additional international opportunities opened for architecture students at the university level. And, as the globalization of architectural practice accelerated from the late twentieth century onwards, architecture schools and allied institutions developed new models preparing students to become global practitioners.

Major models include: 1) individual travel/study grant (offered by a variety of organizations including architecture firms), 2) study abroad course, 3) studio abroad with US faculty, 4) studio abroad with international faculty, 5) studio abroad in an international firm, 6) joint studio abroad in partnership with local school of architecture, 7) community-engaged studio abroad, and 8) virtual studio. The following discussion will focus on the studio-based models, introducing each model and illustrating it with a case study example.

3.1 *Traveling studio with US faculty*

A group of American architecture students and faculty travels to an international destination for site visits and information-gathering, then executes the project on site or returns back to the US school to execute the project. An influential sponsor of traveling studios is the Rotch Traveling Studio Grant, established in 2002 by the Rotch trustees, expanding their funding for international travel from individuals to studio groups.

A case study example of a traveling studio funded by a Rotch Grant is MIT's Cycles traveling studio that brings twelve students to Iceland for one and a half weeks of site research under the direction of Assistant Professor William O'Brien Jr. Students prepare for their international travel by researching current development in Iceland, along with developing methods and techniques that they will deploy on site. During their time in Iceland, students visit sites that give them insight into the relationship between geology and the development of infrastructure and urbanism. Upon returning to the United States, students engage in analysis and design projects based upon their site research (O'Brien, 2010).

The basic model of a traveling studio that brings a group of American students to an international destination where they are guided to learn by an American instructor seems to offer the most minimal preparation for global practice. Students are certainly exposed to an unfamiliar place, where they view local places, people, and activities under the guidance of an American studio critic. At face value, this seems less valuable than some of the other models, which give students

opportunities to view their international destinations through the eyes of local faculty, practitioners, students, clients, and/or local residents. However, the case study examined demonstrates the potential value of this model. In this particular example, the deep local experience and expertise of the studio critic gives these students specific preparation for global practice by teaching them to develop techniques for site-based research and analysis of resulting data. And, the studio teaches students to design based upon this intensive site research and analysis.

3.2 *Studio abroad with international faculty*

American students study in an international location with faculty from that country as their studio instructors.

A case study example is the Architectural Design Studio at the Danish Institute for Study Abroad (DIS). American students studying at DIS enroll in a studio course taught by Danish faculty. The Spring 2016 Architectural Design Studio explores the notion that "there is such as thing as a 'common ground' that guides, inspires, or frames the way architects and designers work in a specific region or culture." The studio takes students traveling in Denmark and farther afield in northern Europe (DIS, 2016).

The studio abroad taught by international faculty prepares students for global practice by introducing them to sites and programs through a local or regional lens. The theme of the common ground embodies the concept that there is a shared understanding. The DIS studio explicitly directs students to seek this common ground.

3.3 *Studio abroad in an international firm*

American architecture students travel to an international destination to participate in an architectural design studio taught by noted practitioners in or near their professional offices.

Harvard University's Graduate School of Design offers a Studio Abroad that gives ten to twelve students the opportunity to each semester the opportunity to engage in a design studio experience with international practitioners. Since the program's inception in 2011, noted international architects leading the studio have included Rem Koolhaas, Toyo Ito, Jacques Herzog and Pierre deMeuron, Anne Lacaton, Frank Barkow, Arno Brandlhuber. In the Fall of 2015, the Studio Abroad was hosted by Toyo Ito in Tokyo, Japan (Harvard GSD).

Students engaged in a series of projects for Omishima Island, titled "Making Omishima the Best Place to Live on in Japan." In addition to Toyo Ito, studio critics included three teaching assistants and studio consultants included a structural engineer from ARUP and a researcher, who also taught accompanying seminars. The final jury gave the students a range of perspectives on their work, from critics including GSD faculty, local faculty from University of Tokyo, and local practitioners. Throughout the semester, the students interacted regularly with Japanese architects through a series of experiences including visits to buildings and a smart city, office visits, workshops, lectures, and critiques. Students also had the opportunity to meet with local residents of their project site, Omishima Island.

This studio abroad experience offers several benefits. First, the semester-long duration offers the opportunity for extensive immersion in host firm, the local professional community, and the local culture. Under the aegis of a highly respected local architect, students gained entrée to people, places, and practices. The seminars accompanying studio provided students opportunities with knowledge to foster their understanding of the various experiences of their study abroad semester. Seminars and workshops taught them local design processes and technologies. The marked politeness of the students' verbal expression in their studio blog suggests that they absorbed lessons of interpersonal communication embedded in Japanese culture (GSD Studio Abroad blog).

In this case study of the studio abroad in an international firm model, we see students prepared for global practice in several ways. The foreign becomes familiar as students spend an extended period of time in another country. They learn about the settings of architectural practice in their destination country. They engage with local architects, consultants, clients, and users in meetings guided by local hosts who serve as cultural interpreters, assisting students in understanding these interactions. Students learn local customs and etiquette through frequent contact. In addition to gaining a set of local knowledge, students likely also gain a generalizable set of competencies that will allow them to skillfully navigate other international places and cultures.

3.4 *Joint studio abroad in partnership with local school of architecture*

The joint studio abroad model engages students from two cultures in a shared studio experience. One or both groups travels to the other's location.

Georgia Tech offers a joint studio abroad experience in the International Urban Design Workshop. This studio brings the College of Architecture together with collaborating schools and other institutions abroad for collaborative teaching and research to develop shared intellectual interests. Sustainable urban design is a particular focus of the studio projects. The primary objective of the studio is to "engage graduate students in the College of Architecture in interdisciplinary, collaborative and real-world experiences in support of global professional practices in urban design, architecture and planning" (Yang, 2016) The first two-week-long studio took place in Shanghai, with fifteen Georgia Tech graduate students collaborating with fifteen Tongi University students in project teams in an urban design project (Georgia Tech).

In this case study example, students are prepared for international practice by learning to work

collaboratively in international teams with students from another country and culture. In order to work effectively, they must navigate differences in language and culture. They learn to see urban situations and identify problems and opportunities from the point of view of local students.

3.5 *Community-engaged studio abroad*

The community-engaged studio model gives student the opportunity to work with clients, users, and stakeholders. These studios model practice and offer opportunities for students to use their growing expertise for the public good.

A case study example is the Old Accra: Upcycling of Agrowaste studio, winner of the 2015 Rotch Traveling Studio grant. This studio is designed to bring twelve students and two faculty from Rensselaer Polytechnic Institute for a ten day travel study experience engaged with local industry in Accra, Ghana. Before departure, students are to prepare by researching context and precedents and engaging in preliminary design exercises. Their itinerary in Ghana includes visits to grass-roots recycling hubs in Accra, a design charrette and workshop with local participants in Old Accra, critical review and public presentation. Back in the United States, students are to revise their designs and construct a full-scale prototype. Design instructions and components to be sent back to Accra will enable Ghanaian partners to fabricate and install the prototype at the Chale Wote Street Art Festival in August 2016 (Crembil and Lokko, 2015).

The model of the community-engaged studio abroad prepares students for global practice by developing their cross-cultural communication skills as they interact with local participants in research, design, critique, and sometimes construction of a project. In addition to developing knowledge of a specific place and people, students learn a process for operating within an unfamiliar culture.

3.6 *Virtual studio*

The virtual studio model brings American students together virtually with international students, unifying the students into a geographically dispersed team.

A case study example of this model is the The Bridging the Gap studio, which brings eight University of Maryland graduate students together with twelve Al Nahrain University undergraduates in a dispersed team working together on a series of projects in Washington DC and Baghdad. Studio critics are Associate Professor Madlen Simon of the University of Maryland (the author), Assistant Professor Shaimaa Hameed Husseini of Al Nahrain University, architect Marlene Shade of Dewberry, and Zahraa Alwash, Ahmed Khalil, and John Rivers of Gensler. Iraqi students are preparing information about a Baghdad site for the American students, who, in turn, are preparing information about the Washington, DC site for their counterparts. Team members exchange project information on an ftp site, get to know one another via a Facebook group, taste each other's local cuisine through a recipe exchange, listen to each other's music, and meet for questions and critiques of each others' work through video-conferences. Team members serve as informants on the ground and interpreters of one another's cultures. This virtual studio offers a means to bridge a gap in knowledge and understanding where actual travel to Baghdad is impossible due to the threat of terrorist violence and actual travel to Washington is unlikely for most of the Iraqi students. Prior to the studio, most of the students had little knowledge of each others countries and cultures other than what they learned from the news media. The studio gives the students new, direct channels of communication over the Internet. And, at the conclusion of the studio, two Iraqi students and two American students will be selected through a design competition to meet in the real world in an internship at Gensler's Washington DC office.

In this case study example, students are prepared for global practice by learning to work in a virtual team. Their need for knowledge about the sites and users they are designing for creates an obligation to learn how to break down the barriers of language and culture to communicate with their counterparts around the world. This involves the development of soft skills as well as familiarity with some rudimentary team communication tools.

Students were asked to select a specific user, construct a narrative, and focus their design proposals on the lived experience of that person. Developing student work in the US and Iraqi studios indicates a high level of cultural understanding and empathy for the users of proposed projects. At the conclusion of the studio, a post-survey will be compared with a pre-survey to measure change in a set of indicators over the course of the semester. Results will be reported in a future paper.

4 CONCLUSIONS

The value of international experience is fundamental to American architectural education, due to the significant influence of American architects trained at the Ecole des Beaux Arts in Paris, carrying on the tradition of the Grand Tour that exposed young architects to the monuments of Europe. Traveling grants for young architects, such as the Rotch Traveling Scholarship, emerged out of this tradition beginning in the late nineteenth century. Architecture schools developed studio abroad programs to broaden opportunities for international experience beyond individuals to groups. The Rotch Foundation supported this effort with the Rotch Traveling Studio grant program founded at the beginning of the twenty-first century. By this time, the value of the studio abroad had already broadened from the original mission of self-improvement through exposure to the masterpieces of Europe to preparation for practice in an already international and increasingly globalized interdisciplinary profession.

While studio abroad opportunities are proliferating in a variety of new models, education is lagging significantly behind the profession in this area. One of the examples examined in this research, the author's virtual studio, has the potential to build students' soft skills necessary for collaboration among geographically dispersed teams, but operates at a level of technological sophistication well below professional standards. Soft skills are critically important to effective global practice, as one of the key benefits of a virtual team is the ability to bring insider insights into local conditions to the benefit of geographically remote team members. Research on the ongoing virtual studio will measure the development of this capacity in participants during the course of the semester.

The next evolution in this arena would be a virtual studio using BIM to create an integrated project delivery environment for the geographically dispersed team. And, an important further development would be the inclusion of multiple professional disciplines, making the virtual student team both cross-cultural and interdisciplinary.

Architectural studio education in the United States developed out of the atelier model that simulated the practice setting to a large extent. While firms have undergone radical changes in response to the globalization of society and practices, the typical architectural design studio has not kept pace. Architectural education is lagging, not leading, the profession as it evolves to meet the challenges of globalization. The experiments in studios abroad and virtual studio examined here offer models for further exploration and development, critically necessary for the evolution of the architectural design studio experience necessary to prepare students for current and future interdisciplinary, multicultural, globalized practice.

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Architectural education circa 2030: Results of master planning research

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ABSTRACT: This paper analyzes exploratory research conducted by the California Polytechnic State University San Luis Obispo Architecture Department in the 2014–15 academic year as part of a larger university wide 15 year Master Plan academic program visioning process. Tasked with visioning the Department in 2030, the intensive Master Planning process included exploring "Future Academic Leadership Opportunities" specifically related to curriculum, pedagogy, and enrollment, in addition to the exploration of strategic interdisciplinary opportunities, and the deployment of "Learn by Doing" educational models. Seeded by global forecasts, regional demographic projections, and observations from the profession, the Architecture Department developed and utilized six future socio-technologically constructed scenarios, driven by dynamic environmental conditions which have significant potential to shape architectural curricula in the decades to come, to further their planning process. These future scenarios include: the impacts of *Megacities and Increasing Urbanization*, *Energy/Matter Resource Relationships*, *Disruptions to Ecosystem Service Provisioning*, *Big Data and Ubiquitous Physical Computing*, *Manufacturing in the Age of Makerbots and Nanotechnology*, and *Economy, Employment, and Means of Production*.

These scenarios initiated a mixed-methods study which sought to answer the question: Given dynamic change, how do we maintain our position as a leader in the field of Architectural Education in 2030? Through a series of anonymous surveys and focus groups, this paper details the research methods, results, and ensuing conversations surrounding the development of educational responses that suggest the following: transitioning to pedagogical models of breadth linked to focus area(s) of specialized depth within Architecture, a targeted investment in representation, communication, and fabrication skills, and an increasingly sophisticated technologically based curriculum that is more seamlessly integrated with traditional studio design practices and formal pedagogies.

1 INTRODUCTION

1.1 *The master planning process at Cal Poly, 2014–15*

In the 2014–15 academic year, the California Polytechnic State University engaged a comprehensive Master Planning initiative that spanned all sectors. Lead by Linda Dalton, P.hD, AICP and the Vice Provost for Institutional Planning, the process was framed by theories of "Disruptive Change… [which] challenges the very role and value of higher education now and in the future" (SCUP 2014). The process was in part driven by a significantly shifting demographic in the State of California which is expected to impact the University's enrollment. As the State's University systems are attracting an increasingly ethnically and culturally diverse population, it is also forecast that it will see fewer California natives, increasing percentages of international students and non-traditional transfer students, and an increase in different languages spoken on campus (Pitkin et. al. 2012).

In the fall of 2014, each unit was tasked with the development of their own program narrative and a set of recommendations to their larger College committee which would compile and ultimately frame the recommendations. Each unit had less than a month to complete this process. This paper details the process the Architecture Department developed, and the results that were generated and shared with the College as driven by the research question: given dynamic change, how do we maintain our position as a leader in the field of Architectural Education in 2030?

1.2 *Research design*

Given the tight time frame, a mixed-method approach was selected to analyze data collected over three weeks. Six future socio-technologically constructed normative scenarios (Van der Merwe, L. 2008) were developed in advance of the first of three weekly focus groups by the author, who took the role of "participant observer" as she conducted the research on behalf of the Department. She also co-authored an anonymous survey with Department Head, Margot McDonald. These two mechanisms, in combination with constant comparison methods, were intended to facilitate the Department's development of its recommendations by focusing and legitimizing the work. After the second focus group, the survey was distributed to all forty-two of the faculty, who had five days to respond.

On October 23, 2014 the faculty of the Architecture Department convened their first of three hour-long focus groups to discuss possible departmental responses to evolving trends in the profession and discipline. All forty-two faculty were encouraged to participate. This initial group consisted of fourteen faculty. The discussion was initiated by a brief update on predicted California demographic trends (as reported in the University-wide meeting the week before) (Pitkin et al. 2012) and the introduction of the six future scenarios framework, developed from the resources made available through the University's Master Planning initiative, particularly the "2013 Forecasts from the Futurist Magazine" (The Futurist Editors 2013). The scenario planning format was chosen because it has emerged as "…a revolutionary alternative to traditional strategic planning because it [is non-linear and] recognizes the unpredictable nature of the future." (Chermack 2011). These scenarios were posited to seed focused discussions which highlighted disciplinary sectors that have significant potential to dramatically shift architectural curricula in the decades to come. Specifically designed to tap industry and academic trajectories observed from both within the academy and in practice, these future scenarios included: the impacts of *Megacities and Increasing Urbanization*, *Energy/Matter Resource Relationships*, *Disruptions to Ecosystem Service Provisioning*, *Big Data and Ubiquitous Physical Computing*, *Manufacturing in the Age of Makerbots and Nanotechnology*, and *Economy, Employment, and Means of Production*. The focus group was targeted to address three impact areas within the school (the 3 P's): *People*, *Programs*, and *Place* (visioned to roughly correspond to: space type, allocation, and adjacency).

The second focus group was held exactly one week after the first. Sixteen faculty attended (half of which also participated in the first group). This second group was focused specifically on issues related to fabrication, which emerged as a significant concern in the first group. Two of the faculty responsible for the fabrication lab and related curriculum spear-headed the group.

This second focus group was followed by an anonymous survey distributed to the faculty as a mechanism to collect a broader range of feedback and follow-up thoughts. The survey was made available to all forty-two faculty on October 27, 2014 at 7:00 pm and was administered via Survey Monkey. It consisted of five questions. Nine faculty completed the entire survey over the course of three days.

The third focus group was held exactly one week after the second. Eleven attended (five participated in both previous groups and two participated in the second group only). The full survey results (completed by nine faculty) were reported out. This third group summarized the data collected to date and focused on content and strategies for producing final outcomes and deliverables.

The process resulted in the production of two documents distributed to the College of Architecture and Environmental Design, one summarizing general recommendations, and the other focused on fabrication. These were then complied with reports from each of the other four departments in the College, and forwarded to the University Master Planning Committee.

1.3 *Six scenarios and survey questions posited*

1.3.1 *Megacities and increasing urbanization sectors*

"In 2025 the planet saw its 27th urban center attain megacity classification [population <10 million]. Globally, as urban areas continue to expand, issues related to their proximity to increasingly dynamic natural infrastructures (such as coastline adaptation to sea-level rise, food and energy sources, etc.) become more urgent issues for built environmental professionals as quantity and quality of resource generation, distribution, and allocation in megacities poses perpetual challenges. While the distinctions between developing and developed world urban contexts continue to blur, there are still critical differences in the relationships between their infrastructures and architectures. In the developed world, heavy footprint 20th century infrastructures continue to need significant maintenance, retrofitting, and upgrading as they slowly migrate toward their lighter/smarter siblings in the developing world. Architects work mainly on renovations and upgrades of existing building stock, and strategies to adapt existing structures and infrastructures to the impacts of changing economies, programs, densities, and climates. They are also struggling to deal with the long-term effects of the poorly conceived and coordinated "green housing boom" of the 2010's. In the developing world, new construction is still dominant and takes its design cues from lightweight/smart infrastructures and new resource savvy technological developments in material science and construction techniques. However, large percentages of their populations still do not have access to critical infrastructural services. Meanwhile, the developing world struggles to rapidly build new, climate and energy sensitive affordable projects."

1.3.2 *Energy/matter resource relationships*

Well into post-peak oil, the harvesting of energy continues to be a challenge as "alternative energy sources" have proven they cannot meet legacy electrical energy needs. "Next-generation" alternative energy sources, such as thermal energy mined from transportation, "junk" energy mined from ambient microwave and vibrational noise, and GMO modified energy producing algae are all harvested and distributed via highly localized systems facilitated by hybrid high-low tech bodies of buildings. Buildings increasingly capture, manufacture, and potentially distribute their own energy form a diverse portfolio of sources. Architects returned to low-tech, predominantly thermal active, high performance building materials and bioclimactic strategies to minimize carbon-based energy use. Nanotechnologies such as Buckypaper and Graphene

greatly improve structural, thermal, and other types of building component and material performance. Resource recovery [recycling] becomes increasingly efficient and ubiquitous as materials, and the energy they contain and manage, are increasingly recognized and valued through both global marketplaces and local economies. The transportation of goods and materials has decreased dramatically due to the cost of energy.

1.3.3 *Disruptions to ecosystem service provisioning*

Since 2010, humans have driven animals and plants to extinction faster than they could evolve due to the acceleration of anthropogenically driven climate change and concentrating levels of environmental toxicity. As critical ecosystem services oscillate between functionality and non-functionality [such as pollination, water filtration], architects, landscape architects, urban designers, ecologists, and engineers collaborate in the deployment of systems thinking to design and built habitat for critical species and services. Hybrid eco-technical interior habitats often prove more productive than their exterior equivalents, such as the aquaponic recycling systems now standard in most kitchens. More lay-individuals are participants in the regular maintenance of these systems. Continuous human management of the larger environment is aided by technology, and necessary to maintain and augment ecosystem service provisioning. Relationships between post peak-water and post-peak oil are widely understood as the energy costs of pumping, conveyance, and treatment of water, and the environmental cost of the resulting carbon emissions, renders access to clean water dubious.

1.3.4 *Big data and ubiquitous physical computing*

As the cloud shifted from being primarily a storehouse to an intelligent data clearinghouse which communicates seamlessly with sensors and actuators, we have abandoned discreet desktops, laptops, tablets, thermostats, etc. for computational devices embedded everywhere within our environment. Architecture and products are designed and built to physically sense our needs utilizing smart materials and environmental sensors [in some cases, through advances in neuroimaging, select sensors actually "see" our thoughts] to deliver both virtual and physical resources on demand. Robots increasingly provide services as they become more sensitive caregivers, and communication has become predominantly image driven, resulting in losses of verbal eloquence and precision. We struggle to manage the complicated energy footprint, the large quantities of data, and the implications of data talking to itself.

1.3.5 *Manufacturing in the age of makerbots and nanotechnology*

In May of 2013 the Department of Defense required "Defense Distributed" to remove 10 downloadable CAD files of their 3-D printable "Liberator" handgun and other firearm components from their public server [100,000 downloads in 2 days], a watershed moment in the history of 3-D print manufacturing. MakerBot 3-D printers cost just a few hundred dollars, free 3-D scanning software for mobile devices is readily downloadable, and print mediums are made from a variety of materials, artificial and natural, recycled and recyclable. Objects are regularly replicated by laypeople, International Space Station replacement parts are manufactured on-site, and 3-D printed eye-glasses have become accessible to thousands of people living in remote developing world conditions. With the variety of 3-D printer scales and materials, architects are printing buildings and building components from concrete, polymers, and recycled materials. Traditional manufacturers are struggling to keep from shutting their doors while nanotechnology manufacturing is booming. The design professions are struggling to redefine their value, market, disciplinary skills, and pedagogy in the face of ubiquitous mass, unskilled replication.

1.3.6 *Economy, employment, and means of production*

Since the global economic shift to "post-growth," steady employment has become increasingly rare. It's been replaced by a project-based economy driven by "service oriented design." Material goods are less and less in demand, in part because their value has inflated exponentially, along with energy, water, and food. As firms can no longer support their own overhead, architects are increasingly working as freelancers, hired into larger, interdisciplinary teams assembled for specific projects, or R&D consortiums. Liability has become an increasingly complex challenge. Architects are designing much more than buildings, the scope of services has expanded to include environmental products, materials, construction technologies/ tools and methodologies, supply chains, logistics, policy, habitats for other species, and whole environments [actual and virtual]. Because site conditions have become so complex, architects are valued for their deep understandings of specific geographies and contexts. Individual architects have become increasingly multi-disciplinary and networked as more of their work engages "wicked" interdisciplinary problems (Rittel & Webber. 1973) and revolves around securing paid work.

1.3.7 *Anonymous survey questions*

1. What are the most dramatic shifts that you anticipate the architectural profession will undergo in the next 15 years?
2. Who will our students be in the next 5, 10, 15 years? Please consider demographic, pre-architecture preparedness, interests, disposition.
3. Students typically experience at least a 10 year time-lag between the start of their architectural education and the point in their career when they have the experience and authority to substantially impact the projects they work on. Given this lag, and the shifts in the profession identified above, what

knowledge/methods/skills are critical to deliver during their education today? In 5 years?
4. What would our program need to look like [people, programs, place] to deliver that knowledge, those methods/skills? In 5 years? In 10 years? In 15 years? Please consider teaching, research, and service.
5. Is there anything else you'd like to add related to the long term vision for the architecture department program offerings?

2 RESULTS

2.1 *Analysis of focus group*

2.1.1 *Summary of responses to megacities and increasing urbanization sectors scenario*

Integration and interdisciplinarity will prove increasingly necessary as we continue to further our understandings of the inseparability between energy and matter related to urban scales. Examples of this include ways that buildings, transportation, food provisioning, and energy/water relationships are increasingly forming a nexus, and how this influences settlement patterns in relationship to climate change. This calls for more interdisciplinary integration, particularly at the program level. It would be possible to contribute to a larger university rebranding based on the development of transdisciplinary programs that merge units such as Kinesiology and Epidemiology with Environmental Studies, City and Regional Planning, and Architecture. The development of other degree program types such as blended degrees or multiple minor options would also facilitate this exchange. Expanded studies in Environmental Control Systems pedagogies will also become increasingly critical.

2.1.2 *Summary of responses to energy/matter resource relationships scenario*

At the building scale, because of the State of California's "Residential NZE Action Plan" (Craig 2015) which includes modifications to the 2019 State Building Code, all new residential construction will transition to Net-Zero by 2020. We must quickly further our students' preparation to fill this knowledge gap in the marketplace. At the environmental scale, resource relationships such as the energy/water nexus are becoming increasingly dynamic as their implications expand exponentially creating environments of increasing risk which is intimately linked to the built environment. Our program has opportunities to leverage this larger scale and complexity, building on our already robust sustainability and resiliency offerings.

2.1.3 *Summary of responses to disruptions to ecosystem service provisioning scenario*

Once again, the need for expanded studies in Environmental Control Systems pedagogies was highlighted. This was posited in relationship to the need for more rigorous pedagogy related to the creation of microclimates and habitats that leverage intersections between architecture, landscape architecture, and civil engineering. The spatial implications of this nexus is significant and worthy of study within the architectural discipline.

2.1.4 *Summary of responses to big data and ubiquitous physical computing scenario*

Increasingly we are seeing "smarthomes" and other spatial products that blur boundaries between the virtual and the physical worlds. There are significant additional arenas of spatial design that are currently not being addressed within the discipline of Architecture such as: smartobjects, augmented realty, virtual space (delivered through physical goods as well as digital), immersive physical/digital space, and even implants. All aspects of these novel spatial situations must be designed, and their spatial configuration would likely be better designed by architects than any other discipline. Data driven design is emerging with increasing force within our discipline. There are significant future employment opportunities for our students in this sector, particularly in the spatial reconciliation of the virtual and its physical interface.

2.1.5 *Summary of responses to manufacturing in the age of makerbots and nanotechnology scenario*

This scenario most directly impacts our students during their education as it is most accessible, immediate, and is a pedagogical focus in our program which is heavily informed by Cal Poly's motto: "learn by doing." In fact, it is so central to our pedagogy and brand that we need to convene a separate meeting to focus exclusively on this topic, and its implications for the Master Planning process.

In addition to this new wave of manufacturing, more traditional models are still prevalent in the marketplace, especially in the building industry, and are critical components of architectural production, so we need to continue to engage these in our pedagogy. The role of craft is necessary in both digital and analog production of products and materials that define space and its use. More targeted conversations about the role of tolerances are necessary for our students as they gain sophistication in their ability to understand and actualize fabrication.

2.1.6 *Summary of responses to economy, employment, and means of production scenario*

NAAB and licensure are increasingly acting as barriers for the profession as they add layers of liability that are prohibitive to many smaller scale firms that are pursuing a significant portion of the professions' technical and social innovation.

As a School, we must do a better job of creating culture and community, not just within our student population, but with our larger constituency which includes: alums, high school and other potential students, professionals, firms, and potential sponsors. This will greatly assist in training our students to work

within the increasing climate of generational barriers that exist within academia and firms today.

2.2 *Summary of responses to the anonymous survey*

As could be expected given such open-ended questions, the responses covered a wide range of topics and viewpoints. Based on quantitative counts, trends emerged in relationship to increasing interdisciplinarity, extradisciplinary knowledge within the disciplinary framework, collaboration, coordination, and visual literacy. There were a significant number of comments related to a desire for simultaneously broadening and deepening the curriculum such that students have a common core in their first two years dovetailed with more General Education coursework, then self-select into one of a range of deep tracks for their advanced study.

The responses revealed significant concern about shifting demographics: among practitioners, among clients, between large corporate and small agile design firms, and within higher education, and what appropriate responses might be to preparing students for these shifts. These shifts extended into socio-economic and eco-technical environmental concerns and emerged in questioning the relevance of design in larger societal issues, ethics, and environmental concerns (many of these were addressed in relationship to the topics of sustainability and resiliency). In order to address these shifts, several respondents referenced the increased use of systems thinking as an integral component of design process.

Responses also revealed significant concern related to the future roles and responsibilities of the profession including being held to higher standards, more interdisciplinary and team work, and increasingly moving away from direct design roles into consultation and coordination. There was discussion of pros and cons, slanted toward cons, related to new Licensure Upon Graduation programs and pedagogies. Generally, these comments were paired with recommendations related to increasing the amount of problem solving, critical thinking, research, and team-building skills which could be addressed through both professional practice topics and studio.

The respondents commented on the need for increasingly project driven research that leverages the "teacher-scholar" model (accompanied by appropriate levels of support) and the importance of "learn by doing" approaches.

Finally, there were a significant number of comments related to the role of technology in architectural design process and pedagogy. These responses addressed the need for more space, equipment and the need for facility reconfiguration to facilitate more integrated usage.

Though the survey sample size of nine was smaller than the Department had hoped, it was offset to some extent by the mixed-method approach and the constant comparison analysis (Given. 2008) (Bamberger et. al. 2006).

3 CONCLUSIONS

3.1 *Emergent issues*

Emergent themes from these conversations were predominantly forced around increased emphasis on systemic pedagogical and design approaches. These manifest through the lenses of health and energy/matter exchanges linked from human scale through building and urban scale to environmental scale. Architecturally, these explorations would likely emerge from an expanded Environmental Control Systems pedagogy augmented with some discussion of policy and regulatory control (emerging architects need training specifically in the design of Net-Zero).

Also emerging from these conversations is an emphasis on relationships between analogue and digital methods, interfaces, and products. Within schools of Architecture, these explorations might grow out of Digital Fabrication curriculum and expanded Structures and Environmental Control Systems pedagogies intentionally embedded within more traditional studio practices. Strategic employment of modeling and simulation, both physical and digital, in concert with Science, Technology, and Society coursework, and other inputs from external disciplines that facilitate an unpacking of ethical, social, technological, and environmental implications is necessary for a balanced understanding of the critical partnership between digital and analogue processes and products.

And finally, the multiplicity of Architectural Practices and Business Models today require that we develop pedagogies to unpack this complexity with our students. Critical issues to be addressed include: the evolution of interdisciplinary and collaborative modes of practice, the fact that architects are held to increasingly high standards with less time to actualize those standards, that architects are designing less and consulting more, the riff between large corporate and small agile design firms, breaking generational barriers, and ultimately, how Architecture can more adeptly position itself as a discipline with increasing agency to innovate constructed responses to diverse and dynamic circumstances.

3.2 *Discussion*

The faculty expressed concern over the tight time frame and limited resources available for the study. Several members expressed frustration that the scenarios and conversations couldn't be conducted in a more focused and structured way, over a longer period of time. Bowman et. al. identify two types of scenario processes: Inductive, in which the scenarios are developed collectively "…begin[ning] with the granularity of available data and allow[ing] the scenario to emerge incrementally." versus Deductive where scenarios are developed by a select few in management positions and posited to a larger group to play out (Bowman et. al. 2013). Their findings conclude that Inductive processes are significantly more successful than Deductive approaches. It's quite possible that

the study's Deductive approach limited the types of responses and conclusions, despite the fact that several of the faculty commented that the scenarios posited seemed correct and in alignment with current and immediately future trends.

3.3 *Recommendations*

Based on the research question, the faculty put forth a series of recommendations to the College and University Master Planning Committees. The basis of which related to transitioning to a scope that expands beyond the traditional scope of buildings, in ways that serve and support the design of the built environment through the studio pedagogical model. Linking breadth (informing studio design studies with required Minors or interdisciplinary General Education Pathway knowledges) with specific and deep focus areas of specialization within Architecture (potentially linked to original faculty partnered research which dovetails with the University's "Teacher-Scholar" research model) as a pedagogical strategy. Increasingly targeted investment in representation and communication skills, and increasing a sophisticated "hands-on learning" fabrication culture that emphasizes fluid transition between digital fabrication and analogue making tools and processes. This could be supported by increasing industry-academic partnerships which would provide first-had professional experience, while enabling students and faculty to design and develop innovative solutions grounded by real world parameters. Ultimately, this would titrate with "design thinking" studio pedagogy tooled to more fluidly integrate architectural technological content with formally based studio design practices.

The spatial implications of these recommendations include consolidating studio spaces currently spread across multiple campus buildings while reinforcing a primary focal space for the school's identity and community. It also includes restructuring studio spaces that are currently spatially isolated so that there can be more interaction between students both within the Architecture School and with outside disciplines. The ultimate goal being the facilitation of more exchange within and external to the studio environment through the creation of flexible collaboration spaces where 2-D and 3-D process work can be engaged in continuous dialogue. This physical restructuring would also include creating studios that are directly linked to shop or fabrication spaces. These, in turn, would be adjacent to a set of Integrated Research Labs, organized by tooling/material type, and an exterior Test Site, that would facilitate "Teacher-Scholar" research (Cabrinha et. al. 2014).

At the College level, the Architecture Department's recommendations, along with those from the other four disciplines within the College: City and Regional Planning, Landscape Architecture, Architectural Engineering, and Construction Management, resulted in proposals for the development of two new interdisciplinary undergraduate majors related to sustainability/resiliency and product design, a General Education core related to Society, Ecology, and Technology, and an interdisciplinary Masters degree.

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Teaching architecture in the 21st century: The role of research and extension in a transdisciplinary view

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ABSTRACT: This work highlights the need for an analysis and a revision of how architecture is taught in the 21st Century. It takes as its premise the idea that increasing urbanization has brought about changes which demand a reassessment of the professional profile of architects. It takes as its basis the notion of Transdisciplinarity and the Complexity Theory and develops a theme considered relevant in this context: the social awareness, interculturalism, design process renewed in the face of digital thinking and ecology with urban ecosystem and biotechnology in the production design. A set of strategies built on concepts and experience reports is proposed here with the intention of promoting a review in architectural education. Social consciousness is especially focused in this paper through the report of two examples of work done at the Federal University of Sergipe, located in the historic city of Laranjeiras (Sergipe/ Brazil). The first, an extension research involving the inhabitants of the historic center of Laranjeiras (SE), kept by the National Historic and Artistic Heritage Institute (IPHAN), in an assessment of their houses' living conditions. The second, the guidance of graduate work that developed a collaborative work with a disadvantaged community in the same municipality. The thesis proposed organizing the community in the search for an architectural solution that could be executed through a participatory process. These two examples aim at forwarding the idea that architectural education should involve both practical work and social consciousness in order to form professionals committed to improving the quality of life and reducing inequality. Extension research and collaborative work that involve inhabitants are part of the way to improve Architecture Education in the 21st Century.

Keywords: 21st Century, Architecture, Education, Transdisciplinarity, Social consciousness, extension

1 INTRODUCTION

The need for a revision of architecture courses in the twenty-first century has been a recurring theme. The international call was given by the charter of UIA (International Union of Architects)/UNESCO for architectural education published in 1996 and revised in 2011.

The document aims at providing an educational structure to train professional architects in order "to enable them to meet the expectations of XXIst Century societies worldwide for sustainable human settlements in every cultural heritage …"(UIA/UNESCO, 2011, p. 1). The justification for the publication of the document is the concern about the future of architecture development in the face of rapid changes in the world. It emphasizes in its text the social problems resulting from the growing population in urban settlements and the need to develop projects with a social focus. An explicit recommendation that these issues are worked on projects and research in the academic world to develop solutions to inequality and social exclusion in urban areas is made.

We can cite other documents that despite having different objectives contributed to the perceived expectation of architectural education in our context.

The first 'Towards a skills training-based architecture: convergence of educational structures in Europe [1] (ENHSA, 2007) is the result of work of the European Network Architecture School Principals (ENHSA) in order to create a parameter in the training of architects in terms of educational changes generated from the Bologna Declaration. It is one of the projects to ensure the consolidation of the educational process based on the Bologna Declaration. The development of professional profiles that can be compared and are compatible with learning outcomes is one of the objectives of this project to ensure the quality of training. The trend in this process is to change the focus to the students and their workload through an academic training less specialized in the first cycle and the possibility of flexibility during the two periods. The

ENHSA document seeks to establish an educational framework and to set parameters in the area of architecture. The ENHSA focuses on curriculum in a more specific way as it believes its structure involves the content of the subjects and the quality of the course. It also defines the professional profile and the possibilities for mobility. A skills platform has been adopted as a parameter basis for comparison of curricula. This platform allows the graduate profile of the European Schools to be equivalent, but allows that they have their own interpretation of the competencies avoiding a rigid posture that could enforce curricula or homogenize the courses.

The second document 'Criteria and Indicators for Regional Accreditation Training in Architecture' is part of the MERCOSUR agreements (Southern Common Market) Education that in the area of higher education is divided into three thematic areas: accreditation, mobility and inter-institutional cooperation (SYSTEM ARCUSUR, 2008).

Accreditation is a recognition system of undergraduate courses to facilitate mobility and ensure the academic quality among partner countries.

The third document 'National Guidelines of 2010 and a proposal revision made by ABEA (Brazilian Association of Architecture Schools)' (2013). The 2010 document is a resolution of the National Education Council (CNE) and the Council of Higher Education (CES) which regulates the architecture of education in Brazil. The Brazilian Association of Architectural Education published a review of the law in 2013. According to the document the ABEA revision of the Curriculum Guidelines is the result of a previous partial modification, from 2006, which in turn was based on a public discussion on the content of these resolutions made in 1998 (ABEA, 2013). The resolution was published eight years later which means that those modifications to the new resolution of 2010 were made without public debate and, unfortunately after a total of fifteen years without a public discussion. Due to the dynamic nature of the profession that is a sufficient period of time for rendering the resolutions out of date.

From this reading, four issues have been highlighted that must be addressed and included in the current reflections on the profile of architecture: social and environmental issues related to the urban life improvement and with the presence and use of both information and interculturalism theory, as knowledge production tools. Interculturalism is the main concept in the development of UIA documents, the ENHSA and ARCUSUL, to facilitate, encourage and orchestrate student and teacher mobility, and especially in the case of ARCUSUR, professionals. These four documents are based on the global context of the 21st century.

The social aspect is referenced in all documents, without any exception. Usually, this issue is associated with social responsibility and in this case we call it "social conscience" to distinguish it from the modernist connotation.

The UIA's document presents a differential outlook when it recommends working with new social segments and emphasizing the skills of graduates:

> "There is no doubt that the architect's capacity to solve problems, can greatly contribute to tasks such as community development, self-help programs, educational facilities, etc., and thus make a significant contribution to the improvement of the quality of life of those who are not accepted as citizens in their full right and who cannot be counted among the architect's usual clients" (UIA, 2011, pag. 1).

Emphasizes among the skills of graduates:

> "Ability to act with knowledge of society and work with users that represent the needs of society." And yet: "Ability to develop a project brief through definition of the needs of society, users and clients" (UIA, 2011, p. 12).

For ENHSA (2007, pag.15), it is the

> "Understanding of the profession of architecture and the role of architects in society, in particular in preparing briefs that account for social factors."

In ARCUSUL:

> "The ability to interpret individual and collective needs of society in its cultural and environmental aspects."

In the ABEA document a reference to the graduate's profile differs in words, but contains the same sense of ARCUSUL's recommendation and skills, as well as it reiterates the need for

> "knowledge of anthropological, sociological and economic aspects relevant and the whole spectrum of needs, aspirations and individual and collective expectations about the built environment."

Note that the document UIA is the clearest in the sense of working with the demand of the population that is really lacking of professional architects and urban services.

Transdisciplinarity was a theme in the documents of UIA (1996; 2011) and ENHSA (2007, p. 13), while the latter is presented as a general competence in the second cycle (master): "ability to develop a transdisciplinary understanding".

This article aims to present ways to engage this issue of social consciousness in the training of architects with the transdisciplinary understanding.

Transdisciplinarity is a term that derives from the complexity theory. Complexity theory works with the concept of the living being unstable and unpredictable, more open and creative, an innovative image of nature and society, which is contained in the concept of transdisciplinarity (MORIN, 2005).

The work of the philosopher Edgar Morin is fundamental for the consolidation of transdisciplinary

concept as well as its dissemination and application. Three principles developed by Morin in complexity theory collaborate to understand the transdisciplinary: recursion, hologramatic, dialogical. Warns the author that the way is linking the three principles (MORIN, 2005). However this time we will focus on the third principle for transdisciplinary understanding.

The dialogic term was found in other texts such as Richard Sennett (2012, p. 26) and Paulo Freire (1996, p. 130). It was also used by Gregory Bateson in their learning process theory (BALE, 1992).

According to the sociologist Sennett the term has to do about what is meant by two types of talk: the dialectic and dialogical. The dialectic is a "verbal game of opposites that should gradually lead to synthesis" (SENNET, 2012, p. 30), the goal is to reach a common understanding. In the second type conversation, dialogical, does not come to an agreement, but there is an exchange process towards to clarify the views of each other and the mutual understanding. Sennett calls the talk of the good listener, which includes silence and attention to gestures and facial expressions that carry on the discussion.

The educator Paulo Freire uses the term "dialogic communication" to address the educational evaluation that in our view is in accordance with Sennett. Freire made critics to evaluation systems as being a way to talk to students and not with students. For the author the evaluation should stimulate "the talk as a way to talk to" (Freire, 1996, p. 131). And it continues:

> "In the process of talking and listening to the silence of discipline to be made accurately and in time by the subjects who speak and listen is a" sine qua "dialogic communication" (Freire, 1996).

That is, as Sennett, Freire emphasizes that without dialogue and without the ability to listen to the other, there is no communication The dialogical speech allows the knowledge of the other, and perhaps the correct way to say the necessary without it being irrefutable. The knowledge should enable a joint construction and not a simple transfer of content.

Complex thinking accepts the uncertainty and conceives the organization.

> "The piecemeal intelligence, compartmentalized, mechanical, disjunctive, reductionist, breaking the world's complex, produces fragments, breaks up problems, separates what is joint, make single dimension what is multidimensional" (Morin, 1999, p. 25).

For Morin, the key challenge is to complement the specialized and fragmented thinking with knowledge from different fields. The author makes a comparison with the tapestry:

> "Let's take a contemporary tapestry. It is made up of threads of linen, cotton, and wool, in various colors. To really know this tapestry it would be interesting to know the laws and the principles concerning each type of thread. However, the sum of knowledge of these types of thread used in the tapestry is insufficient for knowing the new reality that is the fabric, with the qualities and properties that are proper to this texture. It is also incapable of helping us know its form and its configuration" (Morin, 2005, p. 85).

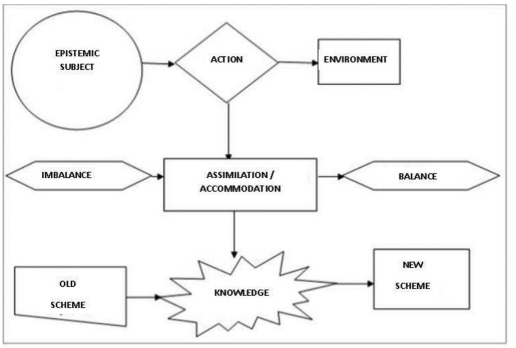


Figure 1. Construction of Knowledge representation according to Piaget. Source: Claudio Drews (2008,online, own translation).

The University is, to the author, where this thought reform should be encouraged, because it is the place of questioning.

How to contextualize knowledge?

Constructivism is the pedagogical theory that connects the concerns of Morin and the understanding of the theory of knowledge. In parallel to the development of complex thinking, and from the same sources as systems thinking and cybernetics, constructivism works with the assimilation of knowledge in education.

Constructivism had its development from the cognitive theories of Jean Piaget. Figure 1 illustrates the construction of knowledge that according to Piaget can be perceived constructivism connection with the Complexity Theory, because both Piaget and Morin believe that the imbalance or disorder is necessary to allow innovation and creation.

What is observed in the constructivist theory is the change of perspective it introduces in the learning process as it highlights personal experience, even if subjective, and that encourages the individual to challenge reality. The learning environment is organized as a system that allows the individual to be highlighted as a scientist.

Transdisciplinarity, according to Casilli (2011), aims to enable an integration of all disciplines in a unique knowledge and to reconfigure, as well, the formation of multi-skilled professionals. It is a collaborative practice and that takes into account the temporal dimension of research. His observation about collaborative practice is, because in this case the notion of hierarchy dissipates.

The methodology of transdisciplinarity, as we saw, considers practice as one of the leading knowledge-building means. And this line of thought leads us to consider the importance of practice in architect's training.

> "[...] 'Knowing it' depends not only on the acquisition of complex formal skills but also on experience and on a culture of practice, both of which impart tacit knowledge through personal interaction and performances, in particular contexts and social networks." (Larson, 2015, p. 21).

The two reports presented aim at introducing social awareness and practice in the learning environment adopting a transdisciplinary approach.

1.1 *First report*

In this first report we will focus on an extension and junior science scholarship project developed by students of architecture and urbanism at the Federal University of Sergipe (Brazil) under Professor Dr. Márcio da Costa Pereira (co-author of this article). The project proposes to identify the houses, as well as the residents, found within the historical heritage city perimeter of Laranjeiras, SE (Brazil) and raise their awareness as to the relationship there is between housing and health.

Following the recommendations of the UIA (International Union of Architects) the extension project emphasizes the architect's social conscience in relation to settlements "sustainable in each cultural context" (UIA/UNESCO, 2011). In the same document there is the recommendation that in developing countries the professionals should include assistance to disadvantaged communities with an attitude of "facilitators" instead of "providers". This suggestion demonstrates a direction for the profession that goes beyond the technicalities to embrace a commitment to society with less inequality in the global context. Therefore, we see the extension as a key tool in the formation of the architects of the 21st century.

The story of Laranjeiras (SE) has its beginning when the Portuguese reached the river Cotinguiba region (1530s) and installed a small river port that gave prominence to the village (IPHAN, 1970). The bases of the local economy dependent on sugar production, slave labor and trade flourished until the mid-nineteenth century and we can say that the architectural wealth of the city was accumulated during this period, when Laranjeiras was considered as the cultural and artistic center of the state. Throughout the twentieth century, the city of Laranjeiras experienced a period of economic decline that led to its condition of a dormitory town of the capital, Aracaju (SE). In this process, the historic site also deteriorated.

According to the IBGE 2013, Laranjeiras has a population of 28,533 inhabitants, 79% living in urban areas and 21% in rural areas. As for the HDI (IBGE, 2015), the municipality has an index equal to 0.642, considered average, putting the city in tenth place in the state ranking. While in the state of Sergipe the HDI is 0.665, in the capital, Aracaju, the HDI is 0.770.As concerns the gross domestic product, the highest value is that of the industrial and service sector. The municipal GDP per capita is R$35,710.09 (US $ 8,881.00), while the Aracaju is R$ 15,328.30 (US $ 3,825.00). It is noteworthy, however, that this figure does not represent a homogeneous distribution of the income of the local population. Laranjeiras has 67.7% of households by type of monthly returns between zero and a minimum wage. In the range between 2 and 5 minimum wages, this figure drops to 24.77% of households. Above 5 minimum wages fall further and reaches 7.53% of households.

Being Laranjeiras a historical city with a strong cultural heritage the county seat was listed by the National Historical and Artistic Heritage Institute (IPHAN) in the category of "architectural and landscape site" (Process IPHAN: 1288-T-89 18/06 / 1996).

According to the IBGE (Brazilian Institute of Geography and Statistics, 2010) there are approximately 7,000 households in urban areas, of which only 500 are located within the perimeter of architectural heritage and harboring a population of about 2,500 residents. It is noteworthy that 70% of houses are busy and have shortcomings with regards to habitability.

> "The houses of Laranjeiras are simple, although the houses and churches are imposing, forming a representative architectural ensemble of the lifestyle of the time of economic boom. Many homeowners are abandoned and the general condition is precarious. The high cost of property maintenance is sometimes inconsistent with the income of the residents." Diogo (2009).

It is observed in the city, the degradation of the surfaces of the residences by the incidence of rain, sun and pollution that cause cracks and cause the proliferation of fungi, mold and mildew, causing stains, deterioration of coatings and consequent unsanitary dwellings.

Self-building in this context is a recurring practice, calling attention to the lack of quality of the houses renovated by the residents themselves.

Through first conversations with residents we identified the high degree of unsoundness of housing, as well as recurrent health problems.

The extension project Technical Assistance to residents of the historic center of Laranjeiras was developed in stages, as follows:

1. Preparation: tour of Laranjeiras (walk through the field and collecting images and initial impressions);
2. Data collection: Live in Laranjeiras Center (primary sources: interviews with residents, architectural surveys of households and secondary sources: books, web and records);
3. Sensitization: Approaching with the population (Mini courses: Preparation and Action)
4. Organization and final systematization: (preparation, review and finalization of graphic designs and images to the final report)
5. Results Release

This led the team to relate the degree of habitability of housing with health problems reported by residents.

Our hypothesis is that the neglect of legal regulations for intervention in protect buildings, and the lack of technology as well as the principles for the preparation of projects to ensure the habitability of housing, can be considered an important factor in the deterioration of living spaces in Laranjeiras.

We define the objective to raise awareness about the relationship between the poor (constructive and architectural design) of housing (health of the housing) and the health of residents.

We define a strategy of providing minicourses on the topic of housing and construction technologies (paint and ceramic coating). Also define the target audience would be composed of elementary school students of public schools in Laranjeiras as replicators of the topics discussed at the family and community.

Minicourses have been organized into four workshops: two addressing the housing (housing and health of the residents and interventions) and two addressing technologies (painting and ceramic coating).

Taking as the theoretical basis the literature review on the topic of habitability, the booklet "LIVING WELL IN LARANJEIRAS" was prepared and distributed to students enrolled in the minicourses.

With reference to the article "Playing and learning to build" [1] the group involved in the project facilitated learning by creating dynamics/games for a better understanding of the proposed concepts.

We also had talks by medical school professors from the University who showed the possible causes of respiratory diseases related to poor quality built environments, and by IPHAN technicians who spoke of the importance of heritage conservation and its implications for the residents of Laranjeiras.

The community received with enthusiasm this activity paving the way for a next step which aims to provide technical assistance to residents of Laranjeiras through new Extension projects.

The research provided the development of skills related to the course of architecture and urbanism and provided an opportunity for direct contact of students and teachers involved in the survey with the local population, thus embodying the principle of social consciousness identified as one of the cornerstones in the formation the 21st century architect.

1.2 *Second report*

The second report focuses on a graduate thesis which had Professor Dr. Maria Cecilia Tavares (author of this article) as advisor. It is about 'collaborative architecture'. The student had a first experience in this approach with the Elos Institute. This Institute was created by architects who had their first collaborative work during the years of graduation in 1995 when they were responsible for the XIX Encontro Nacional de Estudantes (National Meeting of Architecture Students) with the theme "Outside architecture". This event proposed that students get in touch with disadvantaged communities and work with the residents in a few quick solutions to improve their quality of life. Work went on as usual by the group formed by students from the University of Santos. They founded the Elos Institute according to the same philosophy and developed social technologies and activities to mobilize communities.

This experience encouraged the student to carry out collaborative work at Barro Vermelho, a Laranjeiras's neighborhood. Laranjeiras has been previously presented in this article.

The first step was the production of a theoretical work to understand the concept of a collaborative work based on the precepts of Cedric Price. The architect defended that a building is not necessarily the best solution to a space problem. And that the architect should move the hero figure to take a more collaborative approach in which agents work with, and on behalf of another (Spatial Agency, online). Both professor and student believe on these precepts and for the first, it was an opportunity to prepare a future professional for working with new social segments, according to the UIA recommendations.

Thus a work project was designed following Elos methodology. A manual of procedures is provided by the group called Elos Phylosophy of Transformation. Following the guidelines, the first step is the 'look', i.e., the contact with the community seeking the potential contribution of each person and unprejudiced knowledge of space. The second step is the affection based on connections to gain the community trust, followed by the third step called 'dream', where you discover people's dreams and thus implementation possibilities. We are in search of stage resources and contact with employees to carry out the project.

The student has earned the trust and the affection of residents, created a bond and identified partners. The community is organized and prepared for the day of 'miracle', the terminology used by Elos group featuring the day of realization of the project prepared by the working group (teachers, students and residents). During our meetings we identified the need for action to improve access to housing with the reform of the local stairway which currently does not meet the technical standards of accessibility, which creates concern and discomfort for everyone. The latest step performed consisted in an "informal" conversation and presentation of the current situation of the stairway through a model used as a strategy to define the work plan. There were incorporated into the project a new student-team and a course on Technology, and an architecture and urbanism professor as co-counselor. For the professor, supervising this work has been a fulfilling experience as it meets the expectations raised on a survey conducted by her on the need for a review of the training of architects, oriented to practice and social consciousness approach.

2 FINAL CONSIDERATIONS

Following the guidelines of the UIA (2011), the two reports have in common the intention of creating an

educational environment close to reality, thus contributing positively to the challenges faced by society in the new century and being able to work toward a sustainable development taking into account the different cultural heritages. In this educational environment teachers transform their roles and begin to live with uncertainty accepting complex thinking.

The results of these extension projects were extremely important both for the locals as for students and teachers, because while that promoted empowerment, approached the city with the academic community in the search for quality of life of the local population. These actions refer to social issues that must be addressed and included in the current reflections on the profile and architectural education as outlined in the documents presented in this article that address the challenges in architectural education in the 21st century context.

We can also identify in these two experiences transdisciplinary concepts that seek to complement the specialized and fragmented thinking with thoughts from different fields. According to Morin,

> "The piecemeal intelligence, compartmentalized, mechanical, disjunctive, reductionist, breaking the world's complex, produces fragments, breaks up problems, separates what is joint, make single dimension what is multidimensional" (Morin, 1999, p. 25).

Finally, they highlight the need for action in promoting theoretical understanding that according to constructivism, will result in knowledge.

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Case study strategies for designers: Teaching integrative data evaluation

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ABSTRACT: Teaching research methodology and conducting architectural research for years has revealed to the author of this paper that there is noticeable lack of globally established depictions of methods in design research, also called evidence-based design or practice-based research. Partially this is caused by the fact that research carried out by architects and other designers is a somewhat new phenomenon, when compared to many other disciplines, partially by the wide range of subject matters and paradigms in architectural and environmental research. The lack of defined methodology applies particularly to case studies, although those are most commonly employed by designers. In professional jargon, however, the term case study itself seems to refer to anything from a simple 'precedent study' to a 'project description,' sometimes used even as a synonym for an 'example.' Hence, this paper sheds light into the pros and cons of both quantitative and qualitative paradigm from a transdisciplinary perspective, including ontological and epistemological premises of case studies. Special attention is paid to the characteristics of embedded case studies and holistic case studies in terms of their data collection and analysis methods, including conventional surveys, interviews, fieldwork, participatory design, and post occupancy evaluations, but also such novel strategies as memory sketching and phenomenological thick descriptions. These strategies are, then, examined from the perspective of integrative data evaluation with theoretical sampling, triangulation, pattern-matching logic, and analytical generalization. In other words, the focus is on deep understanding of a case within its complex context, in order to provide means of holistic interpretations of empirical inquiries in real-life contexts. The objective and future contribution of the proposition is to promote the value of research as the basis of design excellence among students and professional practitioners alike, with the mastery of case study method informing their design decisions.

1 INTRODUCTION

As case studies, when conducted properly, can be among the most valuable research strategies in many design disciplines, this paper focuses on the many facets of the case study research method as well as the best practices of evaluating, analyzing, and interpreting data coming out of the process. We investigate these procedures from an inter- and/or transdisciplinary perspective by applying the principles of integrative data evaluation, or the 'Four Pillars and the Roof', like Pauwels and Matthyssens call it. This is one of the significant ways in both ensuring the reliability of a case study and educating the proper means of conducting case studies.

According to Scholz and Tietje, most skepticism about case studies is caused by nontransparent knowledge integration, especially in case studies with multiple methods of qualitative data generation. They argue that this is why "integrative evaluation – an evaluation that integrates viewpoints from such diverse disciplines as ecology, economics, and sociology – is crucial component of case studies" (Scholz & Tietje 2002). For this process, they suggest a synthesis of knowledge integration that can be divided into four categories: integration of disciplines, systems, interests, and modes of thought. Correspondingly, in any design research case study, triangulation between methods, not just between sources of data and evidence, is crucial. It also allows great potential for creativity regarding the research design, with opportunities to develop novel data collection and analysis methodologies.

An additional reason for skepticism about case studies is, no doubt, the conventional call for scientific objectivity. In the context of multiple case study research in international business and the 'architecture' of such research design, Pauwels and Matthyssens discuss the ontological and epistemological premises of qualitative research "that departs from a time- and human-free objective reality towards a more context-bound intersubjective reality […], in which the social world is to be understood from the point of view of the individuals who are directly involved in the events that are investigated" (Pauwels & Matthyssens 2004). They go on arguing that "Multiple case study research aims at closing the gap between the objective of the study and the object of the study. In this respect, we explicitly aim at capturing the subjectivity that is embedded in the object" (Ibid). In evidence based design, this can be seen as an invaluable approach in interpreting the interrelationship

between the built environment and its users, from the perspective of the latter.

However, Pauwels and Matthyssens also point out the significance of reducing the researcher's impact on the validation and evaluation process. For this, they suggest the aforementioned principles of 'Four Pillars and a Roof' – an appealing simile for architects. Pillar 1, theoretical sampling, is based on selecting both typical and atypical cases, as opposing to a number of analogous cases. In this process, the analyses of atypical cases produce contrasting results, though for predictable reasons, and create theory-driven variance and divergence of data. Pillar 2, triangulation, is naturally one of the basic 'pillars' in any research project. For Pauwels and Matthyssens, it serves two purposes: it reduces random errors and increases internal validity of a study. Pillar 3, pattern-matching logic, is based on the fundamental scientific pattern model according to which, for instance, events can be explained in relation to sub-elements so that together they constitute a unified system. Pillar 4, then, deals with analytical generalization by testing the validity of research outcome and/or theory development against extant theories. Finally, the roof encompasses validation by juxtaposition and iteration of the pillars that support it, which we examine below.

2 FOUR PILLARS AND A ROOF

2.1 *Theoretical sampling*

In his 'classic' publication with regard to the topic of this paper, titled *Case Study Research: Design and Methods*, Robert K. Yin covers the issue of theoretical sampling extensively, pointing out that replication logic is different from sampling logic. In short, this means that in multiple-case studies in particular the former is analogous to multiple experiments, as opposing to random sampling (Yin 2013), which is further discussed below in the context of pattern-making logic. This kind of analysis process often is performed in two or more rounds in order to validate the outcome. In the first round, the goal is typically production of theory-driven data in order to build theoretical foundation on the divergence of evidence. In the next stage or stages, the abstracted process may require more practical considerations based on typical and/or atypical cases (Pauwels & Matthyssens 2004); in design research, this often means normative theory development with focus on a distinct design problem and its solutions.

The process is somewhat similar to the cross-case analyses Yin describes, though it is important to note that 'the more cases, the better' attitude does not itself provide validity. The cross-analyses can be literal replications producing similar results from multiple cases or units of analysis that are chosen as part of the analytic strategy – if the results are similar, they support the initial theoretical stance, if contrasting, they reject it. Theoretical replications, in turn, produce contrasting results for predictable reasons, thereby testing the theoretical framework, often contrasting it with rival explanations (Yin 2014). Even a two-case study can, hence, serve as the basis of theoretical sampling, while in a single-case study it can be provided by variety of units of analysis in one setting which strengthens the internal validity of an emerging theory. In multiple-case studies, with at least two cases, cross-case synthesis is naturally am essential means of analysis both in terms of theoretical sampling and evaluating research outcome.

In addition to pattern matching (see above), Yin lists four other analytic techniques: explanation building, time-series analysis, logic models, and cross-case synthesis. The three first ones are, in fact, specific types of pattern matching, while the last can be regarded as the 'roof' of Pauwels and Matthyssens. Cross-case comparisons are naturally possible only in multiple-case studies, whether those are performed separately by independent researchers or are part of a larger study by one investigator or a research team. As the goal is to generalize the research outcome, the above-discussed replication logic is the central part of analyses in this method. Explanation building, time-series analyses, and logic models, in turn, can be applied to both single- and multiple-case studies. For Yin, "[t]o 'explain' a phenomenon is to stipulate a presumed set of causal links about it, or 'how' and 'why' something happened" (Yin 2013). That is, obviously, relevant in explanatory case studies and usually involves creation of a narrative explaining the causalities, whereas in exploratory case studies it is primarily a process to generate hypotheses, not to analyze evidence.

However, the aim of this iterative process is not just to find patterns that support the hypotheses, but to test them against rival explanations. In time-series analyses, one also looks for patterns between observed phenomena that are usually empirical, though by tracing changes over a certain period of time; or the so-called time data points. One could, for instance, conduct a single-case study of a certain neighborhood and observe how changes in building code impact changes in the built environment and property values before and after each data point. Finally, logic models allow one to analyze evidence by "matching empirically observed events to theoretically predicted events", as Yin (2013) puts it.

2.2 *Triangulation*

Like theoretical sampling, triangulation should take place throughout the case study process: from the research design, through data collection, to its analysis and evaluation. The simple reason is to maximize the strengths of included data gathering strategies, whether multiple sources of evidence, measurements, methods, references, cases, or units of analysis, and the kind, while minimizing the weaknesses of each. This process convincingly confirms findings and reduces random errors which increases the internal validity of a case study. Originally triangulation is a navigation strategy with which you can determine your position

by the relative fixed locations and distances of two points, such as a landmark or a star, and that is what triangulation does in research as well; in other words, it determines the position of an investigator in relation to various measurements, methods, levels of analysis, or other 'points'.

Triangulation is usually associated with research as a means of avoiding bias or other undesirable impact in the substantiation of empirical phenomena through multiple sources and methods of data collection to improve the convergent validity of a study. Convergent validity is a common concept in sociology, psychology, and other behavioral sciences, including environmental psychology, as part of constructing validity of a study by confirming that the two measures of constructs that are theoretically related (e.g., by the theoretical sampling above) actually are related in reality as well. In the *Encyclopedia of Case Study Research*, Julie Wolfram Cox and John Hassard describe triangulation as a way of "developing a more effective method for the capturing and fixing of social phenomena in order to realize a more accurate analysis and explanation" (Mills & Durepos & Wiebe 2010).

According to Norman Denzin, there are four types of triangulation: (1) data triangulation, as the term implies, deals with corroborating data collected in different times from different sources; (2) investigator triangulation necessitates that different investigators collect data independently on the same phenomenon and compare the results; (3) methodological triangulation entails data collected by different methods, meaning that it requires a multiple method research design; while (4) in theory triangulation different theories are used to interpret the data (Denzin 1978). This kind of meta-triangulation can, then, include various subtypes, such as quantitative and qualitative data played against each other in order to examine various interrelationships within a setting.

However, as the said approach to triangulation is largely based on positivist paradigm according to which singular reality can be understood objectively, it has faced criticism within the postmodern theoretical framework that questions the dualistic subject-object distinction. Hence, Wolfram Cox and Hassard give a few examples of studies in which "new forms of triangulation can be used to analyze supposedly contradictory information and to show how positivist and interpretivist research may be mutually informative" and "can be understood as strategies of convergence and divergence" (Ibid), whether the data comes from quantitative or qualitative research. By convergence they refer to findings that provide a study with reliability and/or validity, while divergence allows its theoretical elaboration. Moreover, they point out that reflexive awareness includes sensitivity toward the relationship between the investigator and the investigation.

Accordingly, one should also look at dilemmas, inclusions, and exclusions within the research strategies which Wolfram Cox and Hassard call "their associated impossibilities". Particularly interesting is their description on how convergence can be found through "holographic typical cases" as a representation of layers of variables or data that helps you to see the whole picture. Without going into the details of this strategy, it is sufficient to note that the metaphor of holograph denotes a three-dimensional, virtual image which is only a re-presentation of reality; thereby it recounts the above-mentioned impossibilities. This is to say that the kind of triangulation, characterized by the involvement of investigators and participants as well as classifications derived not merely from literature reviews, multidimensional scaling, and other conventional tactics, but also qualitative strategies (e.g., metaphors) and other means beyond the status quo, aims to find partial views or new angles and perspectives. In this respect, it is important to bear in mind that in the subjectivist/ constructivist paradigm the investigator is only a tentative interpreter of a particular context with multiple realities.

There are innumerable ways to achieve triangulation in design research case studies and this also is an area in which there still is plenty of potential for creativity. Besides the multiple data collection techniques – varying from conventional observations, interviews, surveys, mapping, sorting, and such, to more novel means, like memory sketching and role playing – the analysis, evaluation, and interpretation, too, can include triangulations of less conformist nature. For instance, interviews or role playing can be followed by posing the initial tasks to a new group of people (for the purposes of theory sampling, preferably people with contrasting views), or conducting open-ended interviews with the same people on a particular new topic; in other words, the first round would be for theoretical sampling, whereas the next provides qualitative evidence for triangulation. Or, as another example, one can return to the field for feedback to check with the previous informants whether they agree with the interpretations, which would be a significant act in qualitative research.

Also, visual communication with both the informants and, subsequently the audience, is critical, which can take such forms as correlational charts, syntax diagrams, composite and/or gamma maps, concept matrixes, and the kind, or even story boards, Japanese *manga* cartoons or *anime* videos (Sarvimäki 2013), as visual interpretations of the phenomena in built environment.

2.3 *Pattern-matching logic*

According to Yin, pattern-matching logic is one of the most desirable techniques for case study analyses. In short, a pattern model explains events or settings in terms of related elements and subsystems so that together they constitute a unified system; in other words, this 'pillar' is linked to logical argumentation in which interrelated 'building blocks' form a conceptual system (see Groat & Wang 2013). As Pauwels and Matthyssens point out, however, this well-known analytical *strategy* has a limited number of established analytical *techniques*.

To overcome this shortcoming, they applied the Inferential Pattern Coding (IPC) of Miles and Huberman (Miles & Huberman 1994) in their study "The Architecture of Multiple Case Study Research in International Business". The research design included both literal and theoretical replications, as well as the following four analytic steps: (1) Pattern coding was based on the list of guiding constructs derived from the initial research questions. The coded patterns, constantly upgraded as the study went on, formed abstracted chains of events and attached meanings, which were visualized in a matrix of interrelated patterns of a particular case. (2) In the next step, the causal relationships that begun to emerge by integrating relevant patterns from different units of analysis were highlighted and further triangulated by the existing literature. Non-causal patterns were, by no means, disregarded either because they supported the delineation of interrelated causal patterns. (3) Through this iterative process of cross-case comparisons, a causal meta-pattern logic was constructed across all 12 cases, which led to an intermediate model of four cases. Although not all causal patterns were identified in all cases, even the contradictory patterns were potential material for cross-case analyses; in Yin's terminology, the rival explanations, or Wolfram Cox and Hassard's impossibilities. (4) Finally, Pauwels and Matthyssens grouped the dominating patterns found in step 3 in seven groups of non-overlapping process propositions that "accommodated both a causal pattern as well as non-causal yet conditioning patterns" (Pauwels & Matthyssens 2004).

Relevant to design research, Yin sheds more light into this process of pattern matching. He points out that while similarities between empirical and predicted patterns can help in strengthening the internal validity of a case study, especially in explanatory studies, in descriptive studies, too, "pattern matching is still relevant, as long as the predicted pattern of important descriptive conditions was defined prior to data collection" (Yin 2013). He also discusses the nonequivalent dependent variables derived from quasi-experimental research designs and warns us about certain threats to the validity of this logic, regarding single-case studies in particular. In those, it is crucial to identify a subset of the initial dependent variables and, using the same data, to show how the patterns could be different in different circumstances: "In essence, your goal is to identify all reasonable threats to validity and to conduct repeated comparisons, showing how such threats cannot account for the dual patterns" (Ibid), he says. In addition to rival theoretical propositions overall, articulated in operational terms (e.g., what are the mutually exclusive variables as opposing to inclusive variables of your initial position), literal replication can successfully match a proposition of a single-case study with evidence supporting the initial hypothesis, whereas similar cross-case results confirm it even more assertively. Likewise, theoretical replication can confirm the pattern-matching logic for rival explanations across multiple cases in which predictable, different results support your initial position.

One of my doctorate supervisees, with Yin as the prime reference in preparing and conducting her case studies, applied the idea of a matrix, at first, in developing the research question and, then, using it as pattern-matching model for the interpretations. This was an embedded multiple-case study, in which she combined quantitative and qualitative data to answer the initial topic of inquiry whether the impact of a building, in this study a house, on its users is actually the same as the architect claims or wishes. The research design included such quantitative strategies as performance analyses, census information of the neighborhoods, correlational questionnaires among the occupants, historical analysis of the settings, and visual scrutiny of pre- and post-occupancy floor plans, supplemented by qualitative data from critical analyses of these buildings, participant observations in the target buildings, open-ended interviews among the occupants (e.g., why they had modified the house design) as well as with the architects; as two comparison groups, the investigator had analogous developer-designed 'cookie-cutter houses' and user-designed-and-built homes (i.e., the atypical cases). In a significant role of knowledge generation was the POE with an open-ended survey with which the researcher was seeking to understand the occupants' own perception of their real-life setting.

Based on and updated by a literature review which focused on reveling why and how the disconnect between the user and the architect may have taken place, this doctorate candidate formulated her theoretical framework in a matrix with three horizontal lines of houses designed by a developer (D), an architect (A), or the user (U), whereas each had two vertical classifications of generic design (G) or that for a specific user (S). This created six categories: DG (developer generic), DS (developer specific), AG (architect-designed generic), AS (architect-designed for a specific client), UG (user-designed generic), and US (user-designed for him/herself). As UG is the least common category, the investigator acquired the role of a 'user-designer' in her design research for a flexible family home, in which design solutions were justified by the patterns found in the five other categories; this established the analytical generalizations for an ideal user-designed generic house (UG) by pattern-matching logic (Trimble 2014).

2.4 *Analytical generalization*

When an investigator has generated a pattern model that consists of related events and subsystems, which explains the workings (and usually causal relationships) of an unified system, s/he should ask oneself whether these relationships are generalizable beyond the setting of the case study, or settings of a multiple-case study. There are two options: statistical or analytical generalization, of which only the latter works in qualitative research. In the above example of an

embedded case study, statistically generalizable census records and some other quantitative data (e.g., median house values, floor areas, number and cost of alterations, etc.) was part of the collected evidence, but in order to answer how does a house design effect the inhabitants, and how to interpret the outcome by comparing developer-designed, architect-designed and user-designed-and-built houses, qualitative findings were of most importance in the validation process. Hence, the investigator tested the research outcome and the evolving theory against the existing theoretical framework on the topic through analytical generalization. This is naturally crucial in multiple-case studies, in which generalizability is the goal, allowing the juxtaposition of an emerging theory and the extant literature, including competing theories.

Pauwels and Matthyssens applied the so-called Degrees of Freedom Analysis (DFA), developed to serve qualitative research, as the means for analytical generalization by validating their "process theory of international market withdrawal […] against two established process theories of organisational and strategic change" (Pauwels & Matthyssens 2004). Although this study on international business, at the first glance, appears quite distant from design research, their method of using DFA in analytical generalization is useful for us, too. Overall, it was based on listing parameters (e.g., motive of initiation) and related questions (e.g., Which stimuli cause a decision process to start or not to start? How and by whom is the decision process initiated? Where is the decision process initiated?), and comparing their emergent explanatory theory to the two theoretical benchmarks.

In design research, just to think about the aforementioned topic of inquiry, the DFA questions could include such parameters as the reasons to buy a particular house/ plot, to hire the chosen architect, to not hire a professional designer, to make changes after occupying the house, etc., while the related questions would be: Why and by whom was the decision made? What were the other options? Which mechanisms prevented choosing the ideal options?, and so on among the myriad of possibilities.

Yin, too, addresses the difference between statistical and analytical generalizations by stating that "in doing case study research, your goal will be to expand and generalize theories (analytic generalization) and not to extrapolate probabilities (statistical generalizations)" (Yin 2013). This distinction cannot be overemphasized, since the characteristics and benefits of case studies are in-depth explanations, descriptions, explorations, even predictions of a setting by using data derived from multiple sources and methods which defines causal links, develops or tests a theory, and/or generalizes to theory. Subsequently, the ultimate objective is to integrate all this in a meaningful way.

2.5 *Validation by juxtaposition*

The four methodological pillars discussed above are essential 'structural' elements in the 'architecture' of multiple-case studies, but without balancing them – or providing lateral forcing, to use structural engineers' vocabulary – the construction would collapse. The 'roof' is what connects the pillars, and while doing so it also stabilizes the whole construct of the research it spans. This validation of data is an ongoing and deliberate process in which the investigator examines and creates possible explanations of both validity and invalidity from the perspective of various sources. The creation of invalidity is similar to the rival theories mentioned above. In other words, juxtaposing data by analyzing, interpreting and validating findings and extant theories, the emergent theory might upgrade, complement, or correct an extant theoretical stance. This, consecutively, provides opportunities for further theoretical sampling. In this process, the goal is not only to search for information that supports the hypothesis, but, most importantly, that which does not support it. Pauwels and Matthyssens, referring to Kvale (1989) go as far as stating that "[t]he researcher plays the devil's advocate by critically assessing the possible impact of sources of misfit or invalidity" and that "juxtaposition and iteration are two highly complementary validation strategies both aiming at the identification of possible sources of invalidity" (Pauwels & Matthyssens 2004).

Somewhat similarly, Yin categorizes the test for judging case study research design in four sub-tactics: (1) In constructing validity, the aim is to identify operational definitions and measures of the study, which takes place particularly in the data collection phase, and is concluded in composing a research report. (2) Ensuring internal validity is a process in which the investigator seeks to establish causal relationships in explanatory or causal case studies; this does not apply to descriptive of exploratory studies, as those focus on thick descriptions of one setting, not cause-effect analyses. The internal validation process occurs almost exclusively within the data collection and analysis stage, although it of course must be planned in the research design. (3) External validity also is considered in this context, as it deals with the generalizability of the research outcome; by using theoretical approach in single-case studies, and replication logic in multiple-case studies. (4) Reliability, then, is ensured by a rigorous case study protocol and database, for which space does not allow discussion here (for more, see Yin 2013).

One example of an embedded single-case study employing the 'four pillars and a roof' I was involved with as a supervisor investigated a relatively broad topic looking at Chinese geomancy (*fengshui*), environmental psychology, and biophilic design. In this instance, too, the topic of inquiry was the user's perception of a house and her own setting, though the primary objective was the architect-client relationship and communication during the design process; in other words, this was a pre-occupancy evaluation focusing on the impending user. In addition to a very comprehensive literature review on these three separate schools of thought with examples of their design

principles (pillar 1), the thesis went on identifying differences and similarities of these principles (pillar 2), pattern models underlying the logic of all three (pillar 3), and then tested the conclusions against extant phenomenological views on the perception of place (pillar 4). The 'roof' was a design project on a real site for a real family (though hypothetical as client) testing and validating the research results attained by the four 'pillars'. Thus, this design research case study highlighted feedback from the client and the impact of that on the design. The goal was to validate the research results and design solutions based on – or perhaps better with this metaphor, resting on – the theoretical framework by juxtaposing them with the extant theories on *fengshui*, environmental psychology, and biophilic design, as well as general theories on architecture and perception (Hudson 2013). In terms of evidence, the challenges were considerable in not only crossing many disciplinary and cultural boundaries, but also in integrative data evaluation deriving from these diverse fields.

In short, integrative data evaluation in design research case studies, like in any research project, amounts to deliberate, ongoing checks of validity or invalidity through concurrence of data and findings, both existing and emerging theories, case selection, data collection, definition of terms, and other internal and external reference points. These principles are reminiscent of Scholz and Tietje's integrative evaluation with emphasis on multiple sources of data and evidence, of the case study doctrines laid out by Yin, as well as of the 'four pillars and the roof' discussed above. As pointed out by Pauwels and Matthyssens:

> The omission of one of these pillars has a baleful influence in the methodological quality of the study and causes the roof – the ongoing validation process – to collapse. Yet, these pillars are only qualifiers: relying upon them is necessary though not sufficient. Each of the pillars should be operationalised and interwoven in a way that best fits the research questions and gives an optimal answer to the operational challenges of the study (Pauwels & Matthyssens 2004).

3 CONCLUSION

In closing, it is my wish that bringing together the aforementioned interdisciplinary views on case studies helps in defining this methodology in architecture and related disciplines, to the extent those could be discussed in the limited framework of this paper, Accordingly, it appears that the curricula in architecture and other design schools could apply much more rigorous interdisciplinary approach with regard to the education of research methods in order to ensure genuine integrative data evaluation in general. This might be stating the obvious, but it does deserve attention because, like in any academic field, design research education is based on determining one's position based on extant 'fixed points', in a similar way than triangulation does in navigation.

Yet, although the case study methodologies discussed above do demonstrate new approaches to design research, one definite challenge in teaching design research methods, as well as in conducting case studies, is over-emphasis on established methodology (as rules to follow) and under-emphasis on the role of creativity and intuition in research. Hence, an appropriate ending is Scholz and Tietje's statement with which I fully agree: "It should be mentioned that, as in architecture, developing projects in the field of the environmental sciences is an art […] in many such cases, the artistic design is a determining factor for success" (Scholz & Tietje 2002).

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From design to research by design: Experimenting pedagogies to face territorial issues

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ABSTRACT: This paper discusses the need to shift from a « design » to a « research by design » methodology when facing territorial issues in the architecture studio. The reasons and nature of this shift are brought to light through a case-study: a third year studio taught at Université catholique de Louvain over a complex but highly potential suburban territory of Brussels. This territory is made of layers erratically added through time, with no global vision. A traditional "design" studio where students individually develop their ability to answer a predefined question is inappropriate to face such complexity. The lack of a clear request requires a different methodology: « research by design ». From this point of view, the morphological structure of the territory is seen as a resource for programs, visions or ambitions. Design becomes a tool for exploring them, while the studio becomes a place where to build collective knowledge of these latent potentialities.

1 INTRODUCTION

The first semester 2015–2016 of the 3rd year at Université Catholique de Louvain (UCL), LOCI faculty is dedicated to the introduction to the territorial scale. The theme of the studio (with about a hundred students) is the study of the south suburban area of Brussels. This site offers great opportunities for the urban and housing development of the Brussels region. However it is a very complex territory, where different layers of transformation have been added over time without any global vision.

A classical « design » approach analyses the context through a specific brief and the project is designed as an answer to that brief. In such studios, the skills of the students are measured through the quality of the correlation between their design and the brief. In this case, the complexity of the project site is such that it is difficult to know what is suited to do or not in that territory. No brief or program can *a priori* be defined. Consequently, students have to elaborate the question as much as the answer. In order to face such indetermination, an individual approach to the brief is not sufficient and the studio has to become a place where an extended knowledge of the potentialities of the territory is collectively set up. Design becomes a tool of exploration, and knowledge results from the systematic multiplication and comparison of the different explorations. In other words, « design » studio as to become a « research by design » studio.

The argument of this article is developed in three steps. Firstly, the context of territory planning and its education is quickly synthesized. Secondly, the difference between « design » and « research by design » teaching methodologies is defined by comparing two types of training programs. Thirdly, the studio led at UCL in 2015 is discussed as both an experiment of « research by design », and an attempt to prepare the students to face the crisis of urban development.

2 THE AMBITION OF THE TERRITORY

2.1 *Planning sub-urban territories*

During the last century, territory was mainly produced through a collection of independent answers to specific conditions. The territory resulting from such processes is hard to describe. Is it a collection of dense cities and open countryside, an urban sprawl, a space in-between, a *Zwischenstadt* (Sieverts, 1997)?

As consequence, the inherited tools of urban planning are inappropriate to manage its development. As André Corboz pointed out: « *Territory as a surface is an inheritance of the 19th century (…). It's useless to underline the fact that this conception has become impracticable (…). A surface has a perimeter, though a web has only terminal points; surfaces don't really mix among each others, while webs, can surimpose and combine; furthermore, webs don't abolish surfaces, which requires to invent a dialectic capable of defining these relations. Such an argument means that most of the descriptive tools must be invented ex novo, the one we have being conceived for surface problematics* ». (A. Corboz, 2001).

Furthermore, most of te time, the service provided by architects tends to be reduced to a « commercial service ». They aren't asked to directly face these territorial issues in their practice. Indeed, within a professional order, a public or private authority who owns a piece of land produces a brief and one or more architects' answer is embodied in the form of a project. The one designated as the « best » answer is the one that reconciles the various given constraints: program, regulations, technical requirement, cost effectiveness, etc. These standards to be respected are the result of political decisions, implemented by instruments codified by engineers or surveyors. They determine the way in which the territory is made and thought. The architectural project is not much more than an answer to theses standards. It is an outcome, not a tool to design territories. These particular « answers » are rarely seen as innovative contribution facing territorial issues.

2.2 *Teaching about territory*

Territory Planning must be more than ever in the centre of debates and long-term visions. In that sense, education can prepare the future citizens for these challenges and has the ability to change society. Yet, what importance is given to territory in civic education? Particularly, in architecture schools, how are the future architects prepared for these problems? What are the methodologies used for teaching about territory? Why can architects bring a specific perspective?

In that regard, one must first look at what is specific about architecture teaching. Firstly, education is based on the « design » study and practice. Secondly, teaching is made through drawings and representations, which are used to represent the world physically, but also as a design production tool. They have this particular ability to makes inner structures readable and bear the potential of wider (and sometimes unexpected) transformations. As such, architects manipulate drawings as « morphological representations », based on construction of latent potentialities of spatial structures.

In order to highlight the shift from « design » to « research by design » as an opportunity to face territorial issues, let's compare two important moment in the history of architectural training: the Bauhaus school program in the 30's and the end of the Beaux-Art architecture education in France in the 60's.

3 TEACHING BY « DESIGN »: TWO METHODOLOGIES

3.1 *Teaching « design » as a development of individual skills: the Bauhaus program as paradigm*

The Bauhaus School, under the direction of Walter Gropius, intended to have a pragmatic approach to design, aimed at construction. The architecture studio was the central part of this training program. The adjunct courses were a complementary support to the studio. The project had to reflect the reality of professional practice.

In the book « Scope of Total architecture » (Gropius, 1955), Walter Gropius gives 12 recommendations on how teaching architecture in design studio could be. Let's consider some of them.

- Design is a work of coordination. Even tough group work is encouraged, the student is to be trained as a « *coordinator whose business is to unify the many social, technical, economic and artistic problems which arise in connection with building* » (point 1 and 8)
- Design is about construction. Education should totally be related to a professional design experience. Construction and design are seen as interdependent, and therefore taught by professional with relevant building experiences (point 7 and 10)
- Design is based on personal experience. Education should be based on an individual experience of matters, and therefore surface, volume and spaces. Students acquire basic convictions through a creative attitude and independence of conception, not by accepting ready-made formulas. « *Knowledge will come to life only by individual experience. Therefore, designing and building – the drafting board and the job – should be related on all levels.* » (point 2, 3 and 4).

According to Gropius, development of individual skills through the studio, based on the reality of construction and practice is the core of the architect education.

At UCL, as in many other universities, this method is still a dominant paradigm. Studio is seen as the place where to learn the reality of a professional order. A specific brief is asked to the students and their aim is to produce one project which best synthesizes the given options. The studio jury evaluates the student's ability to correlate at best the brief and the design through one proposition.

Little collective knowledge is built through this process. The students projects are criticized as individual entities, not as a part of a collection of different projects. Moreover, feedback between the individual experiences of the projects and the question asked by the brief is rarely established. The knowledge gained by all the projects is not used as a rereading of the initial brief. A studio jury has the potential of being a catalog of different project possibilities in relation to the initial request. It could also be a tool to check back the pertinence of the brief asked. However, it is never explicitly used as such.

3.2 *Teaching "research by design" as a production of collective knowledge: « L'atelier collégial » as paradigm*

The teaching experiment lead by Bernard Huet and his students part of the « atelier collegial », during the academic year 1967–68 represents a total rupture with the Beaux-Arts teaching of the 60's, and created a shift in the architecture design studio education.

At the time, architecture education in France was part of the Beaux-Arts School. Teaching was closely related to a « master » who was responsible for the studio and a wide group of students (450). Program was a fact not to be questioned, and often with few or no context at all. The main asset was to produce and compose a final presentation of the project drawings (A0 size) with a « *striking organisation* » (Pommier, 2011).

Bernard Huet, altogether with a group of students (38), thought this sort of teaching was too distant from the issues raised by the « trente glorieuses ». They stepped out from the traditional methodologies and suggested another studio model.

- Design is a collective research. Different teams of students led different researches through the same studio. Each student has an active role in the knowledge of the whole studio. Communication is done through talks or information sheets (A4 size). The studio is a place for collective knowledge and experimentation.
- Design is inter-disciplinary. Education is not only related to construction, but as well as to other disciplines: sociology, economics, … . Students are led to collect data on sites or to make interviews. Inside the studio, teachers and « taught » students are placed on the same level of equality.
- Design results from perspectives. Programmation should result from the preliminary analyses. Each aspect is controlled, documented and checked before designing the project. Its form comes from the analyses. Diagnostics and perspectives are made regarding the potential evolution of the sites.

Through this methodologies based on collective knowledge, Huet wants the studio to be a place of research. Teacher is more a guide than a master, and the student is seen as « *a latent autonomous designer* » (Pommier, 2011). He wants the students to acquire knowledge but especially to raise questions among themselves: what is the meaning of architecture? To whom do we build? A strong link between architecture and society is suggested. Architecture education should be more about a way of thinking than an actual know-how.

This experiment only lasted for one year but is still very relevant. As example, these few studios can be mentioned as experiments on similar pedagogies: O. Ungers with the first summer academy in Berlin (Ungers, 2013), P. Vigano in the Venetto region (Vigano, 2012), R. Diener, J. Herzog, M. Meili, P. de Meuron and C. Schmid with Studio Basel (Diener, 2006).

4 RESEARCH BY DESIGN(S): RE-QUESTIONING THE PLACE OF THE ARCHITECTS IN SOCIETY

A studio based on individual skills give the students the technical tools to design, such as representation. A studio based on collective knowledge put more importance to the process of designing, by raising questions and analyses. How to implement these programmes when facing complex territories such as sub-urban areas?

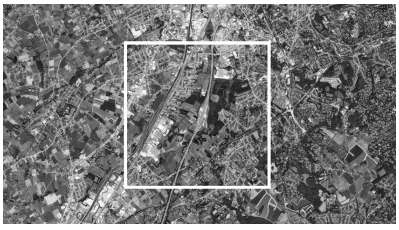


Figure 1. The studied territory.

Design and thinking should result from the territory itself. Its structure and form could be the condition to its own mutation. The territory becomes a project resource. A « design » would therefore no longer be a simple answer, but an exploration of the inner potentialities of the morphology of a territory.

As a result, a single answer to a given brief is no longer appropriate: all the different possible projects are gathered as a series that can be compared and objectivized. Where a jury usually studio fails, this methodology takes that opportunity as a basis.

5 TEACHING BY « RESEARCH BY DESIGN »

Territorial issues are an important challenge of our time and must be placed at the centre of education in architecture schools. A traditional design approach, based on individual skills, mirrors the reality of a professional order, but is not appropriate to the complexity of the territory. Teaching territorial issues could be nourished by « research by design » and methodologies based on collective knowledge, where the territory itself is considered as a resource for programs, visions and ambitions. The architectural project becomes a process initiator instead of an answer to a specific request.

In view of this, different education experiences are used in the studio. A « research by design » methodology is applied through a territory studio with one hundred 3rd year students. The site chosen is a south urban area of Brussels, which has a lot of potential for the future development of the city. It is made of complex layers added through times.

The studio is led and organized so that students express a long term « vision » of what could become of this particular territory and identify a first « action », a pilot project capable of initiating a mutation process. The semester is divided into different phases following methods of « research by design »: a first physical account of the site, a thematic representation of the territory structures, big-scale and micro-scales scenarios, the definition of a vision and a first action, the jury and an exhibition as a feedback. A strong accent is put on collective work and crossover approaches: students coordinate their different hypotheses throughout



Figure 2. First physical encounter with the site.

the semester. A panel of teaching methods are used: group critiques, collective crits, debate, weekly presentations, lectures, public exhibitions, … .

5.1 *The site account*

As an architect, it's the first and natural way to get into a place. To pace up and down, visit, set eyes on. « *Urbanism is done with feet* » (B. Secchi, 2006).

Traditionally, dealing with a project context becomes something nearly reverential, and design is made to be inscribed in its continuity. Here context becomes the tool. It's the matter. It's what the students will manipulate through the studio.

Students are therefore invited on a bike journey through the territory, to physically get into that landscape: to stop, look upon, draw, photograph, film, measure, interview the inhabitants and themselves.

5.2 *Morphological representation*

The territory itself is able to generate questions and ambitions. Therefore, representation of its hidden morphological structures is the key to manipulate it. Big scale drawings can make things appear. Drawing is more than a tool of representation or communication, it's a design tool. It's the root to interpretations. Without it, territory cannot be read.

Groups of students, following their on-site visit, are asked to choose a thematic approach to the territory. Each group is asked to produce one drawing representative of that theme. Different representations are made following the themes: flooded zones as spatial structures, vegetation as landscape definition, historical marks and old byroads as latent traces, housing typologies, night lighting, as traces of post-war planning,…The themes serve as keys to the interpretation and a gate to the reading of the site's complexity. Each theme leads to specific graphic representation choices. As an example, one group of students made a cut-section model of topography as morphological representation (see figure 3).

Within the studio, themes are discussed with the students. The idea is not that each group undertakes its own research alone, but that every theme meets the others. Through collective displays, specific representations are put together in perspective so that the territory is finally described in all of its complexity. A substantial cartography of the territory is established.

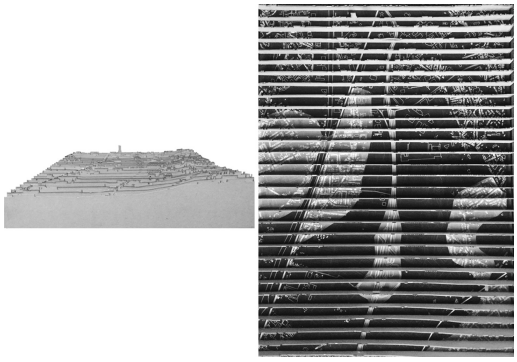


Figure 3. Topography as morphological representation.



Figure 4. Bottom-up scenario: mental representation maps and notion of neighborhood.

5.3 *Scenarios*

In order to improve the thematic and morphological approach, points of view are multiplied. Different approaches can activate the understanding of the latent structures, and can open them to new questioning.

They fall into two categories. Firstly, « Bottom-up » questioning. What can be learned from « below » and a micro-scale level? E.g. encounters with the inhabitants, sociological interviews and analyses, mental maps, local investigation,… .

Secondly, « Top-down » questioning. What are the bigger-scale territory issues? E.g. analysis of the administrative borders, agricultural policies, water management, urban regulations,… .

These are « levers of activation » of the morphological representations. It's in the resulting tension between these two scales that scenarios of transformation progressively emerge.

Students attend two lectures that introduce these new methods and approaches. They simultaneously undertake investigations at both scales. The goal is to teach the students to multiply their observations and point of view about the design they suggest. Their theme therefore becomes stronger, influenced by very



Figure 5. Top-down scenario: territory as an agricultural infrastructure.



Figure 6. Action on the canal as a potential leisure facility.

local request, to bigger scale realities. They are also encouraged to test specific representation of these investigations. Results are presented, criticized while students are asked to carefully step back.

5.4 *Vision/Action*

A themed cartography of the territory is built. It is reactivated by a careful reading of the site from below, with a local input, but also from above, on a larger scale vision of the area and its nearby region. What could the territory be or become? In what way could its hidden potentialities lead to its reevaluation? Far from considering a closed and finished idea of urban planning, an open model is suggested. « Speculation » on physical elements is the starting point of its shift.

The project is the result of an evolutive « scenarisation » (TVK, 2015). The interest is in the process itself instead of the finished product. A series of simple actions can lead to drastic transformation dynamics, by successive chains of events. All the urban planifications foreseen will maybe not happen at the same time, nor the same intensity. Sometimes it won't even occur at all. Territory undergoes a « metamorphosis »: it is transformed without losing its original inner qualities. It's the notion of a « slow » urbanism, latent but more anchored; just like the territory itself.

Through a series of project references, student are introduced to these concepts of evolution and long-term vision from small or radical actions. They now have the potential to build a speculative vision of the territory. A collective pin-up for the whole studio is organized with each group as the start of a critique and debate session. « Design » of the territory is placed into perspective and students are encouraged to « radicalize » their propositions.

Different visions and actions are designed by the students, connected with the different themes: promenade along the limits of the flooded zones, new multimodal transportation station on a wasteland area, public leisure facilities alongside the canal, …These actions are able to generate longterm mutations, but

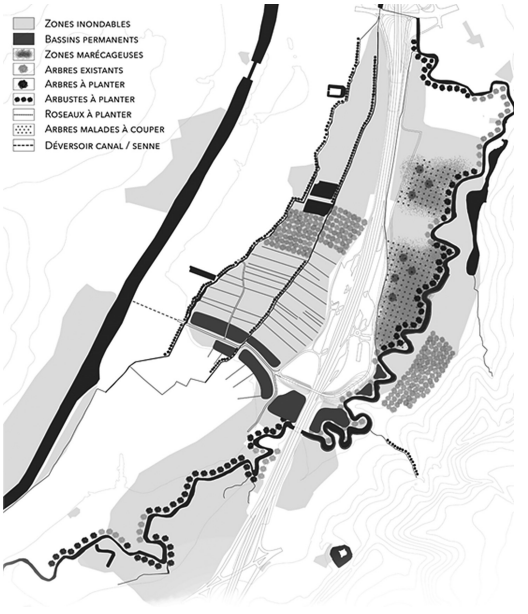


Figure 7. Vision of the flooded zone border as a promenade.

always with the sense of what the territory could handle. Specific forms of representation (e.g. collages) are also tested to achieve this representation of vision and action.

5.5 *Studio Jury and feedback*

The evaluation by the studio jury comes traditionally as the end of the semester. What collective knowledge of the territory has been produced by the different students projects? In a traditional studio based on individual skills, the studio jury is a critic on the different projects with few comparisons from one to another. Few time is usually given for a transversal thematic reading. Here the jury finally reveals its whole potential: it shows all the diversity of design that the brief – the territory – is capable of. All the different visions and projects present a wide catalogue or exploration



Figure 8. Expert critic as feedback.

of the different possible designs: *a field of possibilities* (R. Pleitnix, 2012).

Students present the evolution of their work through the whole semester. It's the total experience that matters, not only the vison and action proposition. They show in what way their proposition is pertinent to the territory. The jury becomes a panel of different hypotheses on the territory. As such, a comparison of the several designs can lead to a more objective knowledge of the potential of the territory.

The studio is concluded with an exhibition built by the students. A conference, on a real case study led on the same territory is also given by an outside expert. The students' work is put in parallel to economic and politic reality.

A transversal thematic reading of all the projects is done with the expert. If the jury is the time for the student to argue their own visions, feedback is the time for experts to bring an overall view and critic on the designs. It is done in a more casual way, without the pressure of the marks. It also invites the students to continue their reflexion after the studio.

6 TERRITORY AS A TEACHING RESSOURCE

Territory and its teaching are essential in term of future challenges and social crises of our time. A design studio based on individual skills focuses the students' attention on producing an answer to a specific question. This mirrors the process of a professional order. By contrast, « research by design » interrogates these models to offer methodologies which enlarge the student's point of view.

An experience of these methodologies based on collective knowledge was led through a territory studio, following different phases inspired by « research by design » methodologies. Students were invited to physically experience the territory, to produce a big scale drawing of its inner structures, to investigate the site from « above » and « below », to define a radical action which would allow a long-term vision mutation and finally, to present their work and objectivize it through an exhibition.

In terms of pedagogy, this method allows to achieve several assets of major importance in architectural education, considering graphic representation, speculation, clarification of hypothesis and collective dimension of the studio.

Placing morphological representation at the heart of the workshop process makes the students realize the opportunity of drawings as an interpretation device and not only as tool of communication. Representation is a design in itself. Each situation requires a specific representation. The latent potential of territorial structures can be revealed and their interpretation is capable of leading to a design.

Speculation on the potentialities of physical elements is taught as a starting point of the project, as the ability to think about the different scenarios without formalizing a finished product. Students are led to direct their own work by themselves and not entirely rely on the teacher's opinion. This forms the basis of a research oriented training.

Students are encouraged to clarify the different possible hypotheses. The studio becomes a place to objectivize several designs instead of being an iterative process on a particular design.

By comparing themes and drawings, students are confronted with each other's work. This helps clarify their own work with the other hypothesis feeding into and nourishing their own. It provokes debate inside the studio. The students learn to be critical not only with their own work but also with the other students work. Collective experience matters more than individual work.

However, this methodology faces several limits. Firstly, students must investigate and speculate on open questions, while having in the same time to position themselves within the studio with a particular design. Some could see this as difficult situations to deal with. Secondly, time is generally running too short for a real dialogue with local actors. To this end, a cycle of studios would be more appropriate.

All these particular skills take a decisive turn in the students' education. Their vision on design acquires new perspectives. Students are made aware of the realities of professional briefs on an urban scale, and learn that architecture has the potential of creating reflections on a political level. Design can also initiate change. To that end, teaching about territory through « research by design » represents a very important resource in terms of architectural education.

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The European Quarter of Brussels: From district to neighbourhood The difference between study and research by design

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ABSTRACT: Two kinds of investigations are usually carried out in the discipline of architecture: research by design and study. They are often mistaken for one another and the current trend is to call the latter research by design even though it does not technically qualify for it.

In order to illustrate the differences between the two kinds of investigations, a similar question is addressed by means of the two notions. This question relates to the issue of the residential attractiveness of the European District of Brussels for which a genuine study was carried out in 2015.

This analysis demonstrates major discrepancies between study and research by design in terms of framework, generalization, reproducibility and falsification. Yet, beyond those differences, both investigations could be valuable for one another if they were recognized for what they are.

1 INTRODUCTION

Research by design is a new phenomenon in the scientific field of many architecture schools. Evidence of this can be seen in the large number of conferences, publications on research by design but also in the general use of the concept in public and private commissions (e.g. investigations commissioned by various Belgian Bouwmeesters). Yet, if the concept is very popular, it is often used very loosely, as if all assumptions around its meaning and its methods were commonly shared.

There tend to be two main confusions regarding the definition of research by design. On one hand, many scholars are prone to declare that ordinary architectural design is research in itself. Yet, there are major differences between a regular architectural project and research by design in terms of produced knowledge, method, systematics, validation by peer-reviewing, or reproducibility (Archer, 1979). On the other hand, studies commissioned by public or private sponsors are also often stamped under the label research by design. Yet again, most of the time, those studies do not qualify for such a definition for the reasons stated above in the case of architectural projects.

In order to clarify matters, this paper tries to shed light on the major differences between study and research by design. To this end, a recent study on the European Quarter of Brussels will be used as a pretext for questioning the relationship between the two concepts.

This paper is organized into four sub-sections. Firstly, the scope of a study carried out in the European Quarter of Brussels is exposed in terms of mission statement, stakeholders and findings. Secondly, the general definition of the concepts of research by design and study are considered. Thirdly, the differences between the concepts are brought to light through the example of the European Quarter study. Finally, the differences, as well as the commonalities, are summarized in a general conclusion.

2 PRETEXT: A REGULAR STUDY

2.1 *Mission statement*

The work that serves as a pretext for bringing to light the differences between research by design and study is a regular study that was carried out in Brussels. The aim of this investigation was to apprehend the residential attractiveness of a particular district, the European Quarter, and its possible levers for improvement. This ambition could be summarized as an attempt to transform the district into a neighbourhood.

2.2 *Stakeholders*

The investigation was commissioned in 2015 by a semi-public organization, the King Baudouin Foundation. The goal of this independent foundation is to improve living conditions for the population in Belgium.

In order to meet the mission statement, a multidisciplinary team was formed. The team comprised experts in architecture and sociologists. It brings together university researchers in architecture (UCL) and an urban studies office (CityTools).

2.3 *Findings*

The study was divided in three major parts (De Visscher et al., 2015). The first part is a sociological survey of the European Quarter. This work demonstrates a great disparity in the assessment of the neighbourhood between its users and the resident population. Moreover, the quarter is commonly perceived as a Eurocrat ghetto with little social life. This stigmatization attached to the neighbourhood is demonstrated to be largely a question of perception rather than a matter of real data.

The second part is a spatial study. Carried out by a team of architects, this investigation analyses the physical constituents of the area. It explores the strengths and weaknesses of the European Quarter in terms of built and unbuilt spaces. In addition, it brings to light the possible levers for potential action to transform the district.

Finally, through the pooling of the sociological and architectural diagnoses, a series of intervention scenarios are developed. Due to the scope of the study as well as the nature of the commissioner, those scenarios are mainly "soft interventions" oriented.

3 DEFINITIONS

The comprehensive framework of the case study is thereby established. Yet, the purpose of this paper is not to expose the results of this particular study about the European Quarter but rather to use this investigation as an opportunity to highlight the differences between research by design and study.

In order to achieve this, it is important from the outset to define precisely both of the concepts that guide this paper.

3.1 *Research by design*

According to the Charter of the European Association for Architectural Education (EAAE), architectural research can be defined as an "*original investigation undertaken in order to generate knowledge, insights and understanding based on competences, methods and tools proper to the discipline of architecture. It has its own particular knowledge base, mode, scope, tactics and strategies."* (Ellefsen et al., 2015).

In the same charter the EAAE stresses the essential role of design for the architectural discipline. Hence, in turn, research by design is defined as *"any kind of inquiry in which design is the substantial constituent of the research process. In research by design, the architectural design process forms the pathway through which new insights, knowledge, practices or products come into being. It generates critical inquiry through design work."* (Ellefsen et al., 2015).

On this basis, there are three different ways to comprehend research by design. In an attempt to understand practice-based research in The Humanities, Bruce Archer lists those categories as: research about design, for design or through design (Archer, 1995).

In the first case – research about design -, the inquiries are carried out about the work of a practitioner or a specific architecture office. As such, it can be considered as a monographic investigation. Hence, design is considered in this case as a subject matter rather than a means. The investigation works carried out by the designed based research Royal Melbourne Institute of Technology (RMIT) reside essentially in this category.

In the second case – research for design -, the investigation can be considered as a preliminary work prior to the implementation of a project. It is the analysis phase of the process. Here again, design is regarded as a goal rather than a means.

Finally, research through design exploits architectural design as a means to an end. In some circumstances, knowledge can be unveiled through the *medium of practical action* (Archer, 1995). In this last case, knowledge is produced through the use of methods specific to the architectural discipline.

The latter approach has been elected by the Laboratoire d'Architectures Potentielles (LAPs) to conduct research by design. This research unit seeks to ground the foundations of research by design but also to develop its own methods (Pleitinx, 2012). The LAPs operates in an academic framework, ensuring the critical distance required to formulate scientific evidence.

The LAPs promotes research by design through a combination of two complementary operations. On the one hand, it makes use of the architectural project, whose role is to reveal potential habitats. In this context, habitat is understood as any *artefact* devoted to dwelling, including notions such as territory, city, building, means of transportation and furniture. On the other hand, once those potential habitats are revealed, the method suggested by the LAPs focuses on a classification of those habitats according to their characteristics as well as the conditions in which they can occur. In terms of outcome, this method offers an objective overall picture of the possible habitats in a given context.

3.2 *Study*

On the other hand, a study can be understood as a *"detailed investigation and analysis of a subject or situation" (Stevenson, 2010)*. Hence, a study is defined as a substantial amount of work accomplished for a specific purpose within a precise framework.

Based on this definition, an analogy can be drawn between the notion of study and architectural design. In addition to a similar *modus operandi*, both develop singular investigations based on personal methods in order to work on a specific assignment. Those methods

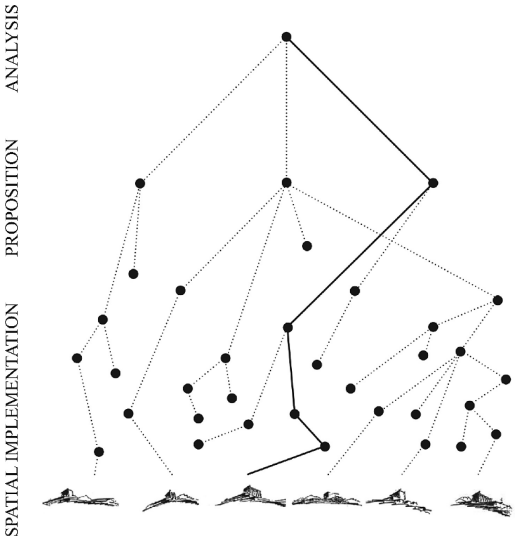


Figure 1. The result of a study.

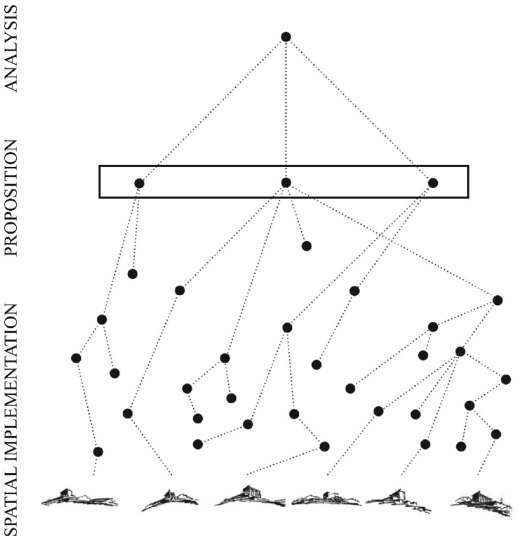


Figure 2. The result of research by design.

are largely tacit since their communication is not relevant to the findings of the project or the study.

3.3 *Comparison*

The process of an architectural project could be summarized in four iterative stages: analysis, proposition, spatial implementation and communication. On the basis of the above, a study process could be summed up according to the exact same scheme.

Firstly, the role of the analysis is to understand thoroughly the question and the aim of the study and its various implications. On the basis of this analysis, a series of hypotheses or propositions can be set forth. This suggests a particular direction – or logic – for the study. Thirdly, this logic is implemented, giving consistency to the study. Yet, it is quite clear that this process is far from being linear. On the contrary, in this process, some investigations will lead nowhere and steps backwards are often necessary. Hence, the role of the last phase – communication – is to trace back a linear and coherent path to communicate the study from its original question to its ultimate findings.

Therefore, the result of a study, similarly to that of an architectural project, is a vertical development where steps follow each other in a coherent order from initial question to the outcomes.

Inversely, research by design yields different results. From a given question, it undertakes a systematic exploration of the possible propositions. Its goal is to provide a general overview of the situation. Hence, instead of a vertical sequence, research by design can be described as producing a horizontal scope.

4 DIFFERENCES

This reasoning will be made more explicit here with the case of the study carried out in the European Quarter of Brussels.

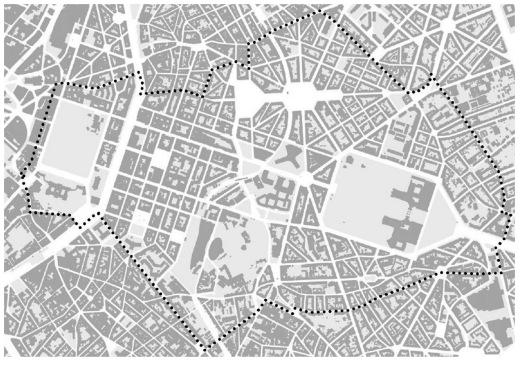


Figure 3. The European Quarter of Brussels.

The European Quarter is a district set east of the historic centre between two major parks, the park Royal and the park Cinquantenaire. This territory represents the perimeter on which the question of the residential attractiveness is investigated.

The differences between research by design and study are explored in the dissimilar outputs they deliver when treating the question of residential attractiveness. This comparison was made possible thanks to the disinterested environment provided by the university. Hence, coupled with the actual study commissioned on the European Quarter, the team of architects pursued the issue of residential attractiveness from the academic standpoint of research by design.

4.1 *Research by design*

As stated above, the LAPs lists two complementary operations in order to carry out research by design: revealing possible logics of habitat and ordering those logics according to their inherent attributes.

4.1.1 *Revealing possible logics of habitat*

On the basis of this strategy, various logics of habitat can be brought to light

The first underlying logic would be to build on the existing major networks of the district. Those are the institutional road axis of the city. Hence this logic could be called "the city as a program". And effectively, the main buildings attached to this logic are essentially institutional ones (e.g. the European and the Belgian parliament, the European Commission and the European Council buildings, the royal palace …). Furthermore, the parks that are articulated to this logic are very formal and give an impression of carefully orchestrated order, once again referring to an institutional character.

The second logic that could be built on is a series of features prior to the erection of the city such as topography and natural elements. As was the case with the first logic, a sequence of networks in the neighbourhood are organised according to this logic. A number of buildings and parks are also fabricated in relation to this particular logic. They develop in a more organic manner along the Maelbeek valley, a small river that once ran through the area. According to the nature of those elements, this logic could be entitled "the city as a natural framework".

Finally, a third logic organizing habitat in the neighbourhood would be the one arranged around the leftovers, the side-lined spaces of the city. A logic that would fit in the cracks of the two preceding structures. In that regard, the ancient Quartier Léopold is very interesting since it assembles numerous spatial bodies responding to this logic. Once again those can be categorized in road networks, buildings and green spaces.

As stated before, there might be other possible logics organizing habitat in the neighbourhood. Research by design should challenge those three logics in order to uncover them all. For the sake of this paper, this array will be regarded as complete.

4.1.2 *Ordering the unveiled logics*

Once the array of logics has been revealed, the second operation of research by design would be to order them according to their attributes in terms of character as well as their implementation conditions. In order to do this, each logic is tested according to the kind of interventions it produces. Hence, within each logic, a series of fictitious projects are drawn. In addition to this, the real projects in the area are listed and analysed. Together, those two types of projects help understanding the nature of the possible logics of habitat in the European District.

The first logic – the city as program – generates larger-scale projects of a highly institutional nature. It is the case among fictitious projects. Those include the covering of the inner ring road of Brussels with a market hall bridging the district to the old city centre, the creation of a gigantic winter garden on the mail running in front of the European parliament to enhance some kind of public life in a usually deserted space …

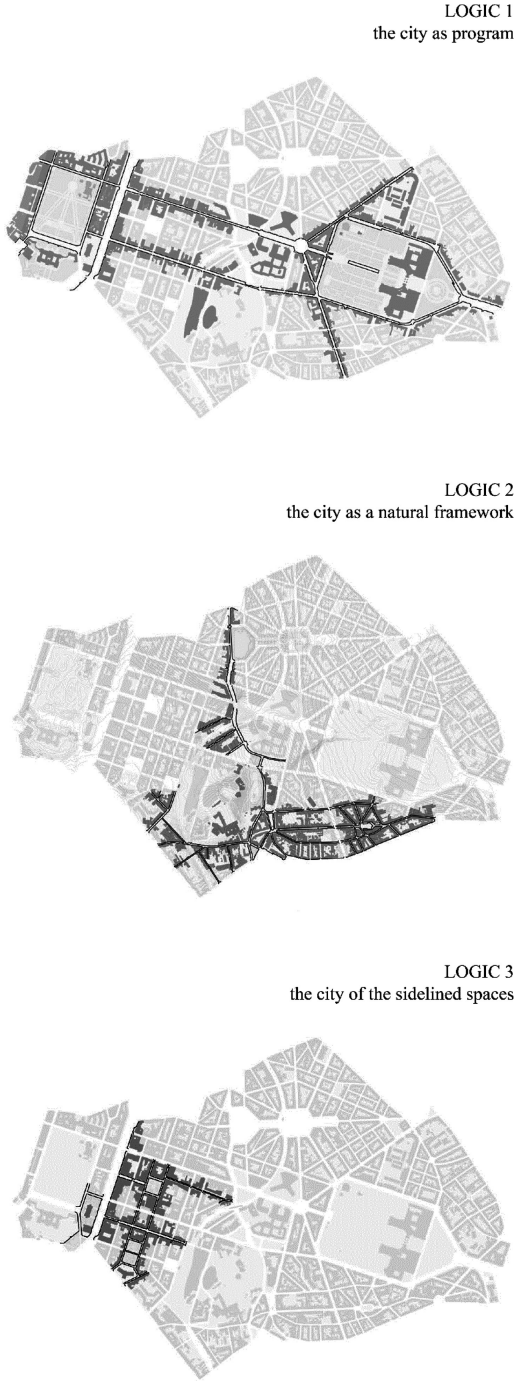
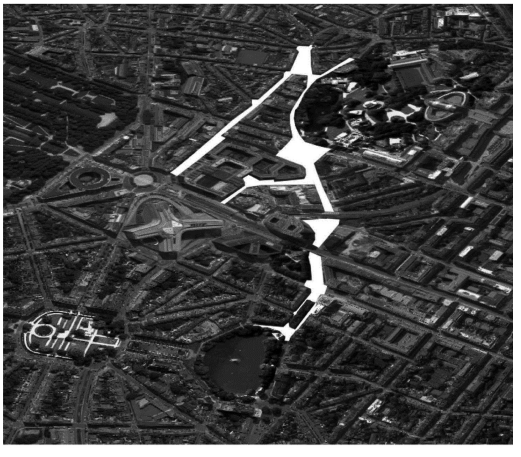


Figure 4. Logics of habitat.

The same nature of interventions can be found in the actual projects carried out in some parts of the district. It is the case for instance with the PUL (*Projet Urbain Loi*) led by Christian de Portzamparc, or the development project for the Schuman roundabout by Xaveer



LOGIC 2
a network of parks along the Maelbeek valley



LOGIC 3
soft strategies for the Montoyer street



Figure 5. Illustrations of the logics of habitat.

De Geyter facing the Park Cinquantenaire. All of those institutional projects require large amounts of funding, extended political support, and a considerable period of time.

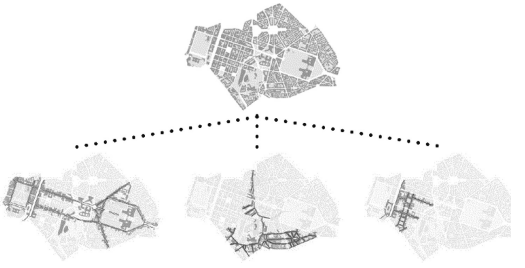


Figure 6. An array of possible logics of habitat.

The second logic – the city as a natural framework – relies on the pre-existing natural infrastructures of the city. Among fictitious projects, a new park system could be imagined, running along the ancient Maelbeek river bed. Not only would such an intervention create an overall structure for the district but it would also set forth a series of opportunities for local projects. Those projects are built on the natural structure of the valley. Once again, real-life projects can also be identified as referring directly to this logic. It is the case with numerous small to medium-scale housing projects as well as the redevelopment of the general accesses to park Léopold, an ancient landscape park set in the heart of the district, in the shadow of the European parliament. By analysing those various designs, the second logic can be qualified as more organic since it refers in the first place to what existed prior to the city. In terms of implementation, the necessary resources are less considerable both in terms of means and stakeholders.

The third logic – the city of the side-lined spaces – is based on scattered opportunities and specific local circumstances of the district. A series of fictitious projects were designed for various neglected public spaces (streets and squares) as well as buildings. Once again, an investigation into real cases provides information about the nature of this third logic. In this case, the interventional means and stakeholders are more flexible and the timeframes are reduced. Most projects are conducted by local associations.

4.1.3 *Overall picture of the possible habitats*

As illustrated above, the research by design process carries out two kinds of operations: identifying the possible logics of habitat and classifying those logics according to the intervention they produce.

Those two operations generate a comprehensive overview of a specific situation. Hence, in our particular case, the knowledge of the built and unbuilt structures of the European Quarter and its conditions for future evolutions has been brought to light by architectural design's specific means.

4.2 *Study*

The study, on the other hand, adopted a very different position. While research by design produces an array of potential logics of habitat, a regular study pursues a particular logic in order to produce a specific



Figure 7. Communicating the findings through a set of coloured postcards .

intervention. This choice is directed by several factors: the commissioner and the nature of the study (global, local, prospective vision …), the practical and financial feasibility, the personality and the expertise of the author…

4.2.1 *The European Quarter study*

In the case of the European Quarter study, the nature of the commissioner as well as the available means led the team to work on design schemes relating to the third logic.

As previously stated in the introduction, a sociological as well as a spatial analysis of the district was carried out prior to the design phase. Based on this in-depth analysis of the district, a series of neglected spaces and buildings were selected to be worked on. For each one, a drawn proposal was produced by the means of architectural design. Then, in order to evaluate and communicate the implementation of the designs, each scheme was summarized on a project sheet listing the location of the intervention, its socio-demographic dynamics as well as the potential stakeholders and the means to implement the design. Finally, in order to communicate the findings of the study, a set of postcards was produced representing each of the interventions. These are treated as ancient coloured postcards as if the future of the district would somehow reflect the bright past of the neighbourhood.

4.2.2 *A specific strategy*

As the foregoing clearly shows in the case of the European Quarter, the principles of the commissioned study differ significantly from those of the research by design carried out in the University.

The study produces its own *modus operandi* in terms of method and communication in order to generate findings. Similarly to an architectural project, it is a subjective investigation taken from the initial demand. Ultimately, the study tries to answer a specific request and its value can only be judged by the satisfaction of the commissioner. Hence, whereas research by design was trying to probe the potential of a specific situation, producing an array of possible logics, the study provides the commissioner with a specific solution for a particular situation.

5 CONCLUSION

The analysis of this particular case study helps underlining the main differences between research by (through) design and study. To conclude, those differences can be summarized as follows.

Firstly, the two notions differ in terms of framework. On one hand, to be conducted properly, research by design should not be affected by the contingencies of the commission. It is preferably carried out in the disinterested environment usually provided in universities. On the other hand, the study is accomplished within the limits of a specific assignment. Such studies are usually carried out in the framework of a "studies office".

Secondly, the concepts diverge in terms of generalization. Indeed, research by design proffers a holistic approach of a specific situation which can hence be helpful for orienting strategic visions of development. On the contrary, a study focuses on a specific and pragmatic proposal. It can thus serve as a lever for implementing particular projects. As unambiguously stated by Jeremy Till, research needs to be systematic while study (or project) needs to be thorough (Till, 2008).

Thirdly, research by design and study are different regarding reproducibility and communicability. Indeed, by definition, two operations are required in the case of research by design: unveiling a series of potential habitats and cataloguing them. Those operations try to be as exhaustive as possible. Henceforth, not only does it permit, but it requires a critical peer-reviewing to be as complete as possible. On the other hand, the search for reproducibility is important in the case of a study in order to communicate the findings in the most coherent fashion.

Fourthly, while the cumulative nature of the process is a fundamental feature of research by design in order to produce a critical array of potential habitats, this feature does not seem necessary for a study.

Finally, the two notions diverge in terms of falsification. By their very nature, the findings as well as the method of research need to be tested rigorously in order to verify the consistency of the knowledge brought to light. In the case of a regular study, no subsequent verification is needed when the findings meet the initial request as well as the satisfaction of the commissioner.

In view of the discrepancies highlighted above, the two notions should be adopted for very different purposes. They afford the opportunity to formulate innovative groups of stakeholders to address issues at various scales. Therefore, a careful distinction should be made between research by design and study since a lot of work labelled as research by design should

probably go under the name study. Once the two notions can clearly be distinguished, their benefits will be more acute and hence of greater value for one another. To this end, architecture academics and practitioner should find some common ground instead of ignoring or using improperly each other's work.

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Design as research: A new trend in architectural design in the United States

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ABSTRACT: This paper introduces "Design as Research," a new trend in architectural design in the United States. With this concept, the design procedure can be perceived as a research project, and design strategies are made based on the evidence of research results. It has been applied broadly and developed fast in architectural practice.

The authors conduct a literature review on the history and development of *Design as Research* and its application. The key events include the rising of Caudill, Rowlett, and Scott which started the architectural programming in the 1960s, the empirical study *View through a window may influence recovery from surgery* by Roger Ulrich published on Science in 1984, and the formalization of Evidence-Based Design in 2003. The application of the concept in practice can be categorized into three ways: (1) scholars providing supports to design firms; (2) devoted research center/department of design firms; and (3) collaborative projects between design firms and research institutes. For each category, examples with details are provided.

The authors discuss the possible misunderstandings of the concept and discuss the challenges for future development. *Design as Research* requires the transition of relationship between design and research, which is a substantial change with design mode. It emphasizes the uniqueness of each project; therefore design should adjust to different needs accordingly. Also with the new trends, architects do not have to be specialized in a certain area but with strong ability of finding problems, solving problems, and collaborating with multi-disciplinary teams.

With rapid development, the pros and cons of an architectural design project may depend on the degree of mastering and controlling the design-related knowledge in some extent. This paper suggests the significance of the approach of *Design as Research* which could be potentially wide used in both developed and developing countries.

1 INTRODUCTION

Making design decisions through the evidence from research have been used in architectural practices. In recent years, some design theories clarified the definition and collaboration method of "Design as Research", which broadly applied in healthcare, education, and office architecture. This paper will introduce the concept and development of Design as Research with practical examples in the United States, then discuss both pros and cons of this new trend on architectural design industry, and provide the guidance to future development and reference to other regions, especially where the architectural industry in transition to scientific and research oriented.

2 LITERATURE REVIEW

The authors conduct a literature review on the history of *Design as Research* and find three key events during its development: (1) Rising of architectural programming; (2) Beginning of the empirical study; and (3) Formalization of Evidence-Based Design.

2.1 *Rising of architectural programming*

It was not rare to analyze the site, resources, user group during an architectural design process, and such analysis involved certain research methodologies. The Caudill, Rowlett, and Scott (CRS) was the first firm to accentuate the importance of research work during the design process and independence the architectural programming from other types of work in the mid 20th century. The firm was famous for providing functional solutions, including the project budget, schedule, and analysis, rather than innovative architectural styles (Kliment, 1994).

2.2 *Empirical study of the impact of window view*

The study *View through a window may influence recovery from surgery* by Roger Ulrich published on *Science* in 1984 established a new era for architectural design

method. This paper was the first empirical study in the field of architecture to scientifically prove the impact of built environment on human health and build the real connection between research and design as well.

2.3 *Formalization of Evidence-Based Design*

Based on Ulrich's study (Ulrich, 1994) and borrowed the concept from medicine, the concept of *evidence-based design (EBD)* was formalized by architect Kirk Hamilton in 2003 (The Center for Health Design, 2008). The EBD inquires designers to make decisions "based on the best available information from credible research and evaluations of projects" (Hamilton, 2003, pp.18). In less than 13 years, which can hardly be counted long but definitely with fast development, many practitioners have designed healthcare projects with such principles and accumulated the new evidences.

3 EXAMPLES OF PRACTICES

The model of design as research have received attention from architectural design industry in the United States during the last decade, which impact on multiple building types such as the healthcare, education, office and commerce. The idea of acquiring the new architectural design evidences through research promotes the revolution of design process and then change the whole architectural industry. Currently, the trend of design as research in the United States can be found from: (1) more and more individuals and institutions with research background directly participating in or collaborating with design practices; and (2) design firms setting up specialized research groups to support design projects. We category the design firms involving research into the following three categories:

3.1 *Experts or research institutions provide research support to design firms*

Since architects may lack of the opportunity to access to the literatures and experience of using research methods, evaluating research results, and composing research papers, a number of design firms need to accomplish research work with the help from scholars or research institutes. For instance, Health System and Design Center (CHSD) in Texas A&M University (Texas, USA) is the largest research center which is constituted by architecture and medical professionals in the world. In addition to the regular teaching and research works, CHSD provides research support to health-related design project.

Sometimes the research for a certain design project is related to other disciplines besides architecture, so design firms would like to hire experts and scholars from other fields which are involved in projects, or develop cooperation with some independent or college research institutes to seek support for research. NBBJ Architectural Design Company cooperated with John Medina, a developmental molecular biologist and visiting professor at University of Washington, in a research project in 2014. John Medina joined design and leadership team of NBBJ and use his own research achievement in the field of information reaction and organization of brain, to explore the design thought and environmental experience. The research achievement is mainly used to guide the design of medical and office buildings.

3.2 *Design firms set up internal research departments*

Some large design firms of the United States, including HKS, Perkins+Will, Erdman, CannonDesign, and WHR, perceive research as an important part of the design process and include it into the core philosophy. They conduct research and train specialized researchers by establishing research departments and providing dedicated research funds. Table 1 listed rankings of design firms by different institutions and whether or not these firms involving in research activities. For example, in 2014 American architectural design firm rankings according to the magazine of *Architectural Record*, 6 out of the top 20 firms set up internal research departments, and 8 of them had cooperated with other institutions or individuals to launch research project.

HKS Architects, Inc. is a leading design firm in sustainable and healthcare design. It set up a non-profit research department named CADRE and a team called LINE composed by researchers and design professionals from several departments, with the aim of improving designs by applying the latest technology and methods. The firm holds a design competition each year: architectural students and HKS designers from all over the world gather together to create new ideas, research, and design in the three days workshop and present to experts composed of professors and partners. HKS also established a one-year fellowship program to discover and encourage talented graduates to carry out researches on healthcare environment. Another outstanding sustainable design firm, Perkins and Will, positions itself to research-based architectural design firm directly and clearly. It set up the non-profit research department named Area Research as a platform to connect designers, scholars, and research institutions and carry out innovative research to improve the living environment.

Since more and more design firms begin to establish research departments and recruit research personnel, architectural doctorate graduates in the United States are no longer limited to looking for jobs in the increasingly saturated academia; research or collaborated design-research positions of design firms become another options. If continuously developing, this trend will change the connection relationship between architectural education and the industry; the education, especially the higher education, and the market and industry will be tightly connected.

Table 1. The application of design as research among top design firms in the United States.

Firm	Ranking *				Set up internal research department	Participate in research projects
	Architectural Record	Architect Magazine	Engineering News Record	Health care Design		
Gensler	1	3	1		—	■
AECOM	2		3	1	—	■
Jacobs	3		7		□	□
Perkins+Will	4	20	6	5	■	■
URS	5		2	16	■	■
HDR	6	19	11	2	—	■
HOK	7	15	4	3	—	■
SOM	8	12	10		—	■
NBBJ	9	23	12	8	■	■
HKS	10		8	4	■	■
KPF	11	34	31		□	□
Callison	12				□	□
Perkins Eastman	13		19	10	■	■
ZGF	14	4	18	14	—	■
Cannon Design	15	43	17		■	■
Leo A Daly	16			21	□	□
Populous	17				□	□
Stantec	18		22	6	—	■
Smith Group JJR	19	35	14	12	—	■
HGA	20	18	20	11	□	□

* Ranking resources include Engineering News-Record, Sivis, Watkins, and Wills, Dickinson, and Karlin Associates. See references for details;
■: Yes, □ : No, —: Not certain.

3.3 *Design firms and research institutes collaborate on research projects*

Another important form of design firms participating in research is to collaborate with research institutes from other study fields. The design firms can provide knowledge and technical support related to human and built environment research from the perspective of architectural design.

The research department of Perkins Eastman, Research Collaborative, collaborated with the Alzheimer's Foundation of America to develop interdisciplinary research of dementia care and pension residential design. They jointly published the white paper "Optimum design: To provide the best living space for Alzheimer's disease and other dementia groups" in 2014. This report lists design details and elements which should be considered for the residents with Alzheimer; can serve as a reference guide for improving physical environment design of this building type.

4 DISCUSSIONS

Although the importance of research in design have been paid more and more attentions in practices, design as research is mainly applied in the big firms or limited to the projects regarding healthcare or sustainability. Some design firms and architects may aware of the trend but be restrained by the budget, schedule, and lack of sufficient methods; others may still doubt or misunderstand the design as research. The common confusions are listed and discussed as followings:

4.1 *Whether the design as research is identically different with previous design models*

In the traditional design models, architects may look up professional journals and books, collect case studies of the same building type, and interview with clients or user groups to collect relevant design information. However, only using the existing resources is not a research supposed to be. To utilize research findings and to conduct a research are totally different concepts: Design as research not only requires the application of existing research outcomes, but more important, it asks for conceiving hypotheses of key design objectives based on literature review and evaluation, then selecting methods to conduct qualitative or quantitative studies accordingly to support the hypotheses or not, and finally forming the new knowledge from the results for future research and design. Therefore, the design as research is fundamentally different with previous design models, especially on the delivery of design process.

4.2 *Whether the design as research leads to strict standards*

New research emerges every day. Design as research emphasizes running live update among projects, which means every project should based on new research findings while the feedback and evaluation from a finished project being the next new research findings. So the design as research will provide the powerful reason to help correct the out-to-date standards rather than been restricted. The design as research also accentuates the uniqueness of each project; design should be always adjusted to meet various needs.

4.3 *Whether the design as research weakens designers' creativity*

Architecture is perceived as a combination of science and art. Design as research is looking for a rigorously scientific method to solve the problems during design process. The contemporary architectural design need react fast and correctly towards challenges by the times, which sets higher standards for creativity. The creativity of designers are reflected from the design solutions under the limits and challenges.

4.4 *Whether the design as research requires designers specializing on certain building types*

With the information globalization, ever-changing environmental and society issues, and fast development of technology, we can expect that the future architecture will face more complicated and delicated questions. Therefore the challenges for designers are not being specialized on certain building types; instead, they will require designers with the ability of finding problems and making decisions through research and multi-disciplinary collaboration.

It is worth mentioning that two books, *Design research in architecture: An overview* (Fraser, 2014) and *The Routledge companion to research in the arts* (Biggs and Karlsson, 2010) discussing the topic more theoretically and providing examples in practice globally, which could be good references for conceiving a framework of this topic.

5 SUMMARY

In this paper we discuss about the development of design as research and its practical models in the United States. Design as research connects designers, clients, and researchers tightly, and provide user/client oriented high-quality design services, which could be a good reference for the industry in other regions, especially where architectural industry being in transformation and upgrading.

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Designing a life-world for designers: A phenomenological inquiry into Weiss/Manfredi's Center for Architecture and Environmental Design building

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ABSTRACT: The work of Weiss/Manfredi reveals essential indexical relationships to which architecture aspires to exemplify and amplify. Through phenomenological inquiry into the design, documentation and construction of Weiss/Manfredi's new Center for Architecture and Environmental Design (CAED) building, I exposit on a work designed for designers. Taken on the whole, Weiss/Manfredi's buildings respond to contextual circumstances that inform their designs by experienced relations set between occupant, building, and context. Some of these affective relations include: connecting inside and outside through light and views, visual contact between spaces, choreographing connections within and around the building, centering the building through an active communal "heart," unifying form and event in a performative relationship, braiding new circulatory flows to preexisting paths, mediating the gap between ground and roof, and applying new materials and tectonics to existing contexts. By targeting significant spaces within the new CAED building, this essay uses phenomenology to uncover and describe these overlapping relationships.

Overall, Weiss/Manfredi has created a relational configuration shaped through space, movement, light, and materials. The building is an arrangement of affective experiences that offer agency to environmental design education. Through perception and experience, *space constitutes an affective bridge* of contextual relationships. By virtue of this insight, Weiss/Manfredi's work is not reducible to forms or images. Instead, the new CAED building is composed of indexical relationships best described through lived-experience.

This essay uncovers the affect-relations that Weiss/Manfredi explore in their work. The new CAED building by Weiss/Manfredi propagates relational interstices that support openness and creative exchange. Their architecture emphasizes the interplay of social, spatial, and material affects. Phenomenology, coupled with affect theory, is employed as a method for uncovering these experienced relations.

1 INTRODUCTION

1.1 *Lived-experience*

"Rooms must suggest their use without name. To an architect, a school of architecture would be the most honored commission."—Louis Kahn (1971).

I do not find it questionable to describe a building before it is fully occupied, since every architect and designer must anticipate and apply techniques for appreciating their designs before they are realized. Designing a building is predicting the affect it will generate for the people experiencing it. The actual has always been imagined through design.

Archimedes—whose name will be forever remembered for his water-lifting helical screw—is also known for his famous "eureka" moment. Archimedes stepped into an overfull bath, as his body displaced the water, he experienced it spill over the basin's lip—a vivid moment of physical insight and movement that answered his king's puzzle over the volume and the density of a gold crown.

Through physical insight and movement, matter may disclose ideas about the world. Archimedes was open to the affective possibilities of taking a bath. Each time we encounter the world through the powerful guise of habit, we fail to notice something extraordinary. The world contacts our body and we apply our mind to the world through daily actions. Each experience affords us the opportunity to ideate upon, poeticize, and appreciate the vagaries of matter. Like Archimedes' entering his bath, a young environmental design student enters a building rich with experiences and speculates on answers to design problems therein. The new Center for Architecture and Environmental Design (CAED) building at Kent State University is designed to compel and inspire invention through interaction.

1.2 *Affect, theories of affect, and architecture*

"Being or relating, that is the whole question."—Michel Serres (2007).

I must respectfully disagree with Elizabeth Diller who began her talk at the EG2 Conference held in Los Angeles, by declaring that, "Aside from keeping the rain out, and producing some useable space, architecture is nothing but a special effects machine that

delights and disturbs the senses" (Diller, 2007). Being more than a special effects machine, a building is an arrangement of relations affecting each occupant differently. The definitional distinction between words 'effect' and 'affect' has plagued users of English for quite some time. But architecture is not about effects, or permanent physical change in people. Architecture is an affective bridge composed of spatial and physical relationships—an intentional arrangement of varied ambiances where people interact over time and in ways that go beyond the full control or expectations of the designer.

The philosophy of affect, or affect theory, derived from the writings of Baruch Spinoza, was outlined initially by Brian Massumi in *Parables of the Virtual* (2002), continuing in Melissa Gregg & Gregory Seigworth's *The Affect Theory Reader* (2010), and with ongoing research and discussion showcased in the recent Affect Theory Conference, *Worldings|Tensions|Futures*, held in October 2015 and hosted by Millersville University. *Effects* are typically nouns, and indicate a permanent change, like the damage done after an accident. *Affect* is normally used as a verb, and therefore happens in time and has a rate of change—just like the person immersed within and living-through a building. A building affects its occupants, who are in turn affected by enclosures and openings that form varying sequences of interstices experienced over time.

Michel Serres introduced the idea of the quasi-object to suggest the interplay of forces that make an object forfeit to its context. Like a macguffin plot in a story or a ball in a game where changes in possession cause the plot or game to advance, a quasi-object—much like indexicals in language—is never totally neutral in and of itself (Serres, 2007). It is redefined each time possession changes hands. A building cannot be grasped like a ball or a button; instead, a building grasps us. So architecture may be understood as a quasi-object, an affective space or a set of indexical relations that shape society—forming a knot derived from contextual forces that altogether produce dynamic interplay. In reality, no object or building is ever settled; each is a set of slows shifting affects experienced differently every moment of our lives.

Reconciling contexts is basic to Weiss/Manfredi's approach to architectural design. Weiss/Manfredi's method winnows the many circumstances that can influence a design down to a set of affective relations that form the context the project is immersed within. I arrived at this set of affective relations from multiple sources, including a careful study of a video from the January 17, 2013 competition presentation by Marion Weiss and Michael Manfredi at Kent State University, their design update on January 16, 2014, close analysis of earlier works, and various statements underpinning the firm's oeuvre. These experienced relations include: connecting inside and outside through light and views, visual contact between spaces, choreographing connections within and around the building, centering the building through an active communal "heart," unifying form and event in a performative relationship, braiding new circulatory flows to preexisting paths, mediating the gap between ground and roof, and applying new materials and tectonics to existing contexts. In the following pages, I employ phenomenology to uncover these overlapping affective relationships by describing significant spaces within the new CAED building.

1.3 *The Life-world and Designers*

"The rooms which one likes to inhabit are never those which the architect conceived with that intent, but the corridors, the stairs, the antechambers . . . Habitable space is relational space. Bridges. Where we cross, from where we see, where we dance."—Michel Serres (1975).

Derived from outward phenomena, perceptions are embodied and therefore personal; but perception is also social—perceived by many over time and in space—and therefore part of a larger phenomenological identity defining the intercourse of things, events, and involvements we call culture. It is within the complement of these levels—or overlaid plena of differing experiences—that we have what Edmund Husserl termed *life-world*. The life-world is a series of strata that coexist and intermingle in the realm of human perception. The life-world is within the filament of relations that any context endows upon us and taken as multidimensional and layered. So, the life-world encompasses our everyday sense of the world and the way it is structured. A life-world, in order to be rich, must be varied and shot through with possibilities that open us up to creative action—it must be inconclusive and open to discovery, spontaneity, and deep interpretation.

Space is social. Spaces are variably charged with social energies that remain inseparable from the experience of the space. A building is an active involvement, not an object to be admired distantly. Architecture, or buildings in general, exists as a stratum between the material aspects of the natural world and consciousness. Architecture is a performance of affects. It is only through our active participation within or around a building—to affect and be affected—that we can truly phenomenologize its worth. Our bodies, and therefore our buildings, are the sum of their affects.

The life-world of a designer inhabits a slightly different 'everyday' since the daily activities of the designer includes questioning the order behind the things with which humans participate. The designer's perceptions should go beyond the habituated and terse use of a given stratum of the life-world. The designer contemplates upon the very production of that stratum, including considerations of its relationship to all the other strata that define a human's life-world.

Designers work by breaking down the prescribed features of things, drawing the relation between things into question, connecting the unapparent together, and creating the potential for new things to emerge. So places endowed to fit with the designers purpose would

differ from the spaces for everyday use in certain ways. A space for designers should form variable bridges and break down the prescribed feature of things, challenging basic assumptions about space, social structure, and material things.

2 THE NEW CAED BUILDING

2.1 *Affective architecture*

"[R]elations that connect experiences must themselves be experienced relations, and any kind of relation experienced must be accounted as 'real' as anything else in the system."—William James (2006).

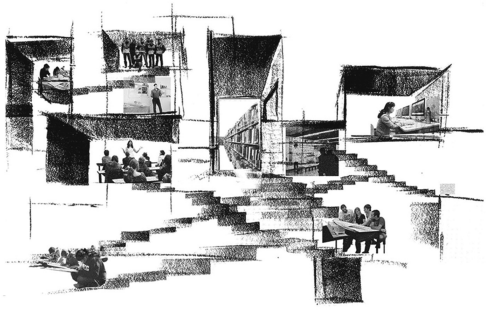
For Weiss/Manfredi architecture is an interplay of spatial, social, and material affects that change over time. The CAED building by Weiss/Manfredi produces and is produced by affects. The designers have created an overall configuration of affects shaped through space, movement, light, and materials. Affect is directly relational; affect implicates the affected as two sides of the same event (Massumi, 2015). Affect extends from the body's ability to act and constitutes *immediate experience as experienced* before reason or language. A building or an environment that inspires us to act aspires to become a universe of affections.

About 60 years ago, a group of vocal and ardent architects advocated that fellow practitioners should "articulate the in between" (van Eyck, 1962). Practitioners such as Herman Hertzberger, his mentor Aldo van Eyck, and other Team 10 members like Alison and Peter Smithson pointed toward a relational architecture of the "doorstep" (Smithson, 1968). Human interaction and innate patterns of association, if taken altogether and interacting through design, can multiply the qualities of a particular place. In other words, architecture should be approached with the same sensitivity and grace found in human culture. Just like societies, buildings are about qualities and affects, not quantities and facts.

The new CAED building can be understood best phenomenologically—as affective relations experienced in the spaces between its physical construction and the particulars of its social program. Architecture is forming a thoughtful space where two people can meet in purposeful exchange. But the new CAED building does more than reify structural anthropology through design. Weiss/Manfredi's work demonstrates that a building is a framework of affects operating within the larger context of human, material, and environmental associations. Their approach to design acknowledges that buildings are participatory experiences, acquired through the actions of the occupant, and inherently uncertain—both the happenstance of the encounter and the geometry of those encounters are arranged through architectural design. In the case of the new CAED building, the design uses the program to bridge between the Kent State University campus and the community of Kent, Ohio. The building's internal activities, displayed outward to the city and adjacent esplanade, connect two adjacent contexts laterally— binding the campus and city together at various scales.

Vertically, the floor levels interact by lofting the space between and stitching those levels together through variously configured stairways. Overall, first impressions of the scheme suggest a simple free-plan, reminiscent of Le Corbusier's century old proposal *Maison Dom-ino*, where structure blandly forms space and partitions distinguish and define the program. However, the CAED building stages the pretense of openness and flexibility, belied by the location of the systems and the tight fit of furniture systems that make reconfiguring spaces improbable.

Achieving an open flexibility between structure and program is not that simple. As Louis Kahn said in his 1971 AIA National Gold Medal acceptance speech, "A plan is a society of rooms. The rooms relate to each other to strengthen their own unique nature" (Kahn, 1971). In the CAED building, the designers adjusted each discrete space to accommodate its neighbor, while trying not to compromise the integrity of the overall space.



2.2 *A reconciliatory approach*

The building closest to the new CAED building in Weiss/Manfredi's repertoire is the Barnard College Diana Center, completed in 2010. The red enameled glass panels suggest the brick masonry of adjacent buildings. The Diana Center's variable facade, its urban alignments, its contribution to adjacent urban spaces, and its command of views both inside and outside are a manifold combination of strategic responses to cues taken from the campus and surrounding city.

With a similar deference to context, Weiss/Manfredi's Women's Memorial and Education Center from 1997 retains the monumental semicircular exedra of the existing entry to Arlington National Cemetery. Their simple strategy preserves the original sculpted retaining wall, carves out programs spaces behind, and creates a transparent building that mediates between old and new. Their Seattle Art Museum & Olympic Sculpture Park completed in 2007 links the city to the shore of Elliot Bay while bridging above the existing road infrastructure. By yearning to span the gap, the building reshapes the two places it connects.


View from Northeast

In these three examples, we see prepositional strategies that accommodate new programs *between*, *behind*, and *above* their settings. Weiss/Manfredi's architectural strategy could be called an *art of prepositions*. In just about every example, their buildings reconcile themselves to contextual cues, fulfill a lack with new programmatic uses, or configure some social or material potential in a given context. By bridging city and campus, the new CAED building activates an interstices between the two—putting into play a set of prepositions that conjugate elements from the surrounding context together by forming a relational middle-ground. The building is not asserted on the land arbitrarily. Instead, the building is implicated, or folded, into its context—wheedling into the adjacent architecture, landscape, and preexisting paths surrounding the site. The new CAED building struggles to assert its own visual and programmatic identity while also seeking to support multiple associations within its given context.

2.3 *The landscape and the lobby*

The northern length of the building's ground level is public and parallels the shallow slope of the esplanade. The east entry opens onto the main stair seen across from, and cattycorner to, the main flow of the lobby. The stair ascends to the administrative offices and studio lofts above. Classrooms, a cafe with openly distributed seating, an adjacent gallery with adequate space beyond it to host receptions, a main lecture hall with a loosely defined lobby, and the library with various open study areas flank the ground level along an axial vista that widens toward downtown.

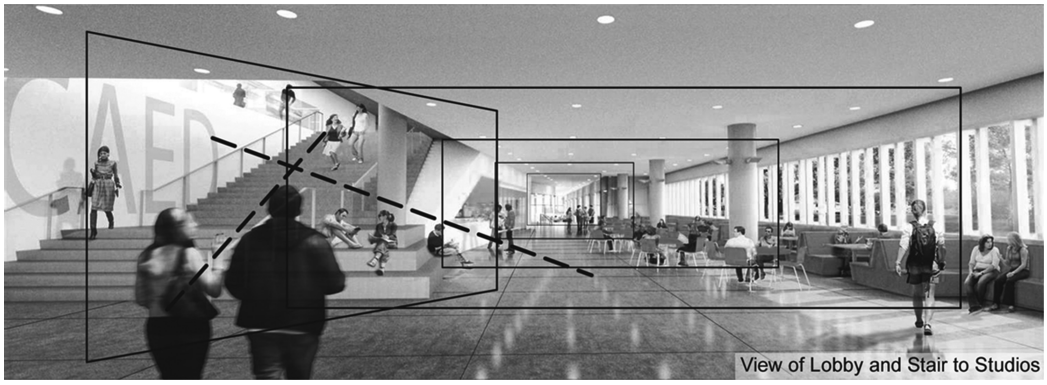
The rotund lecture hall centers the entire ensemble inside and out, forming an active and communal "heart" to the CAED building. The large lecture room's curving glass wall cradles the speaker and audience inside, and simultaneously curves outward, delving into the lobby with a graceful bulge. Curving space on both sides provides a lesson in reciprocity—offering the flexural experience of two curvatures in one element (centrifugal and centripetal)—and demonstrating how the curve of a wall can reverse affections between places—gathering and dispersing depending on which side you occupy.

The lobby increases in volume enough to accommodate a mezzanine. Like a solid ribbon, the masonry defiantly ascends along the north facade, flowing upward along the run of stairs, and connecting the studio lofts together. The technical logistics and the concealed tonnage of steel required to float a masonry facade contradicts the material choice—challenging our natural sensibilities regarding, weight, gravity, and groundedness. Custom masonry shapes protrude from the ribbon facade, forming fins that striate the facade with vertical highlights and shadows. The fins establish an alternating pattern, spaced out horizontally through a sliding sequence of 1, 1.5, 2, and 2.5 bricks in a course, laid out in a vertical stack bond pattern. The coursings shift and slide by one another in horizontal bands, composing a polyrhythm of alignments and misalignments.

At the west end, the facade continues to cut back along the same angle, raking up higher, and allowing daylight to enter the library, mezzanine, and faculty offices on the second floor. By standing at the triangular apex of the projecting light monitors, we can experience the masonry wall beyond its outer edge—making for an uncomfortable but revelatory experience that places the occupant simultaneously inside *and* outside, looking backwards at the building.

2.4 *The library and study spaces*

The layout of the library and study spaces follows the example of Aldo van Eyck's Municipal Orphanage near Amsterdam: make each inbetween space into a place, and design each place as if it were a bunch of places (van Eyck, 1962). The library acts as both terminus and hinge, allowing views outward to the city but also connecting spaces above and around the book



View of Lobby and Stair to Studios

shelves into an interrelated and varied whole. Adjacent study areas are both nestled and open, allowing for solitary, small, or large group study.

Situated above the book stacks, open to the lobby below, accessible long a flowing stair, and just below the faculty offices on the second floor, the mezzanine doubles as a materials library and small group meeting space. By being intimately separated but outwardly connected, the open mezzanine transgresses boundaries in ways attuned to enriching social interaction.

Similarly, the new CAED building will display its social interior outward to the esplanade. Like a *tableau vivant* depicting its narrative through silently related gestures, the library, lecture hall, gallery, cafe, and lobby blend and present together a larger center of action. Visible from the adjacent esplanade, students will be able to view in at night and see the building's inner story unfold. Like Hertzberger's "realm of the threshold" (Hertzberger, 1991), this relay of relations throughout the ground level presents a dance of agency and affect, with exchanges between its occupants choreographed through connections in space.

2.5 *Lateral learning*

In their public presentation during the 2013 design competition, Michael Manfredi spoke about "peripheral vision" in the studios. I take this to suggest that we learn out of the corners of our eyes. Manfredi's consideration of "peripheral vision" is a central feature of most studio-based education; but affordance for this kind of learning is not accidental. Instead, much of studio education happens when students turn their attention away from the professor and view the work of a classmate a year above or a year below.

The configuration of the "design loft" (Weiss/Manfredi's term) performs by doing more than stimulating the occupant's peripheral vision. The layered and vertically connected spaces turn a student's attention about laterally and without hierarchy. Especially from the third floor, the lofted spaces offer multiple views simultaneously—above, below, outward to the campus, and back inward to the columned space of the floor, and upward to the ceiling, cut and folded precariously overhead, tying all the levels together along a diagonal slope mirroring the angle of the sloping esplanade.

Once in conversation with art critic Christian Zervos, Picasso said, "Artists are receptacles for emotions that come from all over the place: the sky, a bit of earth, a piece of paper, a passing figure, a spider's web. That's why they can't discriminate between things. Because for true artists, there are no places of exclusion" (Zervos 1935). Weiss/Manfredi's three-level design loft, in conjunction with the array or spaces on the ground floor, form indiscriminate *places of inclusion*—a set of places where looking, learning, making, and collaborating are all part of an inclusive, permissive, and creative mix.

2.6 *Studio lofts*

Does this building flow despite being lofted and layered? In general, can floors be connected despite being pancaked? This has been a long-standing conundrum in architectural design. Mid-20th century architects recognized that structural and functional efficiencies were not enough to accommodate humans socially. I am thinking here of solutions like John Andrews' 1972 Gund Hall at Harvard, famous for its studio "trays" overlooking its ground level critique area all set beneath a sloping illuminated roof—notorious for its leakiness.

However, as I consider the new CAED building, another light-filled example comes to mind, Sir Evan Owens Williams' 1931 Beeston Boots D10 Building. Williams' wet pharmaceutical factory uses daylight and openness to facilitate flexibility and action. Boots D10 Building flows between floors and glows gloriously at night. Similarly, the new CAED building's structured openness and infiltration of daylight from three sides enlivens the interior during the day and provide views inward from the esplanade at night.

With studios making up roughly half of its useable space, the building's overall shape is determined by the sectional strategy of the "design loft." The spatial concept connects the three studio levels into one vertically layered space. The studio lofts and intervening critique spaces showcase research and design by affording visual and physical connections between





the lofted floors. The zig-zagging glazed stair that flows along the south façade—sloped and slanted with parallelogram-shaped glazing—connects all the floors together, jutting in-and-out jauntily from the stacked masonry facade. The design's three stair elements all transcend the perfunctory role of egress and combine to serve as vital connections, linkages, and circuits of flow.

The open stair skirting between the columns and the building's exterior envelope, the stacked fire stair which borrows light from outside, and the long cascading stair that dodges down the building's south facade link levels together in a manner reminiscent of the intertwining stairs in Hannes Meyer's 1926 Functionalist proposal for the Petersschule in Basel. The studio lofts, combined with the various stairs, form a powerful spatial concept whose performance derives from the potentiality, variability, relativity, and simultaneity of the relational experiences shared between floors.

2.7 *The roofscape and the sky*

Beneath the roof, the studio lofts will be suffused with light. Cut from a single sliced and bent plane, the canted monitors act like clearstories, gathering daylight from the north and east, illuminating the interior as they angle up along the lofted levels. By tilting outward in both plan and section, the monitors tie the campus to the city by opening the interior space outward. The space lifts instead of confines, stitching spaces together diagonally, encouraging occupants to move in one direction with eyes glancing in another. The person sitting down or passing through these spaces can look around variously—up or down, inside or out—always finding something new to look at.

3 DISCUSSION AND CONCLUSION

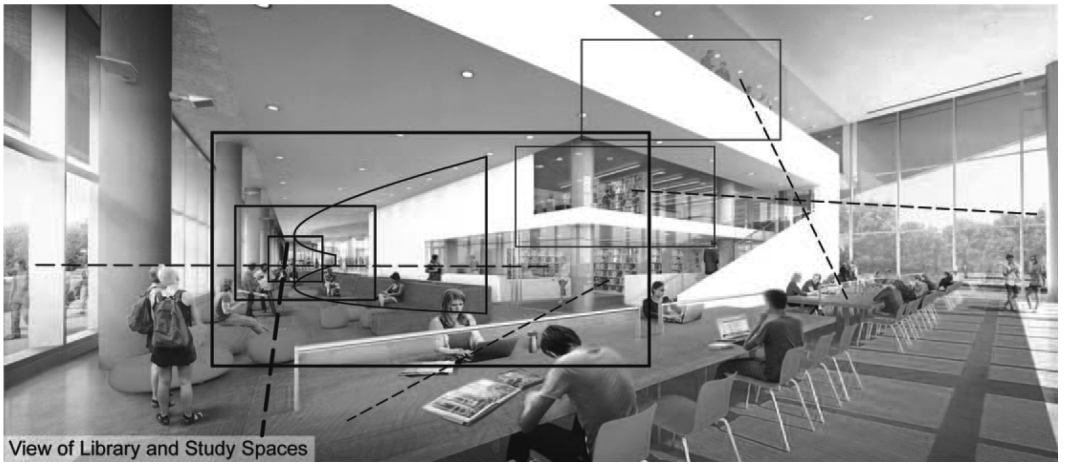
"What does it mean to create a college of architecture and environmental design? Well, it means many things. For us, I think that the spaces where we work in shape us and we are shaped by them . . . it is really a creative mess that shouldn't be so over designed as to not allow us to give it shape and measure that changes over time."—Marion Weiss (2013).

Space habituates society; so to change a society you should redefine its spaces. It is the nature of space to flow and present new encounters over time, forming an occasionally redistributed, adaptive, and memorable inbetween. When it comes to architecture, the elements from which we construct a building are sometimes static and stultifying. How to afford diverse involvements within a static container? If our buildings shape us, then how do we reshape ourselves if our building restricts us?

Weiss/Manfredi appears to dwell on this problem through their work. I believe that their architecture is no simple container of space but instead relates



View of Studio Lofts



View of Library and Study Spaces

experiences reciprocally, operating between interior and exterior, ground and sky, night and day, discrete and continuous—with open potential. This simple definition, that space constitutes an affective bridge, is their means of manifesting variable and articulate inbetween spaces. Weiss/Manfred; designed a building that compels the lazy hierarchies of tradition to split open, allowing occupants to pivot between varying choices. Their best works link an open interior of interconnected activities to an extended landscape of buildings, paths, lawns, and treescapes.

The new CAED building tangles together the varying ambiance of the day's light, students flowing in and out of the building, special events getting set up, looking at work on display, taking down exhibits, conversing in the hallways and on the stairs, eating and chatting at the cafe, designing frenetically at night, and studying silently. The place will grow in memory through lectures by celebrity designers and scholars, visits by alumni, faculty debates, tours by prospective students, shop equipment thrumming below, and people peering in while strolling along the esplanade. If taken altogether and arranged so that each activity correlates though various kinds of affective bridges, then the building will perform as a setting full of possibilities where personal meanings may be discovered but never fully defined.

The "design loft" concept is both obvious and cunning. The daylit drafting loft was an ancillary part of historic shipbuilding; its inspiration was to bring the act of drafting closer to the daylight and away from the dust and distraction of the workshop floor. By allowing overlooks between levels, Weiss/Manfredi connects students of varying year levels and majors into a single unified act of design—going from foundation design to the senior and graduate level. The space does more than demonstrate the upward lift of the loft spaces; it compels the occupant to look up and ascend the open stairs, embodying the very definition of 'aspirant' in studio education—a word pointing back to the beginning of architectural education in the Ecole des Beaux Arts.

Designers coordinate the affective energies that interact between people, things, climate, ecologies,

and material resources in a way where the dynamics of the composition equals something more than the sum of all parts. The new CAED building seeks to bridge between the designer and the world, act as a catalyst for environmental design education, and assist people entering it to appreciate each other, to appreciate building, to recognize their environmental context, and to depart and continue affecting the world.

(all images courtesy of Weiss/Manfredi and Kent State University; graphic overlays by author)

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Transition space and the image of contemporary city

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ABSTRACT: Once the sustainability became an important factor that had impact on surrounding architectural reality through deep changes in the building code requirements the ineluctable process of changing the cityscape began. After the initial phase, in which technology was used to improve building environmental performance the second phase emerged. Nature came back to light, and in variety of forms became a basic element of architectural composition, following its historical, utility path. Therefore there is a tendency observed to implement greenery, water, earth mass in the architectural design to support the building climatic behavior either adjacent to it, or combined in its structure, even in the interior. There are various composition relationships observed, but all of them have a common feature – they create a buffer of transition space between the building and its surroundings. This type of space on one hand interacts with the public space of the city, on the other with a building itself. It became an area for multilayer occurrences, interactions of users, nature and architecture, creating a changing image of the contemporary city. In the paper there are types of transition spaces classified and discussed along with their impact on the contemporary cityscape.

1 CONTEMPORARY CITY SPACE

1.1 *Urban space as multithread environment*

In his essay describing the nature of the city nowadays Jacek Gyurkovich states that urban space is "a natural habitat of contemporary man" (Gyurkovich, 2007). This thesis is based on Jan Turowski's opinion that man is by nature a social being, and his needs in that field are being satisfied within the city, the cradle of civilization and culture (Turowski, 2001) . Contemporary urban planning is focused not only on spatial qualities of the city layout, but also on its potentials to act as the scene of multithreaded events deriving from community's behavior patterns. The city in that case is a subject of socio-urban interdisciplinary research on both – spatial qualities of the space as well as its perception by inhabitants.

1.2 *Changes in perception of urban structure*

These changes in the perception of the city space, which can be described as the multi-threaded phenomena, not only are reflected in the spatial structure of the city, but also in the transformation of architectural forms that it is built of. Wacław Seruga observes these trends and describes them as an adequate point of reference for the research on contemporary anthropogenic environment. "The unity of architecture and urban planning as well as their mutual interdependence, studying the contemporary relationship between architecture and urban space causes the necessity of treating the issues of architecture in the urban context, and vice versa," out of which comes the belief that "there is no architecture without urban planning, equally as there is no architecture without urban planning." (Seruga, 2011) These words illustrate in practice the image of continuity and fluidity of the contemporary city and its architecture. Studying contemporary city space it is noticeable that urban structure acquires its new, hybrid form – an image created by the elements of urban composition, natural and anthropogenic – buildings and spaces. Research on the latest creations within the urban tissue shows that the buildings are no longer designed to form a figure against the background, where the external walls create a boundary to separate the internal space of the object from its surroundings. Contemporary buildings often create extended urban space by blurring the boundaries between interior and exterior space. The edge of the building becomes unclear, the city space penetrates through openings inside the interiors of the structure. Its function and spatial arrangement "flows" outward creating transition space, providing indirect contact with the environment. This is the field of most visible changes in the image of the city, as this zone is a place of interference between stable and unstable elements of composition – architecture and nature, the movement of human traffic... The area of interference described above, creates a buffer space between the city and the enclaves inside the buildings acting as extension of urban public space, making it difficult to define the limits between the building and the city.

2 TRANSITION SPACE

2.1 *Definition*

Transition space (interspace), describes the field of interaction between subject and object. This term originates in child psychology and was first used by D. Winnicott describing the area between the inner life and the objective reality, the sphere of experience. In art, site-specific, where "place" is in some way part of the creation or affects its perception – it refers to the realm of interaction between the work and its location. In architecture, it is defined as a space linking the two areas of different character, usually inside the given environment. In this context, the notion of the transition operates, among others, T. Ando. To understand the meaning of the transition space in the architectural and urban context, it is significant to identify the subject and object of the interactions, which in this case are the interior of the building and its surroundings. (Schoenholz Bee (ed.), 1999, *Tadao Ando*). J. Krenz described transition space as the area of relations between individual elements of a work of architecture, at the verge of the inside and outside world, at the junction forms and functions. He states that this is a place of the creation of messages with a strong emotional, formal and aesthetic dynamics that determine the clarity of meaning. In his opinion transition space is a hidden dimension of architecture, where the direct impact of the building on human emotion takes place. (Krenz, 2003) According to this idea the perception of architecture is not retaining on its external manifestations such as outer shell, but it allows to treat is as an integral part of the built environment.

2.2 *Factors*

New concepts of organizing urban space occurred after the public awareness of negative environmental changes have arisen. They included manifestos, principles and strategies describing how rational distribution of resources can improve the environment. The concepts also included new tasks for architecture and urban planning, with particular emphasis on urban areas. The basic idea, characterized by a very wide field of influence, which formed the basis for many followers was the doctrine of sustainable development. On its canvas, new, more targeted assumptions were created concerning sustainable design, green architecture and urban planning.

Legal requirements for modern buildings in terms of their environmental management of natural resources, led to the search for methods to reduce energy consumption and reduce carbon dioxide emissions in architecture. Initially, a remedy to improve the condition of the environment seemed to be technology – new insulation systems, maintaining comfort indoor air. However, with the growing awareness of the primary energy in the materials and ecological footprint generated during construction and the necessary transportation of materials led to the new direction of research – on the natural elements of composition. The utilitarian properties of soil mass, greenery, water and renewable as well as recycled materials was once more appreciated.

Changes in the finishing layers of the building contributed to the appearance of architecture: the characteristics of elevation, and indirectly also in its interiors. Common structural elements such as the wall and the roof or flat roof are being replaced by an integrated element of covering in the form of a green roof/wall. Traditional finishing materials are being replaced more and more by greenery, mitigating the effects of CO2 emissions or materials gaining solar energy.

At the same time there is a user-oriented tendency in the contemporary design observed, involving community in the investment process by social participation resulting in treating common areas, as a multifunctional space of a specific social importance. The consequences of these changes are visible by emerging a new type of public space – transition area. It can be described as the zone of direct contact of the building with its surroundings. This is an area of the greatest transformations and therefore it became a subject of interest for the designers and theorists.

The reinvented elements of nature have become the building substance for contemporary architectural form and compositional relationships as significant as traditional building materials. By the use of natural elements the extension of the building into its surroundings is possible. The zone of interaction between the structure and the environment is expanded especially by the use of terrain topography and green roofs. Public and semi-public space is extended onto the surface of the roofing providing a walking surface – the soft edge between architecture and nature. Green façades reach out to the city public spaces encouraging users to enter the building. On the other hand they define public space image by introducing greenery into urban environment. Urban space can also penetrate into the interior of the building in the form of open or closed courtyards, creating enclaves – an extension of the public space.

The contact zone between the building and its environment has gained importance as a place of social relations as well as interaction of man with nature in a place of residence, work or recreation.

2.3 *Tendencies*

The ambiguous distinction of interior and the exterior manifests itself in contemporary architecture, both in relationships between the building and the natural landscape, but above all, they allow the formation of a new kind of relationship with urban space. Berrizbeitia and Pollak describe and classify these relationships by studying the connections of the building with the adjacent landscape, natural or urbanized. (Berrizbeitia & Pollak, 2003) J. Rendell sees this interaction as one of the dominant features of the modern city – "the interior and exterior are intertwined together forming the fabric of the city and are again experienced as

a complementary aspect of everyday life." (Rendell, 2000) In many projects, modern buildings can be seen striving to seek liquidity in their relation with the environment. J. Gehl writes about the perception of soft and hard edges of the urban fabric. The first ones are extended transition spaces and they have ability to serve as a place of life and social contacts – the others, are lacking this capability. (Gehl, 2014).

The concept of the transition space, new to Western civilization was apparent in eastern societies. In these cultures, the man never objected to nature and did not intend to tame it. On the contrary, eastern civilizations tried to create an intimate relationship with nature. These beliefs manifest themselves in the form of traditional Japanese forms of residence lacking the separation zone between external and internal structures. Japanese architecture "pulls" the nature of the interior. There is no specific boundary between the spaces, the edge area is a place for penetration. These features can also be observed in contemporary architecture. The elements of nature are incorporated in the overlapping areas of buildings and their surroundings. They provide a composite substance for creating both – parts of buildings and the integrated urban design. They form a dynamic, variable over time, transition space constructed on the basis of the permeation layers of the architecture, nature, human traffic and communication media that results in new forms of urban area, and consequently, the anthropogenic landscape.

3 CONTEMPORARY CITYSCAPE

3.1 *Image of the city*

The pioneer theorist, author of theory of the image of the city. In his study Kevin Lynch who based his theory on the research on mental maps. This hypothesis is based on the observation that the long relationship between the inhabitant and the area of the city leads to substantial experiences, which are then stored in memory in the form of images. Lynch has separated the five basic elements of the imaginative maps – indicators (cues) of formal physical structure of the urban space. These are: landmarks, nodes, paths, edges and districts. (Lynch, 2011)

"Understanding the city and the building by the category of the landscape is a key consequence of the direction taken by the architecture of the early twentieth century (…)," says Lucyna Nyka. She adds that the changes taking place today are forming an increasingly strong and extensive trend, which identification is not easy, as it involves multi-faceted transformation taking place outside the visual language. The interpretation of urban space as a specific landscape finds its origins in the first decades of the twentieth century. Then, when the perception of the city was connected with the narration of the road, so far reserved for the nature of the term landscape, it began to refer also to the city. "Landscape of the city has all the essential features of the landscape. It is designed in such a small extent as nature (…) thus articulates in a way unconscious" writes Kracauer studying modernist Berlin. Lucyna Nyka stresses that this phenomenon coincides with the abolition of historical opposition between the object and the environment – architecture and nature. At the same time there are concepts of binding space with the community formed and indications of the role of direct experience in the creation of urban space.(Nyka, 2006) The current interpretations of the concept of the city are based on the perception of the urban space as environment. According to Lenartowicz, "the subject of architecture is the physical space of the human environment, specifically the built environment, and of which not all architects are aware, the very life of the human being is related to consciously shaped environment." (Lenartowicz 1992) One of the most important interactions of this kind is a mutual relationship between man and nature. In order to achieve and maintain physical and mental health providing a living environment that supports this relationship is crucial. Especially nowadays when more than 50% of world population are the inhabitants of the cities.

3.2 *Transition space and the image of the city*

The result of processes blurring the borders of the building and the city leads to a certain uniqueness resulting in creation of the new forms of public space, which lay in field of attention of contemporary sociologists and urban planners. Nowadays, the dynamic image of urban space, can be described as an active environment with the exposed factor of time. Most of the contemporary interpretations of the city are closely connected with the vision of their public spaces. Radical statements conclude that the buildings in urban space are one of the tools to shape the image of the city public space. It is possible by providing architectural structures with internal circulation routes and transitions spaces. They create a zone of ambiguous contact with the environment and the possibility for inhabitants to interact with the active context. They become an important component of the new image of the city. Buildings in this type of interpretation enhance urban spaces – participate in shaping their expansions and co-create their characteristics.

Such an approach to the problem makes the traditional concept of urban enclosure, as a basic element of the urban space insufficient to determine all the possible solutions in the context of the multilayered forms. Square, street, park – elementary definitions used in the characteristics of the city are supplemented by new forms of space – buildings, which provide circulation trails by creating a new topography, green spaces, vertical gardens and urban farms, intertwining with each other, creating new models of utility. Buildings may act as public spaces on surfaces of green roofs, as well as in the interiors according to their composition and methods of use. These spaces penetrate each other, and overlap with the spa the city public areas. Therefore the architectural form is created or influenced by both, the structure and urban space. This interpretation supports

the view of Jacek Gyurkovich who states that the elements of the public space of the city are an integral part of the ecological system of urban space. (Gyurkovich, 2010). Transition spaces combine elements of the variable layers, including nature – with the solid ones, such as city's spatial structure components, together acting as background for social contacts. Richard Sennett defines the city as a settlement, where it comes to meeting of strangers. (Sennet, 2009). Interaction between them occur in public spaces. Ray Oldenburg also stresses their importance. His theory of the third place, assumes the realization of human needs in terms of social contacts outside the home and work, just in the areas of accessible buildings and the city. (Oldenburg, 1989)

3.3 *Cityscape typology*

Cityscape can be described as a polymorphic structure. The dynamic image of the city seems to be the primary motive for many contemporary, even significantly different concepts. What they have in common is that they are based upon the ideas of pro-environmental doctrines including creating healthy living environment. The requirements related to the implementation of sustainable solutions in the buildings are one of the major factors of change in the contemporary built environment. They stem from the concept of protection of natural resources by placing its elements to the urban space as a tool for preventing negative phenomena. On the other hand they are the manifestation of the expanded concept of sustainable human environment, which is based on active participation in the community, and the sense of identity and belonging, as well as participation in its development. The determinants generate specific spatial forms that appear in the city in the form of pioneer images – showing contemporary trends in architectural and urban design, and thus the built environment. Nature becomes an integral part of the architectural composition. The consequence is creating forms of integrated urban landscape, built of stable and variable components. Their relationships are based upon both, the spatial and technological aspects. Transition spaces are places of connections that are created by the architectural form and the dynamic elements of the city: nature, human traffic, as well as layers of transferring meaning – events in space. Nature, understood as an element of both aesthetic and utilitarian significance, becomes the substance of composition for the fragments of the urban landscape. This happens through the introduction of elements of nature as an integral part of the building in the form of walls or roofs, and introducing them in the contact zone of the building with the environment. In this way they create technology system supporting the economy, energy and/or water management system of the building. In the big picture nature is inserted in the urban fabric as a green area associated spatially and technologically with the adjacent architecture in the form of: – utilitarian landscapes (fig.1), where the elements of nature in the area adjacent to the building



Figure 1. Utilitarian Landscapes. A. Jardin Charles Trénet, ZAC de Rungis, Paris, 2013.



Figure 2. Topography. Museumsplein, S.I. Andresson, Amsterdam, 1999.



Figure 3. Restored nature. Parco Dora, Latz + Partner, Torino, 2004 – 2012.

are an integral part of the bioclimatic system of the building, – new topography (fig.2), where the green roof surface is used for creating an extension of the city recreational areas, – restored nature (fig.3), where degraded areas are converted into urban green spaces or in the form of "garden structures", where greenery is an inseparable part of the building, or – area for circulation (fig.4,5), where additional motion paths are created by introducing an architectural form into the city fabric, also – internal enclaves (fig. 6) where transition areas are located inside the buildings, providing natural elements in the interiors.



Figure 4. Area for circulation. Cité de la Mode et du Design, Jakob & MacFarlane, Paris, 2008.



Figure 5. Circulation paths. Foundation Louis Vuitton, Gehry Partners, Paris 2014.



Figure 6. Internal enclaves. Cité du Design, LIN Architects, St. Etienne, 2009.

3.4 *Visions of the future city*

Awareness of adverse changes that results in a rapid economic boom of the last decades ushered interest in sustainable development, which gained the status of the contemporary paradigm. The answer to the problems of urbanization and metropolisation became a motive of search for a vision of the human environment. It is reflected in the form of the concept of cities of the future, often created from scratch, as means to the global improvement of the environment and the living conditions of the overcrowded areas. These projects are an attempt to answer climatic changes which are believed to be the effects of the greenhouse gas emissions. Their increased concentration in the atmosphere is credited to human activities of economic nature related to the combustion of fossil fuels, mainly coal and natural gas in particular, rising since the industrial revolution. Although the scientists' opinions on the effects of climate change are divided, it is undeniable that the growing global population, results in increasing the number of urban areas at the expense of others – used for agriculture and natural resources. This process disturbs the natural balance between the capacity of CO2 absorption, and its discharge to natural areas: the oceans and vegetation-covered parts of the land.

Scientists seek a solution to the problem of greenhouse gases in the use of alternative energy sources. An important element of this strategy is the introduction of built-up areas in the elements of nature that help maintain this balance. Looking at concepts of the cities of the future the continuous search for the solutions of the contemporary concerns is present. There designs are based on integrating natural elements into the city fabric that contributes to expansion of transition spaces as well as creating its new forms (eg. Lilypad by Vincent Callebaut Architectures or Gwanggyo by MVRDV). Visions of the future cities are presented as a form of integrated urban landscape, where architecture is unified with natural elements of the composition. (Serrats, 2011) Including them in the space of the city derives not only from the needs of aesthetic and the necessity of providing the residents with the contact with nature. Elements of nature are introduced for their reinvented utilitarian functions, among others, increasing insulation of buildings and improving the microclimate of urban space.

4 CONCLUSIONS

The appearance of the city as a dynamic environment introduces new threads to the understanding of urban space. Its physical components are the initiation stage for transformations and events. Both urban spaces and architectural objects – create a flexible environment complimented with events, traffic and media transfer layers. The transition area creates the soft edge of the city as a form of user accessible space in which elements of nature are introduced for their aesthetic as well as utilitarian properties. The buildings are shaped, as a sequence of spaces, directed by the architect. They provide the setting for the action taken by the user. Motion paths, uniting the interior of the structure with the surrounding environment are created by introducing natural elements at the level of the roof to create a new topography, either are integrated into the architectural composition. Nature can also penetrate the interior of spatial structure of the building turning it into a movement path linking interrelated spaces located on the outside and inside. The last type of relationship is to introduce natural elements to the interior of the building in the form of internal enclaves which form an extension of urban space located within the spatial structure of the building. Those tendencies observed in contemporary architecture and urban

space are also present in the future city concepts. In those designs the new forms of transition spaces occur and there is a tendency observed of softening the city edge by interfering interior space with the buildings surroundings. The city of the future therefore may be described as an organism of the multilayered, polymorphic structure.

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Between research and teaching: Green infrastructure for dense urban areas

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ABSTRACT: The debate about climate change – aside of the question whether it is caused by human or natural factors – must become central for architects. The city of Genoa (where the author's institution, the University of Genoa, is located) has seen two floods in the last five years cause serious damage as streams, mostly channelled in tunnels, crossed the urban tissue. In this context, interesting opportunities arise to work with students to redesign of urban spaces in order to integrate green infrastructure strategies and reduce runoff. This work is particularly interesting because it addresses several fields, including the future of depopulating cities, urban structures' resilience, and the relationship between buildings and open spaces, among others. This paper shows some results of teaching activities on the integration of green infrastructure in cities, considering areas affected by minor floods due to rainfall causing rainwater sewers overflow.

1 INTRODUCTION

Often, architecture is identified as the work of a "genius", a professional characterised by both technical and artistic skills, able to realise his or her vision of the world through buildings of significant interest from several points of view. This way of viewing architecture is not new, but it has in recent years become dominant in the media and among the general public. In Italy, this type of architect is known as an "archistar;" elsewhere, the term is "starchitect" (The Oxford Dictionaries report that "starchitect" has origin in 1940s denoting a film star who designed a house).

Students often view the starchitect as a model, a kind of idol, and indeed, the work of architects is very important even when it doesn't qualify as work of artistic importance. Their role can be remarkable in our society, and is wider than simply that of "shapes generators".

There have long been more than seven billion inhabitants on this planet (The United Nations estimated seven billion people at the close of 2011). Environmental imbalances caused by human activities are now revealing long-feared dangers: cities are being transformed alternatively by overpopulation or abandonment dynamics causing patterns of both transformation growth and shrinkage (as stated in the ERA-NET Cofund Smart Urban Futures ENSUF research program).

Architects must be called upon to solve the problems of our civilization, to the extent of their competence. Sometimes the solution is designing a building, sometimes times not.

The educational project of the authors' group begins from this assumption. Many students understand that their professional future will be tied to the processes of urban space transformation that are dependent on demographic and socioeconomic dynamics and by the environmental management processes of sustainable development. Taking a practical approach when speaking about "urban resilience" (as much as possible in a teaching environment) is very important, especially in relation to the authors' backgrounds and roles in university education.

Two basic elements allow the identification of educational issues closely linked to research activities in progress, the need to adapt urban spaces and infrastructures to:

- the processes of economic change that are taking place, especially in post-industrial cities like Genoa; and
- climate change that (regardless of cause) impacts this article's study areas with increasingly sudden and intense weather events that result in property damage and even human injury and death.

So-called "blue and green" technologies (i.e., water cycle management and ecosystem services related to urban greening) are certainly not new but have been little studied in Italy outside of hydraulic engineering and urban planning research (and certainly not in Italian urban design, with urban green areas rarely designed to optimise environmental performance).

Interest in environmental quality and the tools for quality improvement must be encouraged, and it is by the authors, who have noted positive feedback from some students. This issue is highly multidisciplinary, or perhaps even "trans-disciplinary", according to the meaning given by Edgar Morin (1999) that holds that an economist who is only an economist is not a good economist. This issue is also really trans-scalar. This designation speaks to what is sometimes a problem

in the Italian academic environment, where educational practices are divided in "scientific fields" with each sector assigned to a specific scale: urban scale to planners; building to designers; and details to technologists, etc. Thus this "teaching transgression" becomes one step closer to professional practice, which is notably absent from the teaching of architecture in Italy.

2 BEFORE THE THESIS

The authors' research group's interest in green performance in the urban environment dates back several years (Katia Perini PhD thesis "The integration of vegetation in architecture. Innovative methods and tools. 2009–2012"). Educational activities have intensified in recent years as the construction of the first green façade on an office building in Genoa. In October and November 2014, a green facade was built on an office building owned by the National Institute of Social Insurance – Istituto Nazionale di Previdenza Sociale – in Genoa's Sestri Ponente district, an area characterised by relatively high population density. The first results of air quality, fine particle retention, and energy performance monitoring designed by the authors and implemented in collaboration with various research organisations (RSE SpA Research on Energy System for energy monitoring, Città Metropolitana di Genova for NOx monitoring) have stimulated students' interest in green technologies, which we consider both architectural elements and a means to improve air quality.

Four of five Europeans live in urban areas where quality of life is directly influenced by the state of the urban environment. Environmental problems within cities have significant consequences on human health, citizens' quality of life, and urban economic performance (COM/2005/0718). High levels of pollution in the atmosphere and excesses of "cementification" and low-albedo asphalted areas, relative to green areas, cause the urban heat island phenomenon. Temperature difference between cities and suburban or rural areas are between 2 and 5°C (Taha, 1997). Several studies show that this phenomenon causes damage to human health, especially during summer periods when air temperatures remain high at night (Taha, 1997;Tereshchenko and Filonov, 2001). High urban temperatures have caused in Europe drastic increases in the use of cooling systems and consequently fossil fuel sources. This is a particularly important field in the creation of a more sustainable environment because buildings, in Europe, consume about 40% of the energy used (IEA-ECBCS, International Energy Agency–Energy Conservation in Buildings and Community Systems, Annual report 2012).

To reduce this phenomenon, huge quantities of solar radiations have to be intercepted before reaching buildings and roads, or dissipated, possibly through the use of green systems. A study conducted in Florence, Italy, shows the impact of green areas on air temperatures inside the city, concluding that temperature distribution is related to distance from the city centre, the mean number of buildings per square metre, and their height, and that higher air temperatures were found in the city centre. Within green areas located in the city centre (such as parks and gardens), lower temperatures were recorded as compared to the street (a difference of 1.5 to 2°C, Petralli et al, 2006). This happens because greened surfaces have high concentration of water and different albedo values than artificial hard surfaces (Taha, 1997). Within urban areas, the impact of evapotranspiration and plant shading can significantly reduce the amount of heat that would be reradiated by façades and other hard surfaces (Scudo and Ochoa De LaTorre, 2003; Shashua-BarandHoffman, 2000).

The effects of vegetation on microclimate and comfort can be evaluated using environmental modelling conceived to understand many of the current environmental problems; it allows researchers to quantify the effects of zone changes (land coverage) on meteorological parameters and on quality of life consequences through microclimate models such as ENVI-met (Nardino and Georgiadis, 2011).

Students encounter green areas design, or green infrastructures, in a studio conducted by the authors with other teachers and professionals during the final year of their architecture Master's program as an alternative to courses focussing on issues of restoration or architectural composition.

The course is a studio of technological design for architecture called "Project Technology Environment" and dealing with themes of varied complexity where the design of green areas is complementary to the design of new buildings and/or renovation of existing buildings. These students mainly focus on environmental performance (quantitative evaluation of thermal comfort), and material choice, and use ENVI-met software to evaluate cities' effect on their microclimates (figure 1, figure 2). In fact, the results of a research conducted by Yang, et al. (2013), show that the ENVI-met model is capable of reasonably modelling the diurnal thermal behaviour of different ground surfaces and their effects on local air temperature and humidity. ENVI-met is a three-dimensional microclimate model designed to simulate the surface–plant–air interactions in urban environment with a typical resolution of 0.5 to 10 meters in space and 10 seconds in time. ENVI-met can be used to evaluate the effects of vegetation on outdoor comfort and urban heat island mitigation (Bruse and Fleer, 1998). Krüger, et al. (2011), observe and estimate the relationships between urban morphology and changes to microclimate and air quality within a city centre. Ali-Toudert and Mayer (2007) analyse the relation between outdoor thermal comfort and the design of an urban street by using ENVI-met, finding that vertical profiles and different orientations of street have a moderate impact on the air temperature and a strong effect on the heat gained by a human body; that is, the larger the opening of the canyon, the higher the heat stress.



Figure 1. Urban area students design.

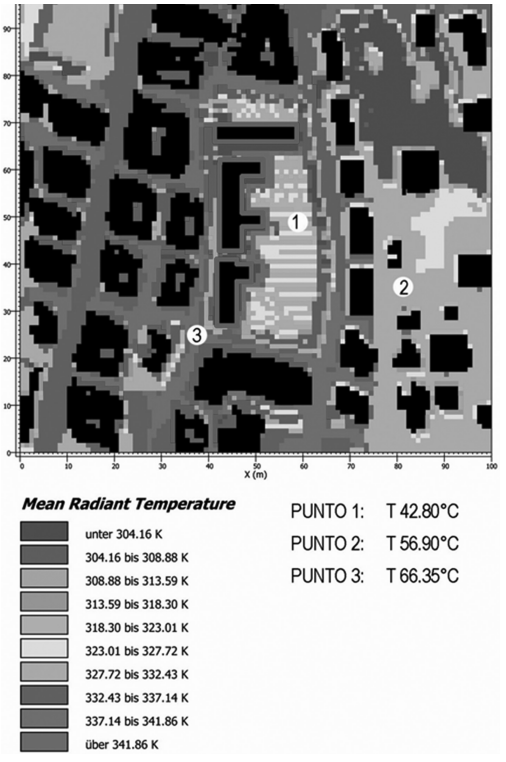


Figure 2. ENVI-met analysis of the above urban area (mean radiant temperature).

Students design green areas on the basis of aesthetic, or at least functional, criteria, but the functions considered are limited to the integration of artificial elements (paths, parking areas, etc.). They usually simply study vegetation's capacity to shadow, but in some cases use, for example, solar cards to correctly draw that capacity. The ENVI-met software allows a quantitative assessment and is useful, beyond the results, because it allows students to understand how physical phenomena can change the usability of an area and interact with the environmental performance of the buildings. Through the use of ENVI-met, students consider soil permeability and the evapotranspiration phenomenon of vegetation, essential elements of the water cycle in urban environment.

3 A NEW TOPIC FOR GRADUATE STUDENTS

The city of Genoa has seen two floods in the last five years cause serious damage as streams, mostly channelled in tunnels under the streets and buildings, crossed the urban tissue. Additionally, many areas are subject to frequent, minor floods due to the overflow from municipal sewer during heavy rainfall. While the municipality is planning structural interventions designed to prevent the flooding of urban streams, designers and citizens' associations are seeking solutions to prevent floods caused by atmospheric events. Interactions between urban tissue, services nets (energy, data, sewer, etc.) and weather (storms, rainfall, etc.) have to be analysed. At a first glance, this seems strictly an engineering issue, but due to its many consequences on the use of urban space, architects must also confront flooding and atmospheric events.

Soil sealing is one of the most pressing problems in urban management, and it is part of the threats identified by the European Commission in 2002. (COM 2002/179). Michal Kravčík argues that the key to global water problems (particularly pollution and scarcity) is to retain more rainwater in the ground to balance the water cycle. (Michal Kravčík is a Slovak hydrologist and environmentalist who won the 1999 Goldman Environmental Prize for his contribution to the environmental management of water in the Torysa River basin, running through the eastern Slovakia towns of Lipany, Sabinov, Vel'ký Šariš, and Presov.)

These educational activities are to verify the applicability of the technology integration of vegetation in the urban space to improve environmental quality and runoff control during intense rainstorms. In many cities, such as Genoa, high building density reduces the availability of open spaces useful for these green infrastructures. It is a difficult subject to address within

architectural instruction but it is a worthy research subject and an essential discipline for students.

Students, and especially graduate students, have learned and contributed much from participating, even at the analytical level, in this active research:

- analysis of the state of the art (including translations into Italian where there is no such field), and synthesis of book excerpts for instance: SUDS TEAM, (2011); Australian Government (2009). The only regions that have, so far, adopted guidelines to use green infrastructure to reduce the risks of soil sealing are Emilia-Romagna, Tuscany, Veneto, and Lombardy, and the autonomous province of Bolzano-South Tyrol. Some municipalities will also integrate their building code with guidelines for urban development (according to the principle of hydraulic invariance) for the creation of green infrastructure to control the runoff and to improve water quality before being discharged into the sewage system. Although many environmental engineers are researching performance in the Mediterranean climate (characterised by alternating regimes of drought and heavy rain), the knowledge of these systems in the design field is not very thorough and there remain risks that information and practices related to other weather systems' rainfall and plant species adaptability will spread;
- analysis of urban sites frequently affected by floods caused by sudden storm events (termed "water bombs" by the media) and the consequent damages to ground floor assets, either by water penetration from flooded roads or the infiltration of rising water from underground streams;
- analysis of the constraints due to the presence of underground utilities (water, sewer, electric, and data networks). Within dense urban areas, the space available for the installation of green areas suitable for filtering rainwater and slowing down time of concentration (from the ground to waste disposal system) is limited not only by the small size of open spaces but also by the presence of network services underground, which are very difficult to change;
- analysis of climate data, particularly related to rainfall, to provide a greater awareness of climate changes taking place and identify the scope of rainwater to be disposed of and the ability, on the part of green infrastructure, to contribute to this reduction in runoff.

These analyses oblige students to consult public authorities and professional employees with very different characteristics. Students, essentially, are accustomed to interact with teaching staffs comprising almost exclusively architects, albeit with different specialisations. Non-architects working in this area are generally engineers, usually specialising in structures design or technical physics. Students thus must learn to interact well with professionals such as hydraulic engineers, meteorologists, and botanists, among others. The tools and methodologies they are therefore using come from disciplines as divergent as sociology, hydraulic engineering, urban planning, or architectural technology.



Figure 3. Greening the city: an hypothesis of green covering of Genoa Sestri neighborhood.



Figure 4. Water square design for Piazza Martinez, Genoa.

Subsequent phases are focused on the design and construction of green areas engineered to filter and slow rainwater in order to reduce the load on sewer systems during heavy rains. These urban areas are thus equipped with green infrastructures that improve environmental quality.

There are graduation works, some complete and others in progress, that authors consider useful not only for students' cultural growth but even to improve

the awareness of professionals and public managers – through public presentation and papers for journals and local conference – of the possibility for rehabilitation the urban environment by implementing green infrastructures.

Giulia Pasqualini (2011–2012) analysed the forecasts for the Vado Ligure municipality in northwestern Italy for the area near Segno river, assuming a design solution enabling optimal use by transforming a former industrial areas within the residential fabric into an urban park – also through the use of ENVI-met software and with the collaboration of the meteorologist Dr. Marianna Nardino of the CNR of Bologna (Consiglio Nazionale delle Ricerche, the Italian national research office). This design hypothesis was shared with the municipal planning office as a possible urban area implementation scenario for the city.

Anna Ragosa and Carolina Queirolo (2014–2015) studied the neighbourhood of Genoa Sestri, an area near the aforementioned green façade, assuming a gradual greening over several years according to a plan adopting urban green solutions and green roofs solutions to change the water retention system and the release time and volume of rainwater bound for the sewer system, as well as improving the general environmental quality, especially of the air (figure 3).

Maria Mazzarello and Monica Raimondo (2015) investigated the state of the art of green infrastructures and identified possible constraints encountered in cities with very dense tissue, such as Genoa, where small sized roads and extensive underground utilities pose significant limits to the creation of green areas. Their project proposal for the area of the former Corso Sardegna market was subsequently shown to the Quarter President.

Ilaria Beghello (2016) is studying a long section of Corso Sardegna street, that is often affected by flooding during storms.

Giada Longo, Sara Moretti, Lidia Nario, and Irene Platania (2016) are studying a large area in the San Fruttuoso neighbourhood characterised by flooding during rainstorms; the area includes a square to be renovated and a former railway area to be allocated to other activities. In both theses in progress, in addition to verifying feasibility conditions for the introduction of green systems (e.g., rain gardens), students are carrying out quantitative analyses with the help of Professor Ilaria Gnecco, who is a hydraulic engineer (figure 4).

4 CONCLUSIONS

Completed and in-progress teaching activities aim to apply blue and green infrastructure (and verify their effectiveness) in a city with a Mediterranean climate and high building density. Sudden and intense weather events – occurring at higher frequency than in the past – cause flooding in some quarters, hurting the local economy. Furthermore, this type of city is subject to pollution due to intense traffic, especially on roads with the low width to height building ratios (known as urban canyons) that consequently accumulate air pollutants (gas and fine particles). Green infrastructures, the blue and green technologies, can simultaneously limit the effects of these events. The urban space quality depends not only on the architectural quality of its buildings but also on its environmental quality. The, the goal is to sensitise architecture students to climate change and socioeconomic changes of our city.

The students were able to understand how the project activity depends not only on the will and creativity of the architect but it is also strongly bound to context. The eminently multidisciplinary activities of the project are also multiscalar and cross-disciplinary, needing not only specialists capable of making quantitative assessments but also able to share knowledge and tools to better understand the project objectives and contribute to the best result. Another goal is to get the students in contact with municipal administrators, on a field of discussion on issues of common interest, showing urban regeneration solutions alternatives to those hitherto used. The teaching experience, thus, becomes an important moment of synthesis and a simulation of the type of collective design process necessary to address the complexity of today's problems.

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A passive-first artificial sky: An educational tool

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ABSTRACT: Architectural design that meets the goals of Architecture2030 or results in zero net-energy performance is most elegantly achieved when employing effective passive strategies before adding high-technology components. With this idea in mind, a research question was posed to a graduate seminar in natural lighting, "Can an artificial sky for testing daylighting models be designed that uses only daylight, rather than electric lamps, as its light source?" The threefold motivation for the question was: (1) matching—use a passive device to test a passive system (daylighting), (2) quality—use high-quality daylight to test daylighting systems, and (3) energy—use a low-energy system for model testing. Currently, all artificial skies use an array of fluorescent lamps to simulate sky conditions. These skies are solely mechanical systems, have color rendering capabilities far inferior to daylight, and consume thousands of kilowatt-hours of electricity. Developing our artificial sky has proven to be a six-year educational experience.

1 INTRODUCTION

1.1 *Project context*

This project has been accomplished in the context of a professional program in architecture by a faculty member and over 30 Master of Architecture student researchers. Since these students are not research-focused, they had to be integrated into the project strategically to compensate for their short (2 year max) tenure. This strategy was to involve students in the project through an elective seminar in natural lighting and to further their involvement via directed studies in non-thesis research. Furthermore, students were encouraged to contribute to the writing and presentation of technical papers about their research.

1.2 *Project history*

Teams of students have worked on this project over the last six years, accomplishing a series of explorations rich in learning experiences. First, teams presented with the theoretical basis for artificial skies (Haglund, 2011) in a graduate lighting seminar, were challenged to design and test a working scale model of an artificial sky that could simulate a standard overcast sky under any exterior daylight condition. They created successful models of two basic types—mirror-box and conical. Their research results helped to obtain university seed grant funding to design and build a full-scale prototype and to receive a donated high-efficiency tubular skylight. Second, the students chose to build the conical prototype because its geometry is unlike that of any artificial sky in existence and its light distribution more uniformly diminishing from zenith to horizon than the mirror-box. Architecture faculty supported the project by designating a space for the artificial sky proximate to the fourth-year and graduate studios—easily accessible for testing design studio projects' daylighting schemes. Third, students were asked to develop protocols for verifying the distribution pattern of light within the artificial sky. They developed a calibration technique to correct for the vignetting of our 180^o fish-eye lens as well as a testing methodology for recording the light distribution for various light levels and sky conditions. During the design and testing phase, students were encouraged to participate in writing about and disseminating their findings. Consequently two students presented a poster at PLEA 2012 in Lima, Peru, (Haglund, 2012) and two others presented a paper at ARCC/EAAE 2014 in Honolulu (Haglund, 2014). Fourth, while using the artificial sky to model a skylighted space, students discovered a slight flaw in the sky's performance—the brightness of the skylight diffuser that illuminates the artificial sky caused a significant difference in light distribution for a skylighted model when compared to the same model tested under the natural perfectly overcast sky. Consequently, a student researcher designed, constructed, and installed a rough prototype diffuser. He tested it for effective diffusion and illumination of the artificial sky's surfaces.

Students are now challenged to design and test a permanent diffuser that would reduce the brightness at the peak and maintain the prescribed distribution from zenith to horizon. They are also tasked with increasing the brightness of the sky by capturing the light that escapes via the gap between the top of the sky and the bottom of the skylight.

Table 1. Artificial Sky Model Assignments

Surfaces	Rectilinear	Cylindrical
Matte White	Model A	Model C
Mirrors	Model B	Model D

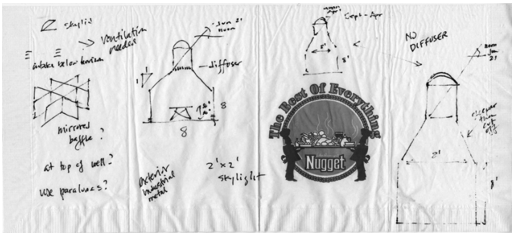


Figure 1. Daylighted Artificial Sky napkin sketch design circa 2009.

The project is focused on learning associated with the design, fabrication, and testing the artificial sky; on the change in mindset—valuing the efficient and elegant use of resources—required for a sustainable future; on problem solving; and on writing and presenting research papers.

2 EPISODE ONE

2.1 *Designing scale models to test sky design ideas*

In fall term 2011 the graduate seminar in natural lighting was introduced to the philosophic and scientific basis for a daylighted artificial sky (Haglund, 2011 & Tergenzer, 2011). They were also given four different scale models (Table 1) of proposed artificial skies built to the specs of a napkin-sketch design proposal (Figure 1) conceived at the Centre for Alternative Technology in 2009.

Philosophically, three points were stressed (1) matching—use a passive device to test a passive system (daylighting), (2) quality—use high-quality daylight to test daylighting systems, and (3) energy—use a low-energy system for model testing. Currently, all artificial skies use an array of fluorescent lamps to simulate sky conditions. These skies are solely mechanical systems, have color rendering capabilities far inferior to daylight, and consume thousands of kilowatt-hours of electricity—existing artificial skies are sized from 12.8 kw at Cardiff University to 1.3 kw at the University of Idaho IDL in Boise, ID.

Scientifically, the daylighted artificial sky would need to deliver the CIE standard luminance for an overcast sky—three times brighter at the zenith than at the horizon. The level of illumination could vary (as it does in the natural sky) as long as the distribution of light was consistent under any outdoor sky condition.

Four teams of five students each were assigned to one of the four proposed prototypes. It was immediately clear to the students that none of the prototypes were adequate to the task. Undaunted, the students developed their own proposals testing them with digital and physical models—the latter proved more useful. Each team had to work collaboratively to develop scale models of artificial skies that met the performance criteria. Their solutions were of two types, mirror-box skies with a diffusing skylight-fed luminous ceiling similar to electrically lighted mirror boxes, and conical skies with matte white walls. The mirror-boxes tested to be virtually identical to the electrically lighted mirror-boxes, which are a somewhat crude approximation of an overcast sky. We choose to build a full-scale prototype of the conical artificial sky because it differed from the norm and provided a more even distribution of light. The outcomes from this seminar were used to secure an internal seed grant of US$12k to construct the prototype artificial sky.

2.2 *Lessons learned*

This episode highlighted inquiry through design. Students applied their problem solving and design thinking skills to translate theory to working models of the proposed artificial sky. They also greatly increased their knowledge of natural lighting design through the conduct of research related to a practical design challenge.

3 EPISODE TWO

3.1 *Demountable prototype sky construction*

This episode took three semesters to complete. During the first semester a handful of students from the fall seminar opted to design and build the full-scale prototype. First we gained support from the architecture faculty to locate the artificial sky in the upper level of the architecture studio building, which has a cathedral ceiling of sufficient height for a 4.88-meter (16-foot) tall conical structure, and is adjacent to the senior and graduate studios.

In the spirit of sustainability we wanted the artificial sky to be demountable and crafted from local materials—in our case timber. The students designed a ten-sided structure that approximates a cone on a cylindrical base, composed of 30 modular panels that can be bolted together (and unbolted). They used *SketchUp* (Figure 2) to create the construction drawings and to calculate the compound angles required to fit the modules together. The students' work also was used to secure the donation of an industrial 53.34 cm (21 in) diameter tubular skylight to the project. University permission was sought to allow the skylight to be installed in the historic architecture building, and was amazingly granted.

Luckily the students were able to continue the project into the next academic year. During fall semester the materials were purchased and outside contractors were hired to install the skylight, which they finally accomplished as the term ended. Because we were quite uncertain about the exact placement



Figure 2. Sketch-Up model of the proposed daylighted artificial sky in the studio context.



Figure 3. Three phase construction sequence.

and height of the installed skylight until it was actually installed, we held off construction until spring semester. It took the entire semester to fabricate the panels, bolt them together in three stages from base to apex (Figure 3), and paint the interior matte white in the cone and 50% gray in the base (below the artificial sky's horizon).

3.2 *Lessons learned*

This episode presented lessons in hands-on design/build of a small architectural project including obtaining permissions and dealing with subcontractors. The amount of time needed to accomplish this phase was a revelation to the students. They also gained skill and confidence in translating construction documents for the artificial sky into a materials list, modular components, and the fabricated structure. The students were also inspired to write a technical paper and present it as a poster at PLEA 2012 in Lima, Peru (Haglund, 2012).



Figure 4. Image from our fish-eye lens before and after correction for vignetting. It's a subtle difference seen at the images' edges.

This trip also afforded them the opportunity to venture beyond Lima to Cuzco and Manchu Picchu, certainly on the bucket list for all architecture students.

4 EPISODE THREE

4.1 *Creating techniques for vignette correction and data collection*

We wanted to use our 180° fish-eye lens and digital SLR camera as a pixel by pixel luminance meter to verify the luminance distribution in the artificial sky (Inanici, 2004 & 2006). In gray-scale RAW file format each pixel of the image is given a brightness value on a linear scale from 0 to 255. However, fish-eye lenses have the tendency to undervalue luminance near the edge of the lens. This tendency is called vignetting and can be corrected for each specific lens and aperture/exposure setting. During the next fall term one of the students took on the task of correcting for the vignetting. In the end, a correcting mask was created that can be combined with fish-eye images in *Photoshop* to produce composite images with accurate luminance values. When this technique was used to analyze the luminance distribution of the artificial sky, it proved to conform well to the CIE standard. The mask is useful with all images taken by our camera (in manual mode, aperture set at F4 with a 1/6 second exposure) with the fish-eye lens attached—very valuable in obtaining accurate visualizations of daylighting scenarios (Figure 4).

Another student took on the task of setting up the data acquisition system that could calculate and give daylight factors for four points in a model being tested under the artificial or natural sky. This task seemed to be simple, but the coordination of the sensors' output with the data acquisition system was not easy. The sensors and the data acquisition system have different manufacturers, so technical representatives from the two companies gave incomplete/conflicting information and the process took the entire semester to accomplish.

4.2 *Lessons learned*

Tasks performed in this episode represented excellent applied research. Problem solving skills for specific

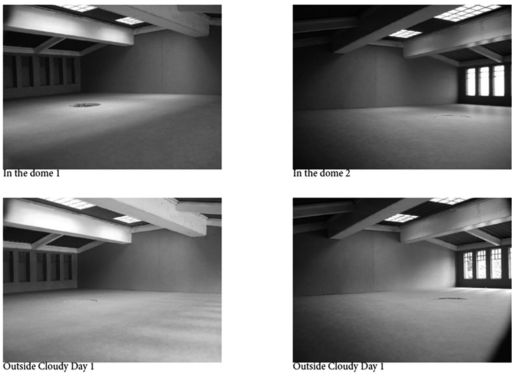


Figure 5. Images of daylighting model taken in the artifi cial sky (above) and outdoors under a perfectly cloudy natural sky (below). In the artifi cial sky, light from the skylight is brighter than that seen under the natural cloudy sky.

situations were invoked and used to find useful solutions. The students had the opportunity to write a technical paper on their work and present it at ARCC/EAAE 2014 in Honolulu (Haglund, 2014). Subsequent to data acquisition system investigation, the sensor manufacturer introduced a new data acquisition device that proved to be easy to use with the sensors and thus, user-friendly for architecture students. We've purchased the new system, well-informed that it is an improvement over the older technology.

5 EPISODE FOUR

5.1 *Diffuser prototyping and luminance distribution plotting*

During fall semester 2014 the graduate seminar in natural lighting was assigned to analyze and model a space that was both top- and side-lighted. They were encouraged to test their physical model with both the artificial sky and a naturally occurring completely overcast sky (similar to the CIE standard).

When they made their end-of-term presentations it became obvious that the light distribution in the models tested under the artificial sky differed from those tested under the natural overcast sky (Figure 5). The difference was caused by the brightness of the skylight's diffuser, acting as a spot source in the otherwise diffuse artificial sky—like a weak sun. So skylights under the artificial sky gave relatively more illumination than those under the natural sky.

Consequently, our next task was to create a diffuser for the top of the skylight to harvest the light and distribute it more evenly. So during spring semester a student continued on the project to create a roughly constructed prototype diffuser and to test its effects on light distribution in the sky. The prototype was constructed and installed. Testing with the fish-eye lens and digital camera proved it to be effective, reducing

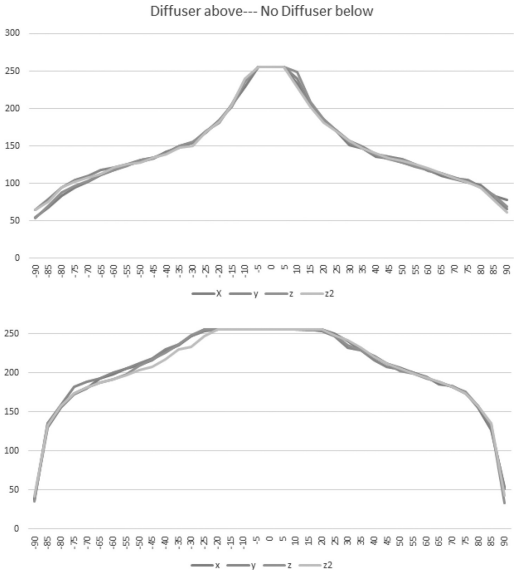


Figure 6. Luminance plots on four diameters of the walls of the artificial sky before (bottom) and after (top) installing the prototype diffuser.

the breadth of zenith brightness and in more evenly lighting the walls (Figure 6). Both before and after plots confirm that light is uniformly distributed on each of the four axises tested—the plots are virtually identical for all axises.

5.2 *Lessons learned*

Comparing model findings from the artificial sky and the natural sky side-by-side showed lighting characteristics that were not obvious in the parametric testing of the luminance of the artificial sky. This field testing is a valuable step in ascertaining the performance of the artificial sky. Even though the parametric testing of the prototype diffuser were promising, another round of field testing of physical models under the artificial sky and the natural sky is needed.

6 EPISODE FIVE

Our experience with the artificial sky has led to two further efforts to improve its performance—to design, fabricate, install and test a diffuser to permanently solve the over-bright zenith problem and to design a device to prevent loss of daylight at the gap between the bottom of the skylight and the top of the artificial sky structure while still allowing stack ventilation. The permanent diffuser requires testing to confirm its performance and the device (a shroud) to prevent daylight loss requires testing to confirm adequate stack ventilation and continued appropriate light diffusion.

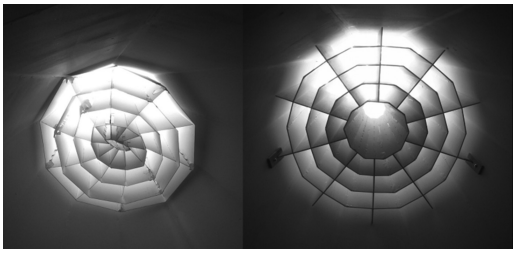


Figure 7. The draft prototype diffuser (left) vs. the initial version of the improved diffuser as described above.



Figure 8. Apex of the artifiicial sky without and with the shroud, which reduces light loss yet allows stack ventilation to occur.

6.1 *Diffuser testing*

The spring 2016 research class was charged to improve the lighting conditions in the artificial sky by designing, fabricating, installing, and testing a permanent diffuser.

Initial findings showed that the naturally daylighted artificial sky was successful at providing the desired lighting distribution without the need for introducing electrical lighting, even on overcast days; however, it became apparent that the tubular skylight created effects more closely related to directly overhead sun than to a completely overcast sky. Our prototype diffuser did provide relief from the direct sun effects: however, it limited the quality and intensity of overall natural light in the artificial sky which darkened the sky, making it difficult to use the sky effectively during all daylight hours of winter overcast days.

An improved light diffuser was needed to increase the amount of light penetration into the artificial sky while still offering the diffusing effects needed to simulate completely overcast sky conditions. Since the prototype diffuser reduced the amount of overall light into the artificial sky, the second-generation diffuser was designed just to be half as tall, allowing for it to absorb less light. The new diffuser has the same number of sides (10) and conical shape as the artificial sky and attaches directly inside the top of the cone (Figure 7). The diffuser's 5 fins are evenly spaced and radiate outward at the same angle as the edge of the sky's cone. The fins are designed to diffuse light from the tubular skylight toward the walls of the artificial sky, eliminating the appearance of a direct light source. The diffuser was painted white to match the inside of the sky's cone matte white surfaces so it would not absorb too much light.

6.2 *Daylight maximization*

Since a naturally lighted artificial sky depends solely on the amount of light brought in from the outside via the tubular skylight, it's critical to bounce all of the possible light entering the skylight down into the artificial sky in order to maximize the time frame for natural lighting model testing. We found that during cloudy winter days at our far northern latitude the time frame for adequate illumination for model testing was reduced to a few hours around midday—and that we were losing significant light through the gap at the top of the sky cone. A highly reflective shroud was designed to capture light escaping through the 20.32 cm (8 inch) gap between the skylight and artificial sky structure to maximize daylighting in the artificial sky (Figure 8).

We designed and installed the shroud during the spring semester of 2016. The shroud was placed on top of the sky structure and exterior to the skylight. The material used is aluminum flashing 25.4 cm (10 in) tall and 203.2 cm (80 in) long. Aluminum flashing was easily molded into a cylindrical shape with a highly reflective interior wrapped around both the skylight and artificial sky. The flashing wrap around the skylight was cinched tight to attach it to the skylight. Because the artificial sky creates the stack effect, it is important for the top of the artificial sky to exhaust heat. To combat heat being trapped in the artificial sky, seven 32.77 cm^3 (2 in^3) cubes of open cell foam were screwed into place at the top of the shroud as spacers to protect the skylight from damage and to allow exhaust heat to escape the artificial sky. The cubes are spaced at 25.4 cm (10 in) intervals. The air gap between the skylight and the shroud minus the area of the foam leaves a gap of 893.55 cm^2 (138.5 in^2) for air to escape. We are testing the artificial sky for heat stratification to ascertain that the stack ventilation scheme is still effective. Our test will compare stratification characteristics of the artificial sky in four stages of modification—with the temporary diffuser, with no diffuser or shroud, with the shroud, and with both shroud and new diffuser.

6.3 *Epilogue*

This semester's research assistants will continue to test the artificial sky performance under a wide variety of natural sky conditions during the spring term. Moreover, they will advise students in a upper division studio who will be using the artificial sky for field testing toplighting precedents. These testing activities may uncover further issues to study. The researchers will report the results from this semester's efforts when they present this paper at the 2016 ARCC/EAAE research conference in Lisbon.

7 CONCLUSION

At the onset this project seemed to be fairly straightforward and easily accomplished in a short time-frame. As can been gleaned from the foregoing text, it proved to be more complex and time consuming than envisioned. The pursuit of the naturally lighted artificial sky has proven to be a rich learning experience and a journey of discovery for all involved, for both faculty and student researchers. During the process we encountered unforeseen problems, difficulties, and opportunities. Our view of the practice of daylight modeling was tested and expanded.

The true value of doing research is not in the results, but in the discoveries along the way—and those that will follow. Students involved in this project have come to value not only daylighting design, but the research skills inherent in architectural design and the writing skills needed to present their work. These values will translate to their future architectural practice. The completed artificial sky will also serve as a facility for future students to hone their model building and daylighting design skills.

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A solar Decathlon House intentionally designed to increase teaching opportunities

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ABSTRACT: Clemson University participated in the U.S. Solar Decathlon competition in Irvine, California, in October 2015. The Solar Decathlon is a student competition that aims at educating the next generation of architects and engineers in the fields of solar technologies, housing design, and construction. This competition provides opportunities to push innovation through collaboration between students from various disciplines, faculty, and industrial partners. Architectural education encompasses two equally important aspects: (1) the study of existing knowledge in building design and construction, and (2) the investigation of innovative ideas and concepts. The solar decathlon competition is an ideal venue for experiencing both. However, the successful implementation of the latter (i.e., innovation) is not as trivial. This paper discusses the teaching and educational intentions set forth by the faculty from the beginning of the project to achieve the desired educational experience and how these intentions significantly influenced Clemson University's Solar Decathlon house design.

1 INTRODUCTION

The Solar Decathlon competition is an award-winning program that challenges twenty selected collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy efficient, and attractive. Open to the public free of charge, the ten-day competition gives visitors the opportunity to tour solar-powered houses, gather ideas to use in their own homes, and learn how energy-saving features can help them save money today.

The Solar Decathlon is also a student competition that aims at educating the next generation of architects and engineers in the fields of solar technologies, housing design, construction, and high performance buildings. This competition provides opportunities to push innovation through collaboration between students from various disciplines, faculty, and industrial partners.

It is recognized that architectural education encompasses two equally important aspects (Rothkopf 2010, Berlinguer 2012, Hunt 2015): (1) the study of existing knowledge in building design and construction, and (2) the investigation of innovative ideas and concepts. The solar decathlon competition is an ideal venue for experiencing both. However, the successful implementation of the latter (i.e., innovation) is not as trivial. This paper discusses the teaching and educational intentions set forth by the faculty from the beginning of the project to achieve the desired educational experience and how these intentions significantly influenced Clemson University's Solar Decathlon house design. The rationale for these intentions was to circumvent the inherent risk of innovation in educational settings. Innovation driven by students is risky and therefore needs time for development. A new idea must be materialized and go through multiple iterations of redesign, prototyping and testing. The time needed to go through this process takes months and sometimes years. As a result, the design of the Clemson's Solar Decathlon house had to accommodate these constraints if innovation was to be incorporated. Timing and design flexibility were the key aspects that led to the development of an innovative floor plan, materials, building techniques, and systems.

Many collegiate teams who participated in previous solar decathlon competitions have been able to incorporate significant innovations (Zaretsky 2009) such as new materials for exterior cladding, a semi-automated shading control strategy based on the climate forecast, and blinds passively actuated by a shape memory alloy spring mechanism. Even though it is difficult to estimate the impact of these innovations on competition scores, these teams have been able to integrate them in their respective designs in a timely manner and present them in meaningful ways during the competition, which should not be underestimated.

This paper includes seven sections. In section 2, the schedule of the competition is described. The Clemson University project and its objectives are discussed in section 3. The benefits of innovation, how innovation impacted the design of the house, and how the risk of innovation was reduced are presented in sections 4, 5, and 6, respectively. Finally, section 7 concludes the paper.

2 THE SOLAR DECATHLON COMPETITION SCHEDULE

The solar decathlon competition takes place every two years. The participation is a competitive process based on a proposal submitted to the U.S. Department of Energy organizers two years before the competition. The selected teams design and build a solar-powered house between 600 and 1000 square feet to compete in ten categories: architecture, market appeal, engineering, communications, affordability, comfort zone (i.e., maintain temperature and relative humidity within a specified range), appliances (i.e., operate appliances for specific tasks), home-life (i.e., operate the house for specific tasks), commuting (i.e., recharge and drive an electric car under specific constraints), and energy balance (i.e., generate more electricity than consumed).

Once selected as one of the twenty participating teams, students have 18 months to design, prototype, test and construct the competitive house. The teams that participate multiple consecutive times have the advantage of recycling their acquired knowledge over the years and develop innovative ideas over multiple years, which is a beneficial strategy. Clemson University (referred to as Team Clemson), like many other teams, intended to participate only once and therefore limited the bulk of its effort to the two-year period prior to the competition.

The competition takes place over a three-week period with a nine-day assembly of the house on the competition site, a ten-day competition, and a five-day disassembly of the house and clean-up.

3 TEAM CLEMSON'S SOLAR DECATHLON PROJECT

3.1 *Educational opportunities*

Clemson University assembled a committed team of students, faculty and professionals to design and build a solar powered house. The reasons for participating in the Solar Decathlon were primarily educational. During the two-year period, Clemson University's undergraduate and graduate educational programs integrated this project into the curriculum with the participation of about 80 architecture students in five dedicated studios and 30 students from other disciplines. Students were involved as decision makers in all aspects of the project, including building the house under faculty and professional supervision, fund raising, communication, and media relations. The educational opportunities provided by the project included, in order of importance and educational impact:

- *Real-life experience*. It is recognized that the quest for knowledge and productivity of the students increases tremendously when their design is actually built and utilized. In this project, it generally pushed the students to reach a higher level of professionalism and maturity that allowed them to deliver a finished product on time, ready to compete against other highly professional and motivated teams.
- *Collaboration with industry*. Most materials, components and systems used to build the house were either donated by or purchased from manufacturers and distributers from the building industry based on a rigorous selective process that required the students to be sufficiently familiar with each product through research. In addition, the students had to collaborate closely with representatives and engineers of each company in order to innovate and integrate new ideas.
- *Multidisciplinary collaboration*. As part of their training, architectural students must deal with a plethora of disciplines including engineering (mechanical, electrical, civil, etc.), communication, marketing, psychology, and sociology, which are all part of this competition.
- *Research activities*. As mentioned earlier, research and innovation is an important driver of a well-rounded and strong education. This project provided many research opportunities for all students involved. This topic is extensively discussed in the subsequent sections of this paper.
- *Exciting student experience*. This type of project can sometimes be stressful and may lack excitement and enthusiasm at the point of becoming a negative experience. Many factors can lead to a negative outcome, such as inappropriate management and scheduling, lack of organization, unrealistic expectations, and sometimes the unavoidable ramping damages from the bad attitude of one or more team members. However, when these factors are properly mitigated, this competition can positively drive the students and provide an extremely rewarding learning experience.
- *National and international exposure*. In order to be competitive, the students must study the previous competitions. A delegation from Team Clemson travelled to California to visit the 2013 Solar Decathlon and to France to visit the 2014 European Solar Decathlon where teams from all over the world exhibited their projects. These visits provided many opportunities for cross-cultural exchange of design ideas and construction practices.
- *Community outreach and involvement.* Clemson University's participation in this international competition triggered the interest of many residents of South Carolina and the surrounding states. It provided the intellectual capital and contributed to the training of the work force for a green economy. It also educated consumers on the potential of solar energy within residential markets, especially in South Carolina where the solar industry currently sees its highest rate of development.
- *Faculty education and training*. Even though all of the above outcomes primarily targeted the students, all faculty members who participated in this project highly benefited from this experience. A tremendous amount of knowledge related to

residential building design and construction, solar technology, and project management was acquired by the faculty. This knowledge will most likely be diffused and incorporated in subsequent courses and studio projects and will ultimately benefits many additional students.

3.2 *Core mission adopted by team Clemson*

The core mission of team Clemson's project was defined as follows:

> *"To design, build, and promote a prototypical, three-bedroom, 1000-sqft, low environmental impact, net-zero, solar house that is cost-effective in today's market and comfortable in South Carolina's hot and humid climate."*

The key objective was to develop an integrated design of the solar house based on the constraints of architecture, mechanical-plumbing-electrical (MPE), construction, transportation, user acceptance and usability while considering affordability constraints.

3.3 *Architectural concept*

The house was designed and built to respond to three significant characteristics of the state of South Carolina: its subtropical climate, its indigenous wood industry, and its domestic patterns. As can be seen in the traditional houses of the southeast region of the United States, the subtropical climate allows for the extension of the enclosed living space to a semi-open breathing space in dialogue with its surrounding context. Following this proven passive design strategy, the goal was to provide comfort while lowering energy consumption. Also, lowering the energy embedded in the construction process and in the materials themselves was a critical step in providing sustainable housing prototypes. The selection of wood as the basic material represented a significant reduction in embodied energy. In addition to it being a renewable natural resource, wood has the lowest embodied energy of any structural material (Wujek & Dagostino 2010). Additionally, the use of wood in South Carolina where it is indigenous and sustainably harvested, not only reduces the energy consumption in logistics but also supports the growing sustainable forest industry in the state. The third local characteristic responds to contemporary domestic patterns as evident in the program of the solar house. Different from the majority of the prototypes in preceding Solar Decathlon competitions, which mostly had a single bedroom and sometimes two at the most, the house includes three bedrooms. The idea of a three-bedroom house was based on South Carolina's housing demographics, which show that the majority of the houses in the state (39.8%) include three bedrooms and the average of persons per household is 2.52. In these circumstances, increasing the number of bedrooms enlarges the range of users and puts forward a more realistic and marketable housing option. Finally, the housing prototype was designed to be flexible enough to adapt to different user profiles and sites.

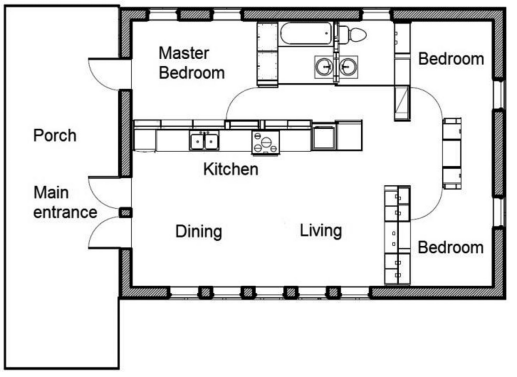


Figure 1. Floor plan of Indigo Pine, 936 square feet.

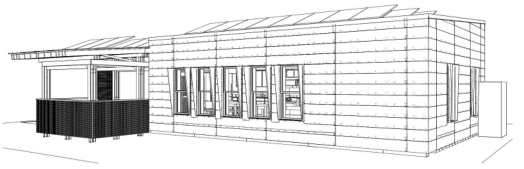


Figure 2. Exterior perspective.

The conceptual story grew from the history and culture of South Carolina. The name of this house, *Indigo Pine*, comes from two important South Carolina crops. The indigo plant was cultivated during the last two hundred years and produced as a dye with great success, thanks to the rich blue color it produces. Like indigo, the pine has also played an important role in South Carolina's development. Pine is a versatile, fast-growing timber used for innumerable functions. The Clemson Solar Decathlon Team is using these crops as representations of its values.

In order to create a home fit for South Carolina, as well as meeting all the competition criteria, team Clemson identified all of the aspects of a traditional Southern home which needed to be preserved to maintain the integrity of a Southern vernacular. The architectural design team attempted to integrate all aspects of a southern home in a contemporary way.

3.4 *Architectural implementation*

Since one of the main goals of this project was to design an affordable home in today's market, the approach used to select and design the engineering systems was based on an incremental improvement of systems currently used and accepted in today's market. The climate of South Carolina is hot and humid with mild winters. Most regions of the state require both heating and cooling, which means that the main goal of the design was to minimize solar heat gain during the summer and maximize heat gain during the winter. These conflicting requirements made the engineering design particularly challenging. Team Clemson

addressed this challenge by quantifying the energy performance of the home as accurately as possible; allowing a precise comparison of alternative design solutions.

Team Clemson used several methods for improving the energy performance of the home while maintaining affordability and marketability. Passive strategies based on natural ventilation and appropriate shading were implemented in order to minimize the use of active systems and maximize the duration of the fall and spring seasons. Another method was to use passive techniques to increase the efficiency of the active systems under extreme conditions.

The design of the electrical systems was based on the idea that the users are energy conscious and are willing to adapt their energy needs to the limits of the electrical production of the house. Under this assumption, the two main strategies were to minimize the unnecessary electrical demands and shift the use of electrical devices to periods of production of electricity from the PV system. While many solar projects consist of producing more electricity than consumed, the PV system of the house was designed as small as possible to produce only what is needed.

The rules of the Solar Decathlon competition often challenges the concepts of housing styles. With height restrictions, ramps, and alternative energy sources, incorporating traditional southern designs was not trivial. Indigo Pine still remained focused on the ideas of these traditional elements that are quintessential to the development of a southern home, yet reworked them to create the same expression through nontraditional solutions. The overall design was focused on the connection of exterior and interior space as well as daylighting that is received by the home and how it interacts with the inhabitants.

Structurally, the home was designed to be a smart wood system with much of the technology embedded into the pieces. For interior materials both wood and cultural colors and finishes were considered.

3.5 *List of innovations*

In order to be competitive in the Solar Decathlon, several innovations must be proposed and incorporated. They can relate to any technical and non-technical field of study. Team Clemson considered a series of interesting innovations listed below.

- *Sim[PLY]: a new structural framing system*. Made from Computer Numerically Controlled (CNC) cut sheets of structural plywood and held in place using predominantly metal zip-ties. This innovation is the center piece of Indigo Pine as it directly impacts the residential manufacturing and construction process.

  Overall, Sim[PLY] leads to reduced material costs, labor costs, and construction time. The advantages of Sim[PLY] can be concisely listed as follows: (1) local fabrication with local materials sources using an existing network of CNC fabricators; (2) quick and easy manufacturing of structural and finishing components including structure, exterior and interior cladding, and cabinetry; (3) set of digital cut files that can be transferred over the internet for easy replication of the house anywhere in the World; (4) accurate components that do not require additional on-site measurement or cutting to alleviate the need of skilled labor and reduce on-site waste; (5) components are designed to seamlessly interlock to adjacent parts based on a set of easy-to-understand drawings and held in place with manually installed metal zip-ties thereby reducing the need of power tools and heavy machinery.

  Historically, most teams pre-assemble the house months before the competition and truck-in prefinished modules that are ready to assemble. Alternatively, team Clemson decided to demonstrate the ease of construction of the Sim[PLY] system during the Solar Decathlon competition by successfully assembling the entire house from scratch in nine days and disassembling it in five days before and after the competition.

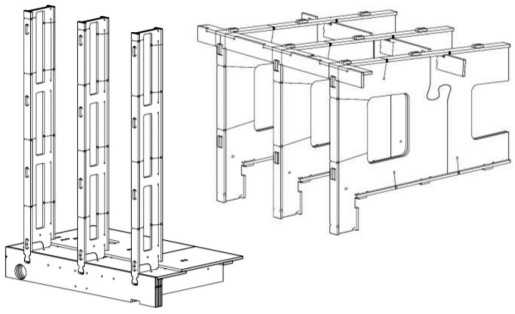


Figure 3. Wall and roof framing details.

- *New exterior cladding system made of CNC-cut polymetal panels.* The panels are made of a polymeric material sandwiched between two thin layers of aluminum for a total thickness of 0.25 inch. Each siding panel (roughly 1.5ft by 4ft) is CNC-cut and folded following origami rules to create a cavity for natural ventilation between the wood sheathing and the exterior siding. All siding panels are stacked, overlapped, and secured by screws and rivets in predrilled holes for easy and quick installation.
- *Enhanced air-source heat pump system*: An air-source heat pump for heating and cooling consists of an exterior fan-coil unit (i.e., also called outdoor unit) that produces the heat exchange between the refrigerant and the outside air. Air-source heat pumps are known for their high efficiency but also for their drastic loss of efficiency when the air temperature drops below the freezing point in the winter and climbs above 95°F (35°C) in the summer. In order to circumvent this issue and increase the temperature operating range, the air can be pre-heated in the winter and pre-cooled in the summer by drawing air under the house (i.e., crawl space) before passing it through the outdoor unit heat exchanger. A set of CMU concrete block was installed under the house as the foundation system but also as added thermal mass for pre-cooling and pre-heating the

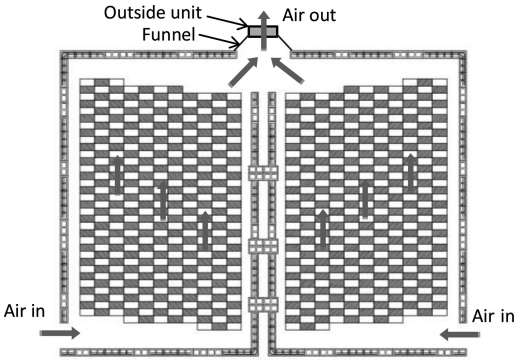


Figure 4. Plan view of foundation system to increase heat pump efficiency.

air. As depicted in Figure 4, the air enters the foundation system through vents at the south-east and south-west corners of the house, passes through the maze of CMU blocks, exits at the north of the house and is then funneled through the outdoor unit. During the competition, the fan of the outdoor unit was sufficient to draw the air through the foundation system.

- *A DC-powered water heater*: The most common water heaters used in the competition are heat-pump water heaters and solar collector water heaters. Both systems generally use alternating current (AC). Team Clemson selected a DC-powered water heater in order to use the electrical current directly generated from the photovoltaic (PV) modules (i.e., DC current, also called continuous current) instead of inverting it to AC current before use, which generally wastes 5 to 10 percent of the energy produced. Another reason was to avoid using solar collectors, which are notorious for their expensive maintenance. Also, DC water heaters are known to have the lowest life-cycle cost of all water heaters due to non-moving parts and low scale buildup on heating elements.
- *A manually controlled air-diverter system*: The ductwork shown in Figure 5 includes three tee's (called diverter tee-boxes) that distribute the conditioned air to four independently controlled zones, i.e., the three bedroom at each corner of the house and the dining room. The diverter tee-boxes include a flapper that controls the percentage of air distribution to each side of the tee. When the flapper is in the middle, each side receives 50% of the incoming air. When the flapper is rotated 45 degrees, 90% of the air is diverted to a single side and the other side receives only 10%. The distribution is symmetric with 100% of the air distributed at all times. The positions of the three flappers are controlled manually using Bowden cables (i.e., 50-foot bicycle cables) connected to three manual levers accessible in a centralized location of the house. Each diverter tee-box and its flapper were made from a CNC-cut polymetal sheet (i.e., same material used for the exterior cladding), folded and riveted together.

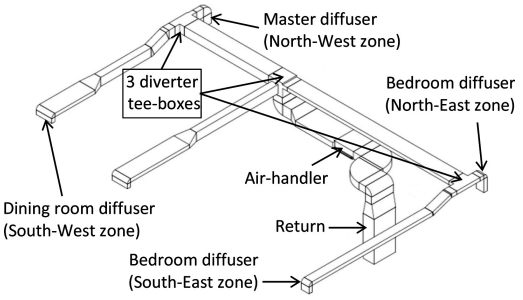


Figure 5. Ductwork showing the three divider tee-boxes.

The purpose of the air-diverter system is not to reduce the energy consumption of heating and cooling the house but mainly to provide additional control to the user and increase thermal comfort. In particular, it allows the user to adapt the supply of conditioned air to the zones based on user occupancy, hourly solar heat gain, and/or specific internal heat generation. As a result, the user is able to specifically define a more uniform temperature through the house or, inversely, a more non-uniform temperature distribution according to his/her desire. Compared to the traditional dampers available on the market, the diverter tee-boxes do not turn on or off the air distribution to a single duct, it only diverts the air flow between two ducts. As a result, the air handler is always able to circulate 100% of its air throughout the house and four zones can be independently controlled using only three diverter tee-boxes.

4 BENEFITS OF INNOVATION

4.1 *Impact on education*

It is recognized that creativity, research and the quest for innovation play a key role in education (Korobaniová 2015, Kuc 2015, Killen 2015). In the field of architecture, students are generally enthusiastic about creative design and innovation. Taping into this energy is a very effective way to motivate students and allow them to reach a high level of involvement. The ability to innovate requires generally the knowledge of current practices, designs, and theories. Unmistakably, most students who had the opportunity to follow their own path through design innovation went well beyond acquiring the basic education. They acquired it rapidly in order to give themselves enough time for developing new ideas, conduct research and ultimately innovate. They usually had a high level of productivity. It does not mean, however, that each quest for innovation was successfully integrated into the design of the house for various reasons.

4.2 *Impact on the building industry*

The need of innovation skills in education is fueled by the interrelated global challenges that we are

facing in terms of energy, food, water, and human health. Solving these daunting challenges will require global systems thinking and proactive local actions (Berlinguer 2012, Hunt 2015, Rothkopf 2010). Even though the building Industry is a very slowly evolving sector, the activities of research institutions such as the universities and colleges that participated in the Solar Decathlon competitions have contributed over the years to the evolution of the industry. Even if each innovation had a small impact, it made people think about the reasons for this innovation, its pros and cons, and it pushed the professional to constantly reevaluate their products and services in order to remain competitive themselves. Ultimately, each student involved today in the development of an innovation will become a professional decision maker at some point and will potentially use his/her knowledge acquired through the research process as a student to change practices as a professional.

5 HOW THE DESIGN ALLOWED FOR INNOVATION

Many researchers studied and reported on how to educate for innovation (Hanifin & Lee 2015, Luft et al. 2013, Ozaltin 2015, Puthoff et al. 2013, Rothkopf 2010). These techniques were considered by the faculty. In parallel, the group of faculty advisers selected the directions that the students should follow from the very beginning of the project. Two main aspects were specifically selected: (1) the use of as many off-the-shelf products as possible, and (2) the use of CNC-cut sheet goods for custom parts. Interestingly, these two aspects were not initially related to the purpose of allowing for innovation. However, in retrospect, it is now apparent that the innovations that were successfully integrated into the design followed these two aspects, i.e., they either used off-the-shelf products or were produced from CNC-cut sheet goods. All other innovations considered at some point during the project that did not make it to reality were based on a custom-made design (i.e., not off-the-shelf) that could not be produced from a CNC-cut sheet good.

The main reason for this trend is that any innovation requires an iterative process that involves, at each iteration: design, prototyping, testing, analysis and redesign. Using either off-the-shelf products or CNC-cut custom part allows multiple iterations to be conducted relatively easily as long as the off-the-shelf products are readily available from any building construction supplier and as long as the team had easily access to a CNC machine and sheet goods (i.e., plywood and polymetal panels), which was the case at Clemson University.

The most significant innovation of this project is the Sim[PLY] structural system. Many prototypes of all scales were constructed and tested using the in-house CNC machine that was easily accessible to the team. The students were able to perform a single iteration in a few hours for simple assemblies and a few days for more complicated wall sections. Without using a CNC machine, testing custom parts and assemblies would have certainly taken weeks and months, which would have been prohibitively long.

Similarly, the development of the polymetal exterior cladding required dozens of prototypes in order to identify the optimum CNC-cutting and folding techniques that lead to a successful design. The ductwork diverter tee-boxes were CNC-cut from polymetal sheets and had to be prototyped a few times before identifying the optimum design. They also incorporated off-the-shelf couplings and connectors for securing the ductwork sections to the boxes. Finally, the enhanced air-source heat pump system used off-the-shelf CMU blocks and spacers.

Innovations that were considered but did not make it because they were not off-the-shelf or CNC-cut include the following examples. The DC-powered water heater receives its electricity directly from five dedicated PV modules. Once the water stored in the 50-gallon tank is sufficiently hot, the five PV modules still continue producing electricity until the sun goes down for the night. This energy is therefore wasted and not using it is a missed opportunity. During the project, the students considered developing a custom-made switch that would divert the electricity generated by these five PV modules to other appliances or feed it back to the electrical power grid for credit (since all houses of the competition were connected to the electrical power grid using a bidirectional netmetering system). However, this valuable innovation required a custom-made electronic component with a specific safety rating and an alteration of the PV system. Several electrical engineering students worked on this topic until they realized that it would require significantly more time and effort in research and development. As a result, the innovation was not included in the design.

A second example is the use of a wraparound heat pipe around the air-handler in order to increase the energy efficiency of the HVAC system and reduce the air relative humidity. A wraparound heat pipe is a custom piece of equipment that cannot be built from off-the-shelf parts and cannot be CNC-cut. The reasons for failing to integrate this innovation are described in detail in the following section as they also relate to risk management.

6 RISK MANAGEMENT

6.1 *Faculty supervision*

As mentioned earlier, students go beyond expectations when driven by the opportunity to innovate. This is generally beneficial for their education. The flipside, however, which is also the greatest risk, is the potentially excessive enthusiasm of the students. In this case, they tend to spend excessive time on their research and neglect other less rewarding but necessary activities. It is therefore the role of the faculty and student project managers to anticipate and take the necessary steps to prevent this issue. This can be achieved by defining,

in collaboration with the students, a realistic and precise time schedule with milestones and deliverables. In theory, as soon as a significant drift occurs, the activity should be cancelled. Unfortunately, the progress of research is intrinsically difficult to anticipate, if not impossible.

As an example, one particular innovative idea had to be cancelled early on. It consisted of integrating a wraparound heat pipe, mentioned in the previous section, for dehumidification and efficiency increase of the heat pump air-handler in cooling mode. A wraparound heat pipe is a sealed tube filled with refrigerant. The pipe is wrapped around the outside of the air-handler and is exposed to the air return (hot) on one side and is exposed to the air supply (cold) on the other side. On the hot side, the refrigerant evaporates and moves passively by buoyancy to the cold side where it condensates and then flows back by gravity to the hot side. The advantage of this passive cycling system is that some of the energy carried by the air by-passes the air-handler, thereby increasing the temperature difference inside the air-handler and increasing its efficiency while dehumidifying the air. This innovative idea had not been used in residential HVAC systems in the past. If successfully integrated, the reward from using a wraparound heat pipe was going to be significant in the energy balance, comfort zone, and engineering contests. Two mechanical engineering students investigated its feasibility for several months. Unfortunately, the rules of the competitions restricted the use of the most efficient refrigerants because of their adverse environmental impact. The research for a valuable refrigerant lead to the use of either carbon dioxide, which would have required an excessively high and potentially dangerous operating pressure, or water. The latter was obviously selected. After a few weeks of further investigation, calculations, prototyping and testing, it became clear that the design needed several more months of research. In the meantime, the two mechanical engineers were not able to work on sizing the HVAC system, which was a more basic endeavor, but of higher priority. As a result, the team decided to discontinue the project. Interestingly, the humidity levels measured in the house during the competition were excessively high due to an unexpected heat wave. In retrospect, a wraparound heat pipe would have turned out to be highly beneficial and rewarding.

6.2 *A back-up plan comes first*

During the entire project, the group of faculty advisers emphasized the constant need of a back-up plan for any potential innovation. This required the team to develop a standard and successful design of each part of the house that was subject to innovation before attempting to innovate. The benefit of this practice was to alleviate any stress due to the risk of not having a successful design in case the innovation did not work out. As a result, the team was able to relax and work under less pressure to perform. Similarly, a recommendation was to avoid non-incremental innovations, which are usually highly rewarding but also extremely risky.

6.3 *Time management and organization*

The faculty guided the enthusiasm for innovation of the students by teaching them the importance of investing judiciously their time and resources in ideas and opportunities that lead to successful design decisions. In other words, the students were encouraged to constantly evaluate as objectively as possible the value of their activities and make sure that each hour spent on an activity was contributing directly and immediately to making progress towards the goal of the project.

During the entire design process of the house, all decisions were made in accordance to the core mission of the project (See section 3.2). When two or more design alternatives presented themselves, the selected alternative was the one that helped the most in achieving the core mission. This was very successful since it helped the design team save valuable time that would have been otherwise wasted on long deliberations among groups of undecided students. This is why the core mission was the first thing that the entire team developed and agreed upon. Each word of the mission statement was selected very carefully in order to provide guidance during the entire project. Interestingly, the core mission was never altered or even questioned during the two-year period. In retrospect, it is clear that the core mission was in fact a pillar of the project that people relied upon for guidance and building confidence in decision making.

7 CONCLUSION

The paper presents learning benefits associated with seeking residential innovations. The readily available construction method (i.e., CNC) and off-the-shelf materials were specifically selected rules to allow multiple iterations of redesign, prototyping, and testing of innovative ideas. The paper discusses the learning outcomes established at the beginning of the project in relation to the design process and how the faculty guided the enthusiasm for innovation of the students by teaching them the importance of investing judiciously their time and resources in ideas and opportunities that lead to successful design decisions.

Like many teams, the goal was to participate in the competition but also to win it, or at least compete at the highest level possible. In parallel to this competitive endeavor, team Clemson conscientiously decided to use the participation in the Solar Decathlon as one step towards developing a long-term education and research program focused on residential sustainability through architectural design innovation.

The educational intentions and the rules for research and innovation set forth by the entire team of faculty and students from the beginning of the project were key in achieving the desired educational experience and are the reasons that lead to a successful project.

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A contemplative pause on the integration of digital computational thinking into architectural education

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ABSTRACT: The use of computation and digital tools is actively shaping the way that designers approach design problems. The emergence of computational logic as a parallel design thinking approach is gradually redefining design reasoning patterns within architectural discourse. While computation offers a multitude of creative spheres for exploration and research, it also poses some unforeseen cognitive and technical challenges, which if not resolved can potentially drive the educational experience out of focus. Increasingly architecture students are required to learn and apply a vast host of digital and computational tools without a proper understanding of their internal algorithms or operating logic. Struggles arise when students depend on the tool's specific architecture and workflow to inform their design processes, without a conscious realization of such influences. These challenges are provoking critical pedagogical debates; raising many questions concerning the affect that this technological-driven shift has on architectural products and discourse. To contribute to this critical discussion, this paper explores the nature of computational logic, as the foundation for understanding the integration of computational thinking into architectural discourse. After looking analytically at the different digital computational models at a cognitive level, it is evident that computational-driven processes often follow a path of rational deductive reasoning, which is more suited for exploring a 'well-defined' design problem. However, when approaching an 'ill-defined' design problem, deductive reasoning can pose limitations on design thinking. Moreover, the type of knowledge-base and digital skills that are required to support advanced computational reasoning paths are often not provided by the architectural curriculums.

1 INTRODUCTION

Since the invention of the Sketchpad; the first interactive drafting computer program by Ivan Sutherland in 1963, computer graphics software has steadily evolved to become the standard means of production in design education and practice. The integration of digital technologies into the design process has enabled new ways of investigation; providing a range of tools for data structuring, visualization and analysis. Recently, the emergence of digital computational thinking models as an alternative design methodology is provoking critical pedagogical debates; challenging our conventional approach to design thinking (Lynn 1999, Knight & Stiny 2001, Oxman 2006, Oxman 2008, Ozkar 2007). While there is no doubt that the computer is actively shaping the way that we approach design problems, until today a robust and comprehensive theoretical framework underpinning the integration of computational thinking into architectural design pedagogy as it relates to cognitive theories is largely missing. There is, as yet, insufficient understanding of how the digital environment and its logic is affecting the design thinking process; often revealing a deep internal struggle within architectural pedagogy.

In architecture the computer as a machine is still seen as the 'black box'. Its operating logic and architecture remains a mystery to most users in the field. This can lead, in my opinion, to users underestimating its imbedded influence, as well as not fully grasping its limitations and potential in the design process. Unfortunately the architecture profession is rarely involved in designing the digital tools that it uses. It is therefore essential to take a deeper look behind the digital environment to understand the functionality of what is actively redefining the way we approach design investigations today. This paper takes an analytical look at the digital computational design thinking logic at a cognitive level, and hopes to clarify some important aspects related to the integration of computational logic into architectural education.

2 DESIGN COGNITION

The study of human information processing during design offers a theoretical foundation for understanding the issues of importance to design cognition, which should be considered essential for informing the integration of computational thinking into architectural design pedagogies. Since the emergence of cognitive psychology in the 1960s, design cognition as a paradigm has gone through many conceptual redefinitions moving away from the original static

conception of identifying design as an objective rational problem solving process (Newell 1969), towards a more dynamic realization that acknowledges the overwhelmingly subjective nature of design interpretations (Schön 1983). Within this new realization, a number of important issues to design cognition are highlighted focusing on the nature of the design problem, knowledge structure, and design representations (Eastman 2001). In this paper, these cognitive aspects are proposed as the theoretical platform for understanding the integrations of computational thinking into design education.

2.1 *The nature of the design problem*

Our understanding of design as a cognitive paradigm has evolved over time. The emergence of Artificial Intelligence, in the 1950, has sparked an interest into understanding the cognitive process of problem solving (Simon, 1968, Winograd & Flores 1987). Originally it was argued that cognitive mechanisms underlying both the processes of design and rational problem solving are identical (Simon & Newell 1958, Newell 1969, Newell & Simon 1972). The design process was seen as grounded in positivistic epistemology viewing the designer as a static being living in an objective world, in which, his/her interpretation of the world is constructed based on rational reasoning, objective data and explicit knowledge (Dorst 2004). This view was heavily influenced by cognitive research within the context of Artificial Intelligence, which views design as an advanced form of problem solving, similar to puzzle making . (Archea 1987). Design thinking was understood as a process of searching for solutions that satisfy a predefined problem space. However, this understanding was later challenged by the realization that design often operates within an undetermined problem sphere (Simon 1973). In cognitive science, there is substantial distinction between a 'well-defined' problem and an 'ill-defined' one. A 'well-defined' problem indicates that the information necessary to construct the problem is clearly specified at the outset. Such information is lacking when approaching an 'ill-defined' problem (Goel 1992). Thereafter, it was widely accepted that the design process overwhelmingly deals with problems that are 'ill-defined' (Eastman 1969, Simon 1987, Cross 1984, Eastman 2001, Dorst 2004). It is only through subjectively-driven exploration process that the problem space and its context can be defined (Schön 1983; Lawson 2005; Cross 2006). Schön (1983) stressed the implicit and subjective nature of design knowledge and activities identifying the design process as immersed in reflective practices. In this paradigm, attention shifts from the objective-rational view to highlight the subjectivity of the designer's conception of the design context. Such context is considered essential for understanding how design information is structured inside the designer's head; how it is recalled and manipulated during design processing (Schön 1983, Eastman 2001). This understanding is grounded in phenomenology, which views the designer as a dynamic, active and emotional social being with a unique view of the world, constructed based on his/her subjective interpretation of reality. Accordingly, the paradigm of reflective practice occupies the opposite end of the epistemology spectrum distancing itself from the paradigm of technical rationality. Mediating this distance a new understanding has emerged arguing for the dualistic nature of design, which involves both objective and subjective interpretations within its process (Gadamer 1986, Goel 1992, Dorst 2004). According to this understanding, defining the dominant interpretation depends heavily on the phase of design activity, the designer's level of expertise, and ultimately resides within the designer own discretion (Dorst 1997, Dorst 2004). Recent research has shown that a novice designer tends to consider the objective attributes of the problem, while an expert designer tends to cast his/her own subjective understanding of the problem under investigation allowing a wider creative sphere for innovation (Eastman 2001, Dorst 1997, Dorst 2004)

Rational	**What**	**+**	**How**	**=**	**Results**
Deduction	What	+	How	=	???
Induction	What	+	???	=	Results
Abduction	**What**	**+**	**How**	**=**	**Value**
Abduction-1	???	+	How	=	Value
Abduction-2	???	+	???	=	Value

Figure 1. Patterns of reasoning.

To understand the different design thinking approaches, it is beneficial to consider the different patterns of reasoning that are used for problem solving in different fields (Fig. 1). For predicting a phenomena that already exists in the world, scientists depend mainly on deductive reasoning (a.k.a. necessary inferences), and inductive reasoning (a.k.a. probable inferences) for seeking truth. It is also common, in the scientific method, to initiate the research by employing an abduction reasoning for hypothesizing the puzzling phenomenon, as explained by Charles Peirce (1839–1914). However, for most design fields the reasoning patterns often follow a non-deductive or inductive path. In engineering, design thinking process is heavily influenced by the logical reasoning of abduction-1, in which the designer knows '*how to*' achieve a '*value*' but the search is focused on finding the '*what*' (i.e. a service, an object, a system, etc.) (Dorset 2010). While the problem space is perceived as too wide, a rational solution to the structured problem is considered attainable. Architecture, on the other hand, deals mostly with an 'ill-defined' design context, which requires the designer to, simultaneously, define the problem space and the criteria applied to finding probable solutions (Akin 1986, Akin & Akin 1998, Eastman 2001, Dorst 2004). Therefore, this design process is better explored by employing an Abduction-2 reasoning logic, in which, the end '*value*' is the only known parameter allowing wider interpretation space

for the designer to figure out '*what*' to create and '*how*'? (Dorst 2004). In the architectural design process, the preliminary phases are seen as 'ill-defined', explorative in nature, and with a low degree of commitment. Design activities at this level are immersed in subjective interpretations (Eastman 2001). Therefore strategies for enhancing lateral transformations are seen as essential for widening of the problem space in search for multiple ideas and to facilitate the lateral movement between them (Goel 1992). At later stages, the focus shifts to a more defined and structured refinement and detailing, in which, attention shifts to vertical transformations moving in the depth of the problem space toward a more detailed version of the same idea. Therefore, the later stages of the architectural design process are seen as immersed in objective interpretations, which respond well to rational design logic (Goel 1992, Eastman 2001, Dorst 2004).

2.2 *Knowledge structure*

In design cognition, attention is shifting towards understanding the designer's conception of the design world and its context. Such conception is constructed by drawing upon multiple sources of information including the designer's sensory experiences, external sources of encoded information and the internal recollection of previous experiences and stored knowledge (i.e. factual, informal, procedural experiential, representational, etc.). Accordingly new questions have been emphasized focusing on how design information is carried in students' heads, how it is linked to other knowledge, and how it is structured, recalled, and manipulated during design reasoning (Eastman 2001). In this context, design is perceived as a knowledge driven process (Davis 2013).

One of the most important aspects of creative design has to do with domain knowledge (Akin & Akin 1998). As different design fields depend on discipline-specific knowledge, it is essential to recognize that designers rely heavily on the internal recollection of stored previous knowledge and experiences to inform design thinking (Eastman 2001). During design reasoning, relevant encoded information is recalled and used to structure the design context, which enables creative connections to happen. A command of domain knowledge is therefore essential for the creative process, and must be present during design reasoning (Akin & Akin 1998).

Depending on the nature of the design problem, designers draw upon different sources of relevant knowledge types. A 'well-defined' problem relies heavily on objective sources of information, such as formal, factual and procedural, while an 'ill-defined' problem relies heavily on the subjective interpretations by drawing upon a combination of experiential, social, cultural, etc. Once again, the subjective interpretation of the design problem and its context is highlighted as an important vehicle for achieving creative design. Therefore, architectural design education should focus on building an experience-based knowledge structure, mixing perceptual, historical, belief, cultural, social, formal, etc., which is brought to bear during design reasoning (Eastman 2001).

2.3 *Design representations*

In design fields, the ability to manipulate symbolic representations is considered essential for stimulating different aspects of information processing during design. Recently, new issues of significance have been introduced focusing on how different design representations are learned, internalized and integrated with other knowledge (Eastman 2001). Different representational mediums facilitate different aspects of design thinking. Cognitive studies have established a strong connection between internal representations (i.e. mental imagery, language processing, mathematical processing, etc.) and creativity. In the creative mind, internal representations play a substantial role in connecting conceptual ideas from different domains, during which mental constructs help to generate new concepts, while external representations act as support structures for the student's own knowledge base (Akin & Akin 1998, Eastman 2001). While there is enough evidence to suggest that imagination can be enhanced with practice (Wallace & Hofelich 1992), relying solely on internal representations can be limiting. Instead, design occurs as a result of a rigorous dialogue between both internal and external representations. (Reisberg & Logie 1993). To stimulate this creative dialogue, architecture education should bring forward a host of qualitatively different mediums, which engage both internal and external representations.

In design cognition, important distinctions between two modes of external representations are highlighted: 'ill-structured' representations (i.e. freehand sketching, diagramming, etc.) and 'well-structured' representations, (i.e. digital representations, computation, etc.). Each of these serves as an important stimulus agent during design processing. It has been argued that the use of 'ill-structured' diagrammatic representations in early design stages helps facilitate important cognitive processes; while 'well-structured' representations are helpful during the refinement and detail phases (Goel 1992). Freehand sketching offers a unique design thinking tool that can abstractly capture some of the structural properties during design processing, which helps to bridge the gap between the mental cognitive process and the physical world (Herbert 1988, Gross et al. 1988, Goel 1992, Goel 1995, Eastman, 2001). Moreover sketching and diagramming encourage lateral design thinking processes, which can be invaluable to concept generation and problem definition at the beginning of the architectural design process. While considerable progress has been made in understanding the role of 'ill-structured' representations during design, a deeper understanding of the role of 'well-structured' representations, such as computation and digital models, remains unclear. However, there is enough evidence to suggest that employing 'well-structured' representations in early

design phases can hinder the lateral exploration of alternative solutions forcing a premature crystallization of the design (Goel 1992). Moreover, Eastman (2000), argued that any learned external representation needs to be internalized in order to become part of the intrinsic cognitive mental reasoning ability of the designer, similar to reading, writing, sketching or math skills. Therefore the effective use of computation, as a design thinking medium, is closely linked to the designer's skill level and his/her ability to automate its use at a cognitive level (Eastman 2001, Peterson, Alexander & Webster 2001), which is necessary for facilitating the creative process during design (Akin & Akin 1998).

Building on this theoretical platform, the next few sections explore the nature of computational logic focusing on understanding the different reasoining patterns that are associated with the integration of computational thinking into the architectural design process.

3 COMPUTATIONAL THINKING

The concept of rule-based intelligence did not start with humans, as it occurs intuitively in many natural processes; including how cells process encoded information in the DNA. Within human history the first mathematical instrument used for calculation appeared in Mesopotamia (2700–2300 BC), with the invention of the Sumerian abacus (Ifrah 2001). In modern times, computational thinking was first introduced in 1980° (Papert 1980). Originally known (1950s–1960s) as '*algorithmic thinking*', computation is defined as the *"mental orientation to formulating problems as conversions of some input to an output and looking for algorithms to perform the conversions*" (Denning 2009, pp 28). The invention of the modern digital electronic systems allowed for the automation of complicated problems, which previously were seen as challenging. The design concepts behind the digital computing systems are mostly attributed to John von Neumann architecture, published in 1945. Neumann (1945 pp1) proposed a device that "*can carry out instructions to perform calculations…. The instructions which govern this operation must be given to the device in absolutely exhaustive detail. They include all numerical information which is required to solve the problem under consideration*". Accordingly, the digital system accepts numerical data '*input*', processes data arithmetically and/or logically, and then produces numerical information '*output*' following a linear '*fetch-execute*' cycle, in which instructions are laid out in consecutive order in memory. Digital computational power allowed for the organization of complex problems through well-defined procedures, which was proven to be instrumental for describing, simulating and modeling natural systems. At its core, computation involves abstraction and rational reasoning about the methods of investigation.

A central premise of using the digital computing systems as design tools, is understanding the "*necessary limitation on computable functions as mediator between input and output*" (Kotnik 2010, pp 6). Therefore, the question of '*computability*' of a relationship or a process becomes essential to its execution. In order to apply computation, it is necessary to describe the problem with "*absolutely exhaustive detail"*(Neuman 194, pp 1), using precise arithmetic and/or logical expressions, which requires the designer to provide a detailed definition of the design problem under investigation before initiating the search for probable solutions. Such definition clearly fits within the 'well-defined' problem sphere. The use of computation mandates that the design problem be mathematically expressed, has an algorithmic solution and that its functionality can be measured quantitatively.

Computational design thinking logic involves the decomposition of the entire decision making process into smaller controllable and quantifiable entities through, pattern recognition, abstraction, algorithm design, rational reasoning, deduction, etc. In this process, a close-fitted association, exists between the degree of '*computability'* of the design intent and the computational modeling logic that is used to derive design alternatives. This association serves as the foundation for understanding the integration of computational thinking into architectural design discourse. This paper identifies three levels of computational modeling logic: an output-driven computational modeling, relationship-driven computational modeling, and process-driven computational modeling. In this context, the designer's command of domain knowledge and level of digital craftsmanship are seen as necessary tools for enabling the integration of digital computational thinking into architectural discourse.

3.1 *Output-driven computational modeling*

The output-driven computational modeling logic, also referred to as '*the direct modeling*' (Davis 2013) equips designers with a computational strategy to quickly capture and manipulate geometry exploring design ideas by focusing on the desired output rather than on the deriving computational logic. Such computational models are descriptive in nature and are characterized by the lack of engagement at the algorithmic levels (Oxman 2006, Kotnik 2010). The output-driven computational logic denotes the utilization of a digital geometric environment that facilitates the representation of the desired geometry.

The range of digital environments, used for descriptive modeling, is wide and extends from the basic CAD modeling software to include high-level programming languages for writing independent algorithmic representations. However, the use of available graphics software environments implies the use of a set of predefined computable functions, or equations that explicitly define the governing rules between cause and effect following a deductive reasoning logic, '*output = function(s)* (*input*)'. The dependent '*output'*

is given in terms of the precise known quantities of the independent parameter(s) '*input'*. Relying on existing software means accepting the limitations imbedded within its code, workflow and user interface, which confines the geometric manipulations to specific tool pallets. Therefore programming skills are seen as providing a wider sphere of exploration not limited by a predefined set of computable functions. In recent years the use of programming has allowed architects to break free from these limitations enabling the exploration of new methods of organization and form-generation, often derived from nature (Weinstock 2010). In this context transferring existing mathematical or physical models into an architectural context, is still seen as operating within the same descriptive explicit modeling sphere. The digital environment in this case, provides the geometric language that facilitates the representation of the complex geometry, which can be challenging to represent using manual tools (Kotnik 2010). Hence, the output-driven digital computational modeling logic is seen as an extension to the traditional geometric environments and, if internalized, is isomorphic to the sketch-driven thinking models.

3.2 *Relationship-driven computational modeling*

The relationship-driven computational modeling, also referred to as *'parametric modeling'*, denotes the design and use of a fixed field of explicit relationships for generating design alternatives. In this context, computational logic shifts from being a tool for descriptive representations towards encoding design intentions at the algorithmic level. This process involves the design of "*a set of equations that express a geometric model as explicit functions of a number of parameters*" (Davis 2013, pp 31). This is achieved through explicitly defining the governing rules between the '*input'* and '*output*' following a deductive reasoning logic: '*output = equation(s)* (*input*)'. Variations of the dependent '*output'* are generated in terms of testing ranges of variations across the independent '*input'* parameter(s) space. The value of the relationship-driven exploration lies in the way that the computational algorithms is created; requiring the designer to anticipate design output by defining the logical sequence of formulas, constraints, explicit relationships, parameters and dependencies, to derive design outcomes (Davis 2013). Such logic denotes the existence of a hierarchical structure with direct cascading and causal relationships, often moving from the global to the local. In this context, design computability becomes a method for exploration, confined within the predefined relationships operating at the level of parametric manipulation (Burry & Murray 1997, Kotnik 2010). While such logic is suited for addressing 'well-defined' design problems with strict performance, aesthetics, or structuring criteria, etc. (Davis 2013). By confining the 'problem space' to a predefined set of relationships and parameters, this process risks narrowing the 'solution space' to a limited range of possibilities. Relationship-driven computational modeling often informs design decisions that are derived by a numerical formula as a measure of testing formative or performative output. This quantitative perspective on design thinking can steer the process towards optimization; potentially limiting the creative design sphere (Kotnik 2010). Moreover, learning to think parametrically requires the designer to express design process and outcome with explicit computational functions, which is a "*hard-won skill*" (Burry 2011, pp 38). Smith (2007) summarized some major technical challenges associated with crafting and implementing parametric schemes including the substantial front-loading investment for building the model, limited flexibility, the instability of the parametric model in relation to substantial variation, the difficulty in visualizing changes, and the difficulty of sharing or reusing parametric models.

Today a range of computational environments are available for crafting parametric models, including, history-based modelers, visual scripts, physical modelling, scripting, high-level programming, etc. However, Most available 2D and 3D graphic software (i.e. AutoCAD, Sketchup, 3D Max, Rhino, Grasshopper, etc.), are not readily designed to facilitate parametric explorations at the algorithmic level. However most of these tools allow for programming languages (i.e. C++, C#, Python, VB, etc.) to extend their functionality enabling better control over programing algorithms. In this context, digital programing skills are considered essential for employing relationship-driven computational logic into the design process.

3.3 *Process-driven computational modeling*

A process-driven computational modeling is a generative design approach, in which, design intent is algorithmically encoded in a system that is structured to evolve independently beyond the designer's initial input. In this model, attention shifts from the parametric manipulation of the explicit filed of relationships, towards the development of sequences of operations that encode the design intent. Process-driven models are characterized by the use of computational mechanism for formalized generation processes (Oxman 2006) operating at the level of algorithmic computability (Kotnik 2010). The use of process-driven generative logic denotes a bottom-up approach, in which, design hierarchy emerges as a result of the self-governing processes (Snook 2012). By defining the local entities, relationships, transformations, constants, constrains, degrees of freedom, parameters, etc., the designer sets the initial rules for the system to self-organize and to independently evolve to generate the design output. This involves building a dynamic model for encoding the behavior of the local values in response to their local environment focusing on the process as a design driver rather on the artifact (Snook 2012). In this case design thinking logic is not geared toward calculating the optimal output, similar to parametric design logic, but rather towards a self-emergent output; evolving beyond the control of the designer's initial input and

derived from the decision-making process of the local entities.

In this context, design solutions are seen as an emergent global outcome of an intensive local processes, in which the interaction among individual entities give rise to the collective emergent behavior at the global scale. It is worthy to note that this concept is not completely new to design, as similar design concepts were applied throughout history. One of the unique examples of a process-emergent design output, can be found in the way that traditional and vernacular cities have emerged over time. By allowing a degree of freedom within the initial set of local ordinance, a dynamic design emerges that is responsive to individual needs as well as bound by the collective global values that safe guard the collective behavior. In principle, the generative design process is a powerful design tool, if allowed to operate intuitively within a complex social, collaborative, bottom up design approach that is intended to evolve in real time. However generative computational design logic, operating within the digital confines, is seen as an experimental method for exploring 'form intelligence' or 'behavioral-driven formations' at an abstract level. The use of digital computation implies a limitation on defining local entities from available digital geometric primitives (i.e. point, line, body, etc.), and are expressed numerically through physical attributes, (i.e. materiality, location, etc.). At the same time, the behavior of such geometric entities can only be manipulated through digital geometric transformations (i.e. translation, rotation, scaling, etc.). While such vocabulary can be effective in expressing the organization of abstract systems of quantified complexity, it is yet to be seen how such systems can encode complex social, economic behavioral patterns when approaching real-life design situations.

Recent explorations of using generative computational logic as a design generator is more about phenomena recognition than formal design method. So far these explorations are focused on extracting complex systems from nature such as genetic algorithms, flocking, and cellular automaton, etc. (Davis 2013) and deploying them as design generators. However, applying such schemes into design process requires the designer to have a higher level of programming skills and deeper formal knowledge of mathematics, biology, physics, chemistry, etc., most of which are rarely provided by architectural curriculums.

4 CONCLUSION

This paper is set to explore some cognitive aspects, associated with the integration of digital computational thinking into architectural education. After looking analytically at the three main modes of computational logic (output-driven, relationship-driven and process-driven) at a cognitive level, this paper argues that the shift towards digital computational thinking as an alternative design methodology has deep pedagogical consequences on design education, as it relates to design reasoning patterns, domain knowledge and technical skill level.

Architectural design discourse is widely recognized as immersed in subjective interpretations as designers respond to the overwhelmingly 'ill-defined' nature of the design problem. The creative design process is enabled by the subjective context of the designer's experience-based knowledge structure mixing perceptual, historical, belief, cultural, social, and formal, etc. However the rationalization of design thinking by means of computable functions is grounded in positivistic epistemology, which views design exploration as operating within an objective sphere, and based on deductive logical reasoning, objective data and explicit knowledge. While this view provides a viable framework for the systematic exploration of a 'well-defined' design problem, it poses unforeseen limitations on design thinking when approaching an 'ill-defined' problem; acting as a thinking barrier by limiting the exploration of wider design sphere. In this context, the computational framework is seen as providing a specialized design strategy; enhancing but not replacing the intuitive nature of the creative subjectively-driven design process.

Moreover the integration of advanced computational thinking logic into architectural discourse, requires pedagogical shifts at multiple levels. A high-level command of formal knowledge structure and programming skills are considered essential for supporting the computational path. While this direction might present an opportunity for offering a specialized graduate interdisciplinary educational path, it encompasses multitudes of challenges at the undergraduate professional level. It is therefore critical to examine the value of shifting architectural pedagogy toward computational thinking.

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Decode: Reverse engineering abstract art a method for teaching computer programming to architects

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ABSTRACT: This article describes why modern art can help architects and designers learn computer programming languages—it is a very suitable medium for reverse engineering new forms. From 1955 until now, a number of artists have experimented with generating fine art in a coded manner. Some of them explicitly use machine code, whereas others use analogue drawing machines or simply code-like descriptive methods for their art. Some of the works, created from the 1950s to the 1980s, are re-purposed in this course as their main formal methods are repetition, recursivity and iteration. After an analysis and 'reengineering' of existing artwork, students develop their own designs using the methods learned and, furthermore, go on to produce/draw these on a table-sized CNC mill or 3D-printer. The goal of this research is to assemble a database of reference samples and create a series of programming handbooks aimed at assisting architecture students to surmount technological barriers. This paper describes the current research stage of this teaching method and provides examples that signal directions for further research.

1 INTRODUCTION

Art and technology have developed concurrently throughout history. Soon after computers were installed in major institutes worldwide in the mid-1960s, we observe a surge of artists eager to create computer-generated art. Shortly thereafter, the first computer aided design (CAD) systems for architects were developed (Weisberg 2008). This was the beginning of coding; that is, the ability to develop a set of rules in computer language and to convert that code into another representation. In this work, we are dealing with codes representing 2D and 3D forms. Typefont, typesize and spacing.

The term 'decode' describes the interpretation and conversion of symbols from their coded to their original form. Decoding is a process mainly used in information technology for communication or visualisation tasks. In the context of this course, we consider artwork as coded work. That is, the process of formal dissection is done by analysing the principles of the formal structure of the original work. With the help of computer languages, the observed works of art are rebuilt experimentally.

When we observe the average architectural work environment, we find that programming skills are not essential for doing the job. For normal designing, technical or communication tasks, an architect will not need any scripting/programming knowledge since most tasks can be achieved using commercially available or free software tools.

Until a few years ago, the barriers to developing an independently programmable tool were quite high in terms of platforms, program language and incorporation into a working system. This is changing and these barriers have been reduced, with a shift towards software development in design and techniques programmed not by software engineers, but by architects. There are several reasons for this: (1) new innovative software instruments are simplifying the act of coding; (2) online learning and exchanging platforms are increasing the speed of getting 'how to' information; and (3) the transition from big universal programs to small custom applications for specific needs.

As this ongoing process is inevitable, the professional development of programming skills for architects is an important step towards better functioning architectural or office applications (efficiency, usability, maintainability, dependability and reusability) (Sommerville 2004; Daniel 2013). Furthermore, architects with programming skills are better informed and motivated in their areas of expertise than software engineers. Considering this, there is a need for an alternative teaching method more suitable for the needs of architectural professionals.

This teaching method is build upon the idea to encourage architects to develop programs, work on complex, procedural and generative design, get into computer-controlled production and be able to communicate with software programmers. For this demands they need to get in touch with programming what the Decode lessons are providing.

The curriculum exists in two parts: Decode 1 and Decode 2, together with a printed/builded output. Whereas Decode 1 focuses on programming language processing and painted art, Decode 2 concentrates on

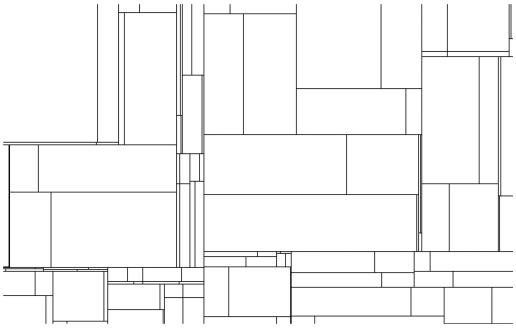


Figure 1. Decoded version of Ohne Titel (Palast des Midas), Georg Nees, ca. 1970.

sculpted artwork and decoding with Rhino-scripting tools.

The computer languages Processing and Python are used because they are simple in use and far spread. In comparison with the graphical algorithmic editor Grasshopper for Rhino, which is been widely used in offices and universities, these programming languages can give a basic understanding how software-programming concepts work.

2 RELATED WORK

Both this article and the course are based on artwork from the 1950s to the 1980s. Some art references come from traditional abstracts while others come from the experimental computer art era. The generic and parametric structures of minimalism, conceptual and op-art provide a sound basis for digital decoding. Conceptual and formal similarities are found between these different art movements despite their artistic deviations (Watz 2010).

The code-like abstract art of Sol Le Witt's Wall Drawings are the best examples of how explicit written instructions can produce form in a conceptual manner. Coding experiments to reconstruct his text-instructions are still very popular in current computer-art and interdisciplinary design courses. Casey Reas, one of the developers of the programming language Processing, describes that his main motivation for the development of a new programming language was the work of Sol Le Witt and the lack of programming instruments available for making intuitive formal solutions (Casey n.d.). Processing is now a widespread programming tool that is predominantly used by artists and those in other graphics-oriented disciplines. With a wide library of additional software add-ons, it can be used as a tool for any kind of media art.

The main collection of computer art is organised through the 'recode project', with a platform for a community-organised collection of mainly computer art from the 1960s to the 1980s. This collection contains a large library of artwork, where some of the work is decoded in programming language. It also holds a link collection for the magazine, Computer Graphics and Art, which was published quarterly between 1976 and 1978 by Berkeley Enterprises Inc. and focused on art experimentation around computer graphics, including essays on electronic art. Although the recode project does not contain a significant code collection, it still provides a good overview of computer art during that period.

Translab in the 'Burundi Datalab Project', in Slovakia, assembles a significant collection of articles and examples of computer art. This is an interdisciplinary research project to study the history of new media and contains a commented list and articles of artists and artwork from the second half of the 20th century.

3 GOALS AND CONTRIBUTIONS

3.1 *New method of teaching programming for architectural students*

The main motivation for the course is the development of a fresh approach to teaching architecture students about computer programming. One question is how these students, with no coding experience, solve design problems using basic programming techniques.

3.2 *Resolving abstract art through code as a driving force for learning programming*

Architects commonly work with visual elements, particularly when they explain their designs or try to describe complex content. Abstract art seems an appropriate graphic equivalent to common coding examples, where programming basics are explained step-by-step.

3.3 *New code solutions for several art works from the minimalism, op-art and conceptual art periods*

The course examines existing codes for art pieces, which are further developed and optimised. Since students are also working with art that has never been decoded, new code is produced. These codes will be published on the 'decode project' webpage to share this knowledge (www.b-tu.de).

4 HISTORICAL OVERVIEW

Art is always connected to its embodied code. When we look at art, we tend to find the 'deeper meaning' of the studied object. With the surge in abstract art 100 years ago, we can observe a switch from figurative narration to non-story-telling geometry and colour compositions. Even if the large part of abstract painted art is two dimensional, we can still often see the spatial components in most of them; for example, Malewitsch's main work, where objects float and overlap in space. Although the intuitive working process of some artists from the first part of the 20th century makes decoding a bit more difficult, this has been replaced by

more calculative art. Abstract expressionism, as a non-geometrical art movement, emerges from the intuitive movement of the artist's arm. It seems that the intuitive working process in abstract art fades away towards the 1960s, especially with the new conceptualist and minimalist art thinking. Conceptualism as an art movement, contrary to the digital art of the 60s and 70s, focuses on concept rather than output; that is, its own code. Similar to digital art, where the terms 'original' and 'copy' are being questioned, conceptualism supports the paradigm shift in the way that the original materialised work is set to background: this is the only similarity to digital art. Digital art, which has evolved from form-finding experiments with new computational methods and is still very heterogeneous, but lacks an overall conceptual foundation; however, digital art prepared the groundwork for the impending media art movement.

5 DIDACTICAL APPROACH

This course comprises four parts:

5.1 *Weekly lectures in programming*

Programming lectures in the first two months with exercises and homework. As most of the students do not have any previous programming experience, a simple programming platform will be used for the first part (Decode 1). Processing, developed by Ben Fry and Casey Reas at MIT in 2001, is considered a perfect platform that unifies a simple IDE (integrated design environment), with a simple command structure based on java and C++, has good graphical output abilities and is capable of most programming routines. For the second course (Decode 2), the Python programming environment of the 3D-modelling program Rhino 3D (from McNeel) is used as it supports a wide range of preconfigured modelling commands. Python is a language that is used for a variety of purposes and a knowledge of Python can assist in further programming development.

Most examples used in the lectures are art examples that deals with common programming problems. The processing lectures encompass the following learning points:

- setup, draw, lines, basic shapes, coordinates, variables, loops 1
- conditionals 1/if then else, loops 2, comments, colors 1, expressions/statements
- export to JS, interaction / mouse, keyboard, colors 2, transparencies
- conditionals 2, classes 1, arithmetic
- harmonic functions, curves, random, translation, transformation
- iteration / recursion, l-systems
- classes 2, importing libraries
- interaction web, sensors, kinect

The Python for Rhino lectures concentrate more on the possibilities inside Rhino 3D, 3D-modelling

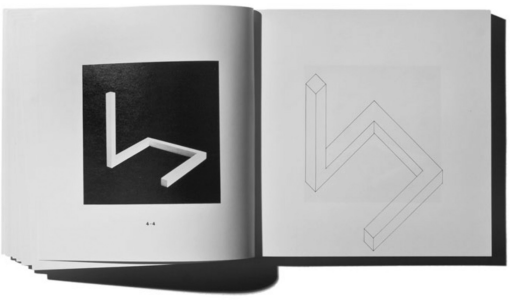


Figure 2. Open incomplete cubes, Sol le Witt, 1974 (Gross 2012).

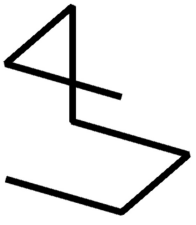


Figure 3. Decoded version, one from a series, open incomplete cubes.

aspects and simple algorithms dealing with balancing an object. The balancing procedures for single-material objects are purely based on geometry and are achieved by:

- finding the mass-centre of a volume;
- defining the footprint of an object (this can be tricky if the object is standing on several supports);
- checking if the vertical projected mass-centre is inside the footprint;
- if yes, object is balanced;
- if no, redefine object or let it fall (and repeating the balance procedure).

5.2 *Decoding exercise of an existing art work*

Parallel to the intensive input at the beginning of the course, students choose their work from a list of artists (Mohr, Nees, LeWitt, Molnar, Vasarely, Malewitsch, Lisitsky, Andrade, Riley, Zajec, Bangert, Basset, Aranda/Lasch, Silvermann, Perry, Hild, Clar, Carrajal, Bill, Serra). The goal is to decode the artwork as well as to explore the chosen artist's context and summarise the structural principles. The produced code gives a formal twin that should follow these principles without making an exact copy of the original work (Figs. 2 and 3).

Hand-schemes are essential for finding out the main principles of the observed art piece. After discovering programmable regularities in the observed work, an appropriate programming principle is suggested. In addition to the individual working with code concepts, this part of reverse engineering art work is crucial to understanding how complex systems can be reduced to simpler ones (Fig. 4.). The degree of difficulty varies

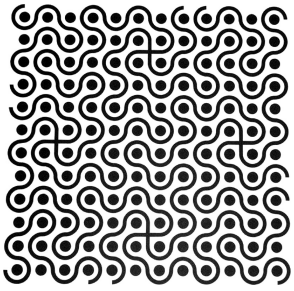


Figure 4. Black Dragons, Edna Andrade.

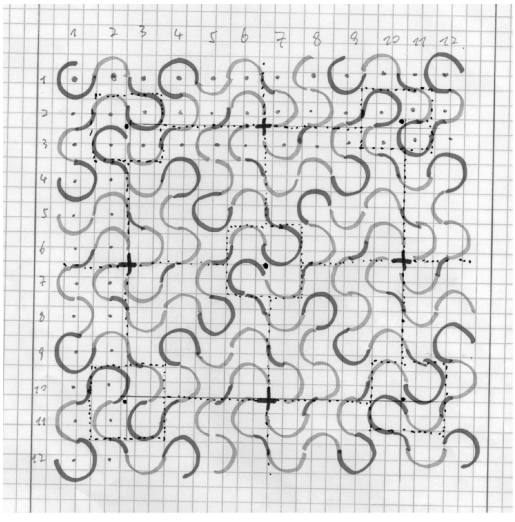


Figure 5. Hand-sketch, student Bing Ding, 2015.

among art pieces. Artwork with an obviously digital background (Nees) is more easily comprehensible in reengineering. Abstract art without an explicit digital context is particularly hard to decode (Vasarely).

5.3 *Individual work – coding*

Applying knowledge gained from the earlier course parts, students develop their own digital art codes. Their individual work is based mainly on code and principles from the decoding process. As the drawings are further processed with digital prototyping machines (CNC-mill and 3D-printer) it is important to consider the output format and its constraints. When exporting an image to a CNC-mill, two parameters are important for processing: (1) the drawing contains only lines. Filled areas should be minimised and pen-behaviour examined (jittering); and (2) inaccuracy of the pen attached to the CNC-machine is to be considered. Uncertain output can be part of the work (error and uncertainty).

If the code is 3D-printed, then all objects have to be closed, without any holes in their geometry; otherwise, only inferior 3D prints will be produced. This is a part of the coding requirements.

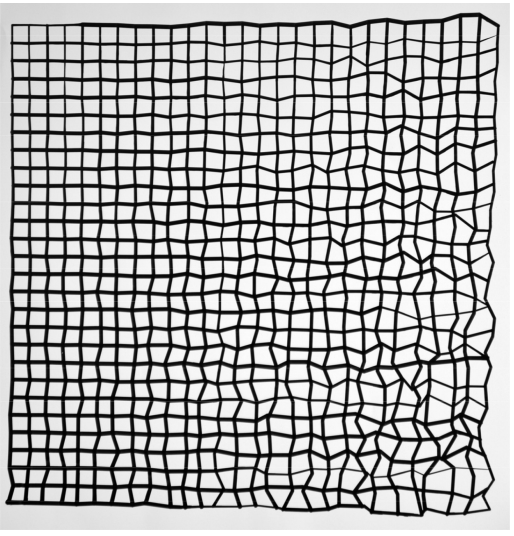


Figure 6. Individual work of the student Maria Fuchs based on a work of Georg Nees, Pen on paper, 2015.

5.4 *Individual work – materialising the code*

Prior to CNC-drawing and 3D printing, each participant learns the basics of exporting art work as a pdf file (Processing) or as a clean model (Rhino 3D) on a separate layer that can then be saved as an stl file. The procedure for using the CNC-mill is as follows: import the pdf file to Rhino-CAM, making the machine-paths, exporting the nc-file to the CNC controlling unit and, finally, controlling the machine-drawing process. Since all work is completed at an individual level, all participants go through the whole production process.

6 OUTCOME

Besides decoding significant art work and individual coded work, the long-term output of the work are the books, Decode 1 & Decode 2 (Decoded Art – a Programming Handbook for Architects and Designers). These handbooks contain code examples for two different programming languages: Processing and Python for Rhino 3D. Most examples come from the programming part of the course and the programming outcomes of the students (Processing and Python) that are then optimised for handbook.

It makes sense to build the lectures/courses in a sequential manner so new knowledge can be built on a sound foundation. Focusing on only one programming language can limit one's view when working with complex formal systems, particularly if they are interactive. To demonstrate alternative approaches in task dependency, it is important to recognise programming language differences. With the rising popularity of Grasshopper, a graphics algorithm editor, it is also important to demonstrate the weaknesses and strengths of graphical- and script-oriented methods.

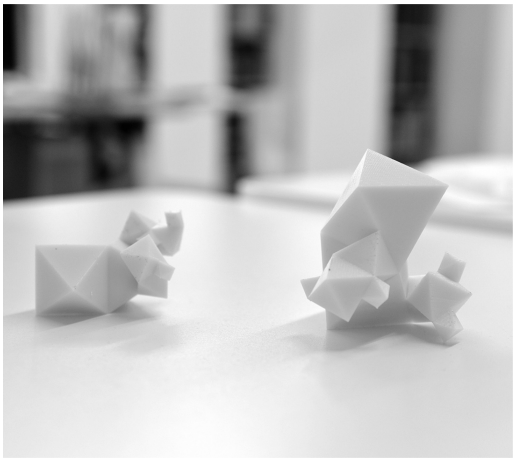


Figure 7. Decode Art: Sculpture – 3D-printed decoded work (student Robert Schwitzky), art by Aranda Lasch.

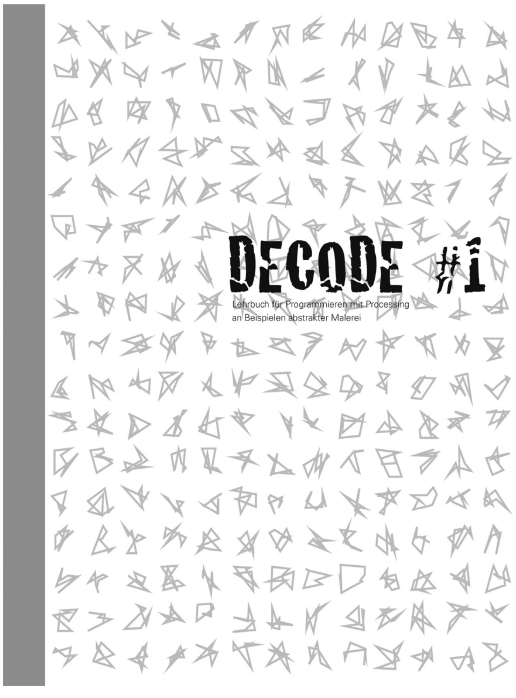


Figure 8. Decode Art: Painting – Programming Handbook.

The main goal of the books is to provide the reader with basic knowledge in programming techniques that will help them solve tasks independently of the programming/modelling surrounding. The code from the book is available on www.b-tu.de, with some additional code examples.

7 NEXT STEPS AND CONCLUSION

Post-course evaluations show that the decoding part of the course was the most demanding (75% of the students declared that it was difficult). Over 40% of the participants are interested in continuing the course towards programming 3D objects. Considering the evaluations, some improvements must be made in upcoming courses; for example, simplifying the examples, and reducing and concentrating on basic scripting principles.

With the upcoming third part of the course, 'Decode Art: Nature', and focusing on regular or irregular forms in nature, the course will emphasis programming 3D-meshes with a graphical scripting tool, e.g. *Grasshopper for Rhino 3D*. This is an entry course to give Master's students basic knowledge in parametric and rule-based design.

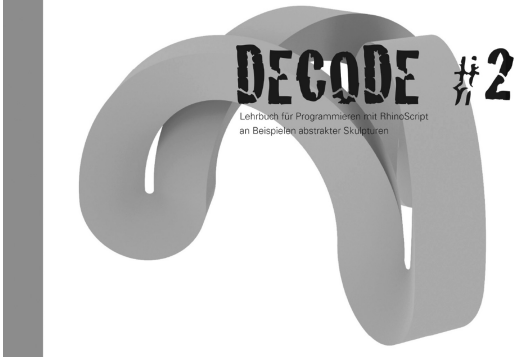


Figure 9. Decode Art: Sculpture – Programming Handbook.

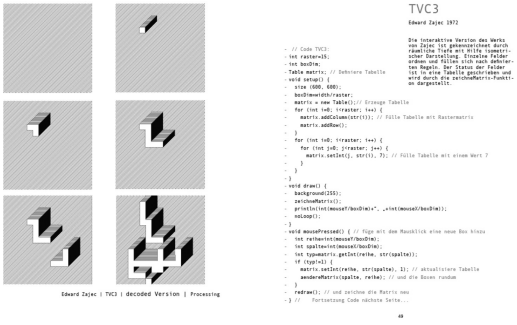


Figure 10. Decode Art: Painting – decoded work (student Martin Lederer), art by Edward Zajec.

Working with art analogies can be a push method for delivering programming abilities to students with no programming experience. The goal is not to make software developers out of architects but to encourage architects to develop programs, work on complex, procedural and generative design, get into computer-controlled production and be able to communicate with software programmers. Quick visualisation results as programming output gives a much better non-abstract approach to this complex topic. Combined with formal decomposition and reengineering of existing artwork in a descriptive and rule-based manner, it is a demanding course, but can provide participants with a basic understanding of how software systems are structured and motivate them towards further investigations in computational methods in architecture and design.

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Exploring learning objectives for digital design in architectural education

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ABSTRACT: What are the objectives of teaching digital design in architecture? While this seems a rather primitive inquiry it in fact is loaded with misunderstanding and disagreement. This paper aims to bring accepted educational research about learning objectives into the discussion of digital design's relationship to architecture. In particular, Bloom's Taxonomy is introduced and referenced as a tool for creating clarity, transparency, and accountability among educators. The purpose of reflecting upon learning objectives for digital design in architecture is not to produce a definitive list of what students ought to learn. Learning objectives are written for specific curricula, student needs, and faculty interests. They are useful because they provide a clear definition of expected outcomes and which becomes a point of dialogue. In order to evaluate something, it first must be named. Through evaluation and discussion, a discipline develops. When Bloom created the learning taxonomy, this was the goal. Not to explain or lay claim to how students must learn, but to provide a shared structure so educators could compare their approaches. In a similar manner, creating and sharing learning objectives for digital design instruction, using established tools like Bloom's Taxonomy, can produce a more organized dialogue about how to align the use of digital tools with the core values of architectural education and the development of the discipline itself.

1 INTRODUCTION

1.1 *Introduction*

During the past 25 years, the introduction of computing and other digital machines into architecture led many schools to consider and make changes to their curricula and courses. However, there is little agreement within architecture departments, much less between schools, on what it means to design digitally, what it means to teach it well, and how this integrates with more traditional methods and understandings of architectural design.

This problem is aggravated because much of architectural education today is what Bruner calls "folk pedagogy", guided by implicit assumptions but not connected with educational theory or evidence beyond one's experiences. (1996) As such, there have been few attempts to to apply peer-reviewed curriculum design strategies and instructional methodologies to the challenge of digital design instruction in architectural education.

In response to this challenge, this paper proposes that defining learning objectives for digital design in architectural education, in connection with established educational and learning theories, can create a productive dialogue and a starting point for evaluating and addressing the challenges of integrating digital design.

1.2 *Pedagogical alignment and the value of digital design*

The lack of agreement and clarity among schools regarding digital design creates problems for the discipline. How can a skillset be taught without a clear definition? And how can the field evolve when there is such contention over education in a critical area? Dialog and common ground are needed.

A key reason for the confusion surrounding digital design instruction in the university setting is a misunderstanding of its educational value as a set of skills beyond technical skilling. In architecture schools, there tends to be a cultural hierarchy that places significant importance upon studio courses as sites where skills are integrated and practiced, and less importance upon supportive technology courses (such as a digital representation course) where those skills are first learned. However, this hierarchy ignores much about how learning functions and how effective learning takes place. A more nuanced understanding of the relationships between digital skills and design processes is needed.

One of the most significant effects of educational research has been to redefine the scope and goals of learning. Decades ago, before the development of contemporary learning theories, schools emphasized developing core skills such as reading and memorizing information such as dates and facts in a history

class. The implicit assumption was that this level of learning was sufficient for students to write reports, solve problems, and produce other sophisticated applications of literacy. However, while many students could demonstrate ability at, for instance, providing the correct solution for a specific type of word problem, educational researchers found that students rarely understood what they had learned, nor could they easily apply their skills and strategies to new contexts. (Clement, 1982) The students knew their lessons by rote and adapted to succeed at their instructor's tests, but they had a superficial understanding of the material. Today though educational models and expectations have evolved, digital technology is often relegated to this type of learning.

While skills and facts remain important to learn, the goal of education today has been restated: to provide students with a foundation of deep learning and the intellectual tools to ask and address meaningful questions. (Bransford, Brown, and Cocking, 1999) In contrast to superficial learning of facts and procedures, deep learning entails knowledge of the underlying principles, domain structure, and strategies to activate skills and knowledge and apply them flexibly in a variety of conditions – particularly conditions which are different from the ones where learning originally occurred. Such as the translation of design thinking from an academic to professional context. Deep learning is what most instructors would recognize as productive and transferable learning yet few courses actually achieve. Architectural studios are examples of a deep learning environment.

In contrast to architectural studios, the current state of digital design instruction in architecture tends to follow an educational model which does not support deep learning. Presently, much of what students learn in technology skills courses is by rote: sequences of commands and procedures intended to produce reliable results. While students can operate software and other tools with what appears to be great fluency, the vast majority do not have a deep understanding of computing or digital media principles (Senske, 2014). As a result, their work tends to be inefficient and derivative. Like the school teachers in the earlier example, digital design instructors emphasize core skills for using digital tools and then expect students to apply them towards design projects. This is the reason a learning gap exists. First, students do not learn the tools with significant guidance to develop depth and rigor; second, they are not taught explicit strategies for applying digital methods to design tasks. Students often fail to develop an understanding of digital design methods because the pedagogy is not aligned with the goal of deep learning. This leads to a frequently cited criticism of digital design: work which is repetitive or uninventive because students are grappling with technology rather than controlling it. The technology does not make it this way – it is how it is used.

This assumes that such a goal is recognized in the first place. Learning digital tools is often seen – by students and faculty alike – as mere technical skilling rather than a way of thinking about design. Professional architectural accreditation (NAAB) in American schools uses a set of learning criteria which specify Ability and Understanding (NAAB, 2014). However, this set of criteria does not address digital design with any specificity. There is no agreement upon the value or content of a digital design education, and so student abilities can vary widely from school to school, and within academic units. Students are less inclined to develop a thorough knowledge of digital design because it is not universally considered a meaningful intellectual and creative pursuit. This not only hinders progress within the discipline, but, in practical terms, it affects the profession. Failure to recognize the principles of digital tools and structures of problems they address makes it more difficult for students to learn and retrain themselves in response to changing technology.

The educational model of the design studio is unique its approach because it has many elements which contribute to the production of deep learning, such as opportunities for synthetic learning, active learning, complex problem solving, and self-reflection and critique. This is precisely the kind of approach that would benefit specialized digital design courses. Unfortunately, the architectural design studio is often seen as one type of learning, while digital design, which is thought of as mere technology, is seen as another. This disconnection is due to a misunderstanding about digital design due to a lack of clearly-defined and shared pedagogical goals. The present situation in education has come about because the implied goal of digital design education is mere tool operation (which does not require deep learning) when the expected outcome should be increased agency and sophistication of design ability.

One way to address the problem of pedagogical misalignment is to develop learning objectives for digital design. Learning objectives have the benefit of being a structured, well-understood, and research-based approach to curricular development. This method informs clarity and represents an explicit way to connect the goal of deep learning with pedagogical execution.

2 LEARNING OBJECTIVES

2.1 *Learning objectives for digital design*

The idea of a learning objective is straightforward, but often misunderstood and misapplied. A learning objective is a specific statement which describes what a student will know (knowledge) be able to do (skills) as a result of engaging in a learning activity. A learning objective must have three parts: a measurable verb associated with the intended cognitive process, the necessary condition (if any) under which the performance is to occur, and the criteria for measuring acceptable performance (this is often implied). A simplistic example of a learning objective that fits this pattern is: "Given a set of contours the student will

be able to generate a topographic model." The condition is having a set of contours and the implied measurement is an acceptable model. Learning objectives are focused solely on student outcomes and do not specify methods or other expectations for the teacher. They are not an attempt to create uniform classroom procedures or hinder instructor creativity through standardization. The teacher has flexibility in their approach, so long as the performance criteria are met. Learning objectives are useful because they help instructors with course planning and the creation of content. Furthermore, the explicitness of properly-constructed learning objectives establishes a basis for student assessment as well as the evaluation of teaching and curricula (Anderson, 2002). A primary challenge of digital architecture evaluation is the lack of criteria and therefore a lack of agreed upon traits for which to evaluate whether digitally produced code, drawings or images are successful.

In this manner, learning objectives support better learning and provide a common framework for schools to organize their efforts at improving education. For this reason, many Universities have standardized their syllabus policies to address learning objectives [see (Vanderbilt, 2016) and (Carnegie Mellon, 2016) for example]. The use of learning objectives may seem obvious or unnecessary if one is only considering their use in one's own syllabi, but in terms of disciplinary alignment, digital design instruction could benefit from the additional clarity offered.

2.2 *Bloom's taxonomy*

A useful tool for developing better learning objectives is Bloom's taxonomy. The taxonomy is a hierarchical framework intended to help instructors coordinate their planning and assessment using a common language (Krathwhol, 2002). It represents the process of learning from acquiring simpler to more sophisticated thinking skills. The general idea of Bloom's taxonomy is that lower levels of cognition support higher levels. For instance, one must understand the difference between different methods of constructing a surface (comprehending) before choosing which surface to use (applying).

In its revised form, Bloom's taxonomy lists six levels of cognitive processes:

1 Knowing: memorization and factual recall
2 Comprehending: understanding the meaning of facts and information
3 Applying: selection and correct use of facts, rules, or ideas
4 Analyzing: breaking down information into component parts
5 Evaluating: judging or forming an opinion about the information
6 Creating: combination of facts, ideas, or information to make a new whole

A more recent addition to the discussion of the taxonomy is the inclusion of types of knowledge. Anderson and Krathwohl addressed criticisms of the taxonomy by recognizing that not all knowledge is equal in complexity and that knowledge tends to be developed from concrete (facts and concepts) to abstract (procedural) and finally to knowledge of one's own cognition (metacognitive). (2001) In concert with cognitive processes, the knowledge dimension of the revised taxonomy enables a more nuanced discussion of learning objectives. For instance, under the newer version, the taxonomy does not progress and stop with creating, but also includes thinking about one's learning progress and how one creates.

Bloom's taxonomy has been criticized because it does not represent the complex and interconnected nature of cognition (Furst, 1981), but the taxonomy was never conceived of as a model or theory. Nor is it a prescription for every course to follow. One could design a course with at least one learning objective at each level. Depending upon the skills required, some levels may need additional objectives. Students with different abilities may be able to begin learning at higher levels. The value of the taxonomy is less that it represents exactly how learning works or that it tells instructors how to teach, but rather in how it helps to organize and align pedagogical thinking.

Educational frameworks like Bloom's taxonomy are not in common use in architectural education. The reason for this is unclear but may derive from a disciplinary resistance to self-articulation. However, for those developing or revising architectural curricula, having access to a set of learning objectives that uses the taxonomy can enable a dialog within the discipline, with other disciplines and educational researchers.

Bloom's taxonomy helps support the goal of developing deep understanding in digital design instruction. One way it accomplishes this is by establishing the basic cognitive processes involved in learning to design thoughtfully. To see all of these steps organized and consider them with respect to digital design is to shed light on what is often an opaque practice. The taxonomy makes it clear that one does not just use or not use various tools, but one must understand them, choose from them, and evaluate those choices as part of a design process. In this manner, an advantage of learning objectives developed through Bloom's taxonomy is that they can elevate student outcomes towards higher-order thinking. (Biggs, 1999) For example, without the proper outcomes articulated, a student might submit a design, but was merely applying a procedure. Bloom's taxonomy makes it clear that creation depends as much on understanding one's decisions (the "why") as knowing the correct commands (the "how" – which is often students' focus). For teachers and students alike, Bloom's taxonomy helps clarify that the goal of digital design instruction is not only to learn how to use digital tools, but to apply them towards better designs and more sophisticated design thinking.

With regards to teaching methodology, the clarity of learning objectives derived from Bloom's taxonomy can help motivate qualities of student performance which are often lacking in digital design courses, such as innovative solutions and well-crafted, thoughtful

representation. As mentioned in the previous section, many learning objectives are not specific enough, sufficiently measurable, or targeted to student's learning level. Bloom's taxonomy can help ensure that students are practicing the skills that they should be learning in their activities and at an appropriate level of cognition. This enables the pedagogical gap between learning digital methods and creating designs to be filled with deliberate (or mindful) practice.

Deliberate practice is a recognized process through which individuals train themselves to high levels of performance. Research has shown that learning of complex skills is most effective when students engage with tasks that are appropriately challenging, with clear performance goals and feedback, and sufficiently frequent opportunities for practice. (Ericsson, K.A., Krampe, R.T. and Tesch-Römer, 1993) The difference between merely making and deliberate practice is that a student monitors their progress towards a specific goal and changes their performance in response to feedback. The student continues to do so while increasing the challenge of the activity to further improve. Learning objectives assist students in deliberate practice by creating specific and appropriate performance goals which they can use to monitor their progress. This guidance directly supports the development of abilities on the highest (metacognitive) level of the taxonomy, which are crucial for sophisticated work and achieving transfer of skills and knowledge to other domains. (Perkins and Salomon, 1992) Thus, the notion of deliberate practice stands in contrast to the disengaged ways that many students learn and use digital tools, which is often oriented towards production for its own sake rather than for quality or thoughtfulness. Introducing deliberate practice is one way for schools to motivate deep understanding and to bring craft back into discussions about digital representation.

2.3 *Creating and teaching with learning objectives*

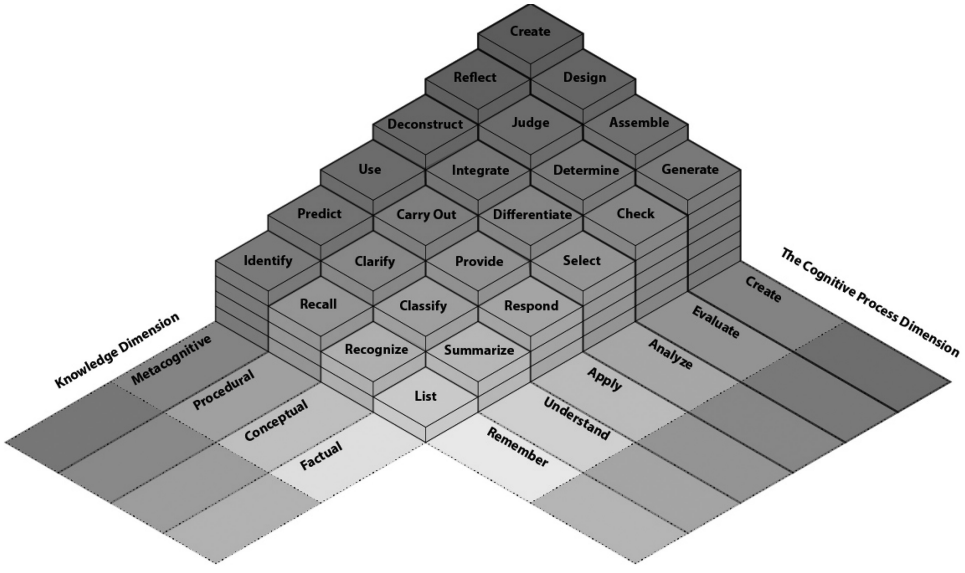
While many digital design courses have learning objectives listed in their syllabi, these are not often used correctly, in response to the findings of educational research. In this section, we propose several ways to make learning objectives for digital design more appropriate and effective.

First, many stated learning objectives do not take into account the learning process for developing complex skills and thinking. As mentioned earlier, traditional digital design pedagogy tends to emphasize learning through design tasks. The tacit learning objective of most activities, ostensibly, is to design something via digital methods. However, this does not acknowledge the steps involved to prepare students for design, such as learning about the tools, practicing methods, comparing and selecting methods, etc. These skills and knowledge are implied by the goal of designing, but by not stating this explicitly, the instructor might neglect teaching and assessing the constituent skills and knowledge that students need, but might not manage to learn on their own.

When developing learning objectives, it is important for digital design instructors to acknowledge how learning occurs as a developmental process. Creativity and autonomy, abilities exercised in design work, are higher order thinking skills. Higher order thinking is dependent upon requisite technical skills and other cognitive resources (Weiss, 2003). As such, these activities may not be beneficial learning experiences for beginner and intermediate students. Research shows the importance of matching learning objectives to student level (Klahr and Nigram, 2004). Novices benefit from direct guidance in basic skills and knowledge, while objectives for advanced students should emphasize synthesis and independence.

Second, many learning objectives for digital design instruction conflate activities and goals with learning outcomes. A goal is a statement of the overall intended outcome of a learning activity or course. Learning objectives are specific achievements which contribute to the goal (Ferguson, 1998). For example, a course description that says "students will be exposed to digital fabrication technologies" has presented a goal, but not stated a specific, measurable outcome. Likewise, a statement such as "students will fabricate a small-scale physical model" describes an activity, but does not provide enough information to discern what students are supposed to learn from the activity. A learning objective that addresses these issues would be: "students will use GIS data to generate a small-scale physical model using appropriate digital fabrication techniques." This objective presents a condition (GIS data), an outcome (the model), and assessment criteria (are the techniques appropriate? / is the model is correct?). Understanding the learning objective helps define the cognitive skill level of the activity and the appropriate assessment. For instance, if the objective was to learn about computing concepts, issuing a quiz with questions about procedures would not be a helpful measurement. To facilitate effective instruction, goals, activities, and learning objectives must be aligned with one another.

Last, many learning objectives as presented do not support a means of formative assessment. Most courses only assign grades for projects, which are typically creative or design work. Again, these are higher order thinking skills and may not be appropriate to assess from novices. Grading project submissions does not give the instructor or the student much opportunity to remediate skills or knowledge that were misunderstood or not acquired. Moreover, feedback on a design artifact may not help instructors and students achieve the goal of deep understanding because it makes conceptual and procedural knowledge indistinguishable from the outcome. Studies have shown that ability to perform procedural tasks does not mean students are able to explain what they are doing or why. (Schoenfeld, 1985) This is not to say that instructors should never grade projects. This is appropriate when the intent is to assess creative work and problem solving, particularly from an advanced class. Learning objectives should measure the correct student outcomes for



Bloom's Taxonomy 1956	Bloom's Modified Taxonomy 2001	Bloom's Digital Taxonomy 2007	Associated Skills	Digital Skills	Communication Spectrum
Evaluation	Creating	Creating	Designing, constructing, Planning, producing, inventing, devising, making	Designing, programming, filming, animating, blogging, mixing, re-mixing, wiki-ing, videocasting, podcasting, directing	Collaborating Moderating Negotiating
Synthesis	Evaluating	Evaluating	Checking, hypothesizing, critiquing, experimenting, judging, testing, detecting, montoring	Blog commenting, reviewing, posting, moderation, collaborating, refactoring, testing	Debating Commenting Video Conferencing
Analysis	Analyzing	Conceptualizing	Comparing, organizing, deconstructing, attributing, outlining, finding, structuring, integrating	Hacking, mashing, linking, validating, reverse engineering, cracking	Reviewing Questioning Commenting
Application	Applying	Applying	Implementing, carrying out, using, excecuting	Running, loading, playing, operating, uploading, sharing with group, editing	Posting Networking Contributing
Comprehension	Understanding	Connecting	Interpreting, summarizing, inferring, paraphrasing, classifying, comparing, explaining, exemplifying	Boolean searches, tweeting, categorizing, tagging, commenting, annotaging, subscribing	Chatting E-mailing Twittering
Knowledge	Remembering	Doing	Recognizing, listing, describing, indentifying, retrieving, naming, locating, finding	Bullet pointing, highlighting, bookmarking, group networking, shared bookmarking, searching	Texting Instant Messaging

Higher Order Thinking Skills

Lower Order Thinking Skills

Figure 1. Bloom's taxonomy was first introduced in 1956 and since then has seen widespread use in instructional design. A revised version was issued in 2001, which changed the levels from nouns into active verbs, added the knowledge dimension, and placed creation (synthesis) at the top of the hierarchy of cognitive process (Krathwohl, 2002). More recently, Churches created a "digital" version of Bloom's taxonomy that updates many its application to computing activities (2004).

the level of the student and in a manner that allows students to respond with changes in their performance.

3 CONCLUSION

The value of learning objectives is not what they add to a syllabus, but rather how they prompt a larger conversation about educational and professional values and standards. Creating learning objectives for digital design in architecture exposes many implicit assumptions about what faculty believe about learning and the role of computing in the studio. At the same time, it raises the bar for architecture schools to consider digital design as more than merely learning to operate tools and software (activities which

are not themselves valid learning objectives) and to instead connect these practices to design thinking and the development of architectural designs.

Bloom's taxonomy assists in framing this discussion about learning to design digitally by offering a structure of cognitive accomplishments for students. This helps re-align architectural educators away from frameworks derived from folk pedagogy and towards established theories and research into educational psychology and learning cognition. Instead of teaching and learning digital skills and knowledge through a hierarchy of the tool's features or increasing complexity, Bloom's taxonomy foregrounds processes of remembering, thinking, and judgment. These objectives are more closely aligned with deeper understanding and integrative mastery. This type of learning is precisely the antidote to the kind of superficial engagement one often finds in architecture schools that prompts negativity towards the use of computing in design.

The purpose of reflecting upon learning objectives for digital design in architecture is not to produce a definitive list of what students ought to learn. Learning objectives are written for specific curricula, student needs, and faculty interests. They are useful because they provide a clear definition of expected outcomes and which becomes a point of dialogue. In order to evaluate something, it first must be named. Through evaluation and discussion, a discipline develops. When Bloom created the learning taxonomy, this was the goal. Not to explain or lay claim to how students must learn, but to provide a shared structure so educators could compare their approaches. In a similar manner, creating and sharing learning objectives for digital design instruction can produce a more organized dialogue about how to align the use of digital tools with the core values of architectural education and the development of the discipline itself. Learning objectives are not only for evaluating one's students or teaching. They help departments and educators understand whether they are teaching the right things. The question should always be: "how does this improve design?"

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The vertical lateral: A model for social impact design education

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ABSTRACT: The Vertical Lateral is an integrated design education model specifically relevant for preparing the next generation of architects taking on multi-dimensional societal and environmental challenges, both locally and abroad. The proposed studio benefits from simultaneous specialist and generalist thinking to link disparate areas of focus both within architecture and also across disciplines external to it. This critical approach is as much about the design of the end product as it is about the interdependent systems and framework that surround it.

This method of design and teaching has been developed over several instances of an architecture course initiated and taught by the author at the New York Institute of Technology. This paper discusses its components, challenges, and outcomes, and positions it within relevant and comparable initiatives, historical and contemporary, alike. The classroom is used as rich testing grounds for these emerging dimensions of social impact practice within our increasingly connected world.

1 FROM 3D TO MULTI-D: A NEW TYPE OF DESIGN PROBLEM

Social impact design is an umbrella of many terms including public interest design, humanitarian design, design-build, bottom-up participatory design, and design for the social good. What all such endeavors have in common is an aspiration to positively affect meaningful change for the masses.

At the very minimum, it is now the responsibility of every architect to confront climate challenges and resource consumption. At the other end of the spectrum, socially-conscious architects are examining complex, multilayered issues ranging from disaster relief to mass migration. Impact design will soon move beyond a separate and distinct subset of the profession. Now more than ever, there is widespread public awareness for the value that architects can bring to everyday people and communities.

1.1 *The 3D design problem*

Social impact design is certainly not new and many design professionals have been committed to such challenges for decades. A typical example of a social impact project may include the design and construction of appropriate shelter in the aftermath of a catastrophic event. An NGO or non-profit might act as a client and the problem at hand comes with a desired architectural and "three-dimensional" physical result – that of temporary or permanent housing. A signed set of contracts between owner and architect as well as owner and contractor specifies a focused scope of work and anything extending beyond is billed as additional services or built into contingencies. The site is pre-determined and the solution is discrete.

1.2 *The Multi-D design problem*

The nature of the social impact design problem, however, has changed. Site and client are sometimes undefined and solutions, no longer local or so discrete. Although such work has always been fraught with challenges, a new "multi-dimensional" social impact design problem has emerged – one that is far less neatly packaged than its "three-dimensional," historical equivalent.

Globalization has fundamentally transformed the world and redefined relationships between nations, communities, and individuals. For example, mass migration is presenting problems both on an infrastructural as well as cultural assimilation level. Dependent on the youth and their ability to secure employment, the means required to sustain growing aging populations in most countries are proving insufficient. Globally linked economies and geopolitical tensions are increasing as food and resource scarcity become real in the face of climate change.

The overlapping and sometimes competing nature of simultaneous forces at play can make the very same problem of a disaster-relief housing scenario described above, far more complex. The now intricate and bureaucratic web of international and local organizations involved can make any immediate and large-scale architectural intervention close to impossible. Successful implementation and long-term impact are not just dependent on a nice design, committed team, and acquired funding. Countless additional challenges exist. How to physically move building materials and construction equipment to a disaster site in the context of failed infrastructure, for example, requires that the initial design problem extend to include these and other dimensions.

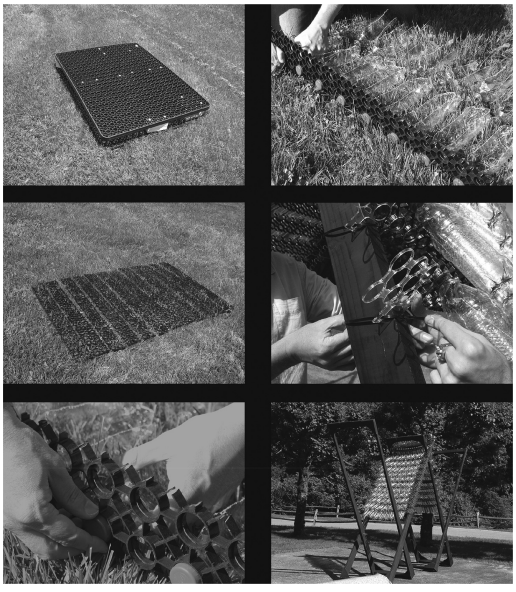


Figure 1. System assembly from shipping pallet to shelter.

2 THE ACADEMY MUST RESPOND

2.1 *The Multi-D at NYIT*

This is exactly what undergraduate architecture students at the New York Institute of Technology (NYIT) realized was necessary when taking on the design and physical prototyping of a kit-of-parts disaster-relief roofing system made of plastic waste. The now patented system takes advantage of the two things that appear naturally in aid delivery – water bottles and shipping pallets. The proposed shipping pallet delaminates and snaps apart into structural purlins. Its inherent offset geometry allows discarded water bottles to overlap and interlock as roofing tile (fig. 1). Hunt, founding director of Parsons' MFA in Transdisciplinary Design, argues that "the ambition is to pick out the feasible solution, the one that makes sense…to identify the inflection point where design will make the greatest change." (Hunt 2015). It was only after careful business planning alongside MBA students and thorough research of aid delivery mechanisms that the architecture students determined the shipping pallet as the point at which design could intervene.

Students at NYIT consider these"multi-dimensional" design problems in a social impact design elective course that the author has developed over several semesters. In another instance of the course, students intervened in an economically distressed community in Puerto Rico. Collaborating with local students at the University of Puerto Rico Rio Piedras, the group researched factors that had led to the area's economic decline and concluded that tourism had decreased substantially due to failing beach facilities. This led students to design and build a modest, prototypical pavilion that could be replicated across the length of the beach to instigate economic improvement and revitalization of the area.

This year, students enrolled in the course are working on a grant supported project for Dakar, Senegal. Although the mobile phone use is now widespread, lack of internet and app literacy keep the use of locally developed apps low. This is unfortunate since this technology can disseminate critical health and agriculture information. The proposed solution is one that complements digital media with a physical place and offers an outdoor classroom for workshop visibility, app feedback station, and charging/wireless hub as public infrastructure. The project aims to create a trustworthy, physical environment where the sampling of humanitarian-based apps increases their use and a direct interaction with local developers facilitates engagement and technology education.

Each of these design problems challenges students to dive deep and to allow appropriate scope, definition, and solution to emerge rather than being established at the onset. The research process undertaken to fully understand underlying and interconnected systems often leads to a redefinition of the problem itself. The right questions are sometimes not the ones we first ask.

2.2 *Social impact design education falls short*

The design problem is clearly expanding and the architectural academy must respond. Social impact design education in architecture has traditionally manifested as design-build studios. Given semester time and logistical constraints, these projects are specific and concise, organized with a real client, site, budget, and program. Students typically engage with full-scale realities by concluding the project with the actual construction of the proposal. While these experiences are, no doubt, tremendously rewarding and valuable, they represent a teaching model that proves inadequate when faced with the more "multi-dimensional" complexities of contemporary socio-economic and environmental problems.

As an alternative, the author offers the Vertical Lateral model for social impact design education. It continues to evolve in light of other challenges, but what is presented here is based on an elective design course she has taught several times in recent years. The very nature of the design problems demanded new ways of working. The model outlines several components as critical: [1] visualization of solutions across scales and within larger frameworks, [2] multidisciplinary collaboration, [3] vertical integration across levels and lateral integration across curricular content, and [4] field work that inspires relationships between local and global contexts.

Like traditional design-build courses at other institutions, students may still work through full-scale construction at the end, but this must be complemented with the detailing of other components that build a larger systemic solution. Learning to work with a client or community may, therefore, occur alongside collaborating with cultural anthropologists, social scientists, or economists.

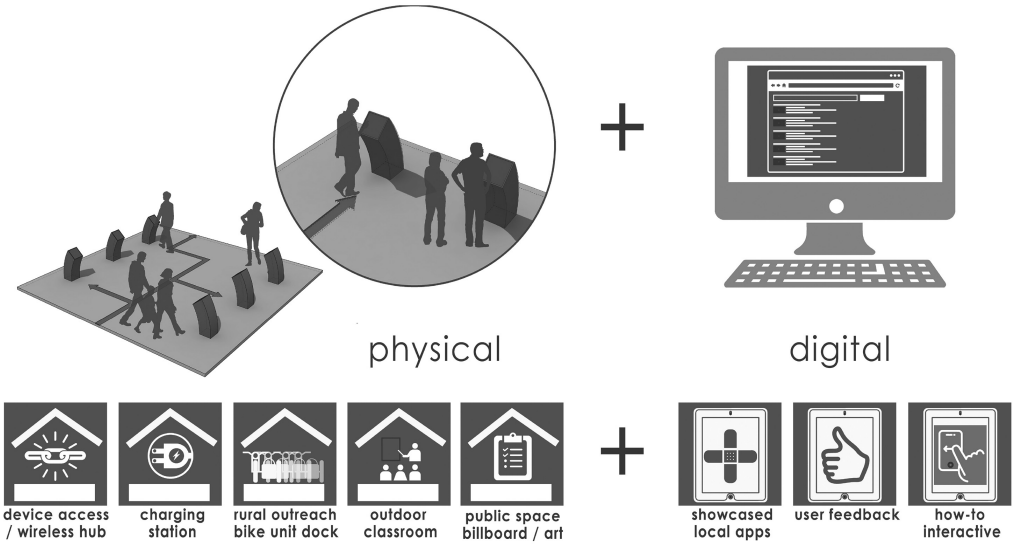


Figure 2. Designing both the means and the end by seamlessly complementing the physical with its digital counterpart.

3 THE VERTICAL LATERAL MODEL

3.1 *Larger frameworks*

In *Good Deeds, Good Design: Community Service Through Architecture*, an "operative practice" is defined as one whose end products of design positively transform the cultural and socio-economic frameworks within which they operate (Pearson 2004). What if this is *also* considered in reverse? Perhaps designing the framework can in turn, inform a better designed intervention. "Edison understood that (his invention) the lightbulb was little more than a parlor trick without a system of power generation and transmission to make it truly useful. So he created that, too." (Brown 2008).

Maybe, we, like Edison, should be designing the *means* and not (just) the *end*. The design of a disaster-relief roofing system made of upcycled plastic waste is only valuable if a system for its delivery is in place and also designed. The design of a public pavilion in an economically distressed area outside San Juan, Puerto Rico is only valuable if its community embraces it and allows it to cultivate urban-scaled change. The design of an outdoor classroom to promote smartphone technologies in rural Senegal, Africa (fig. 2) is only valuable if the digital content it offers can be seamlessly integrated with the physical structure, itself. In each case, students at the New York Institute of Technology realized that an architectural solution is only one piece of a larger scheme. By asking students to design the *means* in tandem with the *end*, new challenges associated with the larger framework emerge that frequently re-set the parameters of the architecture and vice versa. Reframing the problem across scales and beyond a singular client and singular site yields a richer, more comprehensive proposal.

The author believes that widespread social impact can only be achieved at the intersection of architecture and its framework. This framework includes not just a supporting infrastructure of water, sewage, energy, and transportation networks, but also local environmental, cultural, and socio-economic contexts. Studying the site goes beyond typical architectural considerations of adjacent built environs and target user groups. By strategically exploiting the loopholes of an existing framework or modifying one simply, a modest architectural intervention has the potential to act as a catalyst for systemic change.

3.2 *Multidisciplinary collaboration*

No single discipline's domain is sufficient to consider the interconnected layers of these multi-scaled, multi-dimensional problems at once.

At Temple University, students from various courses in architecture, landscape, urban geography, and fine arts work simultaneously, but separately and at different scales for different areas of concern within the design problem. It is at moments of "boundary-crossing" that the teams come together to negotiate implications of each other's work. These conversations "reveal economic, political, and cultural issues that are often excluded from dialogue framed by the studio or classroom situation," (Harrison 2007, 41).

At the New York Institute of Technology, the author is experimenting with a slightly messier form of multidisciplinary collaboration, where participating students are not necessarily limited to allied professions and where collaboration overlaps from the start and continues cohesively throughout. "As a way of working and thinking, design sits between the two poles of science (which observes the facts of the material world) and the humanities (which interprets the



Figure 3. NYIT architecture and Pace computer science students discuss design concepts, both physical and digital.

complexities of human experience)…Design is a culture that blends concerns…to search for outcomes that are balanced and opportunistic, grounded in the real world, but driven by human aspirations." (Boyer et al. 2011, 25). Hence, the dialogue in the author's courses at NYIT commonly bridges between architecture and industrial design; fine arts and applied arts; and infrastructural design and economics.

Most recently, her undergraduate architecture students worked hand in hand with graduate computer science students from Pace University to develop a holistic solution to promote mobile phone technology and app adoption in Senegal, Africa. To ensure long-term success, the project requires the design of a physical space (outdoor classroom, charging station, and wireless hub), but also the design of a digital space (how-to educational videos, sampling of apps, and user-developer feedback system). While these can be designed separately with parceled scopes of work and meetings at key scheduled points, the course examined the possibilities of working together throughout.

The students enjoyed shared brainstorming sessions and found the collaboration extremely helpful in developing a more seamless user experience. Discussions led students to confront issues of scale, dust, security, and even operational cost financing. This weekly dialogue (fig. 3) resulted in an innovative solution where a custom, lightweight, modular door and window system would securely house and display all the technology needed for the project. This system is designed to also detach from the masonry structure of the classrooms to act as a mobile bike-driven cart for additional rural outreach. What was most compelling about the collaboration was that students of each discipline were able to not only design within their scopes of work, but also participate and immerse within the design process of the other. For example, the architecture students mocked up branding/logo concepts and screenshots of potential website flows while the computer science students made full-scale physical mockups of the equipment and smart devices that would be integrated into the architecture. The aesthetics of the digital interface inspired the design of the physical building and vice versa. It was exciting to see the kind of meaningful design insight that can result through hybrid discussions in this grey space of discipline overlap.

3.3 *Integration*

The majority of architecture schools establish degree maps and prerequisites that require students to follow courses in sequence and per level. This structure separates courses into categories including design studios, visual media, history and theory, and technology. Given the credit weights assigned to these courses, a common distinction between studio and "support" courses results – these "other" courses somehow offering skills critical for design, but not necessarily participating at the onset of design. These academic divisions in both levels of students and areas of focus, of course, are false to the way we work in our profession. In practice, junior and senior designers commonly work together and "supporting" topics are not applied to, but rather are inherent to the very process of design and making. Any engagement with a real-world problem, then, must embrace a more synchronized approach.

The Vertical studio is a tried-and-true model in architectural education. It combines upper-level students with beginning students to create peer-to-peer learning and unexpected outcomes. In the proposed Vertical Lateral studio, this "vertical" component proves instrumental to its success given that tasks routinely range from the conceptual to the very technical. The NYIT elective course is open to upper level and beginning design students, alike. With an equal and shared level of investment and commitment, the group comes together and relies on individual strengths to participate in everything from setting up an infrastructure for social media marketing and crowdfunding to developing full-scale prototypes and construction details.

Laterally, the Vertical Lateral studio erases typical studio vs. non-studio separations to allow representation, technology, and construction research to drive design opportunities. In the case of the project in Senegal, students spent the semester researching local materials, traditional building construction methods, and passive environmental strategies to develop a solution appropriate for its site. They began with rigorous precedent studies and scaled wall section models and followed with interviews of project architects to learn firsthand about the challenges associated with building in West Africa. This research led to a series of 1:1 full-scale models of roof, wall, and foundation details.

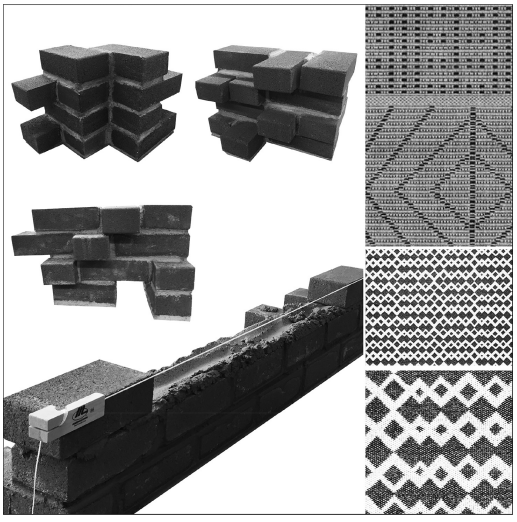


Figure 4. Full-scale brick wall mockups inspired by Senegalese woven mat patterns.

Students confronted the technical challenges of working with actual materials including wood, concrete, reinforced steel, bamboo, brick, concrete masonry unit block, and thatch. Details experimented with a number of passive environmental strategies including the use of breathable roof membranes, a double roof with vented cavity, and angled brick screens for cross ventilation. Historical and cultural research concurrently immersed students in local customs, colors, and forms of expression. To cite just one example of how these areas of focus overlapped in design, students chose to develop a series of brick wall patterns inspired by the geometries found in Senegalese woven mats. Building these as full-scale mockups, they also tested structural integrity and offered potential for cross ventilation (fig. 4). Such integrated thinking continued in developing the full project, where students relied not only on programmatic and site demands, but also on constructional logics from day one.

3.4 *Field work*

Finally, the Vertical Lateral model recognizes that our societal challenges inherently overlap in our increasingly connected world. In each instance of the social impact course taught at NYIT, students engaged in problems that while sited elsewhere (disaster site in subtropical climate, beach and camping grounds in Puerto Rico, and public space at the outskirts of Dakar), could certainly have implications for how we engage similar problems locally.

Miles away from the sites, students adapt with innovative digital methods and social media that demonstrate that meaningful work can be done across geographic boundaries while remaining specific to local needs, climate, and culture. Students use videoconferencing to hold meetings and workshops with the local end users so that community surveys can be distributed and design ideas can be presented for feedback. In some cases, students also travel to the intended sites for on-the-ground field work. For example, the NYIT students spent their Thanksgiving break building their proposed community pavilion in San Juan and current students intend to visit Dakar this summer to meet with local stakeholders and take on the next steps for design development.

Given that the architecture profession now routinely involves distant regions, these experiences prepare students for the kind of virtual client meetings and collaborative design practices they will, no doubt, encounter in their careers. Their solutions are relevant across borders and can also be easily rethought to work right at home.

4 ARCHITECTS MUST EMERGE AS LEADERS

4.1 *Non-designers adopt "design thinking"*

Despite the architecture profession's growing interest in service engagement, it is essential to note that the schools of *other* disciplines are the ones rapidly leading such efforts, surprisingly, often at the *exclusion* of architects.

What is most curious is that most such initiatives identify *design* as a critical component in confronting these global issues. Broadly labeled as "design thinking," non-linear and iterative problem solving strategies are infiltrating curriculums around the world in a wide range of disciplines, from biomedical engineering to social sciences. Both the MBA in Design strategy at California College of the Arts and the Masters in Design Management at the China Central Academy of Fine Arts, for example, offer design courses to augment analytical business and market tactics with creative thinking. At the Stanford D School, a step-by-step methodology to design thinking begins with questions of what, why and how, and follows with interviews, empathy maps, brainstorming post-it note sessions, and prototyping. These steps echo the kind of methods recommended in numerous how-to-manuals and community design toolkits that guide social impact processes at human-centered design consultant firms like IDEO and Frog.

While forms of such "ideation" are clearly becoming commonplace, any architect would agree that what these buzzwords represent do not come close to what it is that we, as designers do and how we do it. Alongside a very particular way of approaching problems, our creative processes are also rooted in the proper training and rigorous mindset of a formal design education, making us valuable contributors to any social impact design problem.

At the University of Virginia, Crisman had to work hard to convince her non-design colleagues to introduce architecture courses within a new interdisciplinary major in Global Studies. She questions, "Is architecture excluded because the physical world is often undervalued in the humanities disciplines that

typically form the core of global studies: politics, history and economics? Climate change, sea level rise, rapid urbanization, disaster relief and development, human health, sustainability and other supranational phenomena examined in global studies research are all connected to how we physically inhabit the planet. The way that architects approach problems using design thinking, speculative research and participatory design can greatly contribute…" (Crisman 2015, 615).

4.2 *Specialists vs. Generalists*

An architecture education *can be* very specialized. This may reinforce a perception by others that we are only relevant when it comes to the design of a building. "A closed loop is set up whereby the profession designates knowledge which architects must possess... students are taught according to set content – which in turn prescribes what architects do, design buildings, and the buildings in turn become constituents of the professional knowledge." (Awan et al. 2011, 43). At the same time, however, architects are great generalists. We have an ability to approach a problem from many different perspectives and can apply our skills to any given program, scale, and location, irrespective of complexity or intended physical result.

While the built environment is clearly central to the issues we face today, an architectural solution may not always be immediately apparent, nor appropriate. Regardless, architects are well poised to lead community-engaged and on-the-ground interventions that are otherwise often wrapped in bureaucracy, number crunching, and political debate. Consultancies taking on multidimensional problems have become known for seeking "T-shaped" people who have a deep core of technical abilities along with collaborative and managerial instincts (Hall 2011).

Arguably, architects are *best suited* to lead cross-fertile exchanges, given our ability to act as both specialist and generalist, at once. While we maintain a deep knowledge and craft within our discipline, we are unique in our generalist ability to shift between the disciplinary/autonomous to cultural/contextual and between parts (detail) to a whole (system). Architects can additionally use visual communication skills to invent common language between disciplines as varied as cultural anthropologists and climate engineers. An inability to speak to one another is often the greatest challenge when sharing in collective expertise.

Any such multifaceted collaboration is no different than an orchestra of specialized musical instruments. Each instrument must be in sync with its own kind, but also in harmony with its counterparts, regardless of whether their roles are in discord with one's own. The musical piece that results has common purpose and its impact is greater than any one individual part. While the architect may recede as a supporting instrument, he is equally able to rise as conductor of the entire production. It is important that we reaffirm the value we bring and capitalize on the growing interest in design within other disciplines to develop more meaningful forms of cross-disciplinary collaboration.

5 ACADEMIC CONTEXT: PRESENT AND FUTURE

5.1 *The structure of universities*

According to Georgetown University's Vice Provost, Randall Bass, "(future) schooling will become more interdisciplinary. Instead of a degree in biology, emerging fields will combine biology and global health, or neuroscience and entrepreneurship. The concept of the major will erode into something that looks like an overall portfolio with a bunch of microcredentials that speak to a whole range of strengths." (Hullinger 2015). In line with this thinking, MIT Prof. Christine Ortiz recently announced that she plans to create a new research university in Massachusetts that will "prioritize project-based learning, where students learn by working together on a challenge for an extended period of time…with no majors, lectures, or classrooms." (Mohdin 2016).

With the onset of massive open online classes (MOOCs), it is clear that education and its delivery will change drastically in the next ten to fifteen years. Able to access narrow subject area content on their own, students will look to face-to-face university settings predominantly for experiential and project based education. Interestingly, it is within architecture schools that structures for such opportunities are already in place.

5.2 *The structure of architecture schools*

Project based opportunities in architecture exist primarily within a single design-build studio or course. In 2008, faculty at the University of Minnesota experimented with a restructuring of their entire program. A traditional architecture curriculum of design studio and support courses in the fall was followed by a decentralized and vertically mixed set of project-based workshops in the spring. Each distinct form of instruction positively affected the other (Cheng 2014).

Although this model is exciting and should be explored further, it and any other such overhaul is not without many challenges. A real project comes with timelines that most often do not fit neatly within the constraints of semester schedules. Multidisciplinary collaborations with other schools or external professionals are difficult to coordinate given legal and monetary considerations. The rigid format of degree program requirements and a faculty compensation tied to contact hours make such project-based experiences far easier to logistically organize as extracurricular activities or within the context of a single course.

Additionally, for accredited university programs in the United States, the National Architectural Accrediting Board (NAAB) sets stringent criteria that would make the structure proposed in Minnesota unfeasible. On the other hand, in 2014, NAAB revised its conditions for accreditation to mandate that schools include evidence for "D.1 Stakeholder Roles in Architecture: *Understanding* of the relationships among key stakeholders in the design process—client, contractor,

architect, user groups, local community—and the architect's role to reconcile stakeholder needs" and for a new perspectives in "E. Community and Social Responsibility…A program's response to social responsibility must include nurturing a calling to civic engagement to positively influence the development, conservation or changes to the built and natural environment." (NAAB 2014). These requirements signal a need to invent new paradigms for architectural education in light of the global challenges that await our graduates in the workplace.

5.3 *Where does the vertical lateral approach fit in?*

Architectural education must not lag behind. *Can* and more importantly, *should* social impact design education fundamentally change the way we teach architecture? Or is it more appropriate to introduce this integrated approach and project-based curriculum on the sidelines?

Historically, architecture education has been shaped by a number of strong schools of thought – first, by the École des Beaux-Arts in France dating back to the mid-1600s which focused on representation, typology, and classical arts and later, by the Bauhaus in Germany in the early 1900s. Experiments in integrated design curriculums can be traced back to the Bauhaus at Weimar, where Walter Gropius first set up a dual teaching system of workshops co-taught by a Werkstattmeister (workshop master) and Formmeister (form master) in an attempt to remove the boundary between architecture and craft. In 1928, Hannes Meyer recognized the conflicts that came from having two directors within a single course. At Dessau, he replaced the system with teachers that had a double qualification as artist and artisan. While this was a stronger program, it resulted in what is most heavily criticized about Bauhaus pedagogy – a foregrounding of technical considerations of mass production and a marginalization of the arts (Wick 2000, 39). One might argue that a design curriculum driven by service learning or architecture-led multidisciplinary partnerships might also lose sight of core building design instruction. This exposure of many things can dilute the profession and result in students not knowing how to actually design.

Emphasizing any one set of skills over another has always been the cause of debate in architectural education, whether it is form in relationship to function, technology in relationship to design, or digital representation in relationship to analog. Rather than maintaining a dogmatic approach or replacing one methodology with another, it is far more productive to see the curriculum as a fully synchronized system, where techniques are considered simultaneously and comparatively to have a positive impact on design.

At the New York Institute of Technology, the author has introduced social impact topics specifically within the context of a single elective design course. Where appropriate, however, she underscores the components of her proposed Vertical Lateral approach (systemic, multidisciplinary, and integrated thinking) in the other courses she teaches and throughout the curriculum. Beginning with traditional groundings in form, proportion, and order, it is important that as projects increase in complexity, a more integrated dialogue be layered into courses rather than be thought of as add-ons or replacements for these foundations. Richer and more comprehensive solutions can result, preparing students for the kind of team-based collaborations they may encounter in practice.

Apparent in the work they pursue post-graduation, in their independent thesis topics, and in the commitment they show to community-based projects, architecture students are increasingly aware of the role that design can play in "real-world" issues. It is imperative that we offer our students lateral and comprehensive ways of thinking in our increasingly connected world. In this exciting time of change and promise, the way our students learn and become architects must radically adapt.

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Designing education in the digitally preformatted age

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ABSTRACT: Departing from the historical and contemporary references to social behavior that induce acts of creativity, the paper discusses the importance of using workflow and interactions between humans, software, and hardware to challenge conventional applications of technology while succumbing to social play—an act of learning fuelled by personal insight and collective thinking while exploring creativity via gaming tactics. All this with the intention of lacing analog and digital means of production to generate multiple outcomes. This pedagogical approach; where the learning sphere has become an interrogative platform for testing/playing with representational technique along with the how and why aspects of it, are discussed and ultimately suggest that we begin to address an educational model as inclusive of design+ing–making and thinking design.

1 INTRODUCTION

According to Google search stats and news media from the NY Times, the number of DIY spaces is, flourishing (Kurtz, 2013). Although, we recognized these types of places are not just situated in garages or basements of desolated towns; they are now spots for social interaction, located in urban spheres among bars, restaurants, and coffee shops. City hackers and tinkerers with knowledge or ability to resurrect equipment, favor these locales from which they intake a daily dose of social intoxication. Such emergence is also believed to parallel English coffeehouses of the 17th and 18th century, where customers would congregate in the hopes of gaining a first class education for the price of one caffeine shot (Johnson, 2011). Indeed, while these physical spaces where once considered incubators of knowledge, the expectation that such specific settings single-handedly promote innovation, is challenged, and one would even argue that this popularized trajectory has clearer understanding of DIY spaces may signal the sedation of ideas.

For this reason, within the pragmatism of these environments, we are attempting to recondition the places and methods of practices where the opposite of sedation is forged and where meditative processes are nurtured. Here, our initial focus was to engage in deep learning, in deciphering how adaptations of obsolete technologies interlace physical and virtual domains; of exploring how resourcing to systems capable of becoming flexible models can equally engage machine and humans; and of experimenting with how to develop new learning environments. The spaces, program, and equipment used challenged our current understandings of what constitutes creative working spheres: ateliers, workshops, coffee shops, design studios or maker-bars. It reinforces the contention that creativity is not reduced to a singular location; it happens anywhere, and in this digitalized era our work underscores that it happens at its best when social behaviors are capitalized on.

2 IN_ACTION

Our research differs from using tools as prescribed. Instead, we are constructing additives, [customized devices] to combine with obsolete equipment like CNC's, 3D Printers and Cameras. The intent behind our design approach is to uncover effective methods for repurposing machines and enable new productions of drawing mechanics. As such, this is a design approach with distinctly opposite agendas than the normative one currently exerted at maker-bars where pieces of equipment are regarded as a functional tool rather than a potential instrument for inquiry. Our concern, therefore, is in testing the grounds to ignite and visualize a new culture of making that stems from asking the following: How can we intervene in established sequences of existing machinery and how can we develop diversions that alter the prescriptive behavior of the equipment?

To start, we presupposed that equipment packaged to perfection is unsustainable. Foremost, because as we move design intentions forward, we regard the nature of standardized equipment as an open port that can receive additives, adaptable parts and newly design instructions formulated from social and digital interchanges. Accordingly, the significance of the work lies in the additives embedded in the machine and in recording imprecise/precise tactics while playing, futzing, hacking or tinkering with CNC machinery. Such actions might seem rebellious against digital standardizations but in actuality, they represent a quest for lacing analog and digital productions to achieve unique outcomes while succumbing to social play.

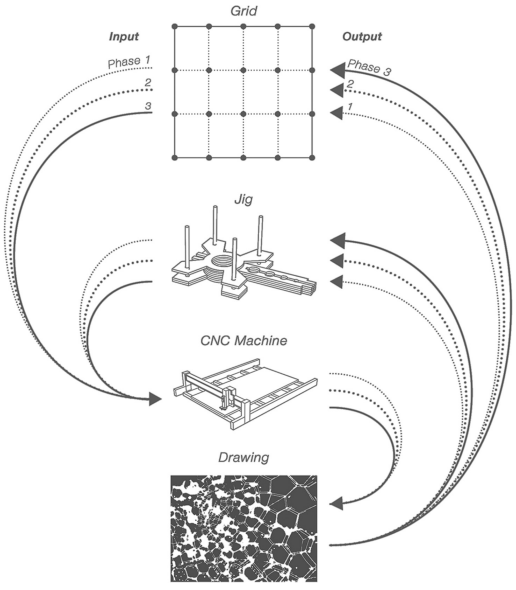


Figure 1. Grid, jig, machine; drawing loop.

This research, therefore, focuses on a problem-based approach that interferes with conventional formatives of studio-based design assignments. Here program based projects were suspended to underpin the initial shift from product-oriented thinking to design oriented objectives. It ignited the testing grounds for creating additives as extensions that interfaced with the axis of preformatted machinery like CNC routers. Subsequently, the work puts into question the deterministic behavior of digital receptors and its equipment. In this scenario, the additives undoubtedly re-conditioned the inherent qualities of both the machine as well as the design goals of human's. Together they afford a new form to examine performance-based studies resulting from tool design and its ability to generate iterations stem from productions and reproductions of combinatorial two & three-dimensional work.

From this inquiry, the work is based on a series of experiments aiming at creating a collective consensus within the studio. One that forges a new learning mandate, triggered by the realization that infinite series of interactive processes and decision-making opportunities could occur between what the machine was preformatted to do and what the human could intellectually, socially and actively alter. A true manifold of events that links information with the physicality of making drawings. In this approach, the customization and adaptability of designing a jig became a direct response to the production of a cyclical design process. (Fig.1)

3 METHOD

The mechanics of the work, like historical permutations of artist and architects, follows the understanding

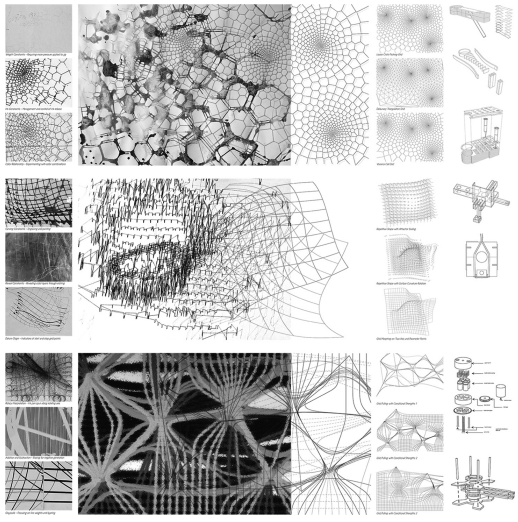


Figure 2. Matrix of Jig, grid, and drawing.

that technologies are often repurposed to alter predictable outcomes. Consequently, the work presented exemplifies the processes and functions we implemented with an interdisciplinary group of design students charged with the task of using a workflow of interactions between humans, software, and hardware.

The format for this undertaking was initially based on a series of challenges simulating a master chef competition that limits equipment and materials to its contestants. The intention for us was to formulate a gaming based agenda, introduce it and then allow it to stir a collaborative dynamic that would set the initial stage to heuristically forge the collective of players who would engage the school's fabrication lab in discovering how to produce unpredictable outcomes.

Beyond these initial task, the sequential exercises were formatted to encourage each team's engagement in communicating ideas and providing revisions interactively and in real-time. Such imposition allowed each team the flexibility of working at whim, anytime and from any place. This means that participants would be motivated to work from remote stations such as their home, the studio, lab, or other wifi arenas. The goal was not to diminish physical interaction but rather to afford all contributing members a richer understanding about interactive collaborations and about producing a series of digital drawings and models that would inform their making process in the absence of spatial confinements. (Fig.2)

4 THE ADDITIVE

The use of a three-axis Shopbot, where varying speeds and directions generated different moments of contact and legibility in the physical delivery of the digital coding to the surface, determined the legibility of the media on the drawing surface. In using diverse types of software to draw, model and build,

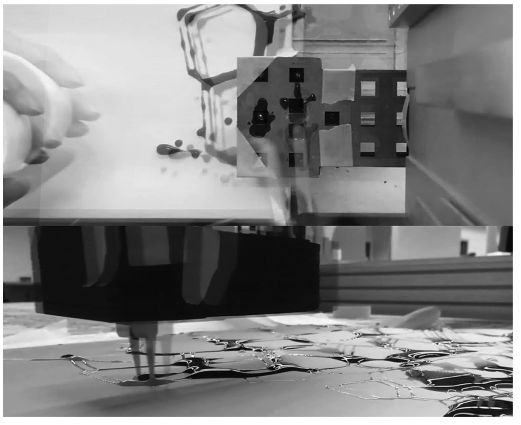


Figure 3. The act of machine drawing with customized jig.

the charge for each team was to imagine and compose unique additives as extensions of the CNC tool. In translation, all teams designed jigs, which needed extensive testing to ensure that they attach safely to the machine's tool head and that it could withstand the rigor of movement; speed and torque imposed by the new design condition—the repurposing of the toll head. Maintaining consistent results with various media types, dynamics of movement and rigidity of the jig, informed additional design decisions related to material strength, weight, and method of attachments. This also forwards attention to how the detailing of media receivers and the machine's tool head must be synchronized to work. After several design iterations, the customized jigs afforded us opportunities to test rapidly and prototype the performativity of the tools. Many of these jigs were reconfigurable and capable of additional rotations along specific XYZ axis and, as a result, these alternatives challenged our ability to control the behavior of the equipment. In time, these auxiliary axes augmented the prescriptive interpolations of non-linear directions and unveiled the manifold potentialities of the jig as an instrument and its latent potential to generate un-prescriptive outcomes. (Fig. 3)

5 THE ANALOG

The analog elements consisted of brushes, pens, blades, and custom dispensers for either liquid or sand. These are referred to as the inscribers, allowing for the passage and recording of information. They ultimately depict the characteristics of originality and uniqueness that each jig posed. However, together, the tool head, jig, and media behave as one synchronized operation against the medium (the drawing surface) and causing multiple diversions. Each gesture often resulted in the instruments inability to deliver marks on the surface. Admittedly, the inability to perform was due to the interlacing of tools and media, which required constant calibration. The most obvious derailment

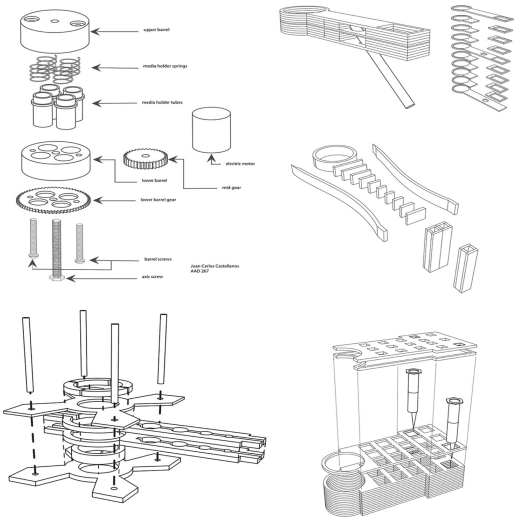


Figure 4. Jig as a media holder; from top clockwise; Spin, Crayon, Spider, and Drip-jigs.

among the variables and constraints erupted from their unpredictable performances and lack of durability, longevity, and dispersal, requiring refilling containers of either ink or sand to complete the drawing without interruption. As such that with each variation a reevaluation of the relationship between media and medium occurred as the parameters of pressure, legibility, or dispersal differ respectively from one jig to the other.

In this regard, testing the relationships between mixed media and medium did not solely rely on the machine interface or its capability for holding multiple drawing tools but in reconfiguring the CNC tool head. This process, in turn, produced unexpected abstractions from generated scripted dialogues between machine, code and surface. We were then able to test these interactions without the constraints of machine parameters and to experiment with the depiction of fundamental drawing methods. Ergo, combining precise tactics of machine coding with the organic delivery of drawing media has generated unexpected outcomes that we recorded, analyzed and refined through both changes in digital coding, jig enhancements, and media adjustment.

These productions are currently unreeling original outcomes that clearly demonstrate how intervening in established sequences of operations introduces new potentials to divert the original behavior of the machine in ways that every printed iteration can be understood as an authentic original drawing. (Fig. 4)

6 ITERATION

Our jig fabrications and their ability to add new drawing mechanics to the standardization of digital fabrications begins to mark a return to the concept of seeking originality as understood by Renaissance masters—artistic simulacrum, where painting

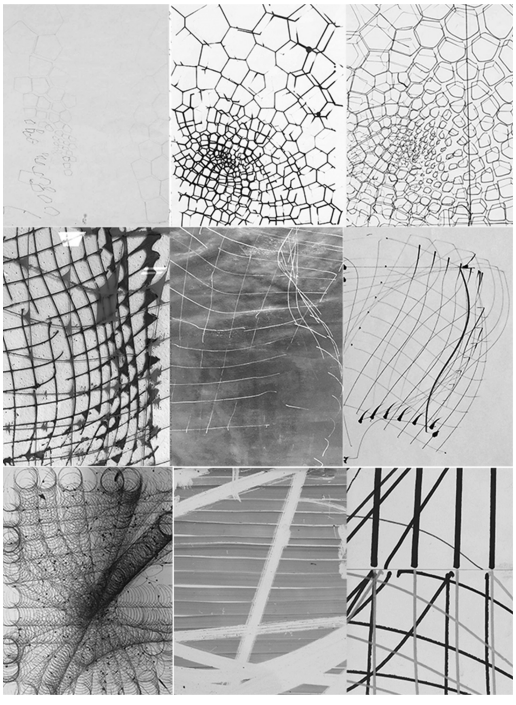


Figure 5. From top; drawing iterations with Drip-jig, Spider-jig, and Spin-jig.

are sometimes created by copying a photograph that is itself a copy of the real (Massumi, 2015). The uniqueness of this thought lies in the combination of the parts. Hence, each drawing unfolds new challenges and opportunities to refine and develop infinite outcomes using a process-based approach. The transition from traditional representations techniques—drawings, to mechanical performance demonstrates how the adaptability of feedback loops becomes repetitively iterative—a process enhanced through the assessment and interpolation of data. (Fig. 5)

7 DRAWING

From a digitized perspective, the procurement of these drawings is assumed to be simplistic yet, these series of exercises add manifold levels of re-understanding design processes. First, they are processed that are elemental to the potentials inherent in learning. In how to modify standardized computer-controlled equipment one is analytically looking at the parts and mentally configuring the steps require. Second, they are digital-analog explorations that are not to be confused with learning to customize robotic tools or with learning to script codes. Third, they are disruptions to predetermined rules. Additionally, noting these distinctions is important because our efforts seek to embed prefabricated tools with the possibilities to produce infinitely flexible and dynamic outcomes; even when the instructions stem from a single G-code file.

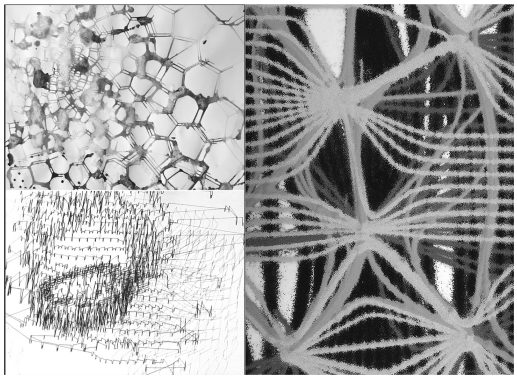


Figure 6. From top left clockwise; inscribing with ink, sand, and magic marker.

In part this body of work attempts to introduce designers to re-engage with drawings and making of ideas using workflows that allow for a cyclical feedback loop approach to help attune one's ability to see the benefits of design investigations.

It is through this experimentation and by repurposing standardized tools that a matrix of constraints and opportunities established by explorative drawing methods that designers might shift from automotive workflows towards new processes that re-explore the opportunities of conventional fabrications. Indeed, these are innovative and rational lessons allowing us the possibilities to reexamine the complexity of our built environment. (Fig. 6)

8 OUTCOME

The research work we have outlined in this presentation has yielded a twofold outcome; one that is about social interactions and the other of cognitive impact on design thinking. Important to note is that it could not have been possible to attain optimal results unless the technology around which play is orchestrated—the jig, become instrumental by its capacity to perform—make drawings. As such, the work rendered was made possible by connecting static and non-static elements to pre-programmed artifacts. This linking approach is not new but similar perhaps to how Jackson Pollock's paintings are said to be about __ technique, and where technique is just a means of arriving at a statement (Herschel, 1984). For us, however, the technique is a way to forge broader understandings about the interplay between humans, code, machine and that which will emerge out of social play. It is precisely in these repetitive moments that observing and documenting how reassembling occurs, that we have come to realize that intentional alterations become innate, and practice becomes strategic-a method to analyze strategically and calibrate previous implementations of interplay. That we believe is the basis of our experiment and that which separates any DIY place from our current studio environment as it is where manifold networks are

working together and collaborating in larger structural objectives.

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Side note

Much appreciation and thank you to all students in 2nd-year design studio of Fall 2014 at UNLV, SoA, who played fairly and with rigor to succeed. Special gratitude for openness goes to our colleagues at the School Architecture, especially to Assistant Professors; Jonathon Anderson and Josh Vermillion whose support and feedback was paramount to the success of this work.



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How CAAD is changing society's role in architecture

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ABSTRACT: It is a modest four decades since the potential for the application of computers to the design of buildings was first realized by a few academics who are still alive. The author is one such! This presentation provides an outline of these four decades but with an emphasis, not on how the technology facilitated the 'production' of the architectural process, more upon the 'product' i.e the *quality* of the designed artefact. Specifically, the relationship between *the objective* criteria – cost and performance - and the *subjective* criteria – aesthetics, cultural significance, etc and on the relationship between design decisions and their consequences.

1 CONTEXT

In October 2015, the ACADIA conference was held in Cincinnati, Ohio. Some one hundred plus mostly young people heavily committed to CAAD, attended. Dr Robert Ash presided over a panel discussion ' Pioneers of Design Computation' It featured Don Greenburg arguably the father of computer graphics, Chuck Eastman, arguably the father of BIM and the current author – Tom Maver, who in the mid sixties struggled to develop primitive computer software to predict how design decisions – the geometry and construction of the buildings – might impact on their capital cost, their recurring costs, their energy performance (heat, light sound), their efficiency in pedestrian movement, their evacuation in emergency and in every other aspect of their cost and performance. The one hundred plus people accorded the panel a standing ovation – some welcome recognition that early endeavours were both welcome and worthwhile.

Four decades earlier, the issues were alive yet problematic. Notwithstanding the intellectual aspirations, the computational competence was truly primitive. In order to communicate a 3-D built form to the computer one had, in the language Algol, to;

- Type in the X,Y,Z coordinates of every vertex.
- Identify those coordinates that terminated an edge.
- Identify those edges that constituted a surface.
- Identify those surfaces that constituted a volume.
- Identify those volumes that constituted a building.

Figure 1 shows an example of a punched paper card, one of many thousand, required to represent the simplest of buildings. One alternative, no less problematic, was hundreds of meters of punched paper tape.

Figure 2 shows how a simple built form had to be encoded and Figure 3 shows how a primitive teletype terminal was best able to output representations of plan forms.

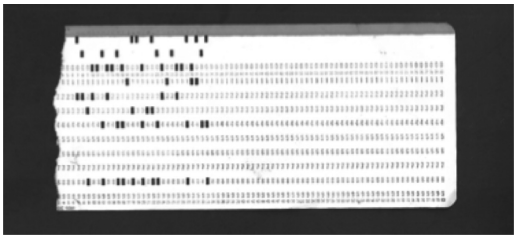


Figure 1. Punched paper card with part torn off to make a roach for a ciggy.

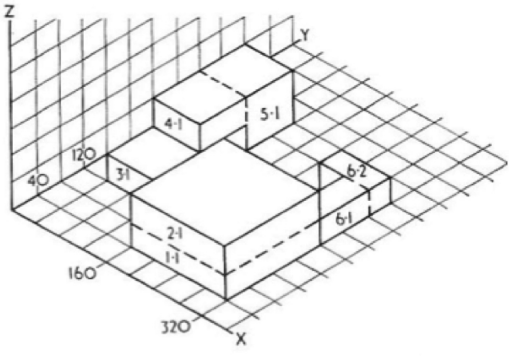


Figure 2. A preliminary drawing prior to inputting the vertices to the computer.

2 ISSUES

From the earliest and the most primitive steps in CAAD the issues were clear.

The architectural profession had its heart set against CAAD. Whereas architectural students would invite the few pioneers in the field to speak about the emerging techniques, quite frequently tutors would attend to revile the speaker.



Figure 3. A primitive output from the computer of a floor plan.

The worry was that computers, dealing solely with the measurable characteristics of buildings – capital costs, recurring costs, heat, light and sound, movement – failed to address the non – measurable characteristics – most importantly the aesthetics of the building and its cultural significance. The consequence, so the profession believed, would be soulless 'boxes'

Those struggling to develop the technology took a different view. The argument (one that was poorly articulated) was that the ability to predict the myriad *objective* characteristics provided a knowledge base that could inform judgements on the *subjective* characteristics. The degree to which this is the case is addressed in the concluding part of this paper.

3 EVOLUTION OF TECHNOLOGY.

The research group set up by the author at the University of Strathclyde in 1969 – the Architecture and Building Aids Computer Unit, Strathclyde (ABACUS) – was one of a handful in Europe and North America to wrestle with the primitive computer tools available at that time and progressively contribute to the development of the hardware and software that is now known within the broad field of Information and Communication Technology (ICT) as Computer Aided Architectural Design (CAAD).

In ABACUS the thrust of the software development was driven by a seemingly simple diagram (Figure 4) in which a design for the building – its geometry, construction and location- was described to the computer. A set of algorithms, based on the laws of physics and economics would then be applied to the design as it was subjected to the vagaries of yearly climate and functional usage. The output would be the histogram of the consequential cost and performance characteristics – capital costs, recurring costs (for heating, lighting, maintenance) energy consumption (heat and light) etc; ie all that could be measured with an acceptable degree of accuracy. This histogram and how it varied with changes to the design hypothesis, would (certainly could) inform the direction of the evolution of the design exploration.

The deceptive complexity of this view of the design activity is that the relationship (particularly the rate of change) between the wide set of cost/performance variables is highly dynamic. For example, changing the area of glazing, say, to the south façade of

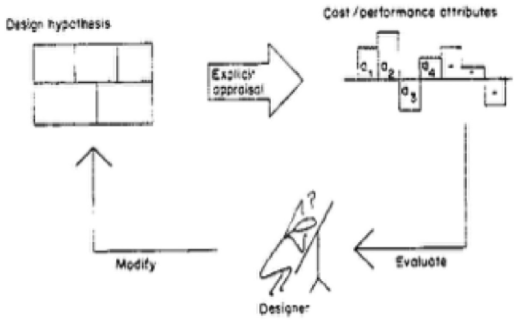


Figure 4. The early concept diagram of how a computer model might produce cost and performance output.

the building alters virtually *all* the cost/performance characteristics. This relationship is *a priori* unknown and can only be discovered as the explicit design investigation is explored.

Although the expression was not applied at the time (circa 1970), it is now clear that what was being created was a *virtual prototype* – as opposed to a *physical prototype* – on which design refinements could be applied.

The earliest publication of an account of the application of such a virtual prototype, deploying the most primitive computer technology (pre -graphics, pre online etc) was entitled PACE: a Package for Architectural Computer Evaluation (Maver 1972).

The difficult though rapid evolution from PACE to the current state of the art, over the exciting four decades, has yet to be properly recorded. However, at the ACADIA Conference in Cincinnati in October 2015, the panel session 'Pioneer of Design Computation' (Maver 2015) brought a standing ovation from the 100+audience of mostly young people and, more importantly a commitment to tell the story in order to extrapolate the future.

Nonetheless, the key development can be summarised as follows.

- The evaluation of 'back and white' (actually green and yellow) computer graphics introduced by the US company Tektronix in its iconic 4010 terminal; changes to a simple plan form requires the image to be erased and then redrawn.
- Encoding of the laws of perspective geometry to allow representation of 3D 'wireline' views of buildings and the subsequent development in BIBLE (Building with Invisible Back Lines Eliminated)
- Introduction of colour graphics to allow the first (embarrassingly crude) colour images of buildings.
- Visual Impact Analysis of constructions in the urban or rural landscape. The representation of alternative electricity transmission routes has moved from an innovative PhD thesis to software free on most PCs.
- The advancement in scale from the representation of individual buildings to the entire city scapes (Maver 1987)

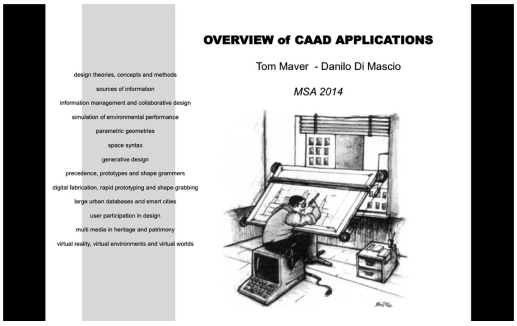


Figure 5. A summary of the current state of the art of CAAD.

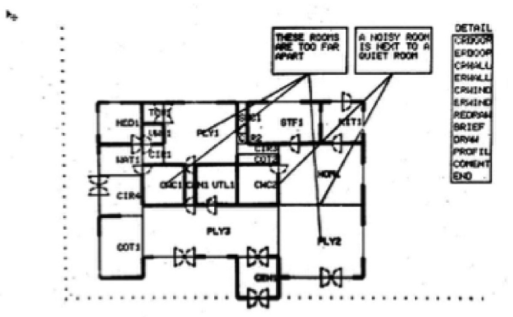


Figure 6. The work in progress for a nursery school teacher.

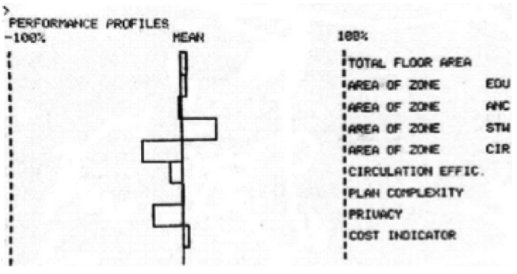


Figure 7. The simple feedback to nursery teacher.

- Animation: the change from stop – frame film-based technologies, set up to run all night, to real time dynamic inter – action.
- The huge increase in the sophistication of the modelling of the dynamic thermo-fluid behaviour of building as they respond hourly and annually to weather and climate (Clarke & Maver1991)
- The application of multimedia software that help to explain our built cultural patrimony
- The evolution of virtual reality and virtual worlds.

4 CURRENT STATE OF THE ART

The current state of the art of computer aided architectural design (CAAD) has been summarised, Figure 5, in the document authored by Maver and DiMascio (Maver & DiMascio, 2014). The areas of application, some well established and some still emerging, are:

- Design theories, concepts and methods
- Sources of information
- Information management and collaborative design
- Simulation of environmental performance
- Parametric geometries
- Space syntax
- Generative design
- Precedence, prototypes and shape grammars
- Digital fabrication, rapid prototyping and shape grabbing
- Large urban databases and smart citites
- User participation in design
- Multimedia in heritage and patrimony
- Virtual reality, virtual environments and virtual worlds

Given the increasing enthusiasm of our able undergraduate and postgraduate student cohort, we can anticipate an increase in the acceleration of the development of this area of architectural evolution. Yet – a central question remains.

5 DESIGN PARTICIPATION

Despite the thrilling advances in ICT and CAAD the fundament issue remains: how to deal with the value judgments that surround the subjective matters of aesthetics and cultural significance. After four decades of rapid development, the view of the author is unaltered: our ability to predict the *objective* characteristics provides the basis to inform the value judgements of the *subjective* characteristics. The question is *whose* value judgements?

Such was the confidence of at least one of the pioneers and a few far-sighted research fellows - that, in the longer term at least, the capability of the users of buildings, powered by increasingly intuitive CAAD software, would allow design participation.

The author persuaded the UK (then) Social Sciences Research Council (SSRC) to fund a study involving Nursery school Teachers in the design of a modestly sized school for which there are already was standard professionally designed and existing options. The ABACUS team developed the Partial (PARTicipation In Architectural Layout) suite of relatively simple computer programmes based on the Tektronix 4010 Graphics terminal. Partial 1 allowed the research team to define the design problem (the brief). Partial 2 allowed some 20 + teachers to create a single storey geometry and construction (with feedback) while Partial 3 recorded the design history of each participants design progression. Elaborate histories, both graphic and auditory, were catalogued (Smith & Watts 1979).

Figures 6&7 illustrate stages in the evolution (and feedback) of one participant's design exploration.

The research team was sufficiently encouraged by the fact that each and every nursery school teacher produced a feasible design within the pre-set constraint to go on to form teams of teachers who were then tasked with working towards a design that represented the best

possible compromise amongst the individual design options. Without exception, despite initially favouring their own design, the member of each design team found a composite scheme that all participants ranked above their own individual scheme.

The team then conducted two important controlled evaluations, with the following results.

i When presented with a number of design options, architectural tutors were unable to distinguish the design quality between those designs created by professional architects and those collaboratively created by nursery school teachers.

ii When (presented with the same set of options, nursery school teachers in another city wholly unaware of the background to the test, universally ranked all the scheme designed by the teacher above those of the professionals.

The final report to the SSRC captured the research team's thrill at these results. Regrettably, the SSRC review committee deemed the work to be too interventionist and declined to support if further.

6 CONCLUSIONS AND THE WAY FORWARD

It is undeniable that the rate and scale of development of ICT and CAAD specifically, over the last four decades has been quite extraordinary, but what of the issues?

Surely the concern that the application of computers would somehow result in all buildings ending up as boring boxes has well and truly been dispelled. Indeed, there is over-whelming evidence that our ability to 'test' design options, has promoted design innovation thereby increased variety in design solutions. A significant number of recently constructed and revered buildings could not have been designed and built without the application of computers.

This would suggest that the aesthetic and cultural characteristics, far from being neglected, are at the forefront of design thinking and that value judgements are, indeed, being given the attention they demand and deserve.

But *whose* value judgements? In section 5 of this paper, considerable evidence is presented to show that, in a relatively simple building type, the users can make seemingly positive contributions to the design evolution.

It is not suggested that this contribution in any sense supplants the expertise of the professional architect, but it is suggested that involvement in the design process, supported by the appropriate computer tools, allow the value judgments of user participation in building design is one of society's most important challenges.

7 ACKNOWLEDGEMENTS

The author gratefully acknowledges the contribution made by over 100 young people who came and went as research students and fellows, in the 40 years of the existence of ABACUS. He also thanks his current employee - The Mackintosh School of Architecture, Glasgow School of Art for its moral and financial support in presenting this work.

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Evaluating the veridicality of two-dimensional representations of three-dimensional architectural space through physiological response

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ABSTRACT: This paper presents research on the perception of three-dimensional space in two-dimensional media, and the methodology and results of a pilot study comparing the eye movements of architecture students when looking at different modalities of spatial representation. The results of this study show that student designers' physiological responses vary with different representation modalities.

1 INTRODUCTION

Architects design with varying modalities of representation, including sketches, drawings, physical models, and digital models. These representations may serve to assist architects in the development of design concepts (Schön 1992), or to communicate design intentions to the client and/or future users. The built work that results from a design process is a new configuration of spaces and forms that humans respond to both emotionally and physiologically. But how does the built work compare with its earlier representations? All modalities of spatial representation are abstractions of physical space and are therefore subject to interpretation. Since graphical representations are the most common form of representation of space during designing, it is important to know what the implications for the designer are when representing space in different graphical modalities. The research outlined in this paper is part of a project which aims to relate physiological responses in the embodied experience of the built space with the responses evoked when looking at architectural representations. This research could have substantial implications for our design process as architects and our pedagogical methods as architectural educators, in our challenge to bridge the divide between concept and built work.

Little empirical research has been done on the human physiological response to space and spatial representations. This project is a cross-disciplinary investigation involving researchers in architecture, computer science and psychology. Our research questions include: How veridical are these spatial representations? Do physiological responses to modalities across a participant group demonstrate consistencies? Are there cultural differences in physiological responses? Can physiological responses to space as represented in various modalities of architectural representation be correlated with physiological responses to physically inhabited space?

For the purposes of this pilot study, we narrowed our focus to pose the previously unexplored question: with the increasing application of computers in architectural design, what is the effect of different modes of digital representation on designers? With this pilot project we aim to produce evidence-based results about designers' physiological responses as they are exposed to two different modalities of spatial representation.

This pilot study utilized eye tracking to collect physiological data, comparing responses to different spatial representations. Through the collection of eye tracking data, our aim was to test our preliminary hypothesis: that physiological responses vary with representational modality. Building on the research paradigm of Scene Perception (Rensink 2000), researchers have been interested in how designers look at scenes. Experiments typically present the scene on a computer screen, allowing for a high level of control over variables of the scene (Holmqvist 2011). Our pilot study follows this methodology. From the analysis of the relationship between designers' eye tracking data and different modalities of representation – perspectival line drawing and photograph - designers' responses to spatial representation will be presented and compared.

The remainder of the paper presents a brief background to architectural representation, spatial perception and eye tracking. This is followed by the research

aim, significance and research design. From an analysis of the eye-tracking data, results are presented and analyzed, and broader impact discussed.

2 BACKGROUND

2.1 *Architectural representation*

Architectural drawings are understood as referential and non-autonomous; they are representations of architectural space and form. Plans, sections, and perspectival views typically follow discipline-specific conventions for representation. These drawings may specify the building, or they may depict it: defined as notational or imaginative drawings by Sonit Bafna (2008). This distinction accounts for the drawing-as-instruction, as well as the drawing-as-provocation. According to Bafna, "Richard Wollheim has argued that depictive seeing activates a special mechanism that he termed 'seeing-in'; faced with such pictures one cannot help but see figures within them despite knowing full well that they are just marks on the surface." Wollheim claims that we simultaneously perceive the drawing as an object, and the objects and spaces depicted within the drawing, with a "two-fold sense of perception" (Bafna 2008). While the intent of the imaginative drawing is not to evoke the experience of the building depicted, it is meant to provoke a "mode of attention," allowing for an engagement with the representation that allows for multiple readings (Bafna 2008).

With photography, however, there tends to be an assumption that it is an unbiased presentation of the space. Yet understanding the content and spatial implications of a photograph is a learned ability, and the photograph is, like a drawing, an abstraction of the architectural space. While studies comparing different cultures have shown no difference in perceptual organization, "the interpretation of perceptual material may differ considerably between two cultural groups" (Weber 1995). For example, African aborigines could not recognize anything in photographs they were shown. Two-dimensional representations of three-dimensional space requires interpretation which "relies on acquired visual conventions that may be as arbitrary as linguistic conventions" (Weber 1995). Photographs are authored and abstracted depictions of architectural space in the same manner as drawings.

2.2 *Spatial perception*

The ambiguity inherent in any architectural representation of space is a characteristic of spatial perception as well. Rudolf Arnheim emphasized the relative nature of perception, describing perceptual experience as being an aggregate of natural and manmade objects. This aggregation forms a "spatial framework" that causes visual percepts to "contain more than what is given in the physical stimulus pattern" (Arnheim 1977). In other words, our experience of an architectural space is influenced as much by the relationships and tension between architectural elements as by those elements themselves.

A related theory of spatial perception was developed by Michael Benedikt. Benedikt's isovist theory helps designers to evaluate visibility within or from a space from the vantage point of an occupant, considering the physically bound space in comparison with what can be visually perceived. An isovist is the volume of space visible from a given point (Benedikt 1979). Oliva et al. (2011) also studied the representation of the shape of visual space. In their study they critique the isovist theory of spatial perception for leaving out other characteristics of space such as texture, material and color that contribute to the human perception of space. They also propose a model called the "spatial-envelope representation," which describes qualitatively the character and mood of a physical or pictorial space, represented by its boundaries (e.g., walls, floor, ceiling, and lighting) stripped of movable elements (e.g., objects and furnishing). Then they proposed a formal, computational approach to the capture of the shape of space as it would be perceived from an observer's vantage point (Oliva & Torralba 2001, 2006, Oliva et al. 2011). The collection of properties describing a space in view is referred to by the authors as the spatial-envelope representation. This distinction in the characteristics that contribute to the human perception of space pertains to our research into representations of space that include or exclude some of those characteristics.

2.3 *Eye tracking*

Eye tracking data includes fixations and saccades, based on movement of the fovea. The fovea represents less than 2 degrees of the visual field, so the eye must move, or *foveate*, in order to take in detailed information (for example, in areas of an image with complexity). When the eye stops to take in information, this is called a *fixation*. The rapid movement of the eye from one fixation to another is called a *saccade*. During saccades, the eye is effectively blind: visual information obtained by the eye occurs during fixations, thus making fixations the most valuable data collected through eye tracking (Holmqvist 2011).

As early as the 1930s, psychologists were interested in how the eye moves and fixates when focused on a work of art. Guy Buswell (1935), a psychologist who invented the first non-intrusive eye tracker, found that the eyes do not follow edges, but tend to scan and focus on central concave areas. More recent studies confirm that fixations are likely to occur in concave and enclosed areas of a figure, rather than in what is perceived as negative space (Weber 2005).

Yarbus (1967) was another pioneer in eye tracking research, who found that the eyes move in different paths when looking at an image depending on the task the observer was asked to complete (Fig. 1).

Kaufman & Richard (1969) measured eye fixation times in several pre-defined parts of figures. The results show that the center of gravity is an attractor as are the edges and corners. Gould & Peeples (1970)

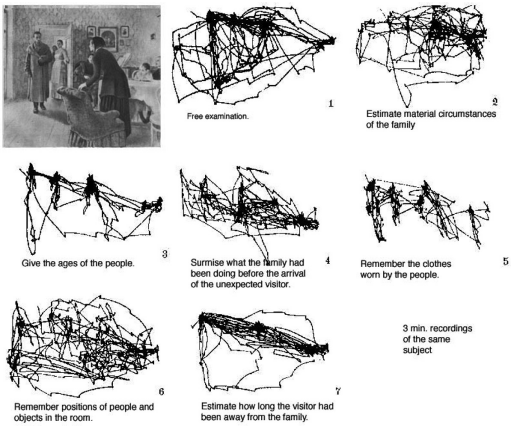


Figure 1. Eye tracking experiment by Alfred Yarbus in which participants were given a series of tasks while looking at Ilya Repin's painting 'An Unexpected Visitor' (Yarbus 1967).

suggest that a subject's interpretation of a figure does not affect eye movements, which means that only physical attributes have influence on the eye movements. Torralba et al. (2006) proposed visual attentional guidance through an experimental search task. Results of their study suggest that the context information plays an important role in object detection and observation. They also suggest some parts of the scene attract more attention than others.

While the relationship between eye movement and perception of artworks has been investigated, there has been very little study on the role of eye movement in the perception of three-dimensional architectural space. One of the few studies on this topic was conducted by Weber et al. (2002) in which they collected eye tracking data as participants were asked to look at three-dimensional models, or photographs of models, of architectural space. These models were constructed to collect data on the perception of the following architectural issues: empty space; symmetry vs. asymmetry; left and right reversed; obliquely-oriented elements; vista; and foreground. The research focused on comparing different arrangements of objects within a space, rather than different methods of representing the same spatial configuration. Their results showed that, with no priori model in a figure, the attention would fixate at the center; while the foreground was common for initial fixations, the eye did not typically scan the edges of interior space or rectilinearly-oriented contours; the objects on the left attract more attentions than the ones on the right. This confirmed the results by Arnheim (1985).

The study also concluded that fixations did not vary significantly when viewing the three-dimensional model compared with a photograph of the model, with the exception of the foreground, which attracted greater attention in the 3D model.

While these studies did not consider cultural background in their data analysis, a 2005 study by Chua et al. tested the hypothesis that those from Western cultures (in this case, American participants) have a tendency to look at focal objects, while those from Eastern cultures (in this case, Chinese participants) tend to look more at context and background. This hypothesis was confirmed by their study. The question of possible cultural differences in eye movement also arose in our study.



Figure 2. Eye tracking experiment setup by authors. This photo shows the setup at HIT in China; a similar setup was used in Charlotte.

3 PILOT STUDY

3.1 *Research design*

To test the preliminary hypothesis that physiological responses vary with representational modality, we set up an experiment that measured eye movement in response to spatial representations. In this experiment, 22 third and fourth year architecture students at UNC-Charlotte (UNCC) and 30 third and fourth year architecture students at Harbin Institute of Technology (HIT) in China participated in this pilot study.

During the experiment participants were asked to complete demographic questions regarding their gender, age, and first language. They were required to look at two images shown on a screen (Fig. 2).

The first image, labeled R1 (Fig. 3), is a computer generated perspective drawing. The second image, labeled R0 (Fig. 4), is a digitized photograph of the same space when built.

When participants looked at the images, their eye-tracking data were recorded by an eye-tracking system (Gazepoint in USA and Tobii studio in China).

Each of the images was shown for 20 seconds with a few seconds for recalibration in between them. Half of participants were first shown R1 then R0. The other half was first shown R0 then R1. After each image session there was a questionnaire session. Data collected included eye fixations and saccades.

3.2 *Results*

Four metrics of eye movement data were captured during the experiment: Time to First View (secs), Time

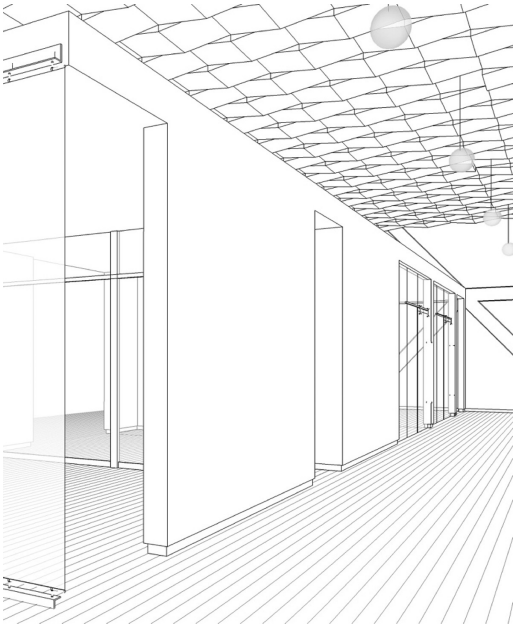


Figure 3. Computer generated perspective drawing (labeled R1 in the experiment).



Figure 4. Digitized photograph of the same space (labeled R0).

Viewed (%), Fixations, and Average Revisits. Time to First View measures how long it takes before a test participant fixates on an active AOI for the first time. Time Viewed (%) is the percentage of time viewed within

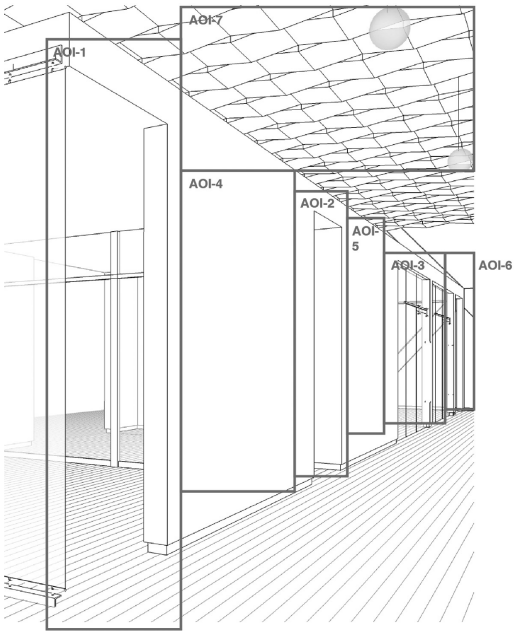


Figure 5. Seven Areas of Interest labeled AOI 1 through AOI 7 in R1; they occupy the same positions in R0.

an active AOI of the total viewing time – 20 seconds in this experiment. Fixations measure the number of times the participant fixates on an AOI. The Average Revisits measures the number of visits within an active AOI. A visit is defined as the time interval between the first fixation on the active AOI and the end of the last fixation within the same active AOI where there have been no fixations outside the AOI.

We identified 7 Areas of Interest (AOIs) in the visual scene presented (Fig. 5). Each AOI defines an area that we wanted to gather data about. AOIs defined the three doorways, the two wall surfaces between them, the terminus of the corridor and the ceiling.

Figure 6 gives a graphic example of the type of data collected: scan path and fixations for one participant are mapped to the images R1 and R0.

There were no significant differences in the results based on the order of viewing of the images.

Table 1 shows the averages of the four metrics for the data of the 7 AOIs in Image R1. Table 2 shows the average for each of the four metrics of eye movement data of the 7 AOIs in Image R0.

We next determine whether there are statistically significant differences between these two representation modalities. Table 3 presents the t-test results of comparing Image R1 to Image R0. Statistically significant differences are marked with an asterisk.

4 DISCUSSION AND CONCLUSIONS

4.1 *Analysis of results*

The results of eye-tracking measurements are discussed initially in terms of the architecture students'

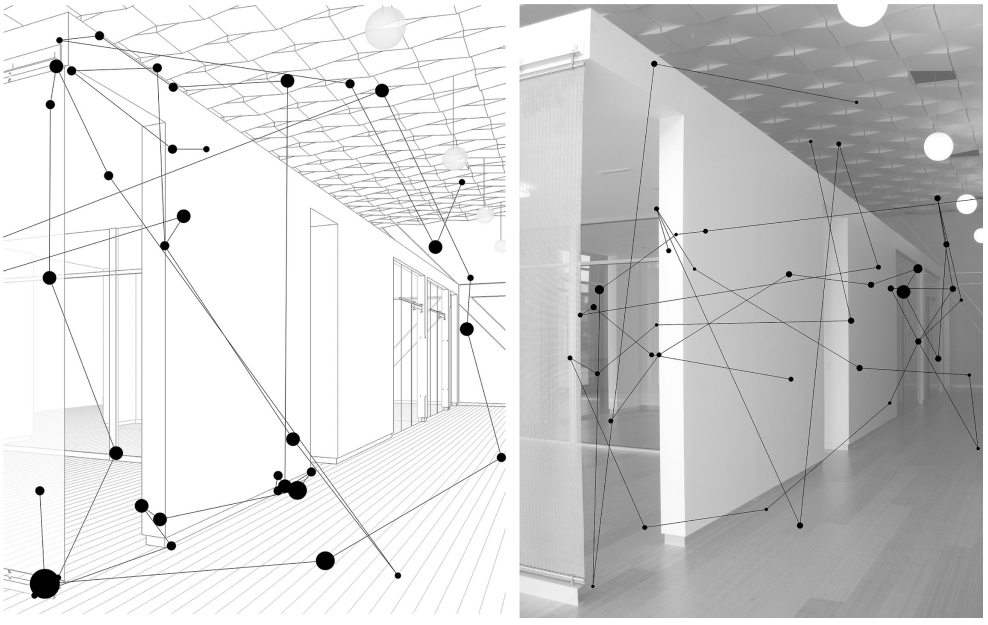


Figure 6. Example of scan path and fixations on R1 and R0.

Table 1. The average of eye-tracking data of 7 AOIs in Image R1.

AOI	1	2	3	4	5	6	7
UNCC students							
Time to First View (secs)	2.84	4.39	2.04	3.50	2.98	3.70	1.14
Time Viewed (%)	14.68	3.61	9.90	4.07	2.66	3.56	12.74
Fixations	12.58	5.18	10.18	6.09	5.55	4.64	13.60
Average Revisits	6.00	4.30	7.73	5.20	5.30	4.80	7.30
HIT students							
Time to First View (secs)	1.16	3.18	0.95	1.44	2.79	5.93	2.50
Time Viewed (%)	24.06	7.05	21.43	6.04	2.10	6.62	12.10
Fixations	19.61	5.87	11.83	6.30	1.83	4.97	9.70
Average Revisits	6.78	4.03	7.10	4.40	1.63	2.97	4.30

Table 2. The average of eye-tracking data of 7 AOIs in Image R0.

AOI	1	2	3	4	5	6	7
UNCC students							
Time to First View (secs)	0.86	3.24	2.31	1.71	4.13	7.83	2.16
Time Viewed (%)	22.16	3.00	10.12	4.06	2.79	4.51	8.49
Fixations	19.71	4.78	9.52	5.52	5.13	4.70	8.48
Revisits	8.13	4.10	6.70	3.95	4.95	4.00	4.46
HIT students							
Time to First View (secs)	0.53	4.63	2.34	0.76	3.70	7.27	4.86
Time Viewed (%)	28.51	5.82	14.48	6.58	3.08	4.21	8.99
Fixations	28.70	5.93	12.17	8.47	3.83	3.97	8.77
Revisits	8.73	3.80	6.77	5.27	3.30	2.83	3.93

behavior when viewing each image. This is followed by a discussion comparing the results of the eye-tracking measurements for both images to determine whether different modalities of digital representation produce different physiological behavior in the viewer.

The results in Tables 1 and 2 show how students allocated their cognitive effort. For example, from Table 1, we can see that the participants from both UNCC and HIT have the longest time viewed in AOI 1, largest average revisits in AOI 3 and the most fixations on

Table 3. t-test of Image R1 compared with Image R0.

	p values						
AOI	1	2	3	4	5	6	7
UNCC Students							
Time to First View (secs)	0.001*	0.558	0.661	0.188	0.412	0.049*	0.224
Time Viewed (%)	0.031*	0.635	0.760	0.888	0.803	0.388	0.234
Fixations	0.042*	0.861	0.895	0.814	0.900	0.799	0.123
Revisits	0.062	1.000	0.621	0.393	0.832	0.478	0.165
HIT Students							
Time to First View (secs)	0.001*	0.204	0.030*	0.633	0.400	0.353	0.029*
Time Viewed (%)	0.028*	0.267	0.009*	0.633	0.154	0.067	0.026*
Fixations	0.003*	0.960	0.873	0.633	0.015*	0.359	0.631
Revisits	0.002*	0.751	0.667	0.633	0.007*	0.820	0.591

*$p < 0.05$

AOI 7, AOI 1 and AOI 3. The least cognitive effort is allocated in AOI 2, AOI 5 and AOI 6.

There are two possible reasons for the longer time spent viewing and fixating on AOI 1. Firstly, participants may have been attracted by the relatively more complex spaces in a spatial figure: AOI 1 is an open door through which they could see a glass wall inside the room, as well as spaces behind the glass wall. When a designer is trying to understand the space, he/she will be attracted by this kind of complexity. Also, fixations tend to occur within a contained figure, rather than in the perceived negative space. While the white architectural volume sits as a figure in the larger space depicted, its two-dimensional representation causes the white wall to be perceived as negative space. (The contour becomes part of the figure it encloses, rendering the ground boundless.) Secondly, AOI 1 is located on the left hand side of the image, and according to study of Weber et al. (2002) and Arnheim (1985) the left side of a composition attracts more attention than the right. AOI 7 is the ceiling, which contains some complex structure, therefore it attracts the attention of the participants.

The most revisited is AOI 3. This may be because compared to AOI 1 it is relatively small and distant so that participants need to revisit to try to understand the space. The least attention is directed at AOIs 2, 5, and 6 possibly because they are relatively simple areas.

The results in Table 3 indicate differences in three of the four eye movement measurements. Time to first view, time viewed and fixations were all statistically significantly different when viewing the computer-generated line drawing perspective compared to viewing the digital color photograph for AOI 1, which is the first AOI to be viewed in the digital photograph but is only the third AOI to be viewed in the line drawing perspective. Interestingly, AOI 1 had the highest percentage of time viewed for both modalities, while there was a lack of congruence for the other three measures.

The results from this study additionally imply the following:

- Architectural students expend more cognitive effort on the relative complex spatial representation areas, as well as the structurally complex parts.

The complex spatial representation areas such as AOI 1 naturally attract more attention probably because it needs more exploration to understand the space. Certain features are more likely to attract eye focus, for example, in a face figure the eye focus is usually on "eye" and "mouth" (Gould & Peeples 1970). In architecture, past research suggest that architects pay more attention to the spatial arrangement of various architectural elements (Weber et al. 2002). The more complex spatial area such as AOI 1 contain multiple architectural elements: the extensive rooms behind the opening and the glass door. Also the complex structural parts in the ceiling attracted more attention.

- The left-hand side elements in an image are likely to attract more attention.

Research on eye movement of static images has shown that elements on the left-hand side attract more attention than the right (Arnheim 1985, Weber et al. 2002). The present research confirms this claim that human eyes tend to "rest" at the left hand side. This may be due to the visual pattern recognition and memory system of the brain. Further exploration of this phenomenon in spatial representations is needed.

- The edges of the interior space were not frequently scanned.

The most fixated areas are the complex spatial areas, rather than the edges or corners of the interior space. This result agrees with Weber et al. (2002)'s research on eye-tracking of interior space. However, in Kaufman & Richard (1969)'s study, they state that icons such as corners and edges are more likely to attract attention, while the current study does not confirm this claim.

- The center of gravity is not always the focus of eye movement.
- In the early eye tracking research, researchers found that the eye fixation is always focused on the center of gravity of a figure (Kaufman & Richard 1969), however in the current study, the center of the image is not the focus of eye fixation, instead it is the relatively complex space. This indicates that the semantics of the image plays a role. Cultural background of the student did not produce different results.

No significant difference was noted between the focal attention paid to AOIs by the American students as compared with the Chinese students. A previous study by Chua et al. (2005) confirmed the hypothesis that Americans fixated more on focal objects while Chinese participants spent more time looking at the context/background. This distinction was not noted in our pilot study.

This paper has presented the results of a pilot study comparing the physiological response of eye movement of architecture students when looking at different digital modalities of spatial representation. Results from the analysis of eye-tracking data suggest that designers' physiological responses vary with the changes of digital representation. In order to make a more comprehensive conclusion, a larger experiment is needed in a future study. Future studies would include a broader demographic (comparing trained designers with non-designers) and a wider range of representational modalities.

4.2 *Next steps*

Our goal is to integrate and expand on research conducted in a number of fields, including architecture, computer science, and psychology. Researchers in these fields have investigated the processes by which we perceive and understand space, by collecting and analyzing physiological data. We intend to further our research by conducting a larger-scale study with more participants, in which the sequence of modalities can be varied, and in which we can test the participants' physiological responses to real space in addition to representations.

The two key sources of relevant data for our next study are eye trackers and EEG. As a counterpoint to eye tracking as used in our pilot study, we are interested in additional physiological responses evoked by a space and its representations, which can be measured by EEG. Researchers have employed this tool to track brain activity and stimulation when viewing an image, as well as the emotional responses evoked by real-world spatial experiences.

Our methodology for the next experiment will focus on the emotional responses to these images as indicated by EEG data, as an additional layer to the eye tracking data. The Emotiv EPOC is a portable EEG headset that collects brain wave data to identify levels of cross-modal sensory processing, alertness/engagement, reflection, and engagement of memory in gamma, beta, alpha and theta waves respectively. As a portable device, we will be able to use it in subsequent studies in which the participants' physiological responses are measured in an embodied experience of a built space.

An anticipated outcome of a future large-scale study would be the identification of modalities of representation that most closely correlate with the embodied architectural experience to predict how spaces will affect the occupant's physiological state. As we improve our understanding of the relationship between our representations of architecture space in the design process and how that space as a built work will ultimately be experienced, architectural educators can work with students to represent their design work in a more authentic way.

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Regenerative design – new role for the built environment

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ABSTRACT: According to the International Union of Geological Sciences we are in the Anthropocene, a new era caused by Human activity characterized by mass extinctions of plant and animal species, polluted oceans and altered atmosphere, among other long lasting impacts.

The building industry has one of the largest negatives impacts on natural systems, even if unintended. When buildings and infrastructures are raised they do not only change the landscape, but they also change the way the natural system works in those places.

To tackle these environmental problems caused by the building industry, several environmental design concepts have been emerging. But what are they really delivering, is energy efficiency, low impact solutions? Or do they have any positive contribution to the health of living systems, the systems that allow life to exist on earth as we know it? To really understand the way these several environmental design concepts perform it is necessary to compare and scale them, in a way in which it is easier to see the real outcome. With references from other environmental design concepts it becomes easier to understand what does the Regenerative Design concept aim to accomplish. This "new" design approach, can be applies to architecture, landscape and planning. It questions how natural systems function and how human activity can co-create alongside them in order to rebuild the web of life.

Instead of just aiming for high efficiency and reduced human impact, Regenerative Design sets a new role for the building environment, creating the idea that, if well design, the act of building and inhabiting a place can integrate human and natural activities, catalyzing a positive effect that will vitalize and benefit both sides. This is a holistic approach to design that spurs and integrates a new set of disciplines (systems thinking, geology, biology, ecology), as well as a new set of design concepts (sustainable, biophilic, and biomimicry design).

1 INTRODUCTION

There is a rising number of people committed to reducing the ecologic footprint, buying biologic food and products, living in more efficient buildings, "driving a Prius and put solar panels on the roof, but that isn't going to take us anywhere" (Moffat 2007). The real outcomes of our good intentions don't really have the impact that we think it could and should have, because most of those good intentions are just aiming to reduce human impacts. Reducing impact is important to slow-down the degenerative path that we are causing, but insufficient to reverse it, because we are still continuing to deteriorate the health of natural systems. Bill Reed, one of the leading researchers and practitioners on sustainable design, raised the question: "if the earth was covered with LEED platinum buildings (very efficient buildings) would the earth be in better shape?" The answer is no, it doesn't make the earth better. Because the problem is not about buildings, but about human activities in and around buildings that change the way natural systems work. Natural systems or natural ecosystems are here defined as communities of organisms (plants, animals, bacteria) that in a particular place provide ecosystem services – clean soil, clean water, clean air, food, natural resources, etc.

These services are essential to sustain life on earth as we know it (Daily 1997).

Building and development are necessary to provide habitat and substance for our society, but development inevitably alters natural systems. (Lyle 1994).

In the Cambridge dictionary, development is defined as "to improve a place or system, especially by making it more active or successful".

The quality of human and natural systems design is crucial to maintain healthy environments. Design is defined here as "conceiving and shaping complex systems", "environmental design is where the earth and its process join with human culture and behavior to create form." (Lyle 1994).

This paper is aimed at reviewing several environmental design concepts and attempt to assess what they are really delivering.

2 HUMAN BUILDING IMPACT

"*The major problems in the world are the result of the difference between how nature works and the way people think*" Gregory Bateson

It seems there is a lack of perception on how our world works and what the side effects of human actions

are. Humans are organisms classified as allogenic engineer's. Organisms that use tools and materials to change the environment, like beavers use trees to build ponds that modify water and nutrient cycle, which ultimately influence the distribution and diversity of plant and animal community (Jones 1994).

The major reason why humans have such adverse effects on the environment is because of the unintended consequences of our activities as engineers, from dam-building and skyscraper construction to forest clearance and the dredging and canalization of water courses, which alter the physical environment and module the flow of resources to other species (Jones 1994).

In the book Desert Meteorology, the author Thomas Warner argues that the Sumerian civilization agriculture and irrigation practices ruined the soil to such an extent that it has not yet recovered, because the system was destroyed to a point that it couldn't restore itself anymore.

We call "sustainable design" to several Environmental design concepts that aim to reduce human impact. Architect Bill Reed claims that "Sustainability is not deliverable. Sustainability is not a thing. Sustainability is not simply about efficient technologies and techniques. It is about life – a process by which living things such as forests, neighborhoods, people, businesses, mushrooms, and polar bears ensure their viability. It is a process of reciprocal relationship – a process by which living things support and are supported by a larger whole. That means a building can't simply be high performance and be considered sustainable." (Reed 2007).

3 EVOLUTION OF BUILDING DESIGN CONCEPTS

3.1 Vernacular – structures were made by empirical builders without the intervention of professional architects, using local natural and easy accessible materials like wood, straw, brick, stone and earth. Local materials combined with the local low-tech technologies allow people to adapt and live in certain places and climate. Buildings were characterized as low impact, low embedded energy and in some cases highly durable buildings/structures. From the example of Sumerian problems caused by irrigation systems we can question the knowledge and "quality" of ancient or vernacular interventions regarding the benefits and integration of natural systems.

3.2 Modern movement – Around the 1920s (in developed countries) modernist architects began to cast aside traditional or classical forms and experiment with sleek new designs that often use new materials such as glass, steel, and concrete. In the urban planning field, modernists moved away from the ecological holism to embrace social sciences and highly quantitative forms of analysis (Wheeler, 2004). Technologies like artificial light and air-conditioning systems allow buildings to have a freer form. This freedom indicates a slow disconnection from vernacular principles of passive design, use of local building materials, etc. Buildings start to have high embedded energy, very low efficiency, and bigger impact on resources and natural systems.

3.3 Turning point – around the 1960's and 70's the ecological movement emerged from the awareness that several notorious works, like "The Silent Spring", "The Limits to Growth" and "Design with Nature", spurred amongst the public. The economic and energetic crisis in the United States in the seventies was key to induce a shift in the way Western society looks at energy and environment. From this period two different approaches emerged to tackle environmental and energetic global problems, with different world views (Mang Reed, 2012).

4 OUTCOME OF DESIGN CONCEPTS

Graphic 1 was developed as the result of a reflection about what are this environmental design concepts delivering or at what level are they working, do they just aim to have low impact solutions, high efficiency, or do they have any positive impact on natural systems? Here three levels of action were defined. The ones on the top levels normally integrate some characteristics of the ones below.

Technological – in the bottom there are concepts that act according to a mechanistic world view, based on technical and engineering solutions (Mang Reed 2012), focusing on quantifiable efficiency and premises of low impact. In fact, this way to operate is just an upgrade of the modern movement in which technology is continually used, but in a more efficient way.

Ecological – In the Book Van der Ryn and Cowan (Ryn, Stuart 1996) ecologic design is defined as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes". Ecologic design or Eco-design is intended to conserve ecological integrity, while allowing ecosystems to provide sustainable flows of resources and to maintain critical services required by the human economy. Potentially, eco-design can contribute to the wise use of natural resources and the conservation of natural habitats, while still allowing people to engage in activities that provide manufactured products and economic services (Shu-Yang, Freedman 2004).

Hybrid – In my perspective, between these two opposite world views, emerged a way to operate that aim to benefit living systems, but still operate with a mechanistic mindset. Just because a building uses an interior living wall (a feature of biophilic design) doesn't mean that the building benefit local natural systems, its design just to benefit human needs of comfort and health.

4.1 Conventional buildings – Today, buildings are in fact getting more efficient. For example, in Portugal, the first thermal regulations for buildings were

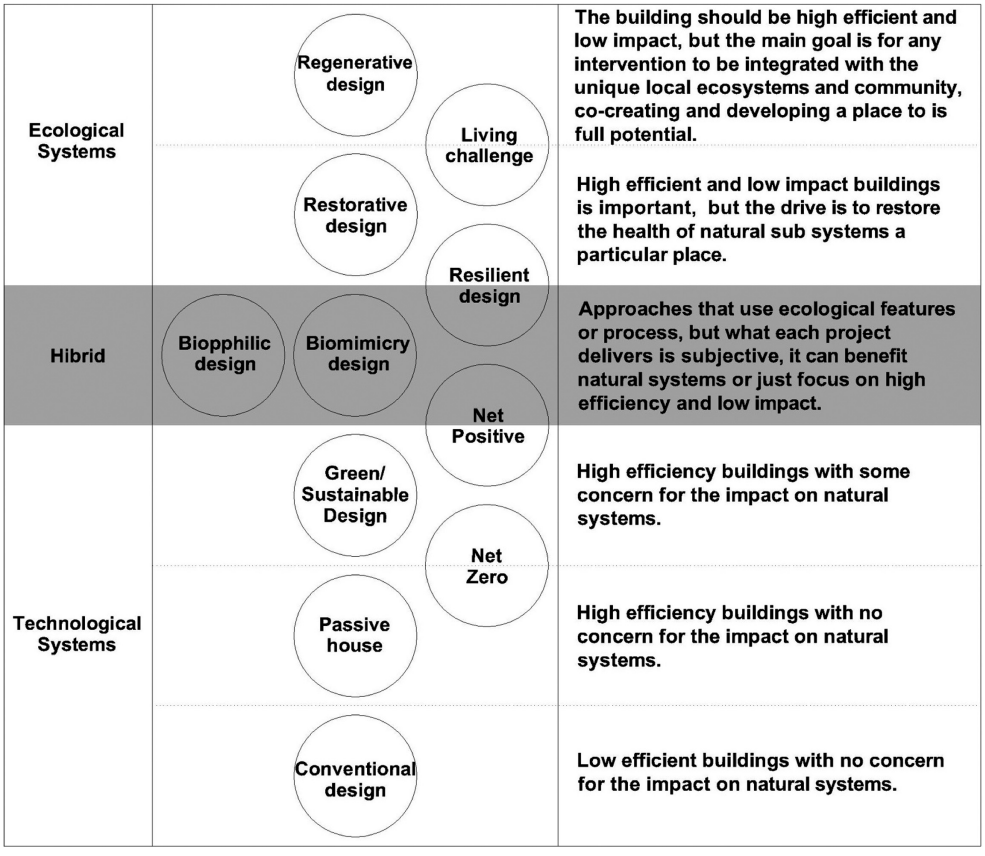


Figure 1. The outcome of environmental design concepts.

introduced in 1990, aimed at making our buildings more comfortable and efficient. Since 2006 we have the Energetic Certification program that has the goal to make buildings more efficient in terms of energy usage. However, this doesn't mean that the building industry is reducing, in any way, the degeneration of natural systems.

Today, comfort and efficiency levels of buildings are growing, but so is the embedded energy because buildings are getting more complex to build and operate.

4.2 Passive House – This program was launched in May 1988. Initially developed for houses, it is now also applied to non-residential buildings (commercial, schools, etc). The focus is on optimizing efficiency of building envelop (thermal insulation, window dimension and insolation, airtightness, absence of thermal bridges) with an efficient ventilation heat recovery system (Feist 2007). The focus is to make buildings as energy efficient as possible, with high comfort to users. It can be very efficient but it doesn't have any preoccupation about natural systems, making it as harmful as conventional buildings.

4.3 Green or Sustainable design – the US "Energy Independent and Security Act of 2007" establish that a green building should "integrate and optimize on a life cycle basis all major high performance attributes, including: energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality and operation considerations (EISA 2007). Green building is currently practiced within a mechanistic world view, using checklists systems like LEED. This can be compared to a health specialist's work on a heart, or intestinal system – healing the particular issue, but not addressing the overall systemic nature of the cause, whether it is diet, environment, stress, or genetics (Mclennan, Reed 2013).

Authors Michael Braungart and William McDonough argue that Sustainable design is a "less bad approach", although it is the first step in order to slow the damage, Van Ryn claims that "this kind of approach isn't going to take us anywhere" (Moffat 2007).

Green buildings have some measure of environmental conservation, but it still continues to degrade natural systems.

4.4 Net-Zero Building – has the goal to "generate enough renewable energy and water on site to equal or exceed its annual energy use". Net-zero is focused on the creation of new buildings and is largely technologically driven. "As currently framed, net-zero could be

seen as the endgame of green building design – doing less harm – or perhaps more symbolically, the vestiges of a reductive, mechanistic world- view." (Cole 2015).

Buildings are designed to mitigate human energy and water needs, but generally they don't aim at engaging with the health of ecosystems.

4.5 Net positive building – is considered as more than simply an extension of net-zero energy. It can foment the goal to produce, on site, more energy than is needed, supply water needs by storing rain water or recycling it. Net-positive approaches emphasize how buildings could work collectively within networks. A key issue, therefore, is how new buildings fit into and work with the existing building stock. Net-positive energy is put into practice by viewing the role of a building in terms of adding value to its context and systems in which it takes part. Rather than considering merely the generation of more exported energy versus its importation to individual buildings or the grid, the emphasis shifts to the maximization of energy performance in a system-based approach. Net-positive energy approaches open a host of new technical, behavioral, policy, and regulatory issues and opportunities not currently evident with net-zero energy buildings (Cole 2015).

These are very valid goals, but they have mainly high-tech aims and seem to be a paradigm change (from mechanistic to ecological) but, in my perspective, that is subjective, it depends on each project.

4.6 Biomimicry design – Janine Benyus defines this concept as "Innovation Inspired by Nature", a "new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems". Benyus suggests looking at Nature as a "Model, Measure, and Mentor" and emphasizes sustainability (Benyus 1997) Biomimicry looks at nature in search for solutions. The Eastgate Center in south Zimbabwe has an air-conditioning system that mimics the way African termites regulate the temperature of their nests (Gunnell 2009) In this case, this design enables us to understand how nature makes the building more energy efficient, but that doesn't mean the building has any contribution to the health of the natural system where it was built.

4.7 Biophilic design – In the book Biophilic Design, co-author Stephen Kellert explores two dimensions. The first is an organic or naturalistic dimension, defined as shapes and forms in the built environment that directly, indirectly, or symbolically reflect the inherent human affinity for nature. The second is a place-based or vernacular dimension, defined as buildings and landscapes that connect to the culture and ecology of a locality or geographic area (Kellert et all 2008).

This is a concept that can be applied to several scales, with different outcomes. In object design and buildings (interior and exterior) it can have a positive impact in mental and physical health of people. When applied to landscape and city planning, depending on the project, it can have a restorative impact on natural systems and people. The real outcome depends on the way designers address the integration of natural systems in the project.

4.8 Resilient Design – Resilience does not imply a return to dysfunctional or unsustainable community conditions, but adaptation to dynamic social and ecological conditions in ways that protect and enhance quality of life, long term ecological productivity, and public and personal health (Beatley Newman 2011). The Urban Land Institute in Toronto argues that Resiliency thinking requires us to think not only about bouncing back from environmental, economic, and social crises, but adapting to changing circumstances by 'bouncing forward' through new paradigms, processes, and ways of working. A project design by the Resilient Design focuses on the concern it has about communities, not buildings. Buildings may endure or survive a disturbance, but it is communities that "come back".

In order to be able to design buildings and communities capable to resist and adapt to unexpected climate change conditions, designers must know in detail how local ecological systems work and use that knowledge to shape building design, finding effective and durable solutions to complex problems (Curtin 2014).

4.9 Restorative design – The aim of this design concept is for humans to restore an environment degraded by human presence. Bill Reed argues that we cannot restore something to the past state because nature is always in evolution. Restorative Design thinks about design in terms of using the activities of design and building in order to restore the capability of local natural systems to a healthy state of self-organization (Reed 2007).

4.10 Living Challenge design – It's a voluntary environmental building certification program with the highest requisites and ambitions, based on a measured outcome, instead of a modulated one.

The Living Building Challenge is, in many ways, a paradox, a reductionist tool to dismantle reductionist approaches. It is a program that is now on its third version. In 2006, the first version aimed at building neutral buildings or 100% sustainable. The second intended to have a restorative effect on the life and process of the site. In the third and last version, the aim is to help design and classify buildings that have the will/tendency to be regenerative (Mclennan, Reed 2013).

Living buildings can be almost self-sustainable buildings, designed to be have no negative impact on the health of the occupants and natural systems (Nugent et all 2011).

This design program as the highest ambitions, but does it have a real positive impact on the systems that sustain life, or can this regenerative goal be measured?

5 REGENERATIVE DESIGN

There are some approaches to Regenerative Design. In this paper we will look at Regenesis, which is referred by several authors to be the leading practitioners of regenerative design and development.

The term "regenerative" was used by Robert Rodale to reference the continuing organic renewal of complex life of the soil. The same principal of ongoing self-renewal can apply to all of the systems that support life (Lyle 1994).

Regenerative design is based on ecology and living systems principles (Mang, Reed 2012). Contrary to a technological world view, this is a concept with an ecologic world view, which looks at the world as a complex living system, interconnected at every level.

In the book Designing for Hope, Pamela Mang states that "we talk about living systems, rather than natural systems and human systems, because they are all living systems" (Hes, Plessi 2015).

There is plenty information about Regenerative buildings that can mislead the real goal of this approach. It is not about high performance building. In fact, a regenerative building only becomes meaningful and beneficial when understood as part of the living fabric of the place (Reed 2007). When properly designed, the act of building can give back more than it receives, building social and natural capital over time (Cole at all 2012).

Adopting one or two regenerative technologies or techniques into a green building practice without understanding the underlying premises and principles that make the approach distinctive, is frustrating at best and counterproductive, at worst.(Mang, Reed 2012).

Regenerative approaches place considerable emphasis on pre-design processes and, in particular, broad participant engagement that not only clarifies the design intent but also helps build collective commitment and capacity to ensure the building's long-term success (Cole et all, 2012).

The Regenesis design process to achieve regenerative design has three phases.

1 - Understanding the place – Instead of starting with the building and what surplus it can generate, a designer should start by asking what ecological services have been disabled in this place and what roles are missing that used to enable those services in the past. Instead of asking how to deploy any excess, in order to add value, a designer should ask what is the role of this particular project and that of the land it occupies in the larger systems of a particular place (Mang, Reed 2014).

Regenesis, defines Place as the unique, multilayered network of living systems within a geographic region that results from complex interactions, through time, of natural ecology (climate, mineral and other deposits, soil, vegetation, water and wildlife, etc.) and culture (distinctive customs, expressions of values, economic activities, forms of association, ideas for education, traditions, etc.) (Mang, Reed 2012).

Story of Place is a tool developed by Regenesis to discover the underline patterns of a place that serve to uncover the real potential of the project to enable regeneration. The site project goes beyond the physical limits of the building plot and can go up to the size of a watershed. After understanding this larger system and its core patterns, one has to develop an idea of the project role within the place (Hes, Duplessi 2014).

2 – Designing for harmony – is the second phase, where the potential of the place and the project aims to develop the regenerative design concept that reveals a greater potential for both (Mang, Reed, 2012). In the book Regenerative Design (Lyle 1994), the author describes design as a means to conceive and shape complex systems, where the earth and its process join human culture and behavior to create form.

After understanding the place and having in mind the potential of that project in that place the design team can start designing the new element that is going to restructure the system of that particular place and make it thrive.

3 – Co-evolution – A Regenerative project is not finished with the construction of a project. The real regenerative outcome can only be manifested if the people that inhabit the project and the land can continually unfold a source of inspiration and spirit to grow stakeholders that can have a role as regenerative agents or Regenerates in the larger system (Hes, Duplessi 2014).

5.1 *The project Aqua Viva*

This project in Loreto Bay, Mexico, is a private-public eco-resort development project with 6,000 units, divided in 6 phases of construction.

At first, the site appears to be a deserted beach. After Regenesis made a field assessment, they concluded that the site was in fact a severely degraded estuary that was landfilled with sand in order to extend the beach. After realizing that, the project team and the developers restructured the project because they found a purpose to this project: "To regenerate the health of the Sea of Cortez". This was a win-win situation. There would be more wildlife returning to the estuary, storm floods could be mitigated, the hydrology of the area would function better, while having a positive impact in nature would be excellent for the marketing of the resort.

The project Aqua Viva brought the promise that human building and development can reshape the way natural systems work and make them better than they were before the intervention. But this project can only became regenerative if the human community can continuously maintain the health and evolution of this living system through time.

6 CONCLUSION

The majority of the environmental design concepts applied to buildings presented in the bottom of graphic

1 are the first step to start making some change in the way people use energy and resources, design more efficient buildings and minimize impacts on natural systems. The concepts presented at the top are the ones that can really make some positive change, sustaining the life of natural systems that human activity have degenerated through time. To sustain life we should be working on both ecological and technological Systems. At the moment we are trying to fix problems that technology is causing on ecosystems with technology, so we creating more problems.

There aren't sustainable or regenerative buildings, the activities that people develop in and around the place and building they inhabit can have a regenerative or degenerative impact on the local ecosystems. When we make any change in a ecosystem, we change a system that took thousands of years to be shaped and work as it was before human intervention.

Regenerative Design is a complex and powerful design system that, in order to be successful, needs a multidisciplinary and integrative design team willing to consider each project as a unique opportunity to rebuild the web of life, not to build things in isolation.

The term Anthropocene remembers that man and its activities have a new role, the responsibility for the health of natural systems that support life on earth as we know it. Politicians, stakeholders, designers and others must be aware of what is the real outcome of the systems they design in a short and long time.

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Building blocks: Abstraction and iteration

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ABSTRACT: This paper describes an architecture studio project sequence in which the students were asked: How can the foundational educational concepts defined by Friedrich Froebel in the development of the first Kindergarten pedagogy, including the value of multi-sensory experience, flexibility, and abstraction, spawn a methodology for design?

1 PREMISE

How can the foundational educational concepts defined by Friedrich Froebel in the development of the first Kindergarten pedagogy, including the value of multi-sensory experience, flexibility, and abstraction, spawn a methodology for design? This was the question posed to a topical architectural design studio.

Norman Brosterman argues a link between Modernism, specifically the geometries of Cubism and the International Style, and a Kindergarten curriculum widely in use when Georges Braque, Piet Mondrian, Frank Lloyd Wright and others were children, which taught children to see the world as simple, repeating, geometric forms (Gabriel 1997).

"In abstract art," wrote Piet Mondrian in 1941, "we see … clearly there the elements of form are no longer veiled by the limited (the naturalistic) forms but appear as the expressive means." (Brosterman 1987) Mondrian's references to naturalistic, pictorial forms were always as "limited" or "limiting," and while that view of the pictorial vocabulary was not what Kindergarten teachers had in mind in their teaching, it may have been the emotional feeling conveyed to the creative children of many school generations (Logan 1950).

Friedrich Froebel, the father of the Kindergarten movement, created a series of 20 "Gifts" to foster a child's creativity. Each successive gift represented an instance in the sequencing of a child's development. Froebel believed that a child must first learn concepts through abstraction before engaging the physical reality. Froebel's "Gifts" and corresponding "Occupations" acted as a set of "graduated tasks that took the child on a quest for spiritual harmony with God, nature, and humanity." (Brosterman 1987)

The "Gifts" were not meant to be played with idly, but were expected to inspire the child, through direct manipulation and play, to form concepts of color, of texture, of size, of number, and of creative arrangements. The "Gifts" held a series of underlying objectives that privileged the sense of touch. The goals of each "Gift" were:

1. To aid the mind to abstract the essential qualities of objects by the representation of striking contrasts.
2. To lead to the classification of external objects by the presentation of typical forms.
3. To illustrate fundamental truths through simple applications.
4. To stimulate creative activity.

The corresponding "Occupations" further reinforced this approach, but could not be returned to their original form (ie. origami). All of this Kindergarten work was deliberately arranged to correspond to a child's inevitable and incessant activity (Logan 1950).

According to Jeanne S. Rubin, "All arrangements made with 'Gifts' and 'Occupations' were categorized into three types of forms: forms of life, geometric abstractions of familiar objects both natural and man-made; forms of knowledge, demonstrations of the principles of simple mathematics as well as plane and solid geometry, made possible by the graphed tabletop; and forms of beauty, a seemingly infinite variety of symmetrically and asymmetrically balanced forms." (Rubin 1989)

Although Kindergarten in its original manifestation by Froebel was lost, the ideals found their way into the teaching of the Bauhaus. Architecture became the keystone of the Bauhaus curriculum. Because it straddles an intersection of the environment, mathematics, and aesthetics (or nature, knowledge, and beauty), and is the sum of all the plastic arts, architecture, particularly after 1900 (and half a century of Kindergarten) ought to have displayed evidence of the impact of Froebel's unified training in any number of ways (Brosterman 1987).

Early modernist architecture was scarcely the simple embodiment of "truth to materials" or "form follows function" that some of its advocates claimed. With new technologies at the architect's disposal, but no tradition for their employment, much of what advanced into modern architecture was provided by

architects' involvement with the theories and practitioners of the allied discipline of abstract art. Cubism and geometric abstraction came just as architects were searching for new means of expression. Their concurrent adoption by architecture, which was recently unshackled from classical models, was assured. Kindergarten, which had become an important ingredient in art, was thus implanted into the architecture equation not only by the architects themselves (everyone of whom was born during the pedagogy's prime), but through contemporary art as well. Cubism, Futurism, and Neo-Plasticism found their way into architecture, bringing Kindergarten along for the ride (Brosterman 1987).

Even more direct connections can be made between Kindergarten and the distinct shift in architectural expression that occurred in the early twentieth century. Looking at the work and writings of Frank Lloyd Wright and Le Corbusier, there is substantial evidence that both were strongly influenced by the instruction of the original Kindergarten.

For Wright, the objective was unity, for Le Corbusier, harmony. A reliance on proportional systems and an almost religious devotion to the power of geometry linked the two, resulting in the creation of a substantial amount of what is definitive about modern architecture. "Wright transformed aspects of Froebel's system into the regulating grids upon which his plans were always organized and the interpenetrating rectangular solids that were their three-dimensional equivalent … Le Corbusier enlarged the Platonic solids to building size and ornamented them with nothing but their own shapes and shadows …" (Brosterman 1987).

2 OBJECTIVE

This paper describes an architecture studio project sequence in which the students were asked to reverse engineer a method of abstraction, using Froebel's "Gifts" as a foil for their analytical and interpretive process. This spatial interaction is inherent in Froebel's second gift, consisting of a sphere, a cube, and a cylinder. Learning is accomplished by way of comparison – the sphere with no flat planes, the cube with no curves and the cylinder being both flat and curved. This suggests a method for understanding the toy and its constraints before designing its classroom. How can the scale of the hand and the rules of play, affect the larger context it is located within? The position is that architecture does not have to be static, but can evolve and learn over time.

The objective was to explore the interactive potential of architecture, design that is responsive to both its context and the user. One of the advantages of working in abstraction is that objects can remain simultaneously scale-less and scalable. As conceptual depth is gained, the site and/or program constraints can be applied to situate and ground the formal logic and rules uncovered.

El Lissitzky, a Russian Constructivists, spoke of his Proun as the seminal object of abstraction (Fig. 1).

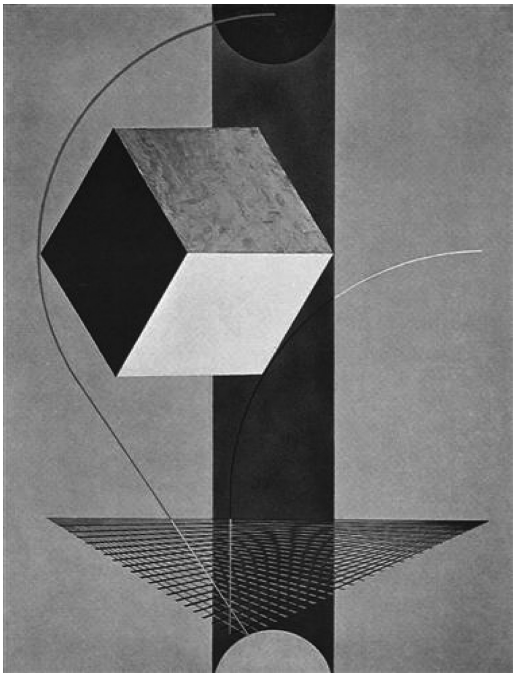


Figure 1. El Lissitzky, Proun 99, ca. 1923–25.

He said the "Proun begins as a flat plane, goes on to the construction of three-dimensional models, and beyond that to the construction of every object of our common life. Thus Proun supersedes painting and its artist on the one hand, the machine and its engineers on the other; proceeds to the construction of space, organizes its dimensions by means of its elements, and create a new, manifold yet unified, image of our nature." (Banham 1967).

This passionate quest for harmony bears striking resemblance to Froebel's premise for Kindergarten pedagogy: "All is unity, all springs from unity, strives for and leads up to unity, and returns to unity at last." (Hughes 1910).

3 METHODOLOGY

3.1 *Assignment sequence*

The studio utilized a design methodology that has exploration at its foundation, able to evolve in order to build on the unknown rather than be limited by it. The studio approached the site and program requirements with the same inventiveness and exploration as Froebel's Kindergarten.

The semester was broken into four assignments. The first three assignments graduate and influence the fourth and final assignment. The sequencing of the course followed the intent Froebel laid out in his gifts – mastering the first step before moving onto the next.

1. Assignment 1 focused on the analysis of the spatial complexities of abstract paintings.

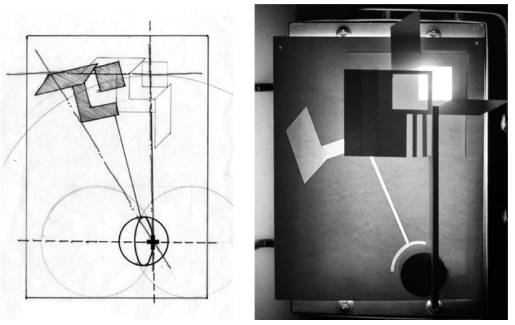


Figure 2. Student diagram and maquette of Proun 99.

2. Assignment 2 used the spatial analysis from the first assignment as the basis for the design of a toy.
3. Assignment 3 explored precedent; specifically, how the detail influences design as a whole.
4. Assignment 4 culminated in the design of a Kindergarten in Brooklyn, New York.

3.2 *Assignment 1: Abstract art analysis*

The students began by diagramming, in both plan and section, the influences of particular Froebel "Gifts" and "Occupations" in a work of Abstract Art. The diagrams demonstrated the concepts of color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points. This exercise was based on Norman Brosterman's theory that the Abstract Art movement began in the "Child's Garden." (Brosterman 1987).

The students selected two paintings: one from the Cubist and one from the De Stijl or Constructivist movements. For each of the paintings they created a bibliography and wrote a short abstract on the intentions behind the artist's work and a theoretical criticism of the painting.

Based on their group research and in-class discussions of the abstract movements they created a series of diagrams, in both plan and section, that demonstrated the influences of particular Froebel "Gifts" in the work of art. The diagrams illustrated the concepts of color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points. The goal of the diagram set was to isolate each layer of the painting in order to develop a spatial hierarchy.

The diagrams prompted the construction of a series of maquettes that described their interpretation of the three-dimensional space represented by the artist. The maquettes were given specific material constraints for their construction in order to explore particular aspects of form and space (Fig. 2).

3.3 *Assignment 2: The toy*

The students next constructed a toy to address one or more of the previous themes. The methods of abstraction discovered during Analysis were intended to provide a sense of order for the movement plays that the 1:1 object facilitates.



Figure 3. Student toy based on Proun 99 analysis.

Friedrich Froebel developed teaching objects as part of a particular, integrated curriculum. "Froebel's program of graduated tasks of arranging spheres, blocks, paper, and other materials was developed from the Enlightenment legacy of understanding the forces of nature through experimentation but was joined to a Romantic quest for spiritual harmony with God, nature, and humanity." (Ogata 2004) Frank Lloyd Wright said that: "The smooth shapely maple block with which to build, the sense of which never afterwards leaves the fingers: so form became feeling." (Rubin 1989).

From their analysis of Abstract Art in Assignment 1, students developed a vocabulary of "Gift" concepts. Assignment 2 asked them to elaborate on those concepts in the construction of a toy. Their toy was to address one or more of the following: color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points (Brosterman 1987).

The students considered the following criteria in the design of their toy (Fig. 3):

- The toy can be adapted to many uses in construction.
- As the child's ability increases, the toy responds to the growing needs and the variety of form grows.
- The construction that suited yesterday can be improved upon today.
- The toy is governed by a set of rules that determine their use in construction.
- The toy allows for subconscious growth in the grasp of number, combination and partition. (Payne 1901).

The toy was required to fit within a $3 \times 3 \times 6''$ volume in its static or contained state. Students produced three diagrams of how they intended to manipulate this volume: one diagram that studied the concepts in a subtractive or solid form, one diagram that studied the concepts in planar form, and one diagram that studied a combination of solids and planes. The diagrams

were axonometric drawings at 1:1 scale showing all components of the volume.

3.4 *Assignment 3: Precedent analysis*

Taking the lessons learned and questions amassed during Assignments 1 and 2, the students were asked to analyze a building and its context. The same themes and methods of analysis from their abstract art exercises apply to the works of architecture described below.

In Cubism, geometry, as something both new and perennial, is comparable to the status of abstraction in de Stijl theory, and the two terms are almost interchangeable, particularly since their associated ideas borrow from the same vocabulary. The vertical and the horizontal are – among the sensorial manifestations of natural phenomena – verifications of one of the most directly apparent laws. The horizontal and the vertical determine two right angles, out of the infinity of possible angles, the right angle is the angle-type; the right angle is one of the symbols of perfection (Banham 1967).

Students were asked to research one of the following projects*:

- Maison de Verre by Pierre Cherault: Paris, France, 1932
- Casa Curutchet by le Corbusier: La Plata, Argentina, 1953

(*Notable precedents omitted: Villa Müller by Adolf Loos and Schröder House by Gerrit Rietveld.)

The students each produced both analog and digital orthographic diagrams. They were required to explore both plan and section, as well as to interrogate the project at the scales of the room, the building, and the urban block.

The diagrams created in the previous step were, as in Assignment 1, acting as drawings for the construction of a series of maquettes that describe their interpretation of the three-dimensional space created by the architecture. The maquettes were again constructed from a restrained material palette – studying the scale of the room, the building, and the urban block.

3.5 *Assignment 4: The 21st century kindergarten*

With the same concepts that guided the students through the Analysis and the Toy, students were asked to design a Montessori School within the ruins of the Tobacco Warehouse in Brooklyn, NY. The change in scale from Interpretation to Intervention was a provocation to test the movement plays (abstraction and discovery) in translation from object to site scale.

The design of the Kindergarten was to accommodate the following programmatic requirements:

- Gathering Space
- Reception and Admin Office
- Classrooms*
- Teacher Offices
- Play Space** (Outdoors)
- Restrooms

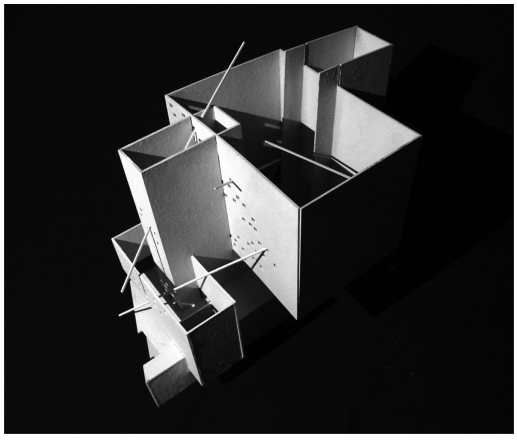


Figure 4. Student maquette analyzing Corb's Casa Curutchet.



Figure 5. Student design perspective.

*All classrooms were to have direct access to the exterior.

**Play Space was to accommodate both group and individual play.

The Tobacco Warehouse shell could not be altered but students could attach to any of the existing walls. The footprint of their project could not extend outside the South, East and West sides of the warehouse. Although there was more than enough square footage within the walls of the warehouse to accommodate the program, they could extend into Brooklyn Bridge Park to the North of the site.

The resulting projects nested within the given structure of the Tobacco Warehouse, facilitating a dialogue between given forms and new forms, in much the same way that Froebel's Gifts set up creative play between given components.

4 CONCLUSIONS

The design of a piece of architecture with a more normative program as the concluding assignment provided for an interesting dialog within the studio. There was an impetus to jump right to the details of the project, assuming that the earlier precedent exercises

served as the conceptual depth for the parti. The mid-review was a critical reminder that the relationship between the diagram and the detail had to be recursive. The reverse engineering assignments were not meant to be formal drivers but to encourage an understanding of the vectors of site and program – and to celebrate the geometry of the context.

Reflecting on the questions posed at the beginning of the project, the strongest projects fully embraced the premise of abstraction to gain a deeper conceptual clarity. The site and its contextual vectors were viewed as a game board where a series of what Froebel called "movement plays" could unfold using the programmatic needs as a foil to the rules of site. The process was itself an abstraction of how Froebel set up the "Gifts" to correspond to their "Occupations."

Subsequent iterations of this studio were given a much less normative program, challenging the students to more deeply analyze potential spatial relationships, rather than bringing deep-seated preconceptions to the project. In the words of Frank Lloyd Wright, "Children should not be allowed to draw from casual appearances of Nature until they have first mastered the basic forms lying behind appearances." (Rubin 1989).

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Introducing digital soft skills: Bridging the gaps in architectural education

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ABSTRACT: Developing technologies, such as computational design and digital fabrication, are transforming the design and construction of contemporary architecture. However, the understanding of how to teach technology as an essential design skill has not kept pace with these rapid changes. Design education and technology education continue to be seen as separate loci of learning. In response, this paper argues that a set of complementary "soft" skills is missing from most discussions of digital design pedagogy in architecture and that these soft skills can bridge the current gap between digital education and design education in architecture. Soft skills are "soft" in contrast to more easily quantifiable "hard" skills such as operating a machine or knowledge of art history. Failure to acquire soft skills such as resourcefulness, good electronic communication, etc. negatively impacts how technology is introduced, practiced, and developed in architectural studio culture. Introducing soft skills will help bridge the gap between studio learning and technology learning. The first section of this paper describes a list of soft skills that support students as they learn digital design. In the second half of the paper, several methods for integrating soft skills into digital design instruction are proposed. Contemporary architecture schools are tasked with introducing digital technologies as they are changing, creating an opportunity to develop innovative curricula and democratize access to these skills. With the rapid pace of technological change, students need to be comfortable with and capable of learning, relearning, and integrating new programs and tools throughout their career. Therefore, this paper proposes that soft skills can and should be taught in architectural education and that teaching them will make digital instruction more effective in the design studio.

1 INTRODUCTION

1.1 *Introduction*

Computer-Aided Drafting and Design (CADD) technologies have become commonplace in architectural practice as tools of efficiency and production. For these very reasons the introduction of CADD in early architectural curricula has been fraught with anxieties along a continuum: from the undoing of creativity through positivist and reductionist logic (Pullasmaa, 1996) to a firm belief that these technologies will revolutionize the way architects practice and think about design. (Kieran and Timberlake, 2003) At the same time, there is a presumption that students who have grown up with digital technologies are "digital natives" who possess special aptitudes or insights which are disruptive to learning computing. The presence of these anxieties and biases often leads to gaps in architectural pedagogy, as digital tools are misunderstood and misappropriated by students and teachers alike.

Defining and using the term "digital design" is somewhat problematic, as there is very little architectural work today which does not use the computer in some capacity, and yet there are also designs which consciously engage in digital aesthetics and processes. For the purposes of this paper, *digital design* refers to the use of the computer and computer-driven tools (such as CNC machines, robots, etc.) when one designs architecture. The key is not what a person designs, rather whether that person employs the computer or not as a tool in architectural work.

Design is the verb in architectural education and in architecture; it is what architects do. It is necessary to distinguish between design and digital design – and to speak of teaching digital design – in this moment, because the introduction of the computer in architecture changes both what and how architects design. It introduces both new capabilities and new sources of bias and error. Therefore, architectural education must address and teach specific ways of designing with the computer – not how to use software or operate machines, but how to *design digitally*.

The very existence of the category of digital design is problematic because it implies two cultural silos in architecture: those who are digital and those who are not. This outlook potentially limits students' educational and professional development. To be clear, this paper interprets digital design as a broad skillset that should be available to all students, rather than a niche specialization.

The aim of this paper is to take control of the pedagogical agenda for digital design in architectural education by debunking the myth of the digital native and applying proven educational research to the pursuit

of digital design. This paper is a discussion of architecture, design, and education; not an argument for software and computer use in design. The relevance of this educational conversation extends only so far as it impacts the development of the profession's relationship to digital technologies as these technologies are changing. The goal of this, and any, educational proposal for architecture must be improving the state of architectural design in addition to advancing learning in both the academy and the profession.

1.2 *Myth of the digital native*

The common belief that students are self-regulating when it comes to learning and using technology may come from the notion of digital natives. The label "digital native" derives from a series of articles written by the technologist Marc Prensky during the early 2000s. Prensky describes the generation of young people born since 1980 as "digital natives" due to what he perceives as an innate confidence in using new technologies such as the internet, videogames, mobile telephones and "all the other toys and tools of the digital age." (Prensky, 2011) Enrique Dans counters Prensky's claims: "Simply being born into the internet age does not endow one with special powers. Learning how to use technology properly requires learning and training, regardless of one's age." Dans goes on to expand upon the issues of assuming students do not need to be taught to use technology thereby becoming "digital orphans", lacking in any model to copy or experiences that might have generated criteria for understanding. (Dans, 2014).

For this reason, beyond basic fluency, architectural instructors are uniquely positioned to model substantive content creation and healthy critical thinking about these technologies. By perpetuating the myth of the digital native, architectural education is missing the opportunity to establish strong pedagogical foundations from which future digital advancements will emerge.

2 DIGITAL SOFT SKILLS

2.1 *Soft skills and fostering learning habits*

Computer use in architecture is often discussed and taught as a series of technical or "hard (as in absolute)" skills. In contrast, "soft" skills are related to emotional intelligence, attitudes, habits, and interpersonal relationships. An example of a soft skill is resourcefulness: being inclined and able to find alternate solutions to a problem, rather than giving up or deferring responsibility. In this manner, soft skills influence the ways that an individual applies technical skills to achieve goals, such as a design. Learning soft skills has been related to improved employment outlook and better job performance. (Andrews and Higson, 2008; Nealy, 2005) Professions such as business and information services have cited employees' lack of soft skills as one of the primary reasons why projects fail. (Bancino and Zevalkink, 2007) Thus, for students, developing soft skills is equally as important, if not more important, than learning technical skills.



Knowing how to operate a smartphone does not necessarily make one an effective computer user.

The influential Boyer report on architectural education concluded that: "[A]rchitectural education is really about fostering the learning habits needed for the discovery, integration, application, and sharing of knowledge over a lifetime." (Boyer, 1996) Soft skills are the learning habits Boyer references, and so are a critical element of architectural education in general. While this paper focuses on digital soft skills, this finding is not to be overlooked.

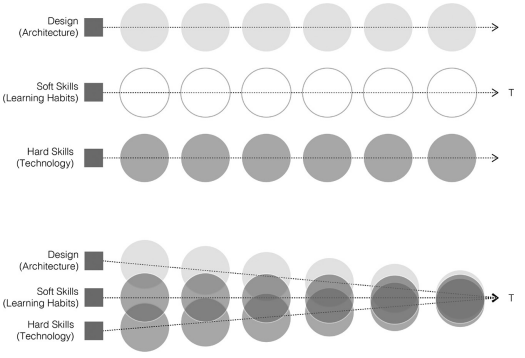
Soft skills must be taught rather assumed to be pre-existing skills. This especially applies to Soft skills which relate to digital design in architecture. Architectural education must recognize that university students are not comprehensively or consistently trained in digital technologies when they arrive on campus. This is exacerbated when less privileged students are potentially less digitally skilled than students from economically privileged backgrounds. By not addressing these inequalities, institutions, such as architecture schools, are perpetuating disparities through education and leaving students underprepared for the future. Soft skills can be reapplied to changing technology, whereas hard skills may fall away as technology changes.

2.2 *Traditional vs. digital soft skills*

The type of soft skills described in this paper are not entirely the same as soft skills introduced in the previous section. While traditional soft skills such as conscientiousness and empathy are helpful for architects, *digital* soft skills have a different purpose and apply specifically to the tools and processes used in digital design. Digital soft skills, such as asking clear questions, estimation, and planning skills, enable effective collaboration with other people while using digital tools and promoting effective workflows for collections of digital tools. Digital soft skills support students as they are learning digital design and, later, help students apply technical skills successfully and with sophistication and to adapt to a rapidly changing technologic landscape.

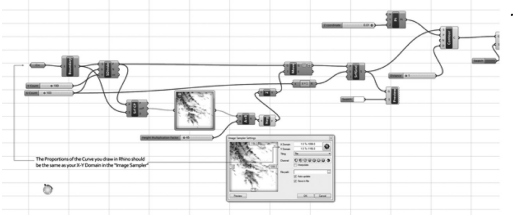
Digital soft skills also differ from traditional soft skills because they take into account the particular challenges of computing and digital machinery. The special attributes of digital tools that make them powerful, such as symbolic logic, abstraction, and automation, can invite cognitive biases when designers operate those tools simplistically, at face-value (i.e. using a computer like a cell phone, a pencil, or a typewriter). Humans must adapt their thinking, expectations, and habits, as their natural inclinations can interfere with working effectively with digital tools. (Sheil, 1983) Even those who work with digital tools frequently need to learn digital soft skills, as they may have developed bad habits and misconceptions over time. Merely using digital tools is not enough to cultivate mindfulness of the medium and one's responses to it.

To cite an example: digital tools are often "black boxes" with complex layers of interrelated procedures that make it difficult for users to be aware of what they are doing and how their software operates. Users expect simple cause-and-effect relationships between their operations and the results on a screen, when the reality is that many "hidden" processes are at work and can affect the outcome of an interaction. (Blackwell, 2002) This is also one reason why computers are not always dependable and why they tend to break down in obscure and obtuse ways. Working responsibly with digital tools requires a certain level of comfort and responsiveness with an opaque tool. Students who lack the digital soft skills to understand and respond to this condition often have a poor attitude when faced with computer problems and may spend their time in unproductive ways trying to "hack" solutions to technical problems. (Pea, 1987) This affects not only the quality of their final designs, but their outlook on technology in general. Digital soft skills are similar to traditional soft skills in the way they affect how students apply technical skills. They are the bridge across the gap that often exists between design skills and technical (hard) skills like digital methodologies. Unfortunately, very little time, if any, is given in architectural curricula to the explicit cultivation of digital soft skills.



The top diagram demonstrates a curriculum where design (architecture) and hard skills (technology) are typically taught in parallel.

The bottom diagram demonstrates that soft skills (learning habits) create the bridge between design (architecture) and hard skills (technology). Over time these skills become mutually supportive.



Example of a downloaded Grasshopper definition. Working digitally demands questions of authorship and intellectual property be discussed with students.

2.3 *Samples of digital soft skills*

The following list is a representative sample of digital soft skills which could be taught in an architectural curriculum, organized according to four primary headings.

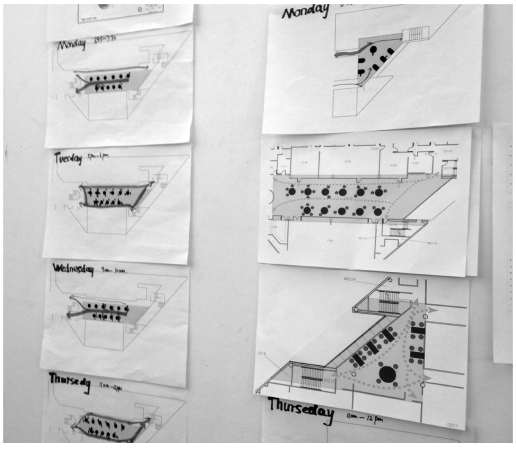
A) Communications Skills

Communication is an essential skill for architects. One could argue it is the majority of what a professional architect does. Whether it is through drawings, models, written, or oral, an architect must be able to clearly express their ideas and intent to an audience. Unfortunately, in architectural education, digital communications are often overlooked as a medium with unique challenges. For instance, many students have never been explicitly taught how to ask a question via email: to provide necessary information and files upfront, anticipate follow-up questions, and to communicate their expectations for resolution. This is important not only professionally, but especially when trying to learn or fix something like a new piece of software. Communicating well through digital media is critical, particularly as it has become a primary means of interacting with others.

Collaboration – The ability to work with others digitally, particularly at a distance. One aspect of this is organizing files and sharing them across computing platforms and software versions.

Authorship – This is the ability to understand digital intellectual property and to distinguish between resourcefulness and plagiarism. This notion of authorship becomes increasingly important when the line between programmer and architect is blurred by the use of digital tools. Of particular note is the downloading of code or Grasshopper definitions which are then deployed as design generators.

Support – Architects should be able to seek, locate, and pursue support for software and technical issues, many of which might exceed the abilities of the instructor or the support offered by an academic institution. These skills include asking fellow students, contacting



Example of a response to a large print which failed. Soft skills encourage students to anticipate such failures and to develop alternatives, such as printing on smaller paper, creating analog versions, and using a projector.

the software maker directly, and using the Internet as a resource.

B) Adaptability

Adaptability is resiliency in response to imperfect tools and a field constantly in change. Architects using digital tools should work with the understanding that failures are to be expected, while being empowered to seek alternatives. They must also update their skills and abilities often while remaining critical users of technology.

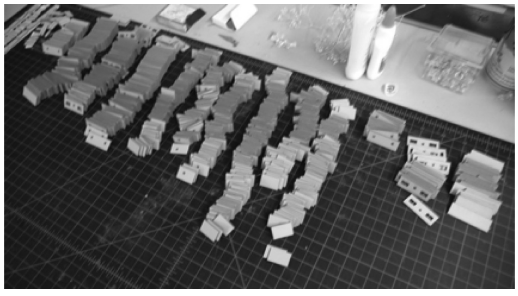
Autodidacticism – The ability and inclination to teach oneself (quickly) is a valuable skill for designers. This includes planning and scheduling regular time to learn and a recognition of common concepts and methods shared between tools, which can make learning more efficient.

Conversion – An effective strategy for error recovery is knowing how to share data several between types of files and programs. It is important to also note that many computer programs are able to convert various file formats and often have similar procedures.

C) Time Management

Digital design projects in architecture are often complex, involving many different programs and machines, as well as human team members. Some of these elements can be hands-off (such as rendering) or very hands-on (supervising CNC fabrication). Part of completing them successfully is knowing the workflows involved and having a sense of their coordination and time requirements.

Estimation – There is a common misconception that technology makes design faster and easier. It takes experience and skill to determine the full amount of time needed to complete a digital task or processes (e.g. milling, printing, rendering).



Example of a time management and workflow issue common in digital production. It must be reiterated that the computer is not automatic nor is digital production in and of itself 'fast.' A tedious laser file will become a tedious model to assemble.



Example of a back up protocol. Soft skills enable students to feel confident that computers will fail and that they are empowered to seek alternatives.

Sourcing – The ability to identify the most effective tool and process for the development of the idea and in relation to the time available for production. This requires understanding the different elements of digital production such as the difference between a raster and a vector.

Preparation – Plan for contingencies and alternatives. Assume some things will inevitably not go as expected and know the options available.

Scheduling – Develop internal deadlines, realistic calendars, and skills for planning and implementing a multi-step process. For instance: development of a digital file for fabrication, then fabrication, then post-production.

D) Digital hygiene

Digital hygiene refers to the good habits of caring for equipment, computer hardware and software as well as preventing and recovering from errors.

Organization – Maintain files in a structure which is both navigable and searchable by users.

Backups – Create a backup routine that is an embedded part of the digital process (cloud, physical media, & storage). This also includes knowledge

and use of software auto-backup and recovery. Keep at least one physical backup off-site.

Maintenance – Keep software up to date (but never upgrade before a deadline). Remove dust and other particles from sensitive equipment, such as laser lenses, after each use. Vacuum computer cases, power supplies, and hard disk enclosures often.

Clean-up – Regularly sort, store, and purge project files to manage storage and make important files easier to locate.

2.4 *Teaching digital soft skills*

Many of the examples listed under soft skills can be classified as character or personality traits. Successful students may already practice soft skills and therefore it is often assumed that these are character traits rather than teachable attributes. One might wonder, given the age of many college students, if such habits can be changed. However, the very notion of "soft skills" implies that these behaviors and habits can be taught to students. There is evidence to support the idea that, with training, young adult students can learn new traits and learning strategies. (Perkins, 1989).

Another common argument is that soft skills are best learned in the workplace. While the workplace presents an authentic context, it does not offer the same opportunities for focused learning as design school. Moreover, one of the reasons for learning soft skills is to make one more competitive in finding employment. Students should have a sense of how these skills translate into practice before they enter the market.

How can schools teach digital soft skills? Merely lecturing to students about them is not an effective strategy. While lectures can be helpful for delivering information or persuading an audience, changing and developing habits requires more engagement. The method of training varies depending upon the attribute and the audience, however, generally-speaking, habits of learning can be developed through a process of investment and practice.

Supporting a new habit which a student does not create themselves requires helping them understand its meaningfulness. It can be easy to dismiss soft skills out of hand because they might seem to be obvious or less interesting than learning technical skills. For this reason, it is important for the instructor to communicate why new strategies and habits are helpful. (McCombs, 1996) Investment begins by identifying the soft skills in question and explaining to students the value of the skills within design and production workflows. To be most effective, those values should be immediate and goal-oriented. Although it is true that developing soft skills can help a student get a job in the future, explaining to a student (for example) how organizing their files saves them time and reduces errors on their current project is less abstract and applies to their current situation. Helping students understand the usefulness of learning soft skills is the first step toward effective habituation.

In many architecture schools, there is a cultural separation between studio courses and technical courses. Students tend to think of studio as their most important course, because it is where they practice design and spend most of their time. For this reason, it is where most of their learning habits develop. This affects how they learn and integrate skills from their other courses. Introducing soft skills can help bridge the gap between studio learning and technology learning by explicitly connecting them through habits.

To be most effective, teaching soft skills should be integrated with hard skills teaching and preferably in the context of projects. (White and Frederickson, 1998) It is not necessary to revamp an entire course around soft skills. An instructor can introduce and reinforce them where they naturally occur within design and production processes. For example, using an error that students commonly encounter to introduce search, problem-solving, and communications skills. Relevant material like this helps focus student attention while a legitimate context helps them retain and access what they have learned later.

Demonstrations can be more effective when they are supported by teaching materials that help organize knowledge for students. (Bransford, Brown, and Cocking, 1999) A simple check-list, for example, can help students remember how to organize a digital group project. Once students have mastered the soft skills involved, the student will not need the scaffolding provided by the list. However, if the student makes a mistake or needs to refresh their learning later, the list provides a useful reference and a prompt for activating digital soft skills. Externalizing implicit practices and helping students focus on relevant information and methods improves the effectiveness of soft skills teaching.

Delivering soft skills in class benefits from a coaching approach. Because the goal is to change student attitudes over time, rather than delivering in formation or procedures, a "one and done" demonstration is not an appropriate teaching style. (Mistrell, 1989) (Bransford and Stein, 1984) With coaching, the instructor discusses the advantages of a skill (creating investment), then models the behavior while explaining to the student what they are doing and why. This last step is important because students need to understand when to apply a skill as much as they need to know the technical operations involved. (Scardamalia, Bereiter, and Steinbach,1984) (Simon, 1978)

Next, students demonstrate the skill and receive feedback from the instructor on their performance. This is followed by more practice and feedback over time and in concert with other skills to approximate holistic design activities. The goal of coaching is to cultivate not just practice but deliberate practice over time – making the student aware of their own actions and motivating retention and refinement. (Ericsson, Krampe, and Clemens,1993). This creates deep and lasting learning.

Adopting a coaching style of instruction requires a change in how students are graded and given other

feedback. Most assessment in studios and seminars is summative, meaning it measures the final outcome of a students' work. This is suboptimal for shaping behaviors, as it does not measure the process sufficiently and is often too late to influence a student's soft skills. Formative assessment techniques, which encourage personal reflection, timely feedback, and student response are useful support for the "coaching". (Vye et al., 1998) To supplement these techniques, instructors should not only observe student behaviors but review digital files, as well. Many courses emphasize the final artifact and never look at the files involved. Reviewing files is critical so the instructor can observe attributes such as organization, efficiency, and other procedural nuances.

Lastly, in order to properly cultivate habits, soft skills should be reinforced in the studio and lab even when they are not being formally taught. Instructors should be mindful and consistent in their own habits, demonstrating modeled behaviors in their personal actions. For example, an instructor's demonstration files should be well-organized to set a good example for the students. Student interactions should also emphasize consistent behavior. If a student asks for help with a tool, for instance, the instructor should evaluate how the student asks questions and replay the scenario with them while making explicit the strategies involved. Learning should be embedded in the classroom experience. It must be a continuous practice, not merely an exercise.

3 DISCUSSION

The challenge of making claims about design pedagogy interventions is proving their success. In educational research the difficulties of empirical measurement in traditional subjects like math and reading are well-known (Black and Wiliam, 1998; Shepard, 2000) but the challenges of demonstrating the impact of an intervention upon design outcomes – which are not easily measured or quantified – make this task even more burdensome and its conclusions unreliable. As such, there is no accepted model for proving the effectiveness of design pedagogy. At the same time, articulating these soft skills and naming them allows a conversation to begin as to why there is such inconsistency in digital education across architectural curricula. Digital methodologies have roosted and flourished in elite institutions whereas other schools have been slow to change (particularly in the area of early design education) and to integrate digital and computational thinking.

What is more important and perhaps easier to 'prove' is that well-articulated digital soft skills create a framework and a platform where technology can be used expansively and in unique ways rather than reductively and repetitively. The value of digital soft skills is to suggest a replicable model which remains relevant and useful for students as technology changes, improves, and adapts.

4 CONCLUSION

While digital design skills are critical for 21st century architects, architectural education must also recognize and deliver more than technical proficiency. Working creatively and effectively with computers, digital fabrication machines, and other devices requires a new set of workflows and adaptations to professional behaviors. Boyer's report makes it clear that one of the key values of an architectural education is developing learning habits. A present gap in student learning is that traditional learning habits have not been updated in response to changes in technology. (Boyer, 1996) Digital soft skills can help to bridge this gap.

Soft skills can and should be taught in architectural education. Soft skills support the goal of not only working well with technology, but together with other people in technologically-supported ways. They help support students who may not have had access to technology or formal training prior to college. Knowledge, abilities, attitudes, and habits not only shape one's process, but one's design goals and outcomes, as well. Soft-skills impact design and so they extend beyond pedagogical or semantic arguments. They should be of interest to anyone who values good design.

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Architectural synergies: Participatory design and construction of a pavilion prototype

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ABSTRACT: An integrated approach to design and construction may be achieved through architectural workshops of specific educational context and aims that may serve as complementary modules within the architectural curriculum. The pavilion prototype presented herein was realized in a six-week design and construction phase. The primary structure consists of non-symmetrical frames, arranged in parallel and in sequential rotation. The frames rotation defines the building morphology of the pavilion and, at the same time, shapes the interior. The objectives of the research program in question involve the investigation of terms and conditions for the development and implementation of an architectural idea. In addition, the particular workshop aims at investigating and promoting the role of the structure and construction elements in the creation of the built form. An important outcome, in terms of the participatory design conducted, has been the actual cooperation of primary school pupils with architecture students.

1 INTRODUCTION

Contemporary architectural design and practice is characterized by an ever increasing complexity. The direct correlation between the architectural design and the potential of realization, construction methods and detailing with contemporary aesthetic expressions, highlights the integrated architectural design approach in contemporary architecture production (Michael & Phocas 2008). Integration may be achieved through architectural workshops of specific educational context and aims. At the same time, workshops may serve as complementary modules within the architectural curriculum at University level (Michael & Kontovourkis 2013; Michael & Phocas 2010; Michael et al, 2008).

Setting the involvement of students in the real process of conception and implementation of an architectural concept as a primary objective, a funded research program entitled 'Synergetic Multi-Objective Design and Construction of Timber Pavilion Prototypes', was initiated at the Department of Architecture of the University of Cyprus in the academic year of 2014–15. The program involves the design and implementation of a number of timber pavilions in open spaces of primary schools.

The current paper presents a case study of a pavilion prototype construction and further elaborates on its individual development aspects and especially the participatory design process.

An important outcome, in terms of participatory design, has been the actual cooperation of primary school pupils with architecture students.

The pavilion case example, presented in this paper, was realized in a design and construction phase during the summer semester 2015, in six weeks. The primary structure consists of non-symmetrical frames, arranged in parallel, in sequential rotation. The frame rotation defines the building morphology of the pavilion and, at the same time, shapes the interior. Seven different types of frames are used, based on the rotational position of their non-rigid joints. In all cases, the frames maintain the same geometrical characteristics.

An essential principle of the design is the standardization of the structural members and the steel connection elements. The specific pavilion was designed to be used by the primary school pupils, both for educational, and leisure activities. The interior space is organized in two main levels; those containing inclined surfaces and a corridor, ensuring, in this way, the exploitation of the structure as a small open air theatre for educational activities. The design of the structure allows the possibility of exhibiting artworks, or other kinds of educational activities. It also provides possibilities of spontaneous activities, i.e. games, theatrical events, debates and others.

2 CONCEPT DEVELOPMENT THROUGH PARTICIPATORY DESIGN

The research project under the title 'Synergetic Multi-Objective Design and Construction of Timber Pavilion Prototypes' addresses the implementation of a creative course that is initiated by children themselves as quest for spatial experience through the concept of developing an installation in the school courtyard. The initial driving mode for the conception was the children's creative imagination, originality of thought, combined with imaginative and at the same time, innovative



Figure 1. Concept development through participatory design.

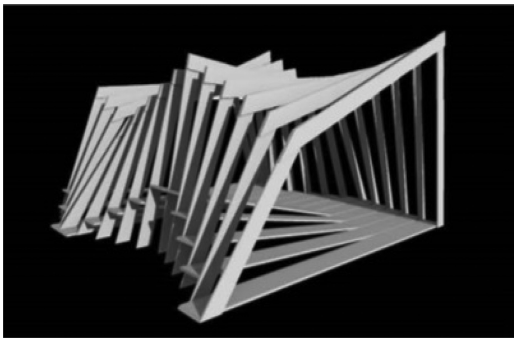


Figure 2. Photorealistic views of the preliminary design concept.

ideas. The result of the reflection was an original idea provided by pupils of the Kornesios Primary School, which referred to an installation in the outdoor space of the school. During this activity, the pupils worked with their teachers and external artists to develop ideas for their proposals. After putting the ideas and thoughts down on paper, the students of the Department of Architecture of the University of Cyprus were asked to shape and further develop the proposals into a real architectural product (Fig. 1). This came about after a parallel processing of functional requirements, architectural form and technological dimensions of the initial proposal.

In the initial phase of the preliminary study, the design was developed through sketches, drawings and three-dimensional models, both in real and digital environments. Specifically, during the academic year 2014–15, within the frame of the undergraduate courses on Timber Construction and Digital Media in Architecture, a series of parallel design proposals emerged. Through a series of participatory design workshops and creative dialogue between primary school pupils and University students, the proposals received further feedback. The process of designing and developing the proposals enhanced the architectural and structural dimension, as well as aspects of geometry, colour and texture.

Six respective architectural proposals were presented to the entire school community. In a special event, which was held in the presence of the Parents Association, the appropriate School Board and the Technical Services of the Cyprus Ministry of Education and Culture, the end users selected and approved a design proposal for further development and implementation.

The procedure for realisation of the pavilion followed by the University of Cyprus team was developed in two phases. The first phase lasted from the 15th until the 20th of June 2015, during which issues concerning the exact location within the open space of the elementary school, and the architectural expression in an integrative content of form, structure and construction, were thoroughly explored. Following the detailing of the structure, all the necessary construction approvals were acquired. The second phase lasted from the 6th until the 24th of July 2015, and involved the actual erection of the structure. The construction was built by a number of students of the Department of Architecture under the scientific supervision of the authors.

3 INTEGRATED ARCHITECTURAL DESIGN

The design and development of the pavilion prototype was based on an integrated architectural design process. The specific integrated design approach proposed enhances the role of the structure and construction elements in the architectural process influencing, at the same time, the aesthetic, technological and other criteria. More specifically, the design and construction process focused on the pavilion creation using timber as primary material, the design of the load-bearing and non load-bearing elements, as well as the design of the construction members and details. The ultimate goal was to highlight the role of the building construction in the architectural composition throughout the process of concept, development and realisation. In addition, the conceptual aspects of the design were explored, the forms, investigated through physical and digital design tools and environmental and construction aspects, were analysed with simulation programs (Fig. 2).

3.1 *Pavilion prototype design concept*

The design concept of the pavilion prototype is based on the development of a timber structure with variable configuration. The overall building morphology is achieved through successive rotation of planar frames. The structure is characterized by high construction standardization. It consists of a number of successive frames placed at fixed distances. The overall frames composition has the geometry of a hyperbolic paraboloid on the projected roof and side facades. On the inside, the space is divided into two main levels; namely, the inclined surfaces and the corridor. The space that is intended for viewer seats is divided in individual parts, with small altitudinal differences that result from the dynamic geometry of the construction.

The overall dimensions of the structure frames are $4.10 \times 5.12 \times 6.30$ m (height $\times$ width $\times$ length) and

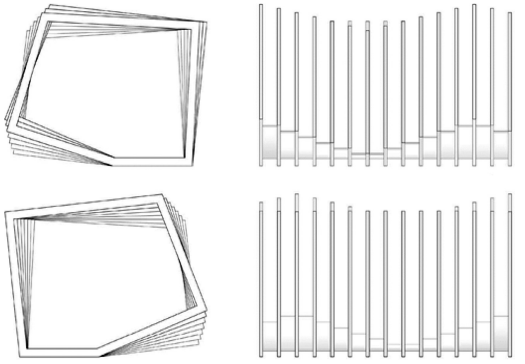


Figure 3. Elevations of pavilion prototype design concept.

the distance between the frames arranged in parallel is 0.45 m. The frames rest on a reinforced concrete slab of 30 cm depth and are strengthened by steel members at the base and at the connecting joints of the timber members. Each frame consists of two pairs of a number of members each, connected over moment resisting joints. The member pairs are interconnected at moment free joints and follow successive rotations, providing respective inclinations at the horizontal projection level. Each frame transforms and rotates at the corresponding joints by 2°. Due to the rotation of the joints, a single member in each frame obtains variable length, while all other members have the same dimensions. Overall, the structure consists of fifteen frames, whereas only seven different types of frames appear in the final rotation position of the joints (Fig. 3).

3.2 *Form investigation through parametric design*

At a further stage, the geometrical development and refinement of the form of the pavilion was realized and modelled in digital environment through parametric design logic and specifically through the use of the software Grasshopper (plug-in for Rhino). This enables the accurate calculation of the structural members of each frame, as well as their exact rotation according to predefined angles. Furthermore, this procedure allows the evaluation of the parametrically controlled morphology according to static and environmental criteria investigating, at the same time, alternative design solutions.

The morphology is achieved by defining fifteen structural frames in linear order, each of which controlled and rotated, based on four parametrically controlled arcs interconnected to formulate the five structural members of each frame. Important aspects that have been taken into consideration during the geometrical development stage included the standardization and fixation of the members according to their dimensions, as well as their length variability. The uniformly distributed difference in each angle of rotation has allowed, on the one hand, differentiation of the overall geometry of each frame and, on the other hand, mass-customization of each structural member, leading to the development of a

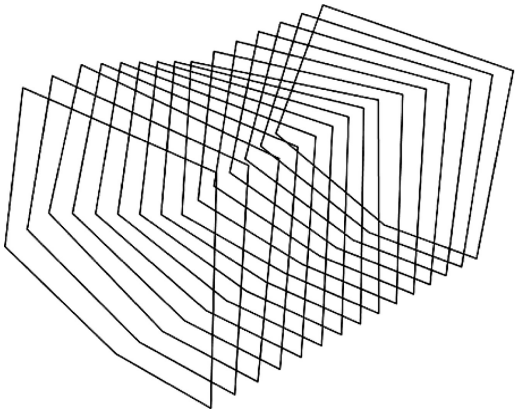


Figure 4. Axonometric parametric development of the proposed construction.

non-standard geometrical outcome. Figure 4 shows the three-dimensional arrangement of the overall system of frames, based on the uniformly distributed angle of rotation.

In addition, the parametric investigation has allowed the accurate realisation of the structure in actual scale, by extracting data related to the length of the structural members, as well as to the morphology of each joint. The design of joints was also standardized and simplified, in order to overcome possible obstacles during the construction stage, especially due to the non-standard nature of the final outcome. The application of CNC laser-cutting machine has allowed the accurate production of steel plates and position of bolts, initially using cardboard material, and then through the use of cut models during the construction and assembly stage.

The further exploration of the structural prototypes in question concerns more a system development rather than a materialized product. At the same time, the process of design and development followed offers opportunities for enriching the qualities of its specific components.

Consequently, its dimensions and shape could vary according to the performance criteria set in each case, based on parametric combinations that produce desired adaptations, required by particular functional or environmental conditions. Thus, a whole new range of possibilities and variations of the structure could emerge. Moreover, it is important to stress the multiple possibilities for architectural expression that the pavilion offers. The different potential variations of the structure may lead to a number of architectural design solutions. The different combinations might provide varying appearances, which may give the design product an added architectural value.

3.3 *Structural design*

The structure is founded on a reinforced concrete slab, 0.30 m thick, and consists of the self-supporting frames placed in parallel at a constant distance of

0.45 m. Each unit is supported on an anchoring base at two points. The timber members consist of two parallel sections, of dimensions of 35 × 195 mm, with an 8 mm gap in between. The connection of the timber members at the joints, as well as the cantilever members that extend to the inclined side of the structure, is achieved through steel plates of 8 × 190 mm. In the longitudinal direction of the structure, the frames are interconnected through steel members to form a secondary frame system, in order to increase the horizontal stiffness of the system. Moreover, the diaphragm created on the horizontal and inclined level of the structure allows the transfer of horizontal dynamic loads to the vertical load resisting elements of the structure within acceptable deformation range.

The permanent and variable loading actions taken into account in the design of the structure include a permanent vertical load of 0.10 kN/m^2, a temporary load of 4.00 kN/m^2 and an exhibits static load of 6.00 kN. The analysis considered safety factors as related to permanent loads, of 1.35, temporary loads, 1.50, structural timber, steel and concrete 1.30, 1.50 and 1.50 respectively. Timber strength grade of C24 applies to all timber members according to EN 338, S275 to the steel members, and C30/37 to the foundation slab. The load combinations for the permanent and temporary static, and dynamic actions (seismic loads) were derived according to EN 1990 and EN 1998-1 respectively. The maximum vertical deformation of the structure amounts to 1.1 cm at the ultimate limit state of the system and the corresponding horizontal one, 3 cm, in the longitudinal direction (Fig. 5).

3.4 *Construction and environmental design of the pavilion*

The materiality of the design proposal, as well as the construction design and process, form a significant part of an architect's education. The selection of the appropriate building materials, and the application of contemporary manufacturing technologies, directly affects the architectural expression of the product. The use of wood, as main structural material, ensures the minimization of the ecological footprint of the pavilion (low emission CO_2, low embodied energy) (Anink et al. 1996).

The aim of the construction and detailing design process is to standardize the timber frame members, as well as the steel components, in order to facilitate the construction process. All timber members have the same respective lengths in all frame types, with the exception of a single member with variable length. The fixed lengths of the members are 3.75, 3.45, 2.95 and 1.85 m while the 'transforming' member varies in the seven different frames between 2.55 and 2.85 m. The secondary steel frames, placed for the creation of the diaphragm, have standard dimensions of 1.12 × 0.37 m and 1.65 × 0.37 m. Steel connections of 0.37 × 0.95 m, 0.37 × 1.70 m and 1.80 × 0.37 m are positioned on the longitudinal sides of the structure (Fig. 6).

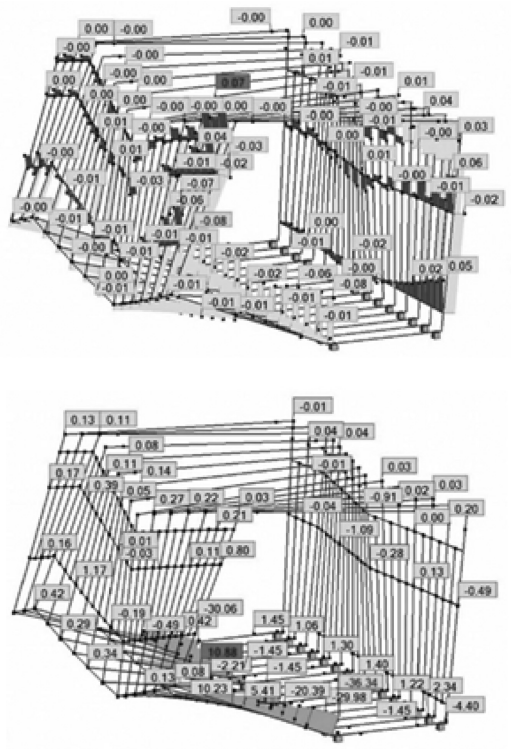


Figure 5. Diagrams of bending moments under vertical loading and horizontal loading.

The high degree of standardization and prefabrication of the construction units ensured the reduction of the individual frames realisation time, and consequently the required total construction time, as well as the embodied energy of the entire project (Anink et al. 1996). Moreover, the reduction of environmental damage involves the use of appropriate building techniques (drywall techniques, assembled constructions) (Fig. 7).

The assembled technique allows the re-use of all construction materials, which ensures recycling without downgrading their initial quality (Berge et al. 2003). The application of contemporary construction methods gives added value to the final construction product and increases the contribution of the construction design to the improvement of the structure's image (Baerlecken et al. 2012) (Fig. 8).

Finally, within the frame of investigating the environmental implications of the pavilion, shading and insolation issues of the construction were investigated. Specifically, a shading study of the pavilion and the impact of the built environment for the hours between 08:00, 10:00 and 12:00 for the periods of December 21 (Winter Solstice), March 21 (Spring Equinox), 21 June (Spring Solstice) and 21 September (Autumnal Equinox) were examined.

The shading study was performed using Autodesk Ecotect Analysis software. The analysis showed that during the winter period, the wider area of the

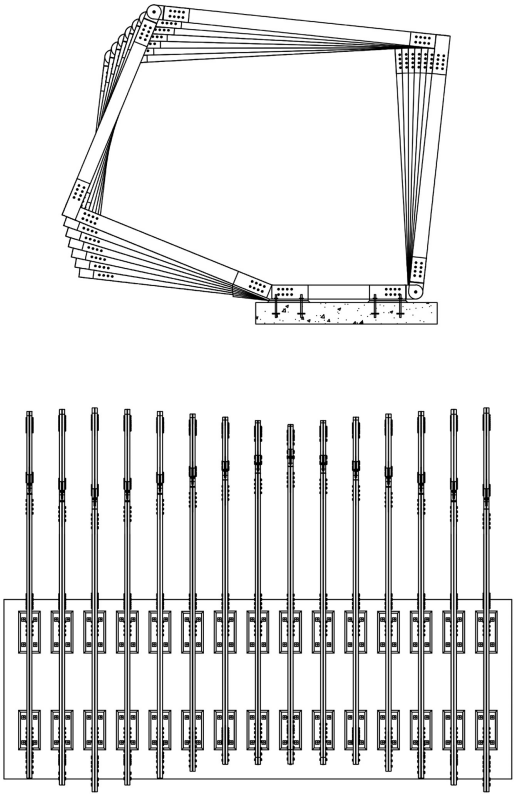


Figure 6. Construction drawings of pavilion prototype.

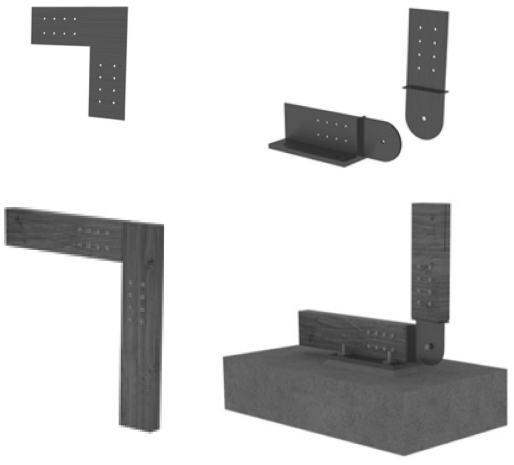


Figure 7. High degree of standardization and assembled construction techniques.

school courtyard is mostly shaded during school hours and the pavilion can be used during all working hours of the school, since solar insolation is desirable. During the interim periods, as well as during the summer, adequate shading is ensured until 10:00 in the morning (Fig. 9).



Figure 8. Parallel timber frames of pavilion prototype.

4 REALISATION STAGE

The realisation stage is considered an important outdoor activity that differs substantially from the typical design development process, which takes place in design studios or other design courses. Hence, the specific construction workshop aims to strengthen the students' experimentation and experience with regards to construction techniques (Figs 10, 11). In a pedagogical framework, students are introduced to the workflow, moving from the conceptual design and digital development of ideas to the actual materialization scale, forming an overall framework of construction development (Fig. 12).

In order to ensure adequate timber quality, a qualitative selection was carried out, taking into account parameters such as geometry, dimensions and material quality. The timber was then cut to predetermined lengths and planed by the timber supplier. The architecture students who participated in the workshop undertook the task of classifying, levelling properly and impregnating the timber with water-soluble varnish, with antifungal and insecticidal properties, suitable for outdoor use. The steel members were delivered, coated with a layer of primer, and were then run with two coats of paint.

While this work was conducted by the students, the reinforced concrete foundation and the anchoring steel plates for the structural supports were placed by an experienced workers crew. Preceding this, the existing reinforced concrete slab was demolished as it was deemed inappropriate to found the new structure. The removal of the frames steel base at the foundation was conducted by the steel construction crew that had

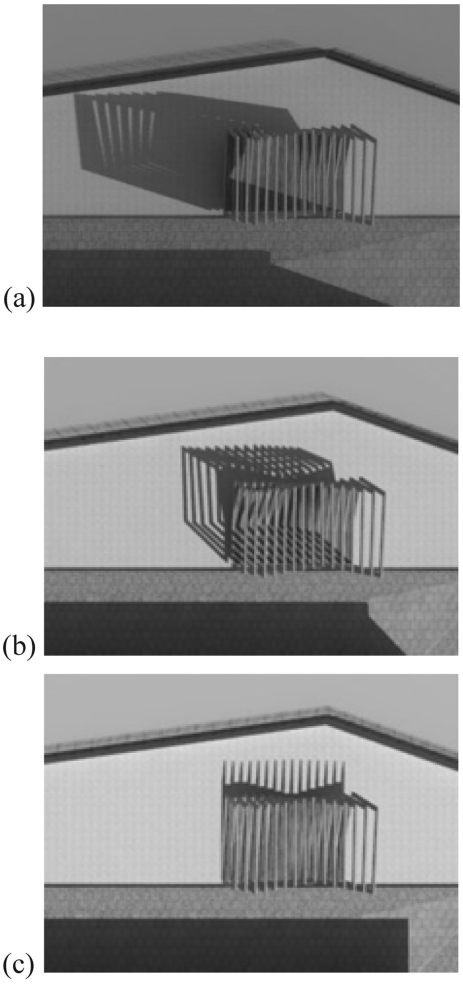


Figure 9. Shading rate for the immediate period i.e. March 21st at (a) 8:00 a.m., (b) 10:00 a.m. and (c) 12:00 m.m.



Figure 10. Construction process.

supplied the steel members of the structure. The connection of the timber members to the steel plates was performed by students using boltings.

Additional effort was made to ensure the best technical quality in the connections. To mitigate possible



Figure 11. Construction process and assembly.



Figure 12. Construction development.

negative effects on bolting positions, rings were used in the screw and nut positions.

4.1 *Usage*

The installation in the outdoor area of the school attempts to answer the initial question on conceptual level; that of investigating concepts of exposing and being exposed; notions which triggered the design development and realisation of the structure. The main functional use of the pavilion refers to the creation of an exhibition space that can accommodate thoughts, ideas and feelings of the pupils. Panels with drawings can be placed on the art posting system located on both sides, or at the deck of the construction. An artwork designed by the school students, which occupied the entire face of the structure, was the first artistic creation. It presents the children's perspective around issues concerning the student community and the school space. The placement of a fabric ribbon on the timber elements of the structure was a spontaneous artistic intervention by the pupils. The ribbon was placed on the first day, pupils returned to school after the summer holidays, and it was inscribed with wishes and goals for the new school year (Fig. 13).

Apart from exhibiting artworks, the geometry of the structure allows the organization of artistic events therein. The pavilion can be used for theatrical performances, children's book presentations and musical events. In addition, the structure can be used as an outdoor teaching area during sunny mornings in autumn



Figure 13. Artworks exhibitions and artistic intervention by the pupils.

and spring. The slopping part of the structure can accommodate pupils of one or two classes, thus providing an alternative teaching space and learning experience (Figs 14a, b). Moreover, beyond any artistic or teaching activity, the structure is intended for spontaneous and creative activities by the children. The structure could become, in the untamed imagination of children, another opportunity for creative play during recess.

The implementation of the architectural concept has been validated in several aspects: the pavilion has influenced reuse of the schoolyard area through intense flows of activities around and within the pavilion; the permeability boundaries of the pavilion enhance, or support, mixed activities to take place by the pupils at the interface of leisure and learning conditions (learning by playing); the different levels of the pavilion, with the varying inclination, support the development of diverse activities, experiences and visual connections by the pupils.

5 EDUCATIONAL OUTCOMES

The objective of the research program in question is to investigate the initiation, design and construction realisation of an architectural concept and to promote the role of integrated architectural design in the creation of the built form. Such workshops offer the participants the opportunity of learning the properties of the materials and the specific requirements of the construction techniques, as well as the basic structural design principles. Through the development of the designs and the implementation process, construction and manufacture are experienced in real terms, while these individual thematic sections are interdependent with no clear boundaries and with substantial overlaps between them (Michael, et al, 2007).

Finally, an important outcome in terms of participatory design has been the actual cooperation of primary school pupils with architecture students. At the same time, the Pavilion is the result of a shared vision and effort of primary school pupils and students



Figure 14. a,b Theatrical performances, children's book presentations and musical events at the pavilion.

of architecture. Through a collaborative process of designing, the initial thoughts and ideas of the pupils were first articulated at the design level and finally as a real architectural product through the process of the workshop. The end product forms a reference point of the school and a symbol of cooperation and optimism for a better future achieved through a collaborative process. This could have further implications on the way actual buildings, in larger scale, are designed and especially educational and public premises.

6 CONCLUSIONS

The present paper examines the introduction of construction workshops in architectural education at University level, with regards to the building component and its interrelation with the architectural design. Following the process of design, development and realization, which form parameters equally important and undoubtedly interactive and interdependent, the structure aims at bringing together and inter-connecting the space with the users. Through its materiality, the structure creates spatial conditions that allow the transformation of experiences, interacting with the natural and built-up environment, as well as with the final users. The development of the structural prototype, presented as case example in this paper, addresses the

stages of conceptual design, construction, and realization. In relevant courses of technology, the objectives should also aim at the integration and practice of basic principles of architectural design, development and realization. Furthermore, the integration of a series of thematic axes, such as construction, materiality and standardization, parametric experimentation, structural analysis and environmental awareness, in a conceptual and construction design process, within an architectural education framework, aims to develop a comprehensive approach of built-up spaces. To achieve this and capitalize on the educational benefits, the authors propose that, in addition to studio-based courses, such practical outdoor activities are taken up on a regular basis, as complementary methods to the design research conducted in studios.

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FAjúnior – Architectural games

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ABSTRACT: The research project "FAJúnior" is a pedagogical project, based on two distinct components: a scientific and experimental view, which includes different teachers and researchers of the Faculty of Architecture of the University of Lisbon. It is the first and unique project of this kind, which is being developed at a Portuguese university. The project seeks to interact with children and young people of different ages, natures and realities. The purpose is to bring the thematic of architecture, urbanism and design to the younger layers of formation, which still unaware the academic world, towards an early awakening of a consciousness centered in the valences and interests of the educational universe of the Faculty. These values present multiple scientific and cultural approaches, where the teaching of practical and artistic heritage, aesthetic and ethical trials promote sensitivity in understanding the faculty and its various public and private dimensions.

1 INTRODUCTION

The work presented here derives from a research project (Fig. 1) in course at the Faculty of Architecture of the University of Lisbon, since 2014. The project is being developed within the Research Center of Architecture, Urbanism and Design of the Faculty of Architecture of the University of Lisbon in close relation with FAjúnior, the recent office created as promoter of the activities planned with the outsider communities.

(website: fajunior.fa.ulisboa.pt).

The presented approach makes part of a vast and complex theme of the awareness of architectural, urban planning and design issues, as an effective teaching strategy in youth training and in the awakening of intellectual sensitivities and creative predispositions that may or may not have subsequent academic developments. It is actually the thinking of "teaching" these themes in pre-university contexts of young age as stimuli-sensitive on the critical and creative reading of the surrounding environment. From the environmental study of the built structures, in close and familiar surroundings, students realize that they can intervene significantly, changing and improving these spaces. Effectively from an embryonic awareness that all it involves is drawn: the objects we use, the houses we live in, the books we read, the streets we walk on, until the cities where we live, all leads to an operative awareness in order to empower the children and the youth to greater fitness and critical intervention.

These logics carried out in various parts of the world, have usually as the underlying the playful dimension and are inserted on cultural programs extended to the family. These various examples are evidenced by the following references that illustrate various logics and assumptions: the thematic programs of the Bauhaus-Archiv in cooperation with the Jugend im Museum (JIM) in Berlin; the Archikidz programs organized in various parts of the world and finally the mediatic events of the Barbie Architect.

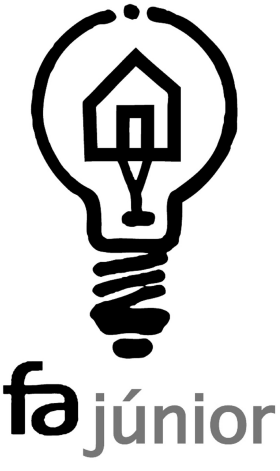


Figure 1. FAjúnior logo.

The thematic programs of the Bauhaus-Archiv in cooperation with the Jugend im Museum (JIM) in Berlin, advocate the ancestral logic, related to pedagogy and teaching of architecture. Perhaps with a most particular and selective character have the aim of stimulating creativity through various multiple expeditions in various museums of Berlin, enhanced with artistic work in workshops. In the background a stimulus to productivity, where children and young people can paint, draw, make pottery works, wood, photography, fashion, etc … A pedagogy that inserted in a basilar education, as is effectively the heritage of Bauhaus reinvents this proximity to children and youth paving the way for an intrinsically architectural

cultural education. These programs have effectively expression in several countries including Portugal, and are carried out in different museum spaces with diverse and comprehensive themes like nature, technology, science and art …

A second example are the Archikidz programs, that support a broader and cooperative attitude of this civic consciousness through concerted actions in several countries that lead the problems of architecture, urbanism and design to the young generation. From the motto: Inspiring Tomorrow's Thinkers and City-Makers, the Archikidz is a not for profit organization, providing a dynamic platform for inspiring and educating kids, probably future city-makers to create better communities and a more sustainable future. Archikidz Began in Amsterdam, in 1998 with an architectural workshop for kids. Events are now held annually in Amsterdam, Rotterdam, Bergen, Barcelona, Buenos Aries, Lisbon and Santiago. These events present a strong social mission that seeks to bring the themes of architecture to an event scale with a very performative character in the cities where they occur.

The third example focuses on the imagery of the global trend of the children, from the emblematic character of the Barbie Architect. The Barbie doll, created in 1959 in the US by Mattel won a new cast in 2011 when it launched the Barbie Architect. This Barbie, of the Barbie collection, I Can Be, called for the imaginary of the architecture through the personification of thisjob, its status and social function. This doll launched through a partnership with the American Institute of Architects, promoted also associated workshops. These were primarily intended to disseminate knowledge of the profession job and the fundamental role of the architect in the built environment, focusing on historical background aspects of the role of women architects over time. Guided between a more informative and ludic contenta and a more playful, the event was implemented freely in schools, educational centers, institutions, etc … and promoted since then a spatial approach asking the participating children to draw sketches of the Architect Barbie's Dream House. A concerted action that expressed, without doubt, the media coverage of these issues and how they can be disclosed and approximate the child's imagination.

These three examples focus, in different areas, scales and purposes, a common concern to bring awareness of the surroundings and its formalization to the younger generation through playful concerted, interactive and innovative actions. "The game of truth and error, is not played on empirical verification and logical coherence of theories. It also plays deep into the invisible area of paradigms". (Morin 1999).

2 SPECIFIC ACTIONS ACTIVITIES

It was effectively in this context that this innovative research project has been developed, both in the University, as at the national context, which seeks to understand the potential of this educational interaction



Figure 2. Open Day event.

with the youth, by promoting several specific actions in complementary themes. The dissemination of these activities are based on: Open Days and monitoring visits to the institution/college; coordination of summer programs; and organization of various recreational events, to which underlies a research content applied on the various actions undertaken.

The Open Days (Fig. 2) and the college visits are organized by the college or requested by secondary educational institutions. They are generally intended for a public that already have an interest or willingness to eventually attend college. They are effectively a pre-university public seeking contact with the college in order to understand the education courses of the institution and to establish criteria for a future selection. These visits beyond the presentation in the format of lecture about the contents taught and entry criteria are complemented with visits to areas where potential future students take contact with workplaces, classrooms, workshops and recreational areas. These approaches beyond to open the college to abroad, enhances livings within the academic environment where young people "experiment" classroom ambiences, contexts of examinations and academic gatherings.

The summer programs (Fig. 3), take place during the school holidays period, usually in the first two weeks of July and are organized by the University of Lisbon that through its 18 schools promotes outreach activities of its various areas of training to young people aged between 13 and 18 years. These activities are workshops, divided in two weeks, a first aimed to older students (secondary school – 10th, 11th and 12th grade) and a second for younger students (basic school – 7th, 8th and 9th grade). The workshops organized during these two weeks are distributed by three research areas: Architecture, Urban Planning and Design, and atr coordinated by professors and researchers from the School of Architecture,



Figure 3. Summer programs.



Figure 4. European Researchers' Night.

which provide practical experiences to the students. In a playful way, these students are faced with specific situations covering the various areas of the surrounding context (since the hand scale object to the scale of the city), as well as various fields of knowledge, addressing conceptually and by an embryonic form themes of history of architecture and urbanism, theory, design and representation. "It is therefore necessary to do well: start by judge. This is mainly a case of personal experience, it is through experience that all young people should learn, challenge the passions and provide them with these rules of conduct." (Bosch 2001).

The participation in events, target public, children, youth and their families (Fig. 4), are activities aimed at a broader public, where by an affordable way, fun and educational some researches on the built environment are promoted. In this regard we highlight

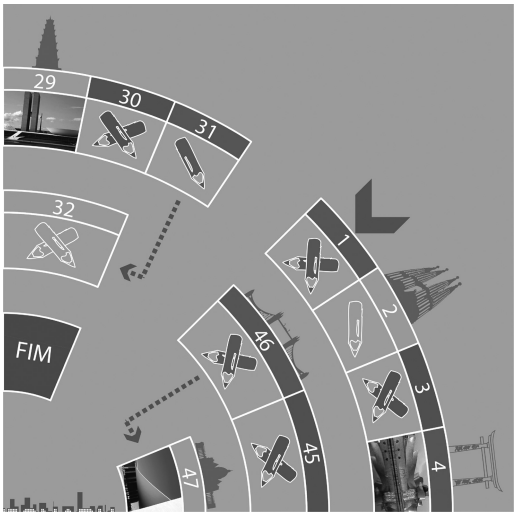


Figure 5. Architionary game.

the participation in events linked to the European Researchers' Night, which linked to the very general theme of the event that is to connect research and civil society, to promote activities where the themes of architecture, urbanism and design, "enter" so direct into the imagination of the participants. Other investments bind with humanitarian actions of solidarity with related events to support social causes such as disasters in cities, destruction of buildings or support to refugees.

3 APLLIED RESEARCH

Framed in this panorama of activity it has been developed an applied research tonseveral architecture games that are released, promoted and experienced in these various actions. Three methodological experiences can be highlighted: the Architionary game, the three-dimensional constructions ArquiBe and the thematic competitions for ideas.

Architionary (Fig. 5) is a game applied in the workshop of the same name integrated in the summer courses offered by the Faculty of Architecture to students of primary and secondary level of education. The theme of the game is inspired in the classic game Pictionary, where the players are conducted on guessing concepts through drawings. In this sense beyond the stimulus to the representation by design it is also promoted the contact with conceptual contents related with the themes of architecture, urbanism and design in all aspects, historical, theory, construction, etc … Organized by three levels of difficulty, easy, medium and difficult the concepts explore various thematic approaches, always accompanied by definitions transcribed of dictionaries or technical vocabularies architecture. Complementing this conceptual approach there are still references to architectural pieces that illustrate "houses" of the game

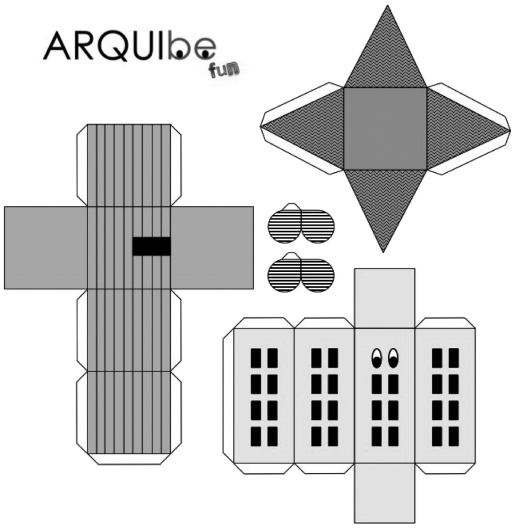


Figure 6. ArquiBe activity.

board that animate the challenge leading players to guess the author, location, or building name to reach closer to the target house.

ArquiBe (Fig. 6), is a playful experience to children and their families, where from sheets of paper printed with volumetric flat patterns organized int three types: base, body and top, the children are taken to cut, paste and assemble the three objects creating an architectural "being". An ArquiBe, which is basically a model, and a puppet that derives from the combination of three modules, which have different configurations, colors and textures and thus the ability to generate multiple appropriations and formalizations. Being an activity mainly developed with children, the objects produced are generally purchased by the authors, a kind of trophy and reward of the task performed by themselves. These objects/models, in addition to the plastic indentation practice, assembly, glue, raise a critical insight into the strategy of choosing shapes and patterns that will result in the final object. It is a sort of critical essay and value judgment, embryonic in the design process and on the way to read, think and conceive the surrounding space.

Finally the contests of ideas, establish themselves as challenges proposed to school communities, involving students at all levels, from pre-school to pre-university. These challenges are related to critical and creative conception of themes related with architecture, urbanism and design. In this sense it was framed the first contest launched by FAJúnior in November 2015: the contest of ideas – The House of the Future. (Fig. 7). This approach addressed students of the 1st, 2nd and 3rd cycle, had as main aim to take students from their creative imaginary to draw a house for the twenty-second century. It was proposed the exploration of various two-dimensional techniques such as drawing, painting, collage, etc … However, the drawing pencil and the pen havebeen the most used technique.



Figure 7. The house of the future competition.

From this experience there was the participation of 129 students from eight schools in different regions of the country. From a very broad and creative approach that explored various plastic, constructive and environment questions for setting up a home for the twenty-second century. In this sense it was achieved the main objective of the action that was to take the theme of the architecture to different school environments, where from the pretext of the House of the Future, several spatial experiences and ideas were developed.

4 FINAL CONSIDERATIONS

In terms of final considerations it is sets out a summary on the three approaches referenced (experiences of the Bauhaus, Archikidz and Barbie); initiatives undertaken by FAJúnior office (open and visiting days, summer schools, thematic events) and the research field formalized in three "architecture of games": the Architionary, the ArquiBe and the House of the Future. In this regard and in accordance with nature, the target public, the methodologies and the objectives achieved are defined as follows considerations.

About nature, the various references determine various perspectives nuanced by one hand by the educational and cultural approaches carried out by the initiatives of the Bauhaus, the summer courses and especially by the playful approach developed by the Archtionary game. By the social approaches taken in Archikidz events, in the themed events carried out by FAJúnior and especially by the event The House of the Future and the broad extension of this initiative to all schools in the country covering the school community and their families. Finally a perspective more commercial and in some way sectorial, evidenced in the events associated with the Barbie architect, the summer courses developed at the Faculty of Architecture and in some way in the patenting logic provided in the Archtionary experience, and in the future intention to take this experience as an educational and commercial product.

On the target audiences are also differentiated diverse perspectives in the three fields statements: references, activities and research. The specialized public and in some way directed to the subjects, for the teaching and the learning issues, related with architecture, urbanism and design stands out in the leisure experiences of museums, but especially in the summer courses developed in the faculty of architecture and in some way established for future students of architecture. A more academic approach stands out in approaches triggered by contests of ideas developed by various school groups, many of them in the classroom environment and guided by their teachers' holders. Finally, the initiatives aimed to families, are naturally extended to broader audiences including children, young people and adults. In this perspective, the themed events are specially highlighted, and by association the logics of the activity ArquiBe. Due to different levels of difficulty on the integrated execution, there is a different adult and child participation in the implementation of the various associated tasks.

On the methodologies applied stand out in this logic varied interactions between individual/group; school/family; community/faculty. This diversification at various scales, highlight the extension of the different actions and their complementary nature.

Finally and framing the final disposition of raids fall into the different objectives achieved, based on taking the theme of architecture, urbanism and design to the younger layers of society, their children and families through differentiated and specific actions, ludic dimensions, educational, and also scientific. Actions that beginning from different principles, such as, solidarity, industry and trade, converge in the joint action for the dissemination strategy as a game, an architectural game as playful way, directly, accessible to propose a research on the surrounding built environment and above all, on its assessment criticizes and its qualitative evaluation.

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Community-driven design aspects of architecture education in Hungary

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ABSTRACT: While community design has enjoyed a more than 50 years long tradition in the Western world, in the post-communist countries of Eastern Europe, the notion of participatory architecture had not taken root until the early 2000's. Since then however, a great number of design practitioners have embraced the idea of a more democratic approach to their profession, and as a result, community design has slowly been finding its path to the mainstream. Architecture education was anticipated to reflect on the trends in a timely fashion, in case of a special program of the Budapest University of Technology and Economics, it even played a catalyst role in the process. This paper intends to recapitulate the various strategies, forms and structures of university-community design partnerships, to examine the particularities of community involvement in the Hungarian social, economic, political and academic milieu and to deduce conclusions through the experiences of a series of university-based community design workshop projects.

1 COMMUNITY DESIGN – OVERVIEW

The idea of community participation in architecture design dates back to the democratic renewal movements of the Western world in the early 1960's. Emerging social consciousness and a crisis of confidence in professional competence revealed the inequity in decision-making on several areas of the public sector (Comerio 1984, Pearson 2002). These symptoms were equivalently existent in the building industry. Government managed affordable housing programs and urban renewal projects that failed due to the lack of social sensitivity, exposed the need of a different approach (Turner 1977). Based on models of self-help community initiatives in the developing countries, where professionals joined the people to improve their environment, architects became the promoters of new, more equitable ways to address numerous issues of concern emerging in the changed socio-cultural environment. Community design was born.

Community design is based on the active involvement of stakeholders, a wide range of affected citizens, in the planning process of the shaping of their built environment. In the second half of the 1960s, a host of new federal and municipal programs focused on underserved urban population, and committed design professionals, who took the role of advocates in the process lead to the creation of community design centers in the United States (Pearson 2002). These community design centers – architecture studios dedicated to inclusive design – have proved to be a unique vehicle through which a crucial array of services in community development has been made available (ACD 2016). Due to the quick success of the model, the number of community design centers increased rapidly during the 1970s (Pearson 2002).

In parallel with the emergence of community design centers in the USA, a number of initiatives embraced similar citizen participation oriented vocation in the rest of the western world, often bringing alternative solutions, at times even contrasting the American advocacy practice. The Byker Wall regeneration project (1968–82) in Britain was among the pioneers, where architects opened an on-site office to develop communication and trust between existing residents (Jones & Canniffe 2007). The new medical campus development project of the Université Catholique de Louvain in Brussels (1969) offered architect Lucien Kroll a great opportunity to implement his methods of user participation (Sennott 2004). Dutch architect N. John Habraken proposed the separation of 'Supports' or base buildings from 'In-fills' in residential construction and design as a means of giving inhabitants a meaningful participative role in the design process (Habraken 1972). In the Saal process in Portugal (1974–76), technical teams, led by architects collaborated with local communities to address the housing shortage and design homes with the direct input of the residents. These are only a few of the various early community design initiatives in Europe.

Political climate however changed in the 1980s. The coming-to-power of more conservative governments on both sides of the Atlantic serially undermined local authority power, while seeking to reduce government roles in economy and promoting private sector and individual initiative. Funding possibilities for consolidating movements were changed in a radical way and over time – while stimulating some community-based activity initially, longer-term and development funding became focused on specific perceived problems (Jenkins & Forsyth 2010). The reduction of governmental support for social programs in the USA resulted

in a sharp decline in the number of community design centers (Pearson 2002).

The downturn of community participation in architecture design, however, proved only momentary. The following decade brought new economic, environmental and socio-cultural urban challenges and a new trend of sustainable regeneration policy highlighted the necessity of social inclusion and community participation in decision-making once again. Livable, human-oriented, sustainable and socially sensitive design of the built environment relies heavily on the comprehensive knowledge of needs and preferences of the local communities.

While several newly developed community powered design philosophy and methodology branches have diverged from the traditional advocacy role of architecture toward more pragmatist approaches (Toker & Toker 2006, Bezdek 2013), the core concept, the importance of community involvement in the design process, has remained largely unchanged.

2 COMMUNITY PARTICIPATION IN HUNGARY

Hungary is one of the post-communist Eastern European countries, where genuine democratic community development was regarded as politically undesirable; community participation in architecture design was therefore virtually non-existent before the democratic transitions. Whereas social sensitivity was officially promoted as a cornerstone of the communist ideal – and it must be acknowledged that there was no shortage of different community-purpose and social facilities – the actual design decisions for these facilities, public spaces and other urban development projects were based more on a curious and often incidental mixture of political ideology, top-down planning and theoretical professional concerns, rather than on the actual needs of the users.

Transition in this regard, however, did not happen as an immediate consequence of the political changes. Potential reasons for the delay are at least threefold. The fall of communism and the subsequent spread of democratic institutions happened to coincide in time with the global downturn of community-engaged design. Furthermore, in spite of the enthusiasm for Western administrative and governance models, the temporary economic recession that followed the transition in former Eastern-bloc countries seems to have diverted attention from the more abstract strands of democratic engagement and citizen responsibility.

In a democratically inexperienced society, which lacked the decades of tradition of community participation in decision-making, the initial disinterest in citizen empowerment may not strike as surprising. In addition, role players in local development projects (e.g. municipalities, private investors, NGOs) are still often unfamiliar, or cannot identify with the values of the local communities, and thus, these values are not reflected in the decision-making processes (Sain 2010). As a result, a number of developments become associated with negative impacts on their surroundings, draw unfavorable public sentiment and fail to catalyze further developments in the area (Sain 2010). As project details are often not shared with the local communities, citizens do not feel ownership and responsibility over new public and private investments even if these were intended to improve their neighborhood.

Meanwhile however, the practice of community involvement in the design process is becoming more common in Hungary. Affected community members are often invited to participate, even from the earliest stages of the design. People are asked for their input or even delegated to certain tasks in several development projects. Community development services are also becoming more readily available.

3 ROLE OF DESIGN PRACTITIONERS

The general attitude of design practitioners towards the idea of inclusion, as well as their competence in participatory design, is determinant in the success of community architecture. Public acceptance of architecture design has proved to depend more on communication and complying with the local socio-cultural identity than on aesthetic values (Lozano 1990). According to the traditional paradigm of strategic planning practice 'design tasks' should be assigned exclusively to highly skilled and properly licensed professionals (AIA 2015). Design activity, however, is not circumscribed as a clear definition. In a wider sense, people make a series of design decisions during their everyday life. While similar in fashion, most of these decisions do not require the technical assistance of qualified professionals.

Hence, it can be appreciated that non-professionals, such as the future users of a building, or an entire community affected by an urban development, could provide valuable input to the design criteria, if sufficiently enabled and capacitated to express that input. Especially, when it comes to strategic design questions derivable from the quality of life, living conditions and value priorities of the people the designed is intended for. Acknowledging the importance of the local knowledge, community participation is regularly set as a condition of funding for several urban rehabilitation and renewal programs and integrated urban development programs (Swyngedouw et al. 2002).

In some cases however, often as an attempt to bypass the labor-intensive and time-consuming but otherwise obligatory community participation process, or to legitimate the imposed proposals of political decision-makers, inclusion is confined to receiving information and a few consultations (Swyngedouw et al. 2002, Sain 2010). Participants, selected upon the judgment and preference of the decision-makers, do not represent the entire range of affected people. They also do not get to interact with each other, therefore, deprived of reasoning and negotiation, the collected

information articulate only a series of competing personal opinions rather than a collective consensus. Based on the gathered information it is the architect, who then makes the design decisions. The wider audience meets the basically finalized plans only at hearings and consultations, where they are often exposed to abstract technical drawings and terminology they do not understand. If, at the end, the concept fails to win the audience, conflict is guaranteed. These forms of *pseudo participation* (Sanoff 2000), or *outsider participation* (Hofman 1998) – even if carried out without any ulterior motive – are largely seen as destructive practice, since they can easily undermine the trust and engagement of community members to future participation.

As opposed to pseudo-participation, in *genuine* (Sanoff 2000) or *insider participation* (Hofman 1998), members of the community would meet already at the earliest stages of problem mapping. They get to know each other's interests, intentions, ideas and concepts. All essential information becomes public domain. Design professionals provide the technical assistance and maintain high design quality. Since design criteria are a result of consensus through interaction, there is no need for subsequent public confirmation. Every interested party has the opportunity to give their input and opinion during the design process. It is needless to emphasize that both the acceptance and the sense of ownership among community members are substantially higher.

As pointed out in this paper before, design practitioners play a vital role in the process. Therefore, it is important that they shall be equipped with the right skills. Beyond the traditional roles as highly qualified artist, technician and social engineer (Lipman 1969), architects engaged in community design also need to prevail as facilitator of the inclusive planning process (Burgess 1983). This requires the ability to listen and to correctly interpret the input – needs and priorities – given by the participants, and the ability to collaborate.

4 PARTICIPATORY DESIGN PROGRAMS AT UNIVERSITIES

Universities have proved to be an opportune host for the long-term provision of community engaged design services (Pitera 2014, Pearson 2002). As academic centers, universities are in a unique position to support access to and effective use of design knowledge (Feldman 2004). Several of the community design centers operating today are in some ways affiliated with universities or academic programs. The cooperation is beneficial for both parties; it provides exquisite opportunities for sustained design excellence and, at the same time, students of architecture and planning get exclusive first-hand experience in working with communities.

Whereas the model and structure of cooperation are usually unique for each partnership, most share certain common characteristics. Pearson (2002) examined the length of the programs, and the shift of focus among educational, community service and aesthetic objectives. Along this line, he classified partnership programs into three main categories. The first he calls university-based design and build programs. Partnership is usually facilitated by a local non-profit organization, which represent the community. They are responsible for the coordination of the program and communication between the participants. The university department provides the expertise and the academic administrative frame for the work. Students usually design and build small-scale, experimental projects as part of their coursework. The cooperation might be occasional or ongoing, but the projects are usually short term, a few days or weeks long. Emphasis is evenly distributed among the three objectives. Success is evaluated on the quality of the completed work and its contribution to the community. The second category encompasses university-based community design centers. It is found very common in the US academic system. These on-campus design centers operate with their own staff, most of which are teachers or students of the university. They provide technical assistance and design services to local communities and NGOs, however these projects are less integrated in the academic curricula. The design centers establish independent relationships to university departments and students get involved in the work as interns. Studios are equipped for longer-term community design projects. Emphasis is less on the completion of the built project, but rather on the help to communities (assessment of needs, developing clear objectives and program requirements) and the educational benefits through student engagement. The third type of partnership model is described between university departments and independent community design centers. The main aspect in which independent community design centers differ from for-profit design studios is that they focus their services primarily to underserved communities, and work at affordable rates. The involvement of the academic institute is mostly informal and occasional. Their ability to maintain high design quality depends on the project scale and the political context in which they work.

The community design center, whose work was selected for evaluation in this paper, has been regarded as an experimental initiative since the time of its creation in 2005. First of its kind in Hungary, the St. Joseph Studio Collegium (*Szent József Stúdió Kollégium*) shares similarities with all three cooperation models detailed in the above chapter. In this unique partnership between Budapest University of Technology and Economics and the Jesuit-founded independent studio, registered architecture students of the university take some of their advanced level design courses working on community participatory design projects. American Jesuit architect, Terrence Curry, AIA, the founding director of the studio, had had created two similar profile design centers in the USA, Fordham University Center for Community and Environmental Development and Detroit Collaborative

Design Center at University of Detroit Mercy, before arriving to Hungary as visiting lecturer of architecture at Budapest University of Technology and Economics. Since 2008, the author of this paper has been directing the operation and the design activities at the studio. Participatory design projects at the St. Joseph Studio Collegium are based on commissions directly from local NGOs, or through community development agencies. Design programs are usually based on bottom-up initiatives, without clear programmatic concept, or working with a group, whose individuals may have developed ideas, but a collective consensus is yet to be reached. The workshop process is one or maximum two semesters long, complying with the academic coursework of the students.

5 WORKSHOP PROCESS

Over the past decades, a great number of well-established inclusive design practices and methodologies have been developed. This paper does not intend to provide a comprehensive description of the different techniques; limiting its focus on those alone that have been applied – and further refined – at the St. Joseph Studio Collegium.

Design cooperation with the participants is structured into a multi-step workshop process. Depending on the availability of the client group program would include five 3-hours long up to eight 2-hours long exercises. The first half of the meetings walks participants through a process of establishing a range of design criteria. These include the programmatic requirements, building character, spatial experience, building quality, and project budget.

The program starts with community building exercises, where the individual participants introduce their vision of the outcome of the cooperation as well as their projected role in the process. Collected aims are then formed into a project statement that can be referred back at different later phases of the process.

Next step is the *program mapping*. Participants compile a list of activities they would welcome to see at the planned building or facility. Once the activities are arranged in the order of priority and sorted into corresponding categories, the list becomes the basis for developing a detailed needs assessment.

The following workshop is dedicated to the establishment of *visual criteria*. Students select a series of quality examples with varying reference and connection to the function, scale, or geographical setting of the design program. Participants then evaluate the examples based on specific aspects (style, spatial experience, character, form, applied materials, etc.). The goal of the exercise is to define a design vocabulary that reflects participants' preference for the visual character, but at the same time, allows enough room for artistic liberty.

Workshops continue with the development of the *quality model* that includes considerations and priorities based on the costs of operation, potential income and resources, applied technologies and the overall image. In order to equip participants with the necessary economical and financial context, the essential terms shall be pre-defined. After negotiation, participants make a prioritized list of the building's physical and operating qualities.

The collected data of the previous exercises form the base of the final scope of the project. Needs assessment is translated into square meters and room or space types, and the quality model helps setting an acceptable budget goal.

With these in possession, the first layout of the building can be started. Students prepare a kit of to-scale room/space cutouts; together with flexibly cut approaching and service areas. During the laying out, students provide design assistance, clarifying the concepts of circulation, proximity, connections, axis, building codes and zoning regulations, lighting, parking and sanitary requirements, geographical conditions, etc. Participants consider the various types of connections between the different functions and premises, spatial and structural conditions and requirements, special circumstances, and take note of all relevant comments. The resulted layouts are then used to confirm spatial relationships, based on which the architecture design can finally be started.

Students present the first conceptual plans to the community at the next meeting. Participants are welcome to comment or make remarks referring back to the established criteria. However, in order to avoid endless redesign and to keep the schedule, changes in the criteria cannot be made at this point anymore. Refined plans based on the input of the consultations get a final approval from the client group at the last meeting.

6 CONDITIONS OF THE EVALUATION

The objective of the evaluation was to reveal the efficiency and the particularities of the community design workshop model in the Hungarian socio-cultural and academic context.

Evaluation was based on the general experience of the operation of St. Joseph Studio Collegium and, in particular, five of the workshop processes conducted between 2005 and 2015. The selected projects share similar characteristics. In each case, the client was a Hungarian NGO or informal organization of the civil society. The number of participants of the client group varied between 10 and 25, while the number of students was between three and six. Programs which would require the inclusion of a wider group of affected citizens and which would involve previous community development process were not considered viable, due to the set timeframe and strict schedule of the students, however in two cases, where the planned intervention potentially affected a wider circle of residents than those represented by the workgroup, students conducted preparatory interviews and surveys.

Emphasis was divided between educational purposes, design excellence and community service,

in that order of priority. The final product of the participatory design process was a set of conceptual plans, specifications and renderings, which the client group then could potentially use for fund-raising purposes.

The projects were officially assigned to the fourth year design studio courses (Comprehensive Design Studio 1 and 2) in the five year combined Master of Architecture program of the university. Therefore, in order to receive course credits, the delivered plans also had to comply with the formal and content requirements set for regular students of the same course.

Evaluation encompassed the judgment of the overall efficiency, based on student recruitment and engagement, acquired skills, the conduct of the workshops, and the feedback from the client groups.

7 FINDINGS AND IMPRESSIONS

Many of the findings and conclusions of the evaluation of the workshop process can be attributed as specific to the general socio-cultural-political context in Hungary, the particular group of participants in the project, the unique relationship with the university and its administrative and academic requirements. Results however can help draw more general inferences with the prospect of further developing the efficiency of the workshop model.

Student recruitment has proved to be challenging. In spite of the advertising, oversubscription for the course has been somewhat lower than expected. This can be attributed to various reasons. Most capable students are already committed to a particular department or design supervisor by the beginning of the fourth year. At the start of St. Joseph Studio Collegium, advanced proficiency in English was a compulsory requirement, due to the English-speaking lecturer. Also, the studio space was originally located at an off-campus facility. While these conditions seemed to be attractive for some students, they may have been dissuasive for a wider crowd.

In spite of the substantial extra workload that complying with both the university course requirements and the community design workshop process meant for participating students, engagement could be assessed as more than satisfactory. After the course, majority of the students would go on to choose design projects with community impacts for their Master's degree thesis. During the entire time of the examined period, only a few students quit the course, those who did, identified scheduling problems or the excessive workload as main reasons.

Activity among the client group members was sometimes less steady. Ensuring all participants to attend every meeting proved to be the most challenging task. While those present tended to give enthusiastic feedbacks at the end of each workshop, some did not manage to fully acknowledge the importance of the continuous participation.

Client groups received both the collaborative workshop process and the finalized conceptual plans very well, in general. In the aftermath of at least two of the five partnerships, the community would continue developing the projects, and took further steps toward the realization of the concepts. A couple of projects gained recognition in the architect society as well (Bardóczi 2009). In some of the early cases, it proved to be difficult to clearly communicate, at what point the partnership and the joint work would end, or what the exact scope and level of the delivered plans would be. Participants would often want to continue the collaboration after the end of the workshop process.

8 CONCLUSIONS

The findings of the evaluation and the overall impressions of the workshop process showed that there is potential in the integration of community design aspects into the university level architecture education in Hungary and in other post-communist countries with similar socio-cultural, demographic and political background. Since the start of the St. Joseph Studio Collegium several other workshops and design programs in both the graduate and doctoral programs of the Budapest University of Technology and Economics as well as other schools of architecture in Hungary, were committed to the idea of community-driven design. While still not widespread, there has been ongoing interest from students in the technique. In light of the results, the first experimental university – community design partnership can be regarded as successful. Experiences can serve as positive inducement for similar future partnerships.

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Applying a blended learning methodology to the study of housing

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ABSTRACT: A blended-learning approach was adopted to create a learning space to introduce architecture students to be basics of architectural design through the study of housing. Components of different courses from three European schools of architecture, in Spain, Cyprus and Serbia, were combined in a joint learning structure. The learning activities were structured as sequences which were carried out synchronously or asyn-chronously by students from the three schools. The main supporting technology was OIKODOMOS Work-spaces, an on-line learning environment specifically created to support the design and implementation of learning activities in collaboration based on a constructivist philosophy of learning.

1 INNOVATING HOUSING LEARNING

Since the academic year 2003/04, we have been steadily developing innovative pedagogic programs co-funded by the European Union to innovate learning and teaching on the field of housing studies. We started with HOUSING@21.EU, supported by an Erasmus Intensive Program (2003–2006) which counted with the participation of five European schools (Madrazo & Massey 2005). It followed the OIKODOMOS Virtual Campus (www.oikodomos.org) carried out under the auspices of the Lifelong Learning Program in two stages, from 2007 to 2009 and from 2009 to 2011. The purpose of OIKODOMOS was to integrate subject matters (housing design, urban planning, energy efficiency, sustainability), academic levels (bachelor, master), courses (design studios, seminars) and learners (students, citizens) to make a joint Virtual Campus dedicated to the study of contemporary housing. A learning platform was created to support the methodology of the OIKODOMOS Virtual Campus (Madrazo et al. 2012).

The last step in this line of work dedicated to innovate learning and teaching about contemporary housing has been "OIKONET: A Global multidisciplinary network on housing research and learning" (www.oikonet.org). Thirty-four institutions representing twenty-five countries in and outside Europe are part of this network. Partners are higher education institutions–architecture, urban planning, engineering, social and economic studies–research groups, local administrations and professional organizations. The goal of OIKONET is to enhance the previous OIKODOMOS Virtual Campus to transform it into a network dedicated to study contemporary housing from a multidisciplinary and global perspective. A distinctive feature of OIKONET, which distinguishes it from the previous two programs, is the interweaving of three areas: pedagogy, research and community participation.

2 A BLENDED PEDAGOGY

A common denominator through all of the three programs carried out from 2003 to date – HOUSING21.EU, OIKODOMOS and OIKONET–has been the aim to create innovative learning spaces following a blended-learning approach. Blended-learning is an ambiguous term which is endowed with multiple meanings. Generally speaking, the term "blended learning" refers to any combination of face-to-face instruction with computer-mediated instruction. More generally, it is also used to refer to any combination of media, pedagogic methods, and theoretical and practical work. Heinze & Procter (2004) have described blended learning as "the effective combination of different modes of delivery, models of teaching and styles of learning". The vagueness of these sort of definitions raises some doubts about the usefulness of the term to convey an identifiable model of education. Yet, much of the research on blended-learning have been concerned with describing the considerable variation of meanings across institutional contexts and charting the boundaries of the term (Moore & Anderson 2003).

One of the basic questions to address in a blended-learning environment is to identify what and how it is blended. Besides physical and digital delivery formats there are other components which might become blended: learners (e.g. students and teachers), learning styles, academic programs, subject-matters, disciplines, and institutional frameworks (e.g. formal and informal learning). Furthermore, there can be different modalities of blending. According to Hoic-Bozic et al. (2009), "Blended learning is learning based on various combinations of classical f2f lectures, learning over the Internet, and learning supported by other technologies, aimed at creating the most efficient learning environment"- whatever the term efficient might mean. The combination might involve using digital resources as *supplement* to traditional classroom education, as *replacement* of traditional classroom-based components by digital resources, or as a seamless *amalgamation* of distinct elements (active learning, collaborative learning, participation) to foster students' engagement (Beer et al. 2010). In this blending process, what is being blended might become diluted to emerge under a new form in a novel environment.

The value of blended-learning transcends the mere application of ICT for teaching and learning. For Garrison & Vaughan (2008), the real significance of blended learning lies in its potential to transform education, since "[it] questions conventional practices and the belief in the lecture as an effective approach to engage students in critical and creative thinking and learning." Furthermore, they contend that "Blended approaches to educational design recombine concepts that were previously considered contradictory, such as collaborative-reflection and asynchronous-community." Therefore, blended learning represents "a fundamental reconceptualisation and reorganization of the teaching and learning dynamic, starting with various specific contextual needs and contingencies (e.g., discipline, developmental level, and resources)" (Garrison & Kanuka 2004) which conveys "rethinking and redesigning the teaching and learning relationship." (Garrison & Kanuka 2004).

Expectations to bring innovation into education also rely on blended-learning approaches. However, blended-learning environments represent a challenge to learners, both students and teachers. Students are expected to adopt a more active role, interacting with "tutors, students, content interfaces, features, code, channels and environments and with other learners" (Donnelly 2010) and teachers need to develop their skills as learning designers, developing novel learning plans and strategies. Meeting these challenges requires from both types of learners skills that go beyond the mere use of the technology. In fact, pedagogic innovation occurs as learners are able to unfold new capacities in a blended-learning context.

The combined use of physical and digital delivery formats in a blended-learning environment can adopt two fundamental models (Bersin 2004): 1. The flow-model, based on well-defined successive steps. In each of the steps of this sequence, physical events can be replaced by e-learning activities 2. The core-and-spoke model, by which a program is designed in one media (physical or digital) and optional supplemental materials are provided by other means. In both cases, it is necessary to lay out a learning plan which assigns a place, a time and a purpose to each component through the learning process.

The unity of space-time-and-content which occurs in classroom-based learning is replaced by a network of distributed spaces-times-and-contents in a blended-learning context. The possibility to combine learning activities in synchronous and asynchronous ways is a distinctive characteristic of blended environments. Learning activities can be carried out at different times and in different places (on-line, in the classroom) combined in interaction with other learning resources. To effectively exploit these capacities, blended-learning environments require specific pedagogic methodologies which take advantage of their potential. Even though we can find examples of intertwining a specific learning style with blended-learning there still is not much investigation about the relationships between both, particularly in higher education. Shannon et al. (2013) have transposed the design studio model prevalent in architecture schools to a blended-learning context. Problem-based learning has been implemented by Donnelly (2010) in a blended-learning environment. Blended-learning is expected to create a sense of community among learners as a result of their solving a particular problem in collaboration following a constructivist approach to learning (Juvancic et al. 2012).

The combination of the all the different components – delivery formats, subject-matters, learners, learner styles following a blended-learning approach results in learning spaces which transcend existing boundaries – physical, disciplinary, institutional.

2.1 *Learning spaces*

Before the advent of ICT in education, the term "learning space" has been used to refer to the physical environment where education takes place. The interest for educators was to know how physical settings influence education, enabling or hindering specific forms of teaching delivery and innovation (Temple 2008). Punie used the term "learning space" to describe ICT-enabled educational spaces which transcend existing limits, physical, conceptual and institutional. In these new learning spaces students would be at the center of the learning, becoming co-producers of contents, and the role of teacher would change or disappear. The learning spaces Punie (2006) proposes would make possible social interaction at different scales (from learning individuals and communities to learning cities and regions), enable the personalization of learning (a personal space adapted to the needs of each learner), be a source of reliable quality contents; help to connect people emotionally and not only through the contents; detach learning from controlling (which in the traditional school system are amalgamated); foster

creativity rather than simply transmit knowledge; be flexible enough to integrate various learning styles, teachers' skills, and curriculums; help to evaluate the learning outcomes solely on the base of the individual's performance; be open and inclusive so that new contents and resources could be added at any pace; and become informal platforms to share expertise and knowledge across organizations.

In the OIKONET project, we use the term learning space to pursue goals which are in line with those described by Punie. In our case, a learning space refers to:

- A space which brings into relationship schools from different countries which include housing studies in their curriculum.
- A space which puts into relationship subject-matters (regular courses, seminars, design studios) from different academic programs addressing housing from multiple perspectives (architectural design, urban planning, representation, architectural theory).
- A space to support the exchange of knowledge among learners from different cultural background and academic levels.
- A space to design and implement learning activities in collaboration, with the participation of teachers and students from various schools.
- A space of collaboration which coexists with the regular academic activities that take place in each institution.

The creation of such spaces requires a pedagogical model strongly intertwined with ICT. In the previous OIKODOMOS Virtual Campus, an on-line platform was created specifically with this aim: to closely interweave a pedagogical model based on a constructivist philosophy and the digital tools to support it.

2.2 *Intertwining tools and learning processes*

There is a variety of tools which can be used alone or in combination to implement blended-learning environments. They range from learning management systems such as Moodle, Blackboard and WebCT to shared repositories of information (Google docs, Dropbox), social media (Facebook) as well as any other ICT tool which can be used to support a pedagogical strategy (Neto et al. 2012).

However, a more challenging way to integrate ICT in blended-learning is to create ad-hoc environments to support a specific pedagogic approach. Within the OIKODOMOS project, we created a full-fledged learning platform to support the collaborative design and implementation of learning activities in the virtual campus. It consisted of three environments: Workspaces – to design and implement sequences of learning activities –; Case Repository – a digital library of housing buildings documented and commented by students and teachers – and OIKOPEDIA – a Wikipedia containing entries about the main topics and issues addressed in the learning activities (Madrazo et al. 2010). This platform is being used to carry out the learning activities in the OIKONET project, together with some social web tools like Facebook and Twitter.

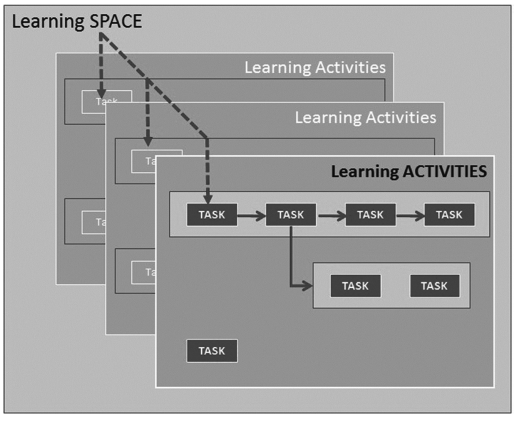


Figure 1. Learning structure of OIKODOMOS Workspaces.

OIKODOMOS Workspaces is a web-based learning environment which facilitates the design and implementation of learning spaces which interlink with other activities carried out at various institutions in design studios, workshops, seminars and courses. A learning space is designed and implemented by a group of tutors who decide to collaborate in the design and implementation of some shared learning activities around a particular theme over a specific period of time. These learning activities are made up of tasks which can be either single or grouped in sequences. A sequence of tasks can be constrained to a single learning activity, or they may cut across different ones (Fig. 1). This learning structure is sufficiently flexible and neutral as to support different kinds of activities – from the collaborative development of an architectural or urban project to course assignments – which can be done by students working individually or in groups, as well as by schools working independently (the platform can be used to support a course limited to the school program) or in collaboration with other institutions.

The theme of a learning space, and the activities and tasks that it encompasses, are put forward by the teachers from the participating institutions. In the OIKONET project, we have developed a procedure for faculty members to design a learning plan in collaboration which will then be implemented in various ways, adapting it to the conditions of the academic programs at each school. Basically, the procedure is abridged in one document which teachers need to jointly complete responding to the following issues:

- *Theme*. This is the general topic which teachers propose to address collaboratively. The theme is chosen as to facilitate different subject-matters taught at different schools to contribute to it.
- *Description*. The purpose and relevance of the theme.

– *Participating institutions*. The partner institutions committed to implementing the learning activities during the time the learning space is active.
– *Courses involved*. A short description of the courses at each institution which will be participating, and the level of the students involved.
– *Partners' contributions*. The expertise and resources that each institution will bring to the learning space.
– *Learning objectives*. The learning outcomes that participating students would achieve. A list and description of the learning outcomes needs to be agreed by teachers.
– *Learning activities*. The structure of activities and tasks which will be implemented in OIKODOMOS Workspaces.
– *Time plan*. A tentative plan of the activities that will be carried out to assure they suit to the time-tables of the course at the participating schools.
– *Forms of collaboration*. The forms of collaboration that will be implemented (team works with students from different institutions, peer reviewing, tutoring from teachers from other school, etc.)
– *Tools*. ICT that will be employed together with OIKODOMOS Workspaces (Facebook, Twitter, Moodle, etc.).

A learning plan described in this way becomes a roadmap for teachers to implement the activities. It also enables them to assess if the results achieved at the end meet the objectives of the plan, as well as to identify any deviations. The lessons learned are taken into account in the design of the next learning plan and in the subsequent editions of the learning space.

As a learning space is implemented, learning becomes a process by which some inputs – study themes, assignments, references and readings – give rise to some outputs – student work, comments on others' work, peer and teacher evaluations. Activities and tasks can evolve in an open-ended manner as the learning process progresses. In fact, they can have an existence of their own: they become more or less active as more tasks are defined and work submitted; they move from the virtual to the physical spaces, depending on the intertwining of sequence of on-site courses with on-line activities; they come to an end as learners stop to interact (between them, or with the learning resources). Furthermore, learning activities can be carried out in a synchronous or asynchronous ways during the time the learning space is active. Thus the temporal structure of the activities will have meeting points with that of an academic program (e.g. semester, quarter) at a particular school but does not necessarily have to coincide with it (Madrazo & Riddy 2011).

2.3 *Implementing learning spaces*

During the first eighteen months of the OIKONET project, from October 2013 to April 2015, six learning spaces were collaboratively designed and implemented with the participation of the 15 European schools of architecture and urban planning and 2 schools outside Europe. Each learning space was dedicated to a theme related to housing:

– Introduction to Housing . An introduction to some fundamentals of architecture and housing design, led by the School of Architecture of Valencia, Spain.
– Habitat Regeneration Strategies. It focuses on the redevelopment of deprived areas at various scales (housing, neighborhood, city, metropolitan area) encompassing multiple aspects of city life: physical, social, economic and environmental. It was led by the University of Belgrade and by the Faculty of Architecture, Slovak University of Technology, Slovakia.
– Threshold Matters. It was dedicated to study the intersection of public and domestic spaces and it was led by KU Leuven, Belgium.
– Housing Systems. Exploring the concept of housing system, from design to construction, which has been led the School of Architecture La Salle, Barcelona, Spain.
– Contemporary Living Patterns. It was dedicated to the preparatory activities for the first OIKONET international workshop in Lisbon, Portugal.
– Civic housing. Fostering the dialogue between professionals and non-professionals in the design of domestic space, led by the School of Architecture La Salle, Barcelona, Spain.

To exemplify these learning spaces, from design to implementation, in the following sections we describe "Introduction to housing", which started in the academic year 2013/2014 and has undergone two subsequent editions since then (Fig. 2).

3 INTRODUCTION TO HOUSING

The pedagogic purpose of the learning space "Introduction to Housing" is to initiate students in the basic principles of designing (and understanding) what a house might represent in our contemporary culture (or cultures).

At its first phase of implementation in the academic year 2013/14, the structure and contents of "Introduction to housing", drew on the curriculum of the first year design studio of the School of Architecture of Valencia, Spain, the housing design studio at the University of Cyprus and the 3D Visual Communication course at the University of Belgrade, Serbia. Around 200 students from the three schools have participated in the learning space.

Each participating school has a particular curriculum and schedule to carry out their study programs which run in parallel to the collaborative activities carried out distantly. Therefore, an important challenge faced in the design of this learning space was to agree on a common plan which embraces the pedagogic objectives of the participating institutions. A joint learning program was collaboratively created applying the OIKODOMOS Virtual Campus methodology. This program enabled the participant architecture educators

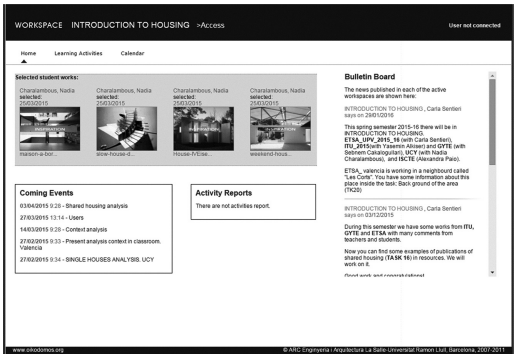


Figure 2. Entry page of "Introduction to Housing" in OIKODOMOS Workspaces.

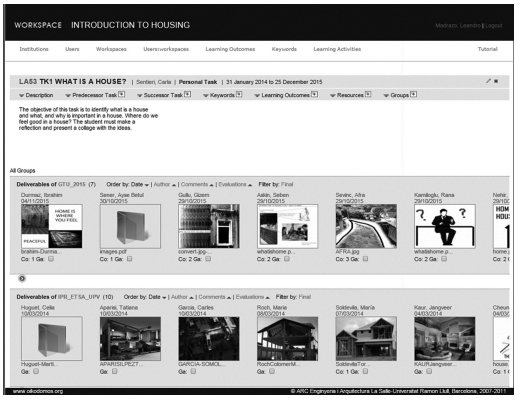


Figure 3. Outcomes of a task submitted by students to OIKODOMOS Workspaces.

to design a joint learning structure made up of learning activities and tasks, aligned with the common pedagogic goals which are reflected in the learning outcomes set by their respective institutions.

Learning activities included precedents analysis, understanding of the concepts of home and house, context analysis and analysis of users' profiles. Learning tasks carried out by students in the OIKODOMOS Workspaces environment were dedicated to apply knowledge derived from the theoretical background, to develop a coherent design process, to make appropriate use of different representation techniques (verbal, textual, and visual, both digital and analogue) in order to communicate ideas and design proposals in an effective manner, to develop team working skills through and the ability to criticize their own work and that of others. These tasks were organized in sequences and were carried out synchronous and asynchronously by the students from the participating institutions (Figure 3).

The learning space "Introduction to Housing" critically questions the conventional face-to-face (f2f) lecture as the most effective approach to engage students in critical and creative thinking. It transcends a simplistic combination of f2f instruction with computer-mediated instruction through a combination of both f2f and digital modes of delivery, teaching methods and styles of learning. Learners have shared comments about their design projects both in classroom and on line and have been exposed to different types of teaching and learning resources (f2f lectures and video-lectures, on line resources). Teachers have incorporated new methods and styles, resources and subject matters in their teaching with direct implications on their respective academic curriculum.

3.1 *Learning space implementation*

In this section an overview is presented of the Learning Activities and Tasks which make the learning space in an attempt to highlight the pedagogic structure devised by teachers of the three schools with the purpose to introduce students to some fundamental issues about contemporary housing.

- Learning Activity RECOGNIZING SPACE. Architects create spaces. Therefore, it makes sense that the first step in an introduction to architecture is to learn, perceive and represent space. The purpose of this activity is to learn to recognize the places we inhabit. Students can develop this capacity by analyzing designs or by observing the spaces we live in. All the tasks included in this learning activity focus on the analysis of the spaces we encounter in a house: rooms and space-defining elements, furniture and other objects, dimensions and particularities.
- Task What is a house? The goal of this task is to distinguish the concepts of house and home. Students are expected to address issues such as: what makes you feel good at home? These reflections are summarized in an A3 document combining different materials and techniques (texts, drawings, photographs).
- This task was done by ETSA-UPV students. The outcomes were commented by teachers from other schools and by students from UCY.
- Task Collective Housing. Examples of collective housing projects are presented and discussed in the classroom. Then, students are asked to reflect on collective housing issues through their own presentations.

Learning Activity DERIVING IDEAS FROM TEXTS. Argumentation is very important for architects, it is the way to explain ideas to people who are not familiar with drawings. An interpretation of a text is never unique. The purpose of this activity is to explore the transformation of the ideas described in a text- or, more precisely, the interpretation of those ideas- into drawings-that will become inhabited spaces.

- Task Interpreting a text. This task aims to provide the students with the graphic skills which enable them to translate a text into drawings. The tutor reads a text from the book "Invisible cities" by Italo

Calvino, which describes cities and places. Then, students draw the spaces described in the reading.

Learning Activty PRECEDENT ANALYSIS. The purpose of this activity is to learn from precedents, to understand the factors that influence residential architecture, to identify solutions provided from previous projects and to transform them into new ones.

– Task Analysis of residential architecture. Analysis of international examples of residential architecture (context, users, social, economic, environmental variables).

This task was done by students from UCY. The outcomes of this task were commented by teachers from other schools and by students from ETSA-UPV. They formulated questions to students, to make them continue thinking about the issues they have identified.

Learning Activity IDENTIFYING USERS' NEEDS. Houses are complex expressions of the social and individual worlds of their occupants. Social structures and patterns of behavior seem to be closely intertwined with domestic spaces. Students are encouraged to understand that the design of a "home" needs to address the practicalities of everyday life while responding at the same time to the owner's idiosyncrasy, personality and dreams. Therefore, it is important to be able to analyze and understand the needs of people.

– Task Analysis of potential users. Students are randomly given existing user types and are asked to describe their daily activities, hobbies, personalities, and needs.

The task was done by students from ETSA-UPV and UCY. Their work was commented by teachers also from Valencia. The revision of this task by the teacher was done on-line in the OIKODOMOS Workspaces platform, giving references to other learning spaces.

Learning Activity CONTEXT ANALYSIS. Homes often reflect differences between ethnic, cultural and social groups, including gender divisions between men and women or differences between adults and children. Also, homes reflect differences in environmental conditions (climate, light, air, topography) of a particular place and culture. Through this activity, students are expected to understand that domestic space is site/context specific.

– Task Visual mapping of context. Students analyze sites employing visual ethnography methods. They represent context specific characteristics (cultural, social, and environmental) through both digital and printed "visual" essays.

This task has been done by ETSA-UPV and UCY students. The outcomes of this task were commented by teachers and students from these schools.

Learning Activity AT HOME. DESIGN PROPOSALS. Taking into consideration all the work done through the preceding tasks, students are asked to design a "home" in a specific context that addresses local conditions and culture, the practicalities of everyday living and the user profiles, personality and dreams. Understanding the relationships between the spatial structure of the domestic space and the social milieu is one of the central challenges of this learning activity. The purpose is to explore the ways in which a home responds to social, cultural, and individual requirements, in the context of an increasingly divided, complex and differentiated experiences of contemporary life.

– Task Initial design proposals. Students develop initial design proposals for collective housing schemes.
– Task Collective housing project. Students develop design proposals of collective housing in a given context and for specific user types.

This tasks were done by ETSA-UPV (Figure 9) and UCY students (Figure 10). The outcomes of this task were commented by teachers and students from these schools.

3.2 *Evaluation of results*

An evaluation of the learning activities was conducted through an on-line questionnaire given to the students at the end of the spring semester 2013–14. The main objective of the evaluation was to assess the effectiveness of the learning activities, the achievement of the learning outcomes, and the acceptance level of the on-line platform into the students' learning experience.

Students had strong expectations regarding networking and sharing knowledge in a collaborative and international context. Their answers revealed that their participation in the joint learning space had changed or refined their approach to design and was particularly useful for getting in contact and communicating with others, as well as for sharing projects, ideas, learning resources, skills and feedback.

The participation in the learning space gave students the opportunity to be exposed to the work of fellow students but also to present their work to both students and colleagues of the participating schools, to comment the work of other students and to participate in peer evaluations, to attend video lectures, to access and to share learning resources through the web-based environment. It also gave tutors the opportunity to work in collaboration, to get to know diverse teaching methods as well as the work done by students from other schools, to attend but also deliver video lectures and to share learning resources through a number of platforms (such as OIKODO-MOS Workspaces, Blogs, Skype, Google+).

However, the first implementation of the learning space in the academic year 2013/14 proved that more time and better planning was required in order to make full use of the collaboration potential. A persistent problem has been the difficulty to reconcile partners' regular learning activities at their institutions with the collaborative learning activities carried

out in the learning space. Differences in schedules, learning approaches and tasks many times resulted in difficulties with harmonization of collaborative activities.

4 CONCLUSIONS

Designing and implementing the learning spaces in collaboration has contributed to forge links among the partners in the OIKONET network, to exchange knowledge about various matters related to housing studies, as well to share pedagogical methods and experiences. As a result of this collaborative work, it was possible to devise new strategies and procedures – which have not been developed in the previous OIKODOMOS Virtual Campus projects– to improve the process of designing the learning and also the implementation of the planned activities. The template used to describe collaboratively a learning plan before starting with the implementation of the learning activities constitutes an example of this. With regard to the technological platform to support the learning spaces, the experiences have shown that is recommendable to combine OIKODOMOS Work-spaces with social web tools which enable a more informal, personal communication between learners.

Concerning the design of a learning space, identifying the learning outcomes right at the start of the learning design process continues being difficult for most teachers in architecture schools. However, learning outcomes should be a constituent part of the learning design process. Besides, the joint evaluation of the students' works by teachers from different institutions can only be done after agreeing on a common rubric.

The implementation of the different learning spaces has demonstrated that it is necessary for the teachers involved in a collaborative learning process to maintain a fluent and constant communication during the whole period of implementation. It is fundamental to agree first on the communication channels to use (email, Twitter, Facebook groups, news board of the Workspaces environment) in order to keep the conversation alive during the whole process. These channels can be manifold. In this regard, the role of the learning space coordinator is fundamental for the success of the shared learning activities. The coordinator should undertake the task of maintaining the consistency of the common work, to keep all participants – teachers and students – informed throughout the whole process, and to highlight the value of what is being achieved.

With regard to the flow of activities being executed by multiple partners in a distributed manner, it is necessary to keep track of their progress summarizing at specific points during the learning process what has been achieved so far, in a way that it can be easily understandable to the learners involved and also to other interested partners – inside and outside the OIKONET network. This can be achieved by releasing regular reports, describing the stages of the learning process, illustrated with works of the students. Such summaries are useful to get a quick overview of what is being done in a learning space.

The work done in a learning space – the learning structure of activities and tasks, the resources collected and the works done by students – is a valuable learning resource which can be exploited later by other schools participating in the OIKONET network. On the other hand, a continuous aggregation of new learning activities and tasks can eventually undermine the coherence of a learning structure to the point the overall work might become unintelligible to later users. To avoid this, it is recommended to create subsequent editions of learning spaces in OIKODOMOS Workspaces, creating each time a new learning structure adapted to the needs of the new user.

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Trouble in Happy Valley.
The documentation of a research through design collaborative project between a postgraduate Atelier at the Manchester School of Architecture and the local community of a small town

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ABSTRACT: Places are defined by the people who live within them. As individuals and communities, deep significance is attached to familiar places, and complex relationships can develop between the residents and the place that they inhabit. This quality is present in the nature of the buildings and the streets, It is often generated by the ordinary actions of local people, many of who believe that their identity is essentially tied to the place that they occupy. This local distinctiveness is characterized by the activities that occur within the specific environment. Thus significant markers are formed, in both the present and in the past, which will allow a society to relate to a particular environment. Events that hold value in a community are often manifested in physical form, and therefore allow a population to trace back meanings and connections with their past. This organisation of the past seems to stimulate social cohesion and the feeling of being part of a community, and so, physical links with the past are often important elements within the cohesion of a community.

1 INTRODUCTION

Neighbourhood planning is a highly controversial policy. It was part of the Localism Bill introduced by the British Government in 2011. The policy shifted the responsibility for the decisions about the size, shape and location of neighbourhood development from central to local government. Communities are now asked to decide upon the nature and character of their particular district and actively participate in decisions about future developments. In theory this should be a positive move and quite straightforward; the UK has a housing shortage and rather than a top-down imposition of new properties, the bill allows local people to decide upon their own development strategy. However, well-meaning residents who have little or no training in planning, or skills in urban and rural development are making decisions too quickly without sufficient consultation or knowledge. This means that residential developers have been able to buy up packages of land and develop areas of the greenbelt and other bits of countryside that had so far been unavailable to them. More appropriate brownfield sites are often overlooked in the need to act swiftly and decisively and developments are not always the ones that the community really needs.

Bollington, known locally as Happy Valley, is a small post-industrial town in Cheshire in the North West of England, just within commuter distance of Manchester. It is a town defined by its topography; with heroic remnants of the Industrial Revolution such as the canal and the railway, contrasting with a calmer and more picturesque local vernacular of cottage, terraces, garrets and greens. Despite the remnants and detritus of warehouses and factories, it is an attractive and desirable place to live. The town council has already approved a number of substantial new-home developments, despite the fact that their Neighbourhood Plan is not yet in place, indeed, the discussion has hardly even started.

Continuity in Architecture is a postgraduate atelier, which has been established at the Manchester School of Architecture for more than 20 years. The atelier runs programmes for the design of new buildings and public spaces within the existing urban environment. The emphasis is on the importance of place and the idea that design of architecture can be influenced by the experience and analysis of particular situations. This interpretation of place can provide a contemporary layer of built meaning within the continuity of the evolving town or city.

The Bollington Neighbourhood Planning committee approached Continuity in Architecture to jointly develop a plan for the town that would sustain the place for the foreseeable future, that would allow the town to grow without losing its inherent character and would facilitate a future for all of the residents, not just those who can afford to live there. This partnership will develop a masterplan for Bollington, it will identify areas that appropriate development can take

place, propose designs for new buildings, suggest the redevelopment of existing structures and recommend areas for public space.

2 COMMUNITY

One of the fundamental characteristics of our post-modern society is democratic modernism and the rise of individualism. A new form of interconnectedness has arisen, one which bypasses normal state control and therefore operates despite of, rather than because of existing regulations. Advances in communications, information and transport technologies have facilitated a revolution in the global flow of objects, information and people. This has led to a pluralism of world-view, expansion of individual choice and a liberation of lifestyle (Gallent and Robinson, 2013: 10). This suggests that the global diffusion of culture and identity is incompatible with the traditional structures of the post-war period, which has inevitably led to a more diverse and separated patterns of sociability. This has prompted a questioning of traditional forms of authority, and conventional ideas of citizenship, social contact and allegiance.

A consequence of this individualism is a substantial rise in the number of community and interest groups, each with their own agendas and priorities. Traditional government, in which policy is formed by experts and administered by state officials, is increasingly being challenged. Within the UK, this movement was recognised as early as the beginning of the 1980s, when the rightwing Conservative administration led by Margaret Thatcher sought to confine the role of central government to strategic direction, while public policy formation and implementation were delegated to autonomous agencies. Since then, this policy of reform that challenges the basic principle of top-down governance, and promotes the devolution of responsibility for decision making away from the centre, has been a key aspect of all UK governments, including the Leftwing (New) Labour government, middle ground Conservative-Liberal Coalition and the rightwing Conservative only administration. (It should be noted that this policy of devolution is not only restricted to the UK, it is an international movement, but this paper is particularly focussed upon the UK and will therefore not discuss the international aspects of devolution).

Over the last generation the structures of community representation have been actively promoted through a series of Local Government Acts, which advanced community representation, especially that of parish councils. National housing delivery targets had been set and the advocacy of the "small state" at the beginning of the second decade of the twenty-first century paved the way for the formation of Localism. The intention of the Localism agenda is to empower local people to control developments within their own neighbourhood. That is, for (unpaid) community groups to work with local government and trained planners upon a strategic plan for their immediate neighbourhood. The existing planning system helps decide what gets built, and where and when it happens, it is essential for supporting economic growth, improving people's quality of life, and protecting the natural environment. The purpose of the Localism Bill is to formulate effective planning, widen ownership of the process, create a broad agreement around development decisions, and ensure the avoidance or prevention of major conflict. The National Planning Policy Framework for England describe the Neighbourhood Plan thus:

> "Neighbourhood planning gives communities direct power to develop a shared vision for their neighbourhood and shape the development and growth of their local area. They are able to choose where they want new homes, shops and offices to be built, have their say on what those new buildings should look like and what infrastructure should be provided, and grant planning permission for the new buildings they want to see go ahead." (National Planning Policy, 2012: Online).

The Localism Act 2011, along with associated regulations, lays out all the processes for preparing and putting in place neighbourhood planning tools. This includes three separate tools; Neighbourhood Development Plans (NDPs), Neighbourhood Development Orders (NDOs) and Community Right to Build Orders. Neighbourhood Development Plans are policy documents (like local plans), which could include policies on where and what kind of development will be allowed in the parish or neighbourhood area. Neighbourhood Development Orders can grant planning permission for a particular type of development, for example housing, on a particular site. Community Right to Build Orders are a special type of Neighbourhood Development Order.

The Neighbourhood Plan is formulated by a number of different groups; each with their own different interests and concerns, but who have come together to forge a new future for their own immediate locality. The intention is to put power in the hands of local residents, employees and business, councils and civic leaders; that is those who know best the needs of their local areas. Neighbourhood planning is optional, not compulsory, and importantly the members are not elected; anyone who lives or works in the in the area can join, simply by turning up, although there is a minimum of 21 members. The community groups are generally self-selected, made up of interested and concerned individuals who genuinely feel that they need to protect or that they can make a contribution to a plan for their neighbourhood.

Neighbourhood planning is occasionally referred to a community-based planning, and although it may be a better description of the process, it is not generally used. Various community groups working together may develop the plan as a shared activity, however it is the location of the activity at a particular geographical scale that defines the title, however uncertain the actual parameters of the neighbourhood are.

There are strict guidelines for how the Neighbourhood planning forum must operate. These were laid out in: Neighbourhood Plans, a Blueprint for Devolution and Local Democracy (Jellinek, 2014: Online) as follows:

1. Each forum picks its own members, sets its own area and writes its own constitution. Membership has to represent the character of the area, for example, balancing business and resident representation and geographical spread.
2. The forum will engage with the local community, assemble relevant evidence and write a development plan.
3. The development plan must: align with European, national and local policy, it must plan for sustainable development, and importantly, it must not be excessively static
4. A national programme offers support from consultants such as highway engineers, health experts and planning officials who can help translate intentions into policy.

Neighbourhood Planning certainly enables communities to play a much stronger role in shaping the areas in which they live and work and in supporting new development proposals. It provides an opportunity for communities to set out a positive vision for how they want their community to develop over the next ten, fifteen, twenty years in ways that meet identified local need and make sense for local people. To encourage the community to engage with the project, they will receive 25% of the revenues from the Community Infrastructure Levy arising from the development that takes place in their area, and the use of these funds should reflect the priorities which were formally set out in the neighbourhood plan.

Of course there are many potential problems with this system and at every stage of the process. Untrained but enthusiastic people who want something specific, which may or may not benefit the whole community could be seen as a recipe for disaster, or it could be that they are so perfectly positioned to understand exactly what the needs of the neighbourhood are that a genuinely productive and responsive solution is created.

Problems that could occur and complex and unprecedented. Will sufficient local people actually engage with the project? The group may not agree upon a unified approach, or more than one group will emerge, each putting forward a proposal for a particular area. Somewhat self-interested business people could group together to bring forward some schemes for commercial development which may give rise to objections from residential occupiers of that part of the neighbourhood. Once the consultations with locals and with experts have taken place, and the proposals for the development of the neighbourhood developed, the plans still could be rejected, for instance, in Slaugham in Sussex, it was deemed not to have taken sufficient account of EU environmental rules, and had insufficient evidence that its housing targets could be met.

In legislative terms, Neighbourhood Planning is still in its infancy. There is very little research into its effectiveness and pitfalls are not being well evidenced, documented or mitigated against. Most importantly perhaps, there is a limited supply of assistance available. Funds (£50m) have been made accessible by the government for local planning authorities to help local groups through the process, but what happens when this is all gone? The local council may reject the proposals created by the group outright, would this undermine the whole process and of course, the biggest concern for any architect, planner or designer is how can such decisions about the future of the built environment be devolved to people with no training and possibly no aptitude for it?

3 CONTEXT

The Industrial Revolution established Bollington as one of the most prominent cotton manufacturing communities in the north of England. Until the late 18th century, the town activities were broadly rural with a focus on sheep farming, wood cutting, stone cutting and surface coal mining. However, the town was ideally positioned to become an important actor in the rapid industrial development that spread across the north-west of England. The town grew fast and was dramatically altered, beginning in about 1760 with the construction of the first of a series of cotton mills. These were powered by the River Dean and located at the lowest parts of the town.

> "Once someone decided to build a mill there was a need for stone with which to construct it, so quarries were opened up. Mills and quarries needed labour so cottages were built and roads laid out. Homes needed warmth so coal mining developed. All of these facets of urbanisation required trade skills - shopkeepers, butchers, brewers, publicans, liverymen, farriers, carters, churchmen, cordwainers, cloggers, dressmakers, hatters, and so on. Very soon an entirely urban community was developed being provisioned by the surrounding rural community." (Bollington Civic Society History Group, 2015: Online)

Advances in industrialisation meant that the river soon proved to be insufficient, and therefore in 1831 a canal was constructed in an elevated position above the expanding town. This necessitated the construction of a number of stone aqueducts which served the larger coal powered mills. This split topography of a town generated by the river and then above that the high level canal is one of the distinguishing features of Bollington; the drama of which was further enhanced in 1870 by the introduction of the Macclesfield, Bollington and Marple Railway. This runs from south to north on a series of high level viaducts.

Workers lived below this massive infrastructure in stone terraces often built with shared yard spaces to the rear. The mill owners and middle classes

occupied larger cottages and semi detached stone houses. Houses were modest but well built, benefitting from the close proximity of a number of quarries, mining Kerridge Stone from the nearby area.

In a story common to most of the Western World, in the 1950's the town began a long slow decline; the textile industry faded, work and commercial activity dwindled and the rise of private transport and out of town shopping centres attracted residents to other areas (Bollington Civic Society History Group, 2015: Online). The Beeching Cuts of 1963 which saw a notable reduction in rail provision in Great Britain, caused the closure of the Bollington railway in 1971, just 101 years after its arrival. Sometime later this high level viaduct was transformed into a recreational path, now called the Middlewood Way. The mill buildings slowly closed and although the majority are still empty, some were demolished and a few have been converted for such uses as apartments, independent retail and a gym.

> The aqueduct is man's design
> A tower of strength to Bollington
> A Herculean labour
> Completed eighteen thirty one
> The advent of the speedy train
> Soon replaced the silent waters
> Whose short life was terminated
> Like a lamb led to the slaughter
> (The Aqueduct 1831. Broster, 1973: 45)

The rapid expansion of the town caused it to grow in an unnatural manner, it contains no distinct centre and the axial road effectively divides the town in two. However, despite this uncomfortable urban organisation and the remnants and detritus of warehouses and factories, Bollington in the present day is seen as an attractive and desirable place to live. With this in mind, housing is almost certainly the biggest challenge to be faced by Bollington and as such has been the driving force behind the development of a Neighbourhood Plan.

4 CONTINUITY

The college of Continuity in Architecture (CiA) at the Manchester School of Architecture was established in 1994. It is a post-graduate studio for teaching and research. The attitude that CiA take towards architecture has its roots in Contextualism. This is an approach to the design of the urban environment that uses the process of analysing and understanding the nature and the qualities of place to develop new elements. CiA believe that it is the responsibility of the architect to work with the identity of a place, to create architecture that is appropriate to its location and does not destroy the character of an area.

Contextualism emerged as a reaction to Modernism and now, more than a generation old, t it is more relevant than ever. Our post-modern society has the need to embrace ideas of memory and experience and this means that Contextualism is at the forefront of theories about contemporary architecture, urban design and interior design. The use and re-use of an architectural site creates a direct connection with the past. It is a strategy that establishes an explicit relationship with history, not just with the site, the building and its immediate surroundings, but also with the society that constructed it. The reading of a building or site can uncover a layered and stratified narrative and the understanding of the inherent qualities and conditions of building or site can provide clues to the redesign of the place. It is through a thorough knowledge and understanding of the existing condition that the architect or designer can uncover the meaning within a place. This knowledge can be used to activate, liberate and instigate a new future for the building. And so the architect or designer who is to develop a new strategy for an urban environment, or design a collection of new structures or even modify, transform or change an existing building to accommodate a new use has to adhere not just of the agenda of the new users, but also the intentions of the original place. This act of modification is part of the evolution of the site, it as another layer in the archaeology of the situation.

For over twenty years, CiA has been promoting a particular approach to the development of architectural solutions, one with profound integrity and which is contextual, expressive, and environmentally appropriate. Modesty and cooperation are emphasised and as such, the atelier encourages a response that does not generate a gratuitously flamboyant or overtly iconcentric solution or attitude, but instead advocates an approach that embraces a close and sensitive contextual reading of place. Building during any period of history represents a significant commitment of human, material and financial resources. The most successful cities have adapted urban patterns and buildings to uses never imagined by their original creators. CiA are inspired by the efforts of architects working within existing structures and urban fabric to produce a responsive architecture of narrative, space, intervention, and detail. Through both theories and the example of architects engaged in critical practice, the aim is to show that the ideas and methods examined within the postgraduate studio have real applications.

5 COLLABORATION

In November 2014 Cheshire East Council agreed to support the production of a Neighbourhood Plan for Bollington thus providing the local community with more control over the future developments in the town. Headed up by Professor Michael Burdekin and Councillor Amanda Stott, the decision came in the wake of the National Housing Crisis with a series of houses allocated to each area of the UK. The committee included key residents: retired Conservation Officer Sandra Edwards, Councillor Ken Edwards and Town Clerk David Naylor.

A few months after the committee formed, recently qualified Architect and CiA Alumni, Peter Millburn-Brown moved to the area and saw an opportunity to

connect the process to architectural education, linking back to similar contextualised projects undertaken in his own postgraduate studies. This partnership were tasked with the development of a masterplan for Bollington, the identification of areas of appropriate development, propositions for new buildings, suggestions for the redevelopment of existing structures, and recommendations for areas of public space.

Over recent years the population in Bollington has been steadily rising (Bollington Civic Society History Group, 2015: Online) which created the need for a number of new developments in the area which have, to date, been designed in a disconnected and haphazard fashion without a wider plan of the area being considered. The loss of the mills and other large industrial buildings has provided the town with a number of notable building plots which have been bought by housing developers (e.g. Bellway Homes). These have been somewhat unsympathetically developed as semi detached family homes.

Interestingly there is some controversy around the number of new houses which have been designated to be constructed the local area; Cheshire East Council have stipulated a quota of 300 new houses (within the UK there is insufficient housing, and each local authority is tasked with making a contribution towards the 240,000 new houses per-year target set out by the 2007 Labour government). Since 2010 there have been 172 houses constructed in Bollington, including the 86 located in Clarence Mill, but it is unknown whether these are included within the original quota. A further 48 houses are awaiting Planning Approval, thus it appears that there is a shortfall of 80 units. However, no further clarification has been offered as to the date when the 300 houses were designated so the exact number, somewhere between 80 and 300, is unknown.

Numbers aside, there is an inherent question of type. Affordable housing is certainly a priority for Bollington, this will allow families to grow without having to move from the local area. Building houses affordably is a challenge to any potential developer on the complicated brownfield sites that are available, with drastic topography, flood risk zones, listed structures and conservation areas. Solutions need to be well considered and thoughtful to their surroundings. Conventional solutions of "cookie cutter housing" may not be the answer.

Until recently Bollington did not attract commuters – it does not have a train station and the journey by car is just too long to be comfortable, but this is changing as house prices in other areas rise. With this in mind it is very much a self-sustaining town with residents who are proactive and passionate about their home. Apart from the approval of two substantial housing developments in 2014, the majority of planning applications in recent years have been met with overwhelming numbers of objections.

However, the town cannot remain frozen as the demands for additional housing will cause an inevitable rise in population; new homes will be required, as possibly will new schools, shops, workplaces and recreational space.

To be successful, the Neighbourhood Plan for Bollington would need to address not only the parcels of land available for development but the type, design, layout and quality of the buildings themselves. One of the biggest difficulties is developing a plan which can act as a design guide without restricting the opportunities for the more unique or perhaps even heroic developments which have come to define the town.

The inclusion of live agendas, such as this one, within architectural education have been increasing in popularity in recent years and this is in contrast with the tendency since the early part of the twentieth century for architectural education to be 'product' orientated most commonly concerning a traditional design brief to create a given building on a given site (Bishop, 1997: 87). This adjustment reflects the changing nature of the profession. One of the key advantages of this Problem Based Leaning (PBL) approach is the development of employability and life long learning skills which begin to set the context for a lifetime of continued professional development both formal and informal. The job of an architect requires both architectural design skills alongside the ability to analyse, organise, collaborate and communicate ideas; that is to solve problems. Within architectural education there has been a inclination to create a simulated setting which allows a students to show off the full range of drafting and design skills but not necessarily the additional skills required to deal with a real life problem.

> "Much design education is very remote and esoteric and even where design work has a 'real life' context there is a tendency to 'tailor' the design brief, often for valid educational reasons, in order that the creativity of the student is not limited by the reality of the context of the design problem." (Bishop, 1997: 87).

CiA was determined that the students would have the opportunity to react to the live context of the Neighbourhood Plan, while also taking into consideration the wider context of the town. This had advantages to both the atelier and the committee. The atelier could look at the problem outside of the restrictive framework set by national legislation and test ideas more freely, meeting wider curricular objectives but also bringing a new way of looking at the situation. Experience has shown that Neighbourhood Planning is a lengthy process requiring a number of layers of consultation, while the committee were bound by these timeframes, the atelier could be more responsive and also more creative, using drawings, models and interventions to investigate the area in a different way.

Work began in September 2015, and the academic-year-long studio project was broadly split into four parts: Interrogating, Intervening, Planning and Realisation. Each project resulted in outputs that were exhibited in Bollington.

'Interrogating' saw the production of a book which collected together initial research and subsequent

analysis of Bollington. The cohort of students were divided into overlapping groups and each were to examine something specific; Town Evolution (historic maps, historic narrative, key figures), Buildings (typology studies, elevation studies, key building analysis), Topography (site sections, site models), and Geography (climate, population, flora, occupation, activities). When all information was collected, the groups saw patterns emerging and split all research into two distinct categories: Heroic Remnants (Geology, Mills, River, Canal, Railway, Cotton, White Nancy) and Slow Vernacular (Houses, Doors, Windows, Churches, Persistence, Growth, Population, Territories, Townscape). After a series of weeks a book emerged: Oddments and Epigrams: An Intimate Interrogation of Bollington.

The second project asked the students to create a temporary solution to a site-specific problem in Bollington. Misselwitz, Oswalt and Overmeyer, who looked specifically at ephemeral projects in Belin developed 'two main hypotheses: 1 – spontaneous, temporary uses can have positive long term effects; and 2 – the unplanned phenomena of temporary uses can be successfully incorporated into the planning and management of cities.' (2013: 273). In collaboration with the local community, students worked on six proposals for interventions which were then either built, modelled or tested in the town.

Each proposition was designed to connect to the earlier research of Bollington and acted as a method of engaging with the local community in the wider objectives of the Neighbourhood Plan. The ideas were diverse and bold; one student used mirrors to reflect the heroic elements of the town back to the everyday lives of its residents, another explored materiality by casting and installing a concave golden stone, a third student used light to redefine the ruin of Ingersley Vale Mill. Others used techniques local to the area, one creating a kinetic machine driven by the River Dean, and another using the process of engraving on velvet called devore to create a panel imprinted with the elevation of the Clarence Mill. Finally, there was a project to reinstate the interior lining of the monument White Nancy into an end terrace house. All ideas were collated in an exhibition in Bollington Arts Centre in January 2016 where the local community began to discuss and comment more broadly on the way they saw the town develop.

This was a precursor to a much more serious project entitled 'Planning'. The students worked with an urban planning specialist from Think Place and through a series of design workshops built upon the knowledge of the town and developed a series of strengths, weaknesses, opportunities and threats for six key areas of the town. These were: Movement, History and Heritage, Townscape, Sport and Culture, Landscape and Economy.

> "Designers don't create communities. Design, however, if done badly can fragment communities and isolate people. If done well, it can bring people together, allow neighbours to bump in to each other, children to play safely and for the gradual shaping of a place over time by its people." (Think Place, 2006: Online)

A proposal for the town was developed which highlighted a number of potential sites in Bollington. Looking beyond these sites as pockets of empty space, the workshop aimed to determine buildings, structures and landscapes which had the opportunity for development as well as traditionally conceived development plots. Working momentarily outside of the Neighbourhood Planning Legislation allowed students to make big marks in the town, to undo previous developments and consider the ideal situation. Through dialogue with the local community this plan will evolve further, it will question how the town might develop in the near future and what type of developments should be sought.

As the project reaches its final stage, the atelier is working in three groups on the 'Realisation' phase of works, one highlighting the Civic Centre of Bollington, one focussing on the Recreational Centre of Bollington and one looking at the Industrial Centre of Bollington. Each group are tasked with developing a series of sites to be used for a mixture of community, commercial and residential uses. A minimum of 80 houses are to designed across the town as part of the process, these will be supported with a series of car parking spaces in line with the objectives of the overarching Neighbourhood Plan. The buildings are to be presented in a further exhibition in Bollington in May 2016 alongside the Policy Documentation for the Neighbourhood Plan. This joint exhibition aims to provide residents with a collective vision for the future of the town.

6 CONCLUSION

> "Obviously some middle ground is needed. To retreat to a hopelessly artificial past is unrealistic, but to allow a brutalizing system to dominate and destroy traditional urbanism is irresponsible." (Schumacher, 1971: 79)

Places are defined by the people who live within them. As they grow and change to meet the new demands of the community that inhabits them, layers of meaning and memory must be 're-read, re-analysed, and re-worked' (Boyer, 1996: 322).

Neighbourhood Planning will continue to create controversy at both a local and a national level as the power to decide upon the future of places is transferred to the local community. This devolution has the very positive potential to engage local people in the decisions that are made about their homes, as they are the ones who know the location the best and they are the ones who will have to live with the consequences of any decisions made. However, this also has the danger of opening up large parcels of land to profit hungry developers in a bid meet the target number of new homes set by national government. Commercial players on Neighbourhood Planning Committees

often outnumber well-meaning residents, who with little or no training in planning, or skills in urban and rural development are at risk of making decisions too quickly without sufficient consultation or knowledge.

In Bollington, by thinking collaboratively, this project has helped empower local people to contribute towards the future of their own town. It has provided the settlement with a plan that is suited to their needs, because it is based upon a thorough examination of the place itself. The analysis and understanding of the existing situation plus the identification of suitable areas for development combined with the design of proposals for new buildings, all of which was generated by the by the students has provided the community of the town with the knowledge to act in an emboldened and informed manner.

Through engagement with the over arching curriculum within architectural education, the project bought together local residents and students from the Manchester School of Architecture with mutual benefit to both the future of the small town of Bollington and the educational objectives of the atelier Continuity in Architecture. It is in this context that the student becomes aware of their role in the 'public understanding of the process of design and construction which requires the student to step outside the protected environment of the school of architecture and communicate both orally and visually, in the context of peoples lives' (Bishop, 1997: 87).

The Neighbourhood Plan Collaboration for Bollington will be completed this academic year and will be documented in the production of a final plan and series of notional building designs. This project takes the Neighbourhood Plan beyond what is normally expected. The general public have been able to comment on ideas because they have been visualised through the generation of real proposals depicted by drawings and models, are therefore easily accessible. An exhibition scheduled for May 2016 and a series of public meetings will advance the dialogue and engagement, which will further enhance the plan for Bollington, this will hopefully provoke great discussion within the town. Although these buildings are entirely hypothetical, they open up a conversation with the local community about the type of architecture that might be fitting for Bollington. It will be an architecture based upon an informed opinion of the place. The project should be viewed as an example of best practice in Neighbourhood Planning and will disseminated further at both a local and national level.

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Ethics in architecture: Introducing concepts of power and empowerment

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ABSTRACT: This article analyzes the results of a broad-scale process of teaching ethics in architecture to both professional and research-based master's students at a major U.S. university. Redefining ethics as a question of both power and empowerment (or agency), classical frameworks such as Immanuel Kant's categorical imperative or Jeremy Bentham's utilitarianism are re-cast as a framework of power discrepancies that can be addressed using negotiation strategies. Using examples taken from both professional practice and areas of current architectural research, students are asked to identify stakeholders and their values and interests, and then insert themselves into the framework as mediators in search of ethically responsive outcomes. This approach has allowed the perceived ethical neutrality of both design and research problem statements to be called into question, as students explore an enhanced role as professionals and researchers in relating problem statements to outcomes, and outcomes to broad stakeholder satisfaction.

1 ETHICS IN ARCHITECTURE

1.1 *The legal view of morality*

Little has been written specifically on architectural ethics, and what is available has generally taken one of three approaches. The first, and oldest, of these presents ethics through the lens of professional practice. From early times, architects and builders have been seen as upholders of human welfare, and social codes regulating their activities were an expression of moral values canonized through laws. The Mesopotamian Code of Hammurabi, written in 1754 B.C., laid out punishments for professional negligence or incompetence, stipulating for example that the builder of a structure that collapsed and killed its occupant would likewise be put to death (cited in Ching and Winkel 2012, 2).

Current laws governing architects' behavior are less drastic, as licensure has sought to insure professional competency, while building codes ensure a structure's safety. In the United States, professional ethics are now largely defined as normed behavior between individuals involved in or affected by the building process. Both the leading national professional association and the national licensure board have developed edicts to this effect: the American Institute of Architects (AIA) has published a *Code of Ethics* and the National Council of Architectural Registration Boards (NCARB) a *Rules of Conduct*. Both texts approach their subject largely from the point of view of contractual law and thus use a fairly limited scope in defining architectural ethics.

Going beyond these legal-based rules to examine social and moral issues such as discriminatory practices and the right of the community to determine what gets built in its midst, Thomas Fisher's book, *Ethics for Architects* (2010) presents a series of hypothetical case studies taken from the point of view of today's architectural practice. Fisher's book offers illustrative examples that go beyond what is covered by the AIA and NCARB documents, covering issues such as respect for community values or avoiding discrimination based on gender or disability. Barry Wasserman, Patrick Sullivan and Gregory Palermo's tripartite book *Ethics and the Practice of Architecture* offers a broader approach, introducing ethical "awareness", before moving to "understanding" and then presenting "choices". The first section introduces the ethical nature of architecture and defines philosophical contexts and theories; the second section more selectively applies these concepts to the architectural process, and the third supplies textbook cases to be used in the classroom. The goal is to help students develop their "ethical stance and reasoning processes" in their role as professional architects (Wasserman, Sullivan and Palermo 2000, 180).

Langdon Winner's 1980 article, "Do artifacts have politics," provides a critical voice, exploring ethics in terms of systems and decision-making processes, or rather, how technical systems have a political dimension. Examining how the creation of artifacts has effects and repercussions that an ethical analysis must take into account, Winner lists examples such as Robert Moses's decision in the 1930s to build overpass bridges spanning the Long Island Parkways, which connected the city of New York with Long Island towns and recreational areas, with such a low clearance that busses could not pass through (Figure 1). The bridges kept the working class, who did not own private automobiles and thus relied on busses, from accessing Long Island's acclaimed public beaches. The bridges themselves appeared as neutral objects of civil engineering, yet their low clearance allowed them to



Figure 1. Low overpass bridges on Long Island Parkways prevented low-income residents relying on bus transportation from accessing Long Island's recreational areas. Photo courtesy NYC Municipal Archives.

become political pawns. In another set of examples, Winner points out that technologies used to maintain public infrastructure – for example that of nuclear power plants – requires a corresponding hierarchical political system, in this case a set of industrial and scientific elites trained to run them.

1.2 *Ethics and aesthetics*

A second area of discussion regarding architectural ethics approaches the topic from the point of view of aesthetics. In this body of literature, the architect is seen as an upholder of social welfare in the broader sense, creating a built environment that is to bring greater social happiness through expressing deeper thinking regarding the condition of life itself. The tenets of material honesty and structural and spatial transparency at the heart of modernism, or the social commentary expressed by the postwar Brutalist movement, are two cases in point. Texts are often based in philosophy, such as Karsten Harries's 1997 book *The Ethical Function of Architecture,* which discusses the uncertain path of contemporary architecture as a reflection on Siegfried Gideon's classic treatise that architecture should express "a way of life valid for our period" (Gideon 1967, xxxiii). Discussions of ethics as related to aesthetics remain the most intensely theoretical of the three approaches to ethics and, as we shall see, the most open to controversy over what is "right" and proper for a given society made up of individuals with differing needs.

1.3 *Ethics and ecology*

A more current direction that has become part of the debate on architectural ethics involves the ecology of our planet, and the role of architecture in our plant's future. In the United States, buildings have been shown to account for almost 40% of carbon emissions as well as 70% of the nation's electrical consumption (Green Building Council 2016). Architects are reminded of the essential role they can play in reducing energy use both in the construction process and post occupancy phases, a role that focuses on efforts to increase the common good. Books such as Warwick Fox's edited volume on *Ethics and the Built Environment* (2012) have pushed such considerations to the forefront as they explore the ethical nature of sustainable design.

1.4 *Ethics and the greater good*

All three approaches – professional ethics, the ethics of aesthetics, and ethics linked to environmental stewardship – can be seen as derived from ethical principles as defined by philosophers, principles that have in common their ideals of justice as well as action for the greater good. While many philosophers have written on what we might call ethics, I focused on two concepts that I felt were most useful for the focus of the class: Immanuel Kant's idea of the *categorical imperative*, and Jeremy Bentham's universalism. Kant stipulates that one should, "act only according to that maxim whereby you can, at the same time, will that it should become a universal law," (Kant 1785/1993). With this phrase, Kant postulates that an action is only morally right for one if it is morally right for all. Jeremy Bentham frames the ideal of social justice a bit differently. In his theory of *universalism* he instructs us to maximize pleasure and happiness and minimize pain and unhappiness for the greatest number of people; the profit of a few may not outweigh the good of the many (Bentham 1789/1988). This theorem can be amended to consider the degree of unhappiness a minority group may suffer – if maximizing happiness for most would create a situation in which a minority is truly miserable, the rules of universalism must be adjusted. Both the categorical imperative and universalism can be seen in contrast to social contract theory (Jean-Jacques Rousseau and others), in which individuals forfeit some of their liberties to the state, or Aristotle's *virtue ethics*, which stresses the moral character of the decision maker. Here, universal principles governing decision-making are less important than a pedagogical approach leading to self-regulation: the training and instilling of a proper, or virtuous, set of values (Aristotle and Barnes 2004). Aristotle's concept of an internalized virtuousness is not unique of course; non-Western philosophies, such as Confucianism, follow similar ideals.

What philosophical ethics deals with in the abstract, and professional ethics largely ignores, is a broad set of ethical questions that architects and architectural researchers have become deeply enmeshed in but rarely discuss: the role of the practicing architect and the researcher in shaping architectural, and with it social, discourse.

In professional practice, building designs, building placement, landscape and infrastructure, building

materials, office organization and the construction process itself all involve both process and product decisions that involve the architect. In most cases, the ethical dimensions of such decisions remain unexamined.

For the architectural researcher, discussions of ethical considerations remain equally limited. Ethical questions are often covered through institutional review boards, which oversee research designs and guarantee that human or animal subjects suffer no physical or psychological harm. Research questions themselves are thus largely seen as ethically neutral. Unearthing new knowledge and developing new concepts has become the measure of success, with little regard to choosing one's questions based on some sort of ethical construct. A longer-range historical view shows the fallacy of such valuation, however, since what is *not* asked is often as telling as what is pursued, or put another way, questions, like artifacts, "have politics". This recognition has led to changes in the research landscape; for example, research of the past two decades has questioned earlier interpretations of architecture and urban planning and analysis as written from the point of view of white, middle-class males, and has countered existing theories with new ways to frame questions and offer theories of space (see for example Colomina 1992, Massey 1994, Sandercock 1998).

2 REFRAMING THE ETHICAL PARADIGM

In the course "Architectural Ethics" offered as part of Penn State University's graduate program in architecture, I propose a new framework for architectural ethics, approaching the topic as a question of both power and empowerment. Put another way, I propose that it is power imbalances that create ethical dilemmas, and as architects and researchers concerned with ethics, we must become aware of who holds the power to act in any given situation, and why others might not share this power.

Students were asked to think of decisions concerning the built environment in terms of stakeholders. Stakeholders have interests in the outcome of decisions, but do not always have the power to act to their own benefit. It is when stakeholder groups become disempowered that ethical dilemmas often occur – when the categorical imperative is cast aside or when definitions of the "greatest good" become skewed. Fueling this tendency is a commonly held view that decisions must involve a zero-sum outcome: that allowing one group to gain must mean a loss for another. Breaking through this pattern of thinking became one of the main course objectives.

2.1 *The course methodology*

In order to gain practice in framing ethical dimensions in terms of power discrepancies and to find solutions for identified problems, I presented students with a series of readings and case studies and asked them to determine the set of stakeholders in any given situation. I then asked students to list what interests those stakeholders might have, as opposed to the positions they were expressing, in order to uncover common ground between stakeholders. Using this analysis of stakeholder interests, students then worked to develop options for mutual gain for all stakeholders, keeping Kant's categorical imperative and Bentham's concept of utilitarianism as reference points.

Students in the course are assigned just one textbook: Roger Fisher, William Ury, and Bruce Patton's book *Getting to Yes: Negotiating Agreement Without Giving In* (2011), a how-to guide written by three members of the Harvard Negotiation Project. The book allowed students to perform ethics analyses based on a simple concept for negotiation strategy: 1) Separate the people from the problem, in this case by identifying the stakeholders involved, 2) Identify each stakeholder's interests instead of simply accepting their stated positions on an issue 3) Develop a set of options for mutual gain, and 4) Identify objective criteria by which such options could be assessed. Student used these principles to work through the readings and case studies assigned.

The course is arranged topically, and covers diverse areas such as contested terrains based on race, ethnicity, religion, social class or gender, expressions of power through the built environment, specifically through spatial arrangements and the use of monumentality; ethics and aesthetics, the role of ethics in green architecture, the role of ethics in technical advances, specifically in computational design, and case studies taken from professional practice. In each situation analyzed, I asked students to consider ethical dilemmas as power discrepancies that could be addressed through negotiation strategy as outlined above.

The first case they were presented with was a 1975 dispute carried out in the New York Times between sociologist Herbert Gans and architecture critic Ada Louise Huxtable on how the Landmarks Preservation Commission of New York City should choose which buildings to preserve. The case, described in Dolores Hayden's book *The Power of Place: Urban Landscapes as Public History* (1997), saw Huxtable arguing that the Commission should focus on preserving major architectural monuments, while Gans countered that this preserved the architecture of the rich and the elite, while the built history of the common people was allowed to disappear. Countering Huxtable's point that "great buildings" designed by "great architects" exemplified public culture, Gans pointed out that the Commission was funded through taxpayer money and warned that while, "[p]rivate citizens are of course entitled to save their own past, […] when preservation becomes a public act, supported with public funds, it must attend to everyone's past," (cited in Hayden 1997, 3). To underscore his point that the Commission was not acting according to these values, Gans presented a quantitative analysis of the buildings the Commission had acted to preserve, most of which were, in fact, created for the affluent.

The students rightly saw this exchange as a failed attempt at negotiation, with each side digging into positional thinking. Huxtable and Gans were using terms such as "architecture", "vernacular", and "neighborhood" very differently, a point they both failed to recognize. Their positions were based on different valuations of these concepts: Huxtable saw vernacular architecture as buildings created by anonymous builders, which meant the building became defined by its general historic style, while Gans saw vernacular architecture as buildings with a wide social use or public accessibility. While to Huxtable the term "vernacular" lessened the historical value of the building, for Gans the term heightened value.

The students saw several stakeholders in this exchange. Gans and Huxtable were identified as two stakeholders whose verbal sparring, evolving from two incompatible positional arguments, was designed to influence the future of the Landmark Commission's activities. Students saw a power imbalance between Huxtable and Gans, noting that, "Huxtable [has] more power because […] Gans is the one who is trying to make a change from the [status quo]," (McKenna 2015), while also noting that when Gans seemed to be winning the argument through pointing out the ethics of using taxpayer money, Huxtable's employer – the New York Times – censored his rebuttal by shortening it and relegating it to an obscure section of the paper.

Despite the strong positions Huxtable and Gans adopted, students found common interests between the two, chief among them the desire to preserve the history of both the city and its built artifacts. Students also recognized that both wished to spend the Commission's money wisely, while satisfying the public, another identified stakeholder. Students suggested options for mutual gain (some already mentioned by Hayden), such as highlighting the role of workers in the construction and upkeep of buildings for the wealthy, or of presenting architectural monuments within the context of adjoining working-class neighborhoods. Such measures, they argued, would give a fuller picture of both the architectural significance and ensuing symbolism of the stately architecture as well as the "back story" context of how earlier societies created and used the built environment. Students pointed out that in this way monumental architecture could be preserved without stripping it of its social context, creating opportunities for more fully recognizing an earlier society's achievements and way of life.

2.2 *The topics of ethical practice and research*

Further cases the students analyzed were socially more complex. Joe Feagin's *Racist America* (2014) traced how the consequences of American slavery of the 18th and 19th centuries resonate to the present day, as the unpaid labor of slaves and the unequal opportunities under the physical segregation that followed its abolition caused inequalities of economic and social capital that have been compounded over the course of twenty generations. Chad Friedrich's film *The Pruitt Igoe Myth* (2011) provided a poignant example of this inequality. Examining the background to one of the most notorious failed housing projects in the United States, Friedrichs pointed out how – contrary to the common narrative that the architecture was somehow to blame – the de-facto segregation of low-income African Americans into the complex, the ensuing lack of investment in the project's infrastructure, social agencies' paternalistic rules for project residents, and poorly conceived financial plans for maintaining the project, led to its assured demise. *The Pruitt Igoe Myth* introduced two ethical dilemmas: treatment of a group of stakeholders on the one hand, and correct representation of historical events on the other. Madhuri Desai's article "Mosques, Temples, and Orientalists: Hegemonic Imaginations in Banaras" (2003) illuminated another example of misrepresented history, as a dominant Hindu society in India claimed the city of Banaras as a "Hindu pilgrimage city", in the process erasing any references to the substantial Moslem population that has resided there for centuries. Barbara Hooper's "'Split at the Roots': A Critique of the Philosophical and Political Sources of Modern Planning Doctrine" (1992) presented the mechanisms of women's exclusion from modern planning doctrine from the late nineteenth century onwards, while Beatriz Colomina's article "The Split Wall" (1992) pointed out how women, as a group, were presented as exotic "others" in the spatial arrangements of iconic modernist architecture. In all of these scenarios, students analyzed not only the cases themselves and how a dominant group exerted power over space and other resources, but also how such cases had been researched and presented in the form of a narrative controlled by the dominant group.

The emphasis on examining both an architectural or urban problem and its portrayal in the literature became a useful tool for understanding how narratives – including those the researcher contributes to or controls– affect a power matrix. Analyzing the underlying questions of power and agency showed that neither the artifacts created through the architect's labor, nor the questions and narrative of the researcher's work are neutral.

The course examined a range of topics related to the built environment. Simon Guy and Graham Farmer's exploration of "Contested Constructions: The competing logics of green buildings and ethics" (2012) opened an avenue towards understanding the debate around how the concept of "sustainability" is interpreted by different groups of stakeholders. Daniel Cardoso's article "Inertia of an Automated Utopia: Design Commodities and Authorial Agency 40 Years After the Architecture Machine" (2011) shed light on the early hopes for how design computing would make the built environment more humane by allowing users direct input over the product, and Lilli Irani's article on Amazon's mechanical Turk (2015) led to a lively debate about the role of humans and machines in rote tasks, and the ethics of allowing humans to perform repetitive

and machine-like functions as part of a profit-making system.

2.3 *Ethics have politics*

As one of the students pointed out, the political angle of the course readings was largely liberal. This resulted quite simply from the way the assignments were constructed: in placing an emphasis on identifying stakeholders' interests – no matter their conventionally perceived level of social importance – and attempting to find areas of mutual gain, I was following a narrative based largely on the value of social egalitarianism, rather than one based on more conservative values, such as merit or in-group loyalty. I had also not introduced social contract theory as a working philosophical framework because, based on my experience with feminist, race- and class-based theory, I did not believe that a process by which persons negotiate among themselves to shape society would necessarily yield morally valid results. To introduce students to an example of conservative thinking on ethics, I assigned an article by the economist Milton Friedman from 1970: "The Social Responsibility of Business is to Increase Its Profits," in which Friedman argues that a corporate CEO may not take social actions that could lessen the corporation's profits, since doing so would represent a from of shareholder "taxation" to which the CEO is not entitled. In developing his argument, Friedman pointed to the government's role as initiator of social action through democratically voted demand (a form of utilitarianism), and pointed out that a CEO would be usurping the government's role if he initiated – and had his shareholders pay for – social programs. The discussion that this article provoked in class showed the importance of considering value systems when analyzing ethical questions. Friedman assumed that a free market system incorporates the checks and balances needed for ethical behavior to remain the norm (a form of social contract). This belief was the basis for his call to consider the needs of those stakeholders best capable of performing under the "open and free competition" of Friedman's lauded meritocracy. With other words, Friedman argued that a market system created inequalities, and that these inequalities were justified. Having by now performed a series of analyses to present stakeholder interests and win-win options as part of a non zero-sum game, the students quickly realized a pattern that allowed the wants and needs of the have-nots to simply be canceled out of Friedman's social equation.

3 APPLYING ETHICAL THINKING

The final assignment for the course required the students to develop a case study based on their thesis topic. Students in both the professional and the research-based programs choose their own thesis topics, which range from highly technical projects to exploration of social issues. In the related ethics assignment, students identified stakeholders, analyzed stakeholder interests, and developed options for mutual gain, based on their analysis of the background issues associated with their thesis topic.



Figure 2. A proposal for a disused London underground station reconfigured as a public bicycle path. Photo ©Gensler.

Of the eight students in the class who were pursuing a professional degree, six centered their analysis on the urban contexts of their proposed building designs. One used David Harvey's matrix presented in *Social Justice and the City* (1973) as a basis for developing scenarios for disused London underground stations in a way that would benefit as many diverse stakeholder groups as possible (Figure 2). One created an analogy between the urban gentrification process and natural ecosystems, analyzing that changes at too large a scale in the urban fabric can have results, good or bad, similar to natural disasters in the wild such as a forest fire or flood, and arguing that as a rule, change should be more controlled. Another student questioned the "modernization" plans for a thriving community in Mumbai, concluding that stakeholder interests could be satisfied with far less radical interventions than were being planned. One student took a different path, looking at the stakeholders involved in end-of-life scenarios, and concluding that new types of spaces that cater to the dying and their families would serve those stakeholder groups better, while saving patients, hospitals and the health care system millions of dollars annually.

The five students pursuing a research-based degree largely focused on the interplay between architecture or urban spaces and policy decisions, many examining who controls urban space and how such control is presented to the population. One student examined how political parties in a major city in India make use of a waterfront park to erect monuments that, while presented as public recreational spaces, in reality use public funds to showcase the parties' own political agenda. Another student traced how a major park in Bogota, Colombia failed because the municipality and the architects neglected to acknowledge the presence of a large homeless and drug-using community that quickly took over the park's spaces, making them unattractive for the intended users (Figure 3). A further project analyzed the commercialization of public space in global cities through the presence of lit billboards occluding the buildings they cover, and



Figure 3. Tercer Milenio Park in Bogotá, Colombia. The park remains underused, due to social problems unrecognized by the planners. Photo by Pedro Felipe.

questioned the architect's role in this arrangement. In all cases, students learned to understand the process of creating spaces as something that involves a variety of stakeholders. They also came to understand how analyzing the power structures between stakeholders, as well as stakeholder's interests, can lead to a better understanding of what is needed for a successful, and ethical, design.

3.1 *Negotiating power structures*

In framing ethical problems as an issue of power discrepancies and questions of agency, students began understanding design problems as more than just a question of function, structure, cost or aesthetics – considerations they are commonly taught as part of an architectural education. Instead, students began to systematically consider the broader implication of design and planning decisions and how such decisions affect the built environment and the people it serves. Identifying stakeholders affected by design and planning decisions became a first step in assessing stakeholders' relative degrees of empowerment and stakeholders' ethical treatment. Analyzing stakeholders' interests moved the design problem beyond the creation of space and form, allowing students to consider how their own actions ripple beyond the architect's immediate set of tasks to encompass ethical questions they can address. Most importantly, teaching students negotiation strategies to achieve win-win options, and helping them to identify values and criteria by which such options could be evaluated, helped students to address conflicting interests between stakeholder groups as a quest for ethical solutions to architectural and urban design problems.

For students engaged in architectural research, expanding the search for stakeholders beyond those immediately touched on by the research problem allowed students to consider how stakeholder groups sometimes remain invisible, how such groups, once identified, can be empowered through providing information or through reframing the research question, and how exploring research problems as a quest for mutual gain allows far more wide-reaching research results than if results were geared towards a more limited or immediately accessible set of stakeholders. In both cases, identifying power imbalances, naming stakeholders and their interests, developing options for mutual gain, and evaluating those options based on a set of agreed-upon values and criteria led to an understanding of architectural ethics as central to architectural decision-making.

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In search of meaningful interdisciplinary work in architectural education

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ABSTRACT: This paper assesses one promising approach to establishing interdisciplinary work in architectural education in the form of an interdisciplinary LEED Lab course, led by a partnership between the North Carolina State University (NCSU) School of Architecture and the NCSU University Facilities Division. The overarching goal of this course is to establish a method for interdisciplinary teamwork structures within the architectural curriculum, but outside of the studio setting. Example exercises for increasing meaningful partnerships between students of different disciplines are shared, with a review of how this type of course can address accreditation requirements. Future possibilities for research are presented.

1 INTRODUCTION

The process of architectural education is simultaneously uniform and diverse. While countries have established standards for accreditation, the emphasis of that education can vary quite a bit and range from an emphasis on history, to urban planning, to building science, to theory, and more. One thing that is historically common among these veins, however, is the difficulty in providing meaningful interdisciplinary experiences to the architecture students.

Interdisciplinary teams are becoming increasingly emphasized in the architecture profession. While architects and designers have always had to work with other disciplines, both the depth and number of interactions with other fields is growing. The manner in which these different professions are interacting, and in which the students will soon need to participate, is different than it has been historically. As the architectural profession makes the transition, so must architectural education. Realistic engagement with interdisciplinary teams must be better accommodated in the education of future practitioners. This paper assesses one promising approach to address this burgeoning need in the form of an interdisciplinary LEED Lab course, led by a partnership between the North Carolina State University (NCSU) School of Architecture in the College of Design, the University Facilities Division, and the University Sustainability Office.

While reviewing possible strategies for building partnerships between diverse student backgrounds through intentional exercises, this approach seeks to establish a common framework for complex environmental issues for use in architectural education and aligned disciplines. One of the primary goals – and challenges – of this interdisciplinary approach is to help separate disciplines understand the value of each other, as is often understated and begrudgingly addressed in the professions. The different offerings, perspectives, worldviews, processes and work strategies of each discipline are valuable tools for the students to understand prior to entering the workforce.

1.1 *LEED Labs at NCSU*

The NCSU LEED Lab course is one of a growing number of similar courses being offered around the world, and one of the largest with twenty-five students from across three different colleges including the College of Design, the Poole College of Management, and the College of Natural Resources. The NCSU LEED Lab course addresses two fundamental goals: (1) supporting architecture and aligned-major students with skills, knowledge and expertise to be effective critical thinkers, engaged leaders, and team players; and (2) assisting the owner in achieving efficiency, savings, and sustainability in campus facilities. The first objective is the focus of this paper. The course structure, activities, partners, and possible next steps will be reviewed through a teamwork lens. Reflection on these initial courses results in a solid template for including meaningful integrated design experiences in architectural education, and provides a method for sharing the value of the architectural education across campus.

1.2 *The development of LEED Labs*

The NCSU LEED Lab course is based on a specific program established by the U.S. Green Building Council (USGBC) called Leadership in Energy and Environmental Design (LEED). While the United States is home to USGBC and most LEED certified projects, many countries are establishing like-minded organizations, such as the Indian Green Building Council (IGBC) and the Green Building Council of Australia (GBCA). An increasing number of countries are either adopting or adapting the LEED rating system to their particular needs.

More specifically, the NCSU LEED Lab course reviewed here was developed based on an additional education program out of USGBC's Center for Green Schools. As noted on the Center's website, "LEED Lab is a multidisciplinary immersion course that utilizes the built environment to educate and prepare students to become green building leaders and sustainability-focused citizens." (USGBC 2016) Using this provided framework, the goal of NCSU's LEED Lab course was not particularly to achieve LEED certification for the subject building, but simply to involve NCSU students across disparate disciplines in meaningful interdisciplinary work with a common goal.

2 BACKGROUND

2.1 *Interdisciplinary opportunities*

With the need for interdisciplinary teams and integrated processes growing in the built environment professions, practicing and future architects are finding it necessary to expand existing dialogues to better collaborate with other disciplines (Keeler 2009; Moe 2008; Yudelson 2009; Deutsch 2011; Reed 2009). Literature shows that courses facilitating teamwork through interdisciplinary groups better engage students in simulations of communications and projects in practice (Smit & Tremethick 2013; Fixson 2009; Rhee 2010). Because no built environment projects can be completed without interdisciplinary collaborations, these types of educational experiences can have lasting implications for students after graduation.

Unfortunately, the lynchpin of architectural education – the studio – is also what causes the most difficulty with interdisciplinary collaborations. Potential collaborators in disciplines outside the design fields, such as engineering, do not have the history, credit structure, or cultural understanding to easily, meaningfully participate in a studio course. The sheer amount of time allocated to the studio course, both in and outside of official class time, is difficult for other disciplines to comprehend. While studio is the preferred setting for interdisciplinary collaborations, where most meaningful connections are established between design concept and implementation during education (Kurt 2009; Schon 1984), interdisciplinary engagement is not easily accomplished in this venue due to logistics.

While some architecture programs have been making strides in establishing successful and repeatable methods for true interdisciplinary learning in a studio setting, other opportunities do exist for architecture students to engage meaningfully with other disciplines on campus in a classroom setting. This profiled course is one such opportunity.

2.2 *The local context and service learning*

The NCSU LEED Lab course is hosted out of the School of Architecture in partnership with the University Sustainability Office and the University Facilities Division. With co-instructors from both Architecture and Facilities, the course is structured to include meaningful learning objectives and experiences for the students, as well as conceivable benefits for operations of the campus. Logistically, the instructional partnership helped address the perception that an institutional commitment to service learning is a barrier to success (Bringle & Hatcher 2000; Morton & Troppe 1996). By not trying to force-fit the design education process into facility operations structure, or vice versa, the objectives and products of the course were enhanced.

By using the campus as the sample boundary for project selection and thereby enlisting the university as the "client", students were given the opportunity to participate in a real-world, environmentally-focused project with committed stakeholders. A self-selected participant population, the students were able to better develop their skills for future employment in a sustainability-focused field, which helped forward personal goals. The benefits of incorporating real-world and service learning projects in university courses and the significance of experience in interdisciplinary teams in a real-world setting (Bryson et al. 2006) are popularly recognized in literature. Encouraging students to focus on critical, reflective thinking while participating in service learning projects also supports the development of personal and civic responsibility (American Association of Community Colleges 2015). Billig et al. (2005) noted that using service-learning projects to clarify course content was one of the greatest predictors of all academic outcomes, while Astin & Sax (1998) claim that participating in service learning projects increases a student's growth in academics, life skills, and sense of civic responsibility.

By using a modified service learning approach, participating students were able to significantly contribute to an initial assessment of existing buildings on campus through an interdisciplinary lens. Through the strategic selection of a campus building, viewed as one of their own, the course instantly establishes a common foundation and value for the students. The students come to the course as unified stakeholders in the project, despite being from differing disciplines. Attitudes toward the project building, as well as the project processes, would have likely been different the project building was owned by a third-party, such as a standard office building or corporation. The integration of a real-world project in the local context is believed to be a significant element in the success of the course, specifically as it encourages goal-oriented teamwork. By selecting a project in the students' immediate context, the values of the project and its deliverables were effectively set early in the process.

3 COURSE DESCRIPTION

3.1 *Dual course goals*

Because this unique course was highly dependent on two discrete university departments, addressing both academics and facilities, distinct but complementary

goals were established. One set of goals addressed student learning objectives while the other goals addressed serviceable deliverables to Facilities to impact future standard operating procedures.

Learning objectives for the course primarily targets two areas: the development of student knowledge regarding green building tactics in practice, and the importance of interdisciplinary teamwork as addressed earlier. The overarching goal of this course, academically speaking, is to establish a method for interdisciplinary teamwork structures within the architectural curriculum, but outside of the studio setting.

The first academic goal for the course was to use the established framework of LEED to provide a structure for students to make sense of complex issues surrounding post-occupancy and sustainability issues in buildings. As substantially addressed in literature (Espinosa & Walker 2011; Kay et al. 1999; Waltner-Toews et al. 2008; Zellner 2008), sustainability is a tremendously complex issue that is too convoluted and meticulous for one field alone. However, grasping this innate complexity, including the primary components of green building projects and systems, is precisely what is being asked of design students and future practitioners. The intent was to establish a framework to help organize this knowledge.

With a different focus area in the university structure, the goals for the course were different from the perspective of the University Facilities partner. More focused on how course deliverables could impact the university's movement toward sustainability, their interest was in the product of the course, not necessarily the process. Because this article is more interested in the course process, these goals will not be elaborated on here.

3.2 *Course structure*

While some other university hosts of the LEED Lab course extend the project over multiple semesters, the NCSU course was contained within one semester. Interested in both expanding knowledge of the students beyond their fields, as well as providing detailed experience to support their current fields, provided a challenge in designing the course. This, cross-referenced with the sheer number of issues to address within the LEED structure, led to establishing two different modules linearly within the semester, both of which follow the same general process. This phased module structure provided the students two distinct opportunities to go address different credits and considerations during the course. Ideally, in one module students would research credits applicable to their discipline, while broadening their exposure to other considerations outside of their fields of study in the other module. These two opportunities were thought to better help facilitate building an expertise outside of their field.

Students were given one group for Module 1, and regrouped with other classmates for Module 2. An example of these groups is shown in Table 1.

Groups were arranged not only based on student preferences, but also with equal numbers of students in each group. Even more important was to balance the distribution of students from different disciplines within each group. There were three disciplines represented in the class each semester, including architecture, engineering, and environmental sciences. Working within the student populations of both semesters, each group was ensured to have at least one participant from each discipline, but no more than two from each. Using these established guidelines, the five groups for each of the modules were as well balanced as possible within the makeup of the course rosters.

Table 1. Examples of Module 1 groups.

Group 1 Sites/Location	Group 2 Water	Group 3 Materials
Site Management	Indoor Water Use	Purchasing Policy
Site Development	Water Metering	Maintenance/Reno
Rainwater Mgmt	Outdoor Water	Purchasing: Ongoing
Heat Island Reduction	Indoor Water Use	Lamps
Site Management	Cooling Tower	Purchasing: Reno
Site Improvement		Solid Waste Mgmt

3.3 *Delivering content*

Though groups were given particular credits and considerations to focus on during the course, it was important that all students received the basic information for all topics. While student teams worked on gathering data for the considerations assigned to their groups outside of class time, all major topics were covered in class and presented to all students. With these layers of hands-on (from independent work with their groups) and lecture-based (from class time) information gathering, all participants could become more knowledgeable about all green building considerations, including indoor air quality, energy consumption, waste management and recycling, and more. By using the LEED framework to establish a conceptual structure for the wealth of information needed, students possessed a tool to relate the content received in class back to the relevant credits addressed by their teamwork outside of class.

When structuring the course, representatives from the University Facilities Division were asked to participate as guest speakers whenever possible. For example, one class session reviews issues pertaining to indoor environmental quality. Instructors provided an overview of the larger concepts surrounding indoor air quality in the first half of the three-hour class. During the second half, staff members from the University's Environmental Health and Safety team presented to the students about their responsibilities in practice, including examples of typical issues seen on campus and in different building types.

These practitioners provided valuable background regarding real-world processes while also supplying students with information to facilitate productive teamwork and relevant deliverables. Representatives

from University Facilities departments including Building Maintenance and Operations, Repair and Renovation, University Housekeeping, Energy Management, Waste Reduction and Recycling, Environmental Health and Safety, Energy Solutions, Purchasing, Grounds Management, and the Building Maintenance and Operations' Commissioning Team participated in classes throughout the semester. Staff from each of these University departments addressed the class individually to share their daily processes with the students. When appropriate and feasible, staff facilitated in-class workshops for students to better explore issues.

These guest visits not only establish a basic level of knowledge for students, but also begin to create a unique partnership between the students and the University staff. These sessions allow students to ask questions of the staff and engage in meaningful discussions about concerns and perceptions of the different fields in the built environment. These sessions also had a secondary impact of energizing the staff themselves, providing additional kudos and energy to their roles and responsibilities on campus. These guest-speaking roles for staff helps to unify both sides of the university around the same common goal of green building, helping to further develop and extended the unique premise of a team consisting of both students and university staff. Though not the focus of this paper, this was found to be an important facet of the course.

4 CASE STUDY METHODOLOGY

This exploration was approached as an explanatory case study, which seeks to understand how or why something happens (Yin 2009). Rooted in a pragmatic approach, this study is interested in looking more closely at how meaningful interdisciplinary teamwork might be facilitated in a seminar format in design education. The case study methodology accepts that the context is important to the findings of the study (Yin 2009), and cannot necessarily be generalized to other settings or populations. The case study methodology explores interest areas in the natural context, collecting data within the real-world settings as opposed to contrived, laboratory settings.

The primary qualitative data to support this exploration was gathered through direct observations and unstructured interviews. Indirect secondary data was gathered through online pre- and post-surveys addressing perceptions on interdisciplinary teamwork, as well as through online assessment questionnaires focusing on the productivity of their teamwork and team members. All online surveys were hosted by the university survey service. The team assessment surveys included both Likert scale questions speaking to the perceived efficacy of teammates, as well as open-ended questions for further comment on teamwork processes. This data was gathered to establish insight on students' perception of how their teamwork progressed, as well as opinions on the need for teamwork in this type of interdisciplinary setting.

5 EFFORTS IN TEAM BUILDING

To address the primary goal of fostering interdisciplinary partnerships between on-campus disciplines that rarely intersect, the course design integrated a series of in-class exercises in an effort to build familiarity and fellowship between the students. The inclusion of team building exercises has been found to be a key to improving deliverables and process in student team projects (Hansen 2006). Similarly, a sense of solidarity, or investment in a group, is significant in establishing powerful teams (Albert et al. 2000). With an eye to teamwork development literature, a series of exercises were incorporated throughout the class to help establish a sense of teamwork, entity, and commonality. Two exercises included in each of the first two classes had the goal of establishing a "safe place" where participants would feel comfortable with others, as well as become more aware of other expertise and value in the room. Additional in-class exercises that addressed real-world issues of existing buildings were also included to give the same experience to students of different disciplines, helping to level the playing field.

5.1 *Identifying myths and stereotypes*

To kick off the first class and to set the stage for both cooperation and owning assumptions, a *Myths and Stereotypes* exercise was shared. Participants were asked to identify three myths and stereotypes about each of the collegiate groups, including their own. The resulting comments were both entertaining and illuminating. Stereotypes identified by other disciplines about Design students included, "They have a lot of free time, but are always stressed," and "Often forget to shower." Stereotypes relating to the Natural Resources students included, "They hate to wear shoes," and "They all work on grass and things …?" and "We don't really know WHAT they do …" Engineers were regarded as, "Detail oriented and snobby," and also "So stressed – ALL the time." (Rider & Bowen, in press)

Verbally reporting these myths and stereotypes to the entire class helped to highlight the silliness and absurdity of some of the statements. This exercise worked toward cultivating a level of comfort between students of different disciplines and academic structures. Through this activity, each student was given the opportunity to better appreciate multi-disciplinary perspectives on environmental challenges and opportunities. This was one of the best-received and most productive exercises focused on team building.

5.2 *Experiential exercises*

As stated, a primary objective of the course was to create a basic level of comfort regarding non-traditional partnerships for and with design students. Though teambuilding exercises help with this, as outlined in the previous section, the course also addresses this fundamental need through strategic in-class activities. These events are purposefully designed to form

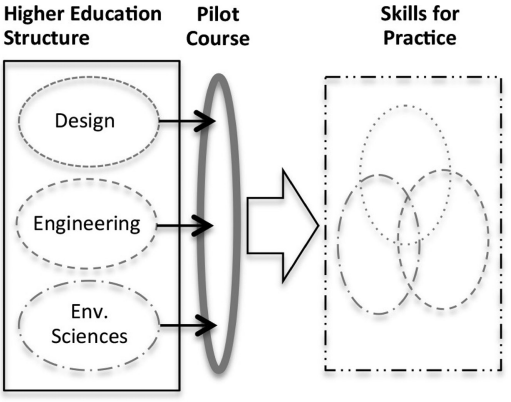


Figure 1. Conceptual diagram of the course addressing interdisciplinary design requirements in the building professions.

a collective understanding of in-field processes and terminology. These joint understandings then help to establish a common vocabulary for the participants, centered on existing building and operations. The precision and efficiency terms from the engineering and environmental science students are merged with the conceptual knowledge from the design students. This new (to the students) joint-rhetoric and experience also bridges the abstract and theoretical knowledge provided in the classroom into a context of application, and useful for future practice. This is shown conceptually in Figure 1. Three in-class exercises were completed, including an indoor air quality test, an energy audit, and a waste audit. The exercises were each planned and executed to build relationships and interactions between often disparate fields in academia, as well as with facilities departments that are rarely engaged.

Contribution of the proposed structure toward architectural eduction objectives

The course objectives, which emphasize collaborative skill development, enhanced understanding of complex issues, hands-on experience on a real-world project, and data gathering and analysis, are more suitably accomplished by using a collaborative teamwork approach. Meaningful interdisciplinary relationships were critical to complete the final course deliverables. In addition, these strategies also addressed larger goals for architectural education as outlined in the accreditation process in the United States.

The National Architectural Accrediting Board (NAAB) is the sole organization in the United States responsible for accrediting professional degree programs in architecture. As reviewed in the 2014 Conditions for Accreditations, a series of requirements are outlined for programs to show they are meeting established minimum standards. Within Part Two: Educational Outcomes and Curriculum, four Realms are identified as the pillars of a quality architectural education: (1) Critical Thinking and Representation; (2) Building Practices, Technical Skills, and Knowledge; (3) Integrated Architectural Solutions; and (4) Professional Practice. (NAAB 2014) This interdisciplinary seminar course as reviewed speaks to each of these pillars.

The design of the course addresses three of the eight points outlined under Realm A: Critical Thinking and Representation. Specifically, the participants' direct engagement with the stakeholder, including their final deliverables and presentations to the university staff, directly addresses the criteria pertaining to Professional and Communication Skills. The primary deliverables for the course are a culmination of weeks of gathering, assessing and recording data. This results in a gap analysis addressing both the current state of the building operations as well as the goal for building. With this, the course project squarely addresses the criteria for Investigative Skills.

Relating to Realm B: Building Practices, Technical Skills, and Knowledge, the course addresses seven of the ten criteria outlined. Because participants are exploring an existing building in-depth, most major building systems are addressed in the final analysis and documentation, including Environmental Systems, by way of daylighting, solar geometry, indoor air quality, lighting systems and acoustics; Building Envelope Systems and Assemblies, in terms of moisture transfer, durability, energy consumption and material resources; Building Materials and Assemblies, as participants explore the performance and environmental impact of construction materials, interior finishes, cleaning products, and assemblies; Building Service Systems, by exploring building systems through audits, measurements, data collection and staff interviews; and Financial Considerations, through cost estimates of repair and renovations, such as life cycle costing of retrofitting plumbing fixtures, equipment, or even adding solar panels. Other criteria in this Realm are also addressed, including Site Design and Technical Documentation.

The course activities and deliverables address all criteria as outlined in Realm C: Integrated Architectural Solutions. These criteria are actually somewhat innate in the course because the two primary issues in the course were (1) providing interdisciplinary approaches to (2) complex problems. Each of the considerations addressed individually were complex, and in total contributed to a more complex whole. Participants were tasked with assessing these complex projects with an eye to environmental stewardship, building systems, site conditions, user populations, and stakeholder goals and engagement, as outlined in the Integrative Design criteria. Skills developed in the course are addressed in the Integrated Evaluations and Decision-Making Design Process criteria. Embedded throughout the course was the requirement to implement applied research methodologies as they relate to the built environment.

Lastly, in Realm D: Professional Practice, the role of students as pseudo-consultants to the university enables them to step briefly into a real world scenario.

While they are not practicing in a firm, nor experiencing the business and legal practices of an architecture office, the participants do get an in-depth understanding of stakeholder roles in an existing building project, including owner, maintenance, users, community and consultants. While these roles are not those regularly seen in new construction or major renovation projects, the roles encountered are exceptionally valuable to understanding the goals of a building. These roles are addressed in the Stakeholder Roles in Architecture criteria.

Though this course was not structured to require individual execution of the final course deliverables, it is believed that the products delivered were more thorough and of higher quality than those that would have been delivered by individuals. One participant noted, "The biggest strength of the course is giving students access to knowledge and interdisciplinary experiences not typically available to students, making them more valuable in their future job-hunting endeavors." (Rider & Bowen, in press) Another stated that, "The interdisciplinary work between the three schools was beneficial and helped us all to grow as students and helped prepare us for working after school." The goals of the course would not have been achieved without a solid foundation in interdisciplinary work.

6 DISCUSSION OF FINDINGS

Feedback received from students via an online post-course survey indicate that participants had not been in such an interdisciplinary, collaborative, project-based academic setting prior to this class, and thoroughly appreciated the opportunity. One participant noted, "I also liked that there were other students from different majors in the class. I think having the variety of different majors in the class helped us learn from different perspectives." (Rider & Bowen, in press) By addressing complex built-environment issues through a multidisciplinary perspective, class participants would be better prepared for their future roles in their chosen professions, and were encouraged to begin to understand the importance of complexity (Johnson et al. 2010; Rapoport & Kantor 1967).

Similarly, emphasizing teamwork and investigative strategies in the course structure was undeniably valuable for the participants. As one graduate student notes, "Rather than being taught at us, which is usually the case, the students played an integral part in providing data and analysis. Having spent nearly half a decade in school, I have grown tired of teachers leading us down a winding road. One in which our skills are not tested and we are not challenged to excel and progress. This progression is not so for this course. We had the opportunity to learn from professionals outside of our fields. This challenged me to be comfortable communicating with my peers as well as the university faculty." (Rider & Bowen, in press) The common framework for analysis established and recognized early in the semester assisted teams in communicating more effectively, and working more efficiently toward a meaningful final deliverable. As such, the common knowledge framework presented in the course addressed the issues of challenging communication in interdisciplinary teams (Hall et al. 2004; Minssen 2006; Dayton & Henriksen 2007).

7 FUTURE RESEARCH

Future research on interdisciplinary efforts in architectural education could explicitly explore LEED Lab participant schools, beyond just NCSU, through pre- and post-tests to assess the different models, processes, structures and activities used the variety of courses (Rider & Bowen, in press).

Additional research is also needed on the topic of interdisciplinary teamwork as it relates to design education, investigating different methods for team building between design fields and other disciplines. Though design teams are often indiscriminately placed in working groups while in school, there is substantial literature on team development that could support future efforts of interdisciplinary teams of students (Dyer & Dyer 2013; Thompson 2009; Way & Bordass 2005), and benefit them both in school and later in the profession.

Still further studies could explore various ice-breaker activities, assessing which might provide the most opportunity for meaningfully engaging design students with those from other disciplines. There is also a need to assess varying approaches to interdisciplinary courses in different settings, such as comparing opportunities within a studio setting with those of a seminar. The differences between shorter and more transferrable opportunities compared with the intense setting of a studio could provide further clarification and insight into prospects for meaningful partnerships.

8 CONCLUSION

The NCSU LEED Lab structure is a practical model for significant, collaborative relationships between architecture students and non-design students using the LEED rating system as a both a conceptual and applied framework. The first two offerings of the NCSU LEED Lab course resulted in multiple positive outcomes, one of the most important of which was building rapport between previously disparate and seemingly distant student disciplines (Rider & Bowen, in press). Used as a model for student engagement, environmental stewardship, policy management, and interdisciplinary collaborations, NCSU's LEED Lab could be transferrable across all NCSU campus precincts and to similar institutions in the region.

The primary goal of the NCSU LEED Lab course was for all participants to obtain a well-rounded understanding of the considerations needed to operate and maintain a building after occupancy. This exploration indicates that interdisciplinary projects can be meaningful in a design-based seminar setting, illustrating that students from different disciplines can form significant, productive partnerships.

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Spatial imagination and representation, a method for integrating the theory and practice of spatial analysis in architectural education

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ABSTRACT: The course "Spatial Imagination and Representation" brought two rather unlikely subjects together: philosophy and drawing. They have become a promising couple, braiding the theoretical with the practical. Special about the new course is its methodological approach. We have made the philosophy of space into a tangible and concrete subject, explaining various conceptions of space and working out how these conceptions affect our way of responding to space. At the same time, the lessons in drawing explore these theoretical positions, giving the theory a foundation in practice. Both philosophy and drawing are concerned with processes of abstraction in the exploration of our environment. These abstractions express themselves in images and descriptions that can be explored through both disciplines, after all drawing is often defined as a kind of 'thinking of the hand'. Philosophy on the other hand thinks about the process of thinking itself, but also about the object of its thought.

Keywords: architectural education, models and concepts of space, philosophy & drawing, thinking & doing

1 INTRODUCTION

For the past three years we were given the opportunity to explore the setting up of a course in which cross-fertilization was a central goal. A teacher of drawing techniques and an art historian-philosopher working together to give students of the built environment the tools to study and conceptualize the idea of space and thereby to help them further their studies in design. The collaboration has proven very fruitful. This paper describes how we set up the course and discusses some of its results and concludes with an attempt to explain the success of the formula through the means and intensity of the integration of disciplines.

Nietzsche wrote in his notebooks for the years 1886-1887 that there are no facts only interpretations. Well, that fits in with current constructivist thinking. Henri Lefebvre (Lefebvre, 1991) developed a model of space in the 1960's whereby he distinguished three intimately braided activities: firstly, the actual behavior of bodies and things in space, secondly the perception of that behavior, and thirdly the conception of what is happening, that is, the generation of meaning. This triadic model in fact fits in very well with Wittgenstein's idea that the logic of relations is spatial and temporal and that therefore space is about the relations that obtain in a situation. These two models of space form the starting point and core of the course.

For students it comes as something of a surprise that the idea of space as a design tool for architects is relatively new. It was introduced by the art historian August Schmarsow in the 1880's (Mallgrave, 1993) and it is from that moment on that space gradually came to be a normative concept in the design of architecture. This instrumentalization of the idea of space as a design tool, and as a criterion by which designs and buildings could be judged, does not however mean that this was the beginning of spatial practice in the arts. The arts have, albeit implicitly, always worked with space in some way or another. Painting and film have always concerned themselves with the production of framed virtual spaces. Music and architecture are immersive arts; they make you undergo their spatial relations through movement. Music moves through time, while you perceive architecture by moving through it. Dance in fact confronts the two; it is an art that specializes in movement through space to express the movement of the music, which in turn expresses some or other emotive or narrative moment. Like sculpture, dance shows itself in space, thereby transforming it. These considerations formed the sketch version of our argument to combine the thinking about space with the creation of virtual and interpreted spaces through the practice of analytical and exploratory drawing.

The purpose of the course is to help students learn to observe analytically, critically and creatively, to make

them spatially aware and allow them to instrumentalise what they have learnt in confronting the philosophy and history of spatial representation with their own excursions in the analysis and creative or investigative exploration of space. At the end of the course students have learnt to describe and learnt to apply a specialist set of spatial concepts and tools of representation to the analysis and criticism of objects and spatial situations, and demonstrate a more refined understanding of the design process and in the qualitative evaluation of a design. In short students develop a critical apparatus tailored to practical skills of representation with reference to the production of space that will help them refine their professional interest in the design and production of the built environment.

2 EDUCATION AND METHODOLOGY

The subject is taught in the third year of the bachelor course of the built environment. In the charter of the faculty we are told that "The Department of the Built Environment is primarily oriented towards the technology of the building and technological solutions that contribute to the cultural dimension of the built environment." The signature indicates that the emphasis of the bachelor program is technological and that this technological bias is then applied to questions of culture and quality of life. Subjects like ours are serviced by the department of Architecture, Urbanism, Design and Engineering (AUDE) group which offers a carefully delimited part of the bachelor course. Our subject helps the large number of students who will, after the third year, go on to do a master in architectural design.

Design is both a technical as well as an artistic discipline. Our course "Spatial imagination and representation" is geared to exploring the possibilities of this attitude in tying theory and speculation to the development of practical skill, whereby we are careful to contest and explore the often problematic division between the technological and the artistic. We want students to realize that theory and speculation are inextricably connected in design and that the technological and the artistic both contribute to the design of the quality of life in equal measure and are in fact not so easy to separate. The word technology comes from the Greek Techné, which referred to the *art* of some discipline or craft. Moreover if technology refers to the technique of *how to do things* then art is itself serviced by technology. A last argument to contest their separation is that technology may be quantitative in its evaluation, but in its development and application it qualifies as an art. The reason we dwell on this is that, especially in our subject which concerns itself with the improvement of the spatial quality of life, however indirectly, it is very desirable that we do not see technology and art as enemies. Such an attitude, though common is restrictive and destructive to both.

The course, which is given 5 ECTS, is built up of three equally important parts. A course of lectures on the history and philosophy of space, in which students are confronted with various models and conceptions of space and are given examples to see how these concepts can be used as instruments of analysis and critique (8×1.5 hours). The content of the lectures is carefully coordinated with the lessons in drawing (8×3 hours) where students are challenged to explore various means of representing space. The two parts of the course come together in the seminar, where the students are asked, in groups of three, to analyze, critique and artistically explore a particular instance of space or spatial representation. The weekly development of the students doing this assignment is discussed and given feedback by both teachers as well as the rest of the student group taking the course. The seminar culminates in an exhibition accompanied by a presentation to the whole group in which the result is described and explained with the help of arguments underpinning the decisions that the students made. Both the work and the exhibition are carefully documented in a report. The method helps students not just to make decisions, but requires them to argue them through.

During the first year of the course students were asked to analyze a work of art in 2 dimensions, depicting some form of virtual space. As it was the first time, we thought it wise to select the works ourselves and chose salient examples from the whole range of the history of world art. It was the task of the student to analyze and transform this two dimensional virtual space by adding a dimension, this could be the third dimension, but it could also be the dimension of time, or a dimension of meaning. During the second, and current academic year, students were asked to find a space in their daily surroundings, analyze it and transform the space by exploring their specified method of analysis and critique.

What we hope is special about our approach and method is that we are attempting to achieve a high level of integration between theory and practice, the thinking about space and the thinking about the representation of space as well as the integration of the technical and the artistic in the design of spaces. In this way all facets of spatial design are consciously confronted with each other to achieve a well-argued synthesis.

3 SPATIAL CONCEPTS

Apart from the ones already mentioned, such as Lefebvre and Wittgenstein, the lecture course investigates a number of specific models of the way space has been conceived and represented from the Pre-Socratic philosophers who were concerned with ideas such as chaos and cosmos, infinitude and emptiness to the Platonic ideas of Chora and Topos; from medieval ideas of godly space to early modern developments such as Brunelleschian Perspective and Cartesian space; from enlightenment ideas such as Kant's Copernican revolution, in which space and time became categories of mind rather than categories of the world to late modern and post-modern constructivist theories such as those of the phenomenologists, J.J. Gibson and Gilles Deleuze. Rather than just contextualizing and

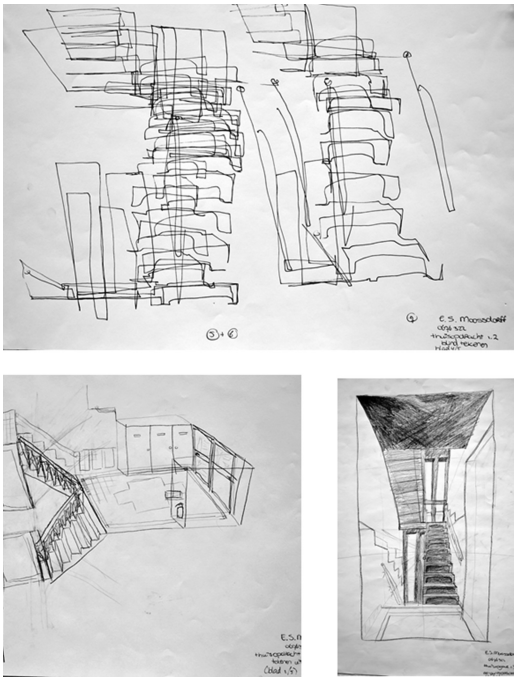
describing these models, we spend a lot of time making sure that the student is able to apply the concepts in the analysis and critique of concrete spatial situations and objects. Students are encouraged to don the glasses of a particular concept and approach specific examples in the other parts of the course. In this way students learn to free themselves from unhelpful habits and the mire of pre-conceived notions determining their outlook normatively.

4 THE DRAWING WORKSHOP

It is important, we believe that the student learns to look critically at his own perception of the environment he finds himself in by considering his own perceptions, the conceptual instruments he uses and the assumptions he makes. The course is about making students conscious of what they do. They are shown how our habits of perception and our thinking are both determined by silent assumptions that are descriptive, evaluative and prescriptive. They soon experience how difficult it is to distance themselves from such notions. However there are useful techniques that allow students to take a conscious position regarding their own perceptual habits and preconceptions. To help them decondition themselves, both the teacher and the student are required to leave their pictorial comfort zone by drawing from multiple points of view (Schaeverbeke, Aarts, Heylighen 2015). In what follows, we will illustrate some practice-based examples of drawing assignments, which aim to extend the language of drawing.

4.1 *Conceiving space – representing space*

The first assignment confronts the student with diverse ways of experiencing and imagining space. Their first confrontation with a space of their choice is devoted exclusively to observation for a period of 20 minutes. Afterwards they are asked to document their observations (picture 2). We purposefully do not tell them how to do this, it is up to them to explore the possibilities, after which the various approaches used are discussed and evaluated. A second exercise is to draw the same space 'blindly' (picture 1), with which we mean that the student is restricted from looking at the paper she is busy drawing on. In this way the eyes explore the space, but cannot control the hand to make it follow the acquired logic of a way of coding that space through, for example, the learnt tricks of spatial organization and perspective. Because they are not allowed to look at the paper they are forced to course exclusively on observation and an intuitive sense of relationships and their logic. The result is thus dependent on the realization that the draughtsman has to let go of preconceived aesthetic schemas and ideas of the correct. Normally when we draw, we are continually checking the actual drawing, to see whether it matches correctly the actual situation. However, correctness is very much determined by the visual schema's we learn from others, rather than from our own observation. When



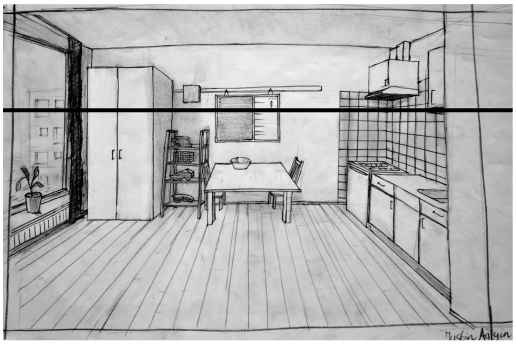
Picture 1 & 2 & 3. From Lisa Moosdorff; resp. two "blind" drawings, drawing from memory after observation, drawing by observation.

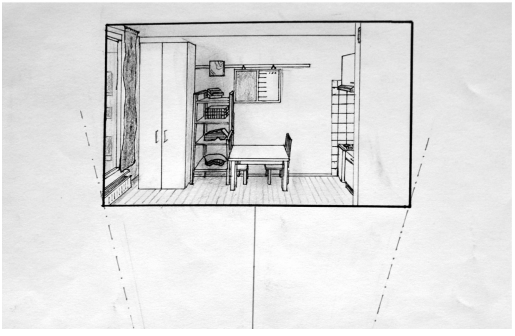
drawing blindly, preconceived order breaks down as the observing eye cannot correct the drawing hand. Order collapses and in the realization the focus of the draughtsman shifts to the pictorial exploration of the hand. One student testified that after a while her hand stopped drawing as soon as she stopped observing.

A third exercise requires the student to draw the space according to the laws of perspective and a fourth is to reconstruct a perspective representation using documentation such as plans, elevations and sections (pictures 4 & 5)

The drawings by Andrea Dolfsma (pictures 6 and 7) show, in her own judgement of them, that the construction in perspective gave her drawing a totally different expression and missed the untidy or messy character of her room, which is more visible in the drawing from memory.

The first assignment shows students that there are widely divergent approaches in the representation of space. This aspect is of course also explored in the later assignments, but the particular exercise, by separating the hand from the eye, dislocates the silent habits and continuities of perception and representation, thereby producing a very different image of the same space, containing very different information about the logic of relations. The phenomenological and Wittgensteinian approach in philosophy similarly look at meaning not in the things themselves, but in their active relations and their use. The 'I', the body and its environment are immersed in a continuous negotiative process in thinking about what to do.



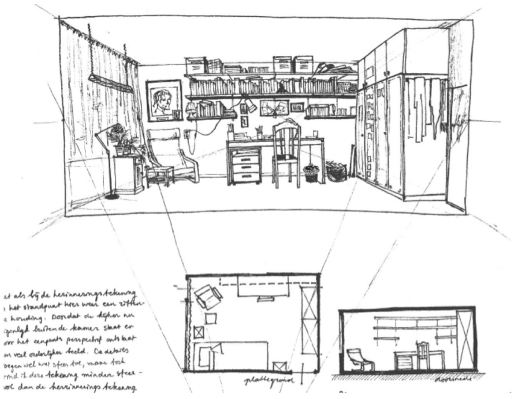


Picture 4 & 5. Justin Agyin; resp., drawing by observation, perspective construction.

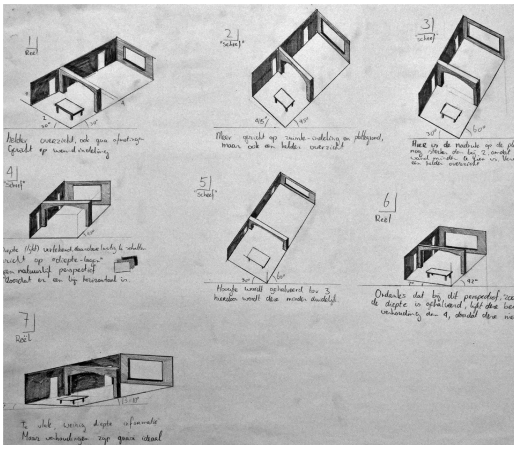


Picture 6. Andrea Dolfsma: drawing from memory.

Once students have learnt to let go of preconceived notions of representation, blind drawings select and relate the information they show on the basis of different criteria, giving us a compelling view of how space is experienced and used. How for instance the staircase is walked (picture 1) by Lisa Moosdorff. In the perspectival drawings made by the same student we see a much more cerebral and constructed approach.

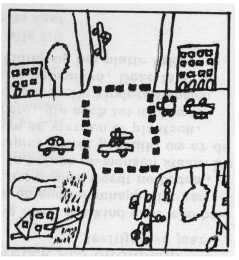
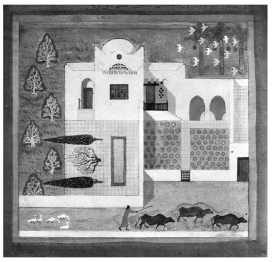


Picture 7. Andrea Dolfsma: drawing with perspective construction.



Picture 8. Student's work; drawing different kinds of (parallel) projections and perspectives.

The contrast between the "blind" drawings and the drawings that have been constructed on the basis of perspectival logic is enormous (pictures 1 & 3). However it is even more remarkable when comparing them to the constructions made from plans, sections and elevations, based as they are on Euclidian or rather Cartesian space (picture 5 & 8). Cartesian space in the work of the mathematician is a conceptual model in which the position of something can be expressed in coordinates using three numbers each representing a point along the X,Y and Z axes respectively, of a continuously calibrated space. In this way the relations between points are expressed in standardized distances, angles and vectors. Examples of representations of such spaces are flat projections, axonometries and converging projections such as perspectival constructions. During the drawing workshop students are introduced to various systems of representation and to get them to try them out and to discuss the way these systems achieve an effect on the beholder of the image (picture 8, 9 & 10).

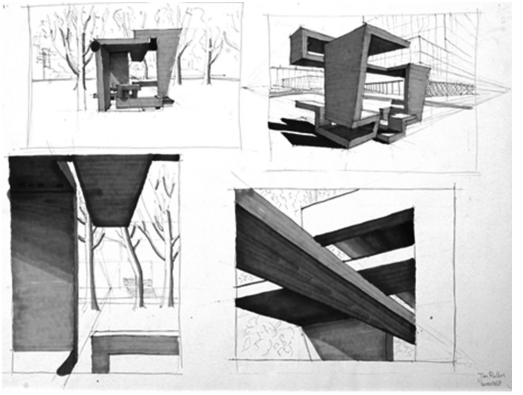
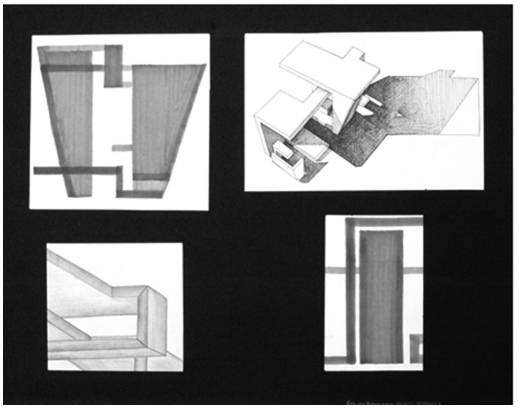



Picture 9 & 10. Resp. child's drawing and Hassan Fathy, Villa Hasan'Abd al-Razik, gouache exhibited in 1973.

Students are given examples of various types of projection, including various forms of perspective and how these systems have been used by artists. In this exercise students' work with a space of their own choice and experiment with as many different kinds of projection as possible, annotating each with a few remarks about the effect the projection has on the object represented.

At the start of the assignment and during the lecture course examples are used to show the many and diverse ways of translating a three-dimensional world to a two-dimensional surface. In each of these approaches the meaning emerges in the way that these various projections have been used. The child's drawing shows how various objects are assembled and represented in a way that makes them recognizable. It is important to strip our approach to such drawings from our educated, adult eyes which have learnt to see the world in a perspectival organizational scheme. Perspective creates a totalizing image in which the logical relations between things is exclusively approached from the point of view of the 'I'. When the perspective is only used as a system, blindly following its "rules" without any connection to the world around us, the outcome is a drawing that has little to do with any reality.

Wilson & Wilson (Wilson and Wilson, 1986) assume that any drawing is not so much a *representation* of reality but is itself a sign. A cloud is a sign and the drawing of a cloud as well as the word 'cloud' are also both signs *to us*. The drawing of the cloud is no more accurate as a representation of the cloud than the word 'cloud'. No language of representation, in word or image is isomorphic to the real world (Peckham, 1967). Wilson and Wilson see learning to draw as the learning of a sign-system, learnt not by observing reality itself, but by imitating the signs used and developed by others. Only after learning the sign-language themselves, do students begin to explore the reason why things are depicted in this or that way and to observe which situation demands certain shapes to be used. Apparently we need models to imitate. An Egyptian image seems comparable to a child's drawing in the way the objects are represented (figure 11 & 12). The objects are shown from the side from which the object can best be recognized as *that* object. The Egyptian image captures nature in a strict elementary way,

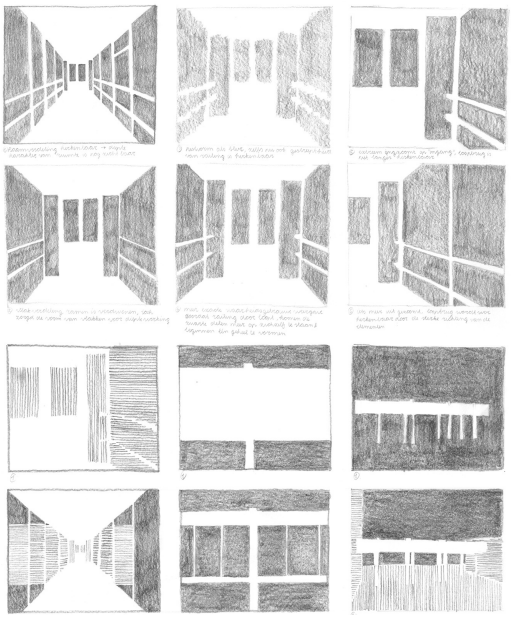
Picture 11 & 12. Student's work; drawing an object which is in front of them, using point of view and framing to manipulate the expression and spatiality of the image.

concentrating on essentials. In Egyptian culture it was important to represent completeness and give clarity as to the identity of the object. The Egyptian architect Hassan Fathy refers to this tradition using the rabattement, the geometry of rotating a plane to align it with another. After the exercise the drawings made by the students are discussed and compared with historical examples.

4.2 *Portraying and Framing*

In the workshops, parallel to one of the lectures on this subject, students investigate how "portraying and framing", one of the titles of the philosophical lectures, influences the atmosphere of the image. They make different studies while they are observing an (architectonic) object and try to analyze the outcome afterwards (pictures 11 & 12).

How does my point of view – a higher or lower point of view-, my angle of vision – close to the object or from a bigger distance and the way I frame the object, influence my image of that object? Those are questions that lead students in their research, making drawings that can be compared. How do we, the observers of the drawings, "read" the images? What

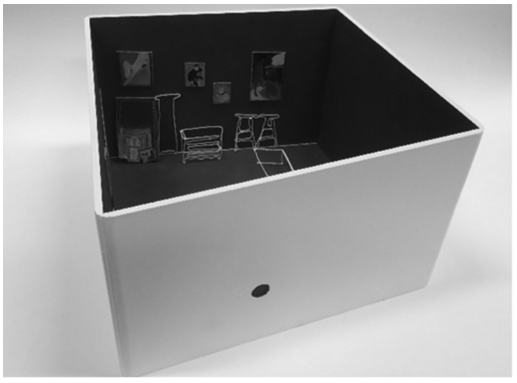


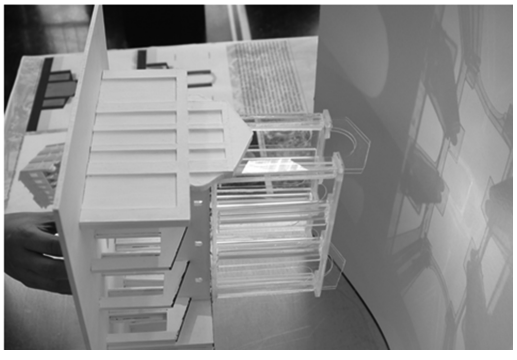
Picture 13. Simone Creemers, some of her studies exploring the spatial effect by not drawing the object, but only the surrounding space.

is it the other person observes? Here we enter the world of visual literacy. Glenda C. Rakes, professor of instructional design and technology, defines visual literacy as the ability to accurately assign meaning to visual images, combined with the ability to create and communicate with such images (Rakes, 1999). Visual literacy implies that images and drawings represent a language or a symbol system on their own. Visual literacy implies that pictures can be "read" and that meaning could be communicating through a process of reading them. (Kress, Van Leeuwen, 1996).

4.3 *Form and residual form*

Usually when a student is asked to make a drawing of an (architectural) object, he/she is focused on representing the object, very often without drawing the surrounding space, or framing the image, which itself creates a space around the object, be it undefined (picture 13). The intention of this assignment is to create awareness that the space surrounding an object is as important as the object itself. Students are asked to draw the object without drawing it, but rather concentrating on the surrounding space. Students thus learn to play with the role of hierarchy, questioning what determines a space, the object or the surrounding or negative space. Negative space is an established exercise within art drawing courses. It is often linked to a Buddhist's awareness for the non-material and negation (Maslen M. and Southern J. 2011, Edwards B. 1989). Negative space establishes a relation between a form and its background. The change of focus forces the draughtsman to study the interaction between form and space, between subject





Picture 14 & 15. Students work for the seminar 2015. Resp. Hein A., Hillenius T., de Rooij W & Meeuse M., Nuijten B., Wijers C.

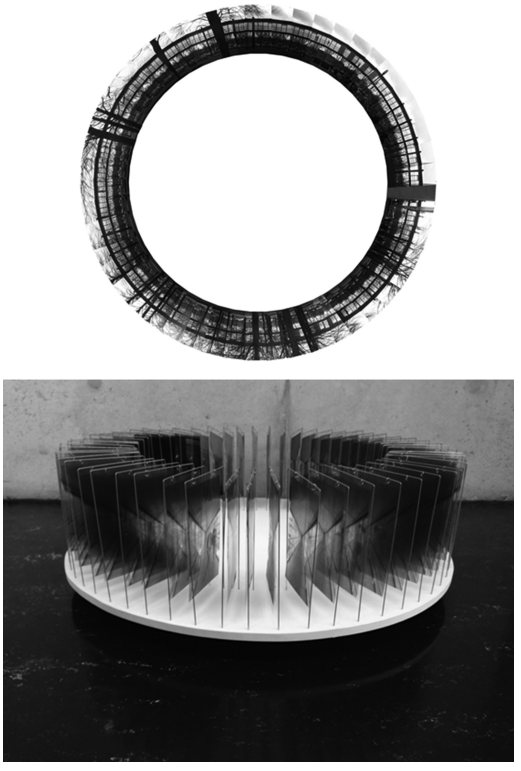
and its surroundings. Within this exercise an object is studied not by drawing the thing in itself, but by building its contours from the surrounding space (figure 13). This exercise avoids our inclination to start drawing lines with the lines functioning as a boundary between objects and the space around them. Drawing negative space breaks with one's perceptual habits. (Schaeverbeke, Aarts, Heylighen, 2015).

5 THE SEMINAR

In the seminar the workshops and lecture courses link up explicitly. The students are asked to analyze, critique and creatively explore a particular instance of space or spatial representation. The first year it was a two-dimensional pictorial representation of space (an art work such as a painting, a print or a drawing), which needed to be transformed by adding a dimension (Pictures 14 & 15).

Picture 14 shows a 3 dimensional object made after The Red Studio from Henri Matisse, 1911 and picture 15 shows an extension of the Church San Ignacio made in Perspex and projected as a shadow on a rounded surface. This was made after Andrea del Pozzo's painting, the Triumph of St Ignatius on the ceiling of the San Ignacio Church in 1680.

This year students were asked to choose a specific space they wanted to investigate and which could at



Picture 16 & 17. Students work for the seminar 2016. Hemesath J., Creemers, S., Kromhout W. The 3 dimensional object (left) representing the 'He' perspective as seen from outside the bridge and the 2 dimensional work (right) representing the 'I' perspective, as seen from the inside of the bridge.

the same time be used for the drawing workshops. The experience they acquired here helped them investigate the meaning of the concepts of space dealt with during the lecture course and by transforming the space with the help of those concepts using an established work of art as a point of departure. One group of students chose one of the bridges connecting the first floors of each building on our campus. The group researched the historical background of these bridges, investigated descriptions of the space in words and in images, the function of the space and observed how people behave there while looking at the light and temperature and contingent circumstances. They noticed a difference between the strict organization of the space, with the strict rhythms of its mullions and vertical tie rods, and the movement of people through the space, shifting from moment to moment. The contrast illustrated the difference between Gilles Deleuze's "striated" and "smooth" space, a concept that featured during the lectures (Deleuze 1987). They also observed how the bridge changes from an 'I' perspective, walking through the bridge, to a 'he' perspective, observing someone walking through the bridge from afar. Seen from the inside the strict articulation of the structure and the windows gives a feeling of indeterminate infinity from a single point perspective. Seen from the outside, the bridge looks like a long horizontal beam hanging in the open air. Their inspiration was the work of the Dutch artist Jan Dibbets, who uses photographs of spatial elements to encourage people to think about our spatial observation. In the end the group made two objects, one was a set of photographs composed in a flat circle –representing the observation as seen from "he", the other object was a set of separate photographs hanging in vertical frames, arranged on a circle which could turn around, representing the observational position of the 'I' viewpoint (Pictures 16 & 17). Within those two models the students brought together all the aspects they mentioned as specific for this space.

6 CONCLUSIONS

One of the main questions for the educational part of this conference is: "Which didactic principles best prepare students to take a well-argued position to face future societal challenges?" Of course we don't have any idea what the future will bring, but perhaps one of the most important future societal challenges will be dealing with the globalization and increasing complexity of the world. This requires a multivariate point of view, based on a well-grounded understanding of our own ways of understanding spatial relationships and their representation. It is necessary to understand and become aware of what your own position is regarding the things about you and what determines those relationships: "What is my personal viewpoint from where I start observing the world, how does it work, where does it come from and what are the viewpoints of the people surrounding me?" In a global complex world students need to have the capacity to consciously and carefully analyse and transform their own point of view so as to make them at least compatible to those of other people they have to cooperate and collaborate with. We have to at least be able to consciously step out of the shadow of the 'I' perspective, developed during 15th century to see how a view of the world is a philosophical construction showing how theory and practice are in fact intimately and inextricably linked.

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Displacements and notes on searching the architecture of the placeless

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ABSTRACT: Today, we are witnessing an enormous number of people displaced worldwide ever recorded. From the vast migration of refugees to expulsions due to economic, political, and climatic reasons, from students to transnationalist capitalist class moving across territories constantly, we have become nomadic subjects living in the age of temporary or permanent displacements. This constant condition of displacements causes a state of placelessness, conceptually if not only physically. What is the architecture of placeless and how can it be addressed within the realm of architectural education? This paper does not aim to find solutions to the global phenomenon of displacements but rather demonstrates the necessity of framing new questions addressing the spatial dimensions of this immense condition. In this regard, it introduces three lenses as a background for new didactics in architectural education: the territorialization/de-territorialization of the nomadic human subject, site/non-site condition, and concurrences of temporalities and permanencies of (infra)structures.

1 INTRODUCTION

"By the end of 2014, 59,5 million individuals were forcibly displaced worldwide as a result of persecution, conflict, generalized violence, or human rights violations," reported the United Nations High Commission on Refugees (UNHCR) Mid Year Trends 2015 document. This amount perhaps exceeded 60 million so far, reaching the highest level of worldwide displacement ever recorded. This number in fact does not cover number of people displaced due to the large-scale land acquisitions, financial manipulation, catastrophic climate change, etc. as Saskia Sassen (2014) highlights. When all these causes are considered, number of forcibly displaced people worldwide shows the primacy of this global phenomenon. According to Sassen (2014), the issue can broadly be understood as a type of expulsion where "people, enterprises, and places [are] expelled from the core social and economic orders of our time." She argues that today's global capitalism triggers expulsions in contrast with Keynesian Welfare State, which was based on incorporating individuals within mass production and consumption cycle (Sassen, 2014). Globalization and its economic organization also provoke other forms of displacements where workers, students, transnationalist capitalist class – temporarily or permanently – move across territories. All these different forms of displacements of people, norms, and milieus resulted in a state of placelessness where home is neither the country of origin, nor the migrated land. According to urban sociologist Walter Siebel, we are anyway placeless since urban lifestyle or urbanity as a way of life is not tied to a particular place (Upmeyer, 2015).

Displacement of people has been for long an issue in many parts of the world, which, however, has become central to the debates in Europe within the last few years due to the direct effect of the consequences of the Syrian war. Unfortunately, the discussion on the recent "refugee crisis" is limited to providing temporary accommodation for the new comers. This is a very narrow point of view, not only because other modes of displacements are ignored but also due to the (un)conscious misreading of the refugees' legal, political, and social status. Designing refugee camps and temporary structures address a very small part of the "problem" when the overall picture is reviewed. For instance, there are now 2,5 million Syrian refugees registered in Turkey, among whom only around 280 thousand are leaving in the camps. In other words, more than 85 percent of the refugees are living in cities, mostly in the ones closer to the border or in the big cities like Istanbul. Hence, neither the refugees' situation can be considered temporary, nor the issue can be reduced to the problem of building temporary accommodation.

Against this background, the current modes of displacements and the state of placelessness have not yet fully been addressed in the field of architecture except some design studios and organizations (such as What Design Can Do Refugee Challenge), which problematize prefabricated shelters as the zero point of architecture. In fact, similar approaches were developed during the catastrophic World War II period. From Le Corbusier's "Flying Schools" proposals to Buckminster Fuller's "Dymaxion Deployment Unit", from Walter Gropius and Konrad Wachsmann's "The Packaged House System" to Ernö Goldfinger's "Holiday and Evacuation Camp for Families," many architects searched design strategies, structural systems, and materials for fast and easily built prefabricated constructions (Jean-Louis Cohen, 2011). The difference today is that developed countries see design as the ultimate way to deal with the "problem"

of displacements. Fortunately, new voices are rising regarding the limitations of these approaches within the field of architecture. Very recently, Ruben Pater (2016), the Netherlands based designer and researcher, criticized positioning design as the principal tool for solving the refugee problem – which is "political and socio-economic at heart" – and for legitimizing "a state of permanent temporary living" while the problem demands more permanent solutions. Similarly, Wouter Vanstiphout and Michelle Provoost (2016), in their article titled "A City of Comings and Goings", argue that instead of providing temporary shelters, cities have to be designed more flexibly to accommodate mobility of people.

Hence, the issue of displacements is also of importance not only in regard to the current intensity of migration patterns but also in addressing future migrations, which might be caused by many other reasons such as environmental and climatic changes. For instance, just recently the head of the task force in Iran published a report regarding a critical shortage of water source in Iran, announcing the fact that in forty years most part of the Iranian plateau might become with no possibility of habitation if the reduction in water source continues with the same speed. We are aware of the fact that architects do not hold powers to intervene in the mechanisms of these global phenomena. Moreover, many think that "the socially minded architecture is a choice not a moral responsibility" as also introduced by the Chilean architect Alejandro Aravena, the curator of the Venice Architecture Biennale of 2016.

However, we still do believe that architects are important social agents that could reflect on the spatial dimensions of these complex situations. In this regard, schools of architectures are the first places where critical insights towards displacements and the realm of placelessness have to be developed. To do so, the pedagogical models, which integrate research and design, should be emphasized. Thus, instead of approaching design pragmatically as a problem solving task and research as fact-finding and data analysis, current societal challenges should be addressed through a rigorous conceptualization of the phenomena. Architectural design education today still relies on conventional definitions of design problems where site, user, and program are considered as predefined fixed design entrees. However, the current mass displacements show that architectural design and research cannot get these dimensions as granted anymore and should re-examine their transient nature. This paper thematizes three entrée points – human subject, site of intervention, and time dimension – hoping to generate a debate for re-approaching the conventions of architectural design in relation to research.

2 PLACELESS STATE OF THE HUMAN SUBJECT

It has been posed several times by various philosophers, theorists, and critics that nomadism is a recurrent state of human subjects. Rejecting the modernist notion of a unified, homogeneous, rational, and expressive subject, postmodern philosophers such as Gilles Deleuze & Félix Guattari (1987) attempted to frame possible emergence of new decentralized subjects liberated from fixed identities. In this way, they anticipate new modes of existences emerged and shaped in the constant process of becoming and transformation as expressed through the concept of nomadology, or in the process of de-territorialization as Deleuze puts it. On the other hand, architectural theoretician Stephen Cairns (2004) claims that the status of migrants falls into a different sort of nomadism since their aspirations are oriented towards stability and settlement. In other words, it embodies both the processes of de-territorialization and re-territorialization. It is in this act of constant movement and displacements – this space in-between – that the state of human subjects is defined. For instance, pastoral nomads strengthen their status through displacements while refugees or asylum seekers lose their legal status due to migration, which sometimes even result in statelessness. According to United Nations (UN) there are more than ten million people in the world who fall into the category of statelessness, which means not having nationality or citizenship.

Through the processes of displacements, a discrepancy between human subjects and their politico-juridical status might occur, which can lead to a state of exception and exclusion. This is what the Italian philosopher Giorgio Agamben (1998) explains in the life of *Homo Sacer* (sacred man), a subject of Roman law who "presents the originary figure of life taken into the sovereign ban and preserves the memory of the originary exclusion through which the political dimension was first constituted." Under Roman law, *Homo Sacer* was someone who committed certain kind of crime and, as a punishment, excluded from the civil rights, which means "he may be killed but not scarified." And it is in this state of exception as the "no-man's-land between public law and political fact, and between the juridical order and life" where the human subjects become placeless, conceptually if not physically (Agamben, 2005). In short, placelessness might be a result of different mechanisms of nomadism, process of de-territorialization and re-territorialization, state of exclusion, etc. Hence, architecture of displacements should address the placeless state of its human subject. We ask then how architectural design can address placeless subject rather than a predetermined and fixed user?

3 SITE/NON-SITE

Placelessness is not only limited to the human subjects but also it is about elements of architecture transposed for place-making strategies elsewhere. Copying and imitating authentic places are some of the strategies used in architecture to deal with global phenomenon of displacements. For instance, Gaoqiao, a Holland Town

built in Pudong area in Shanghai shows how traditional Dutch buildings and cityscapes were imitated in China to establish a Dutch Village miles away. On the other hand, there are utopian architectural approaches, which abandon any reference to physical place. For instance, avant-garde architectural group Archigram developed hypothetical projects in the 1960s where buildings or even cities become machines moving along indeterminate places. In their Walking City project, city was interpreted as an insect like giant robotic object that could move wherever in the world with its nomadic citizens. In the Instant City, the project does not even touch the ground since an airship carries balloons containing educational and cultural facilities and drop them from air onto remote areas to cultivate a metropolitan life there. So, in addressing displacements of people and their living environments we see on the one hand an attempt of artificial place making and on the other hand complete abandoning of place as a reference.

Alternatively, there are approaches, which are addressing the transition between site and non-site. Artist Robert Smithson developed several non-site projects in 1968. He represented actual sites in New Jersey in indoor gallery spaces by moving the land into containers and transforming them into abstract artworks. In his "Provisional Theory of Non-Sites" Smithson (1996) stated, "…one site can represent another site which does not resemble it – this *The Non-Site.*" Hence, site is displaced without imitation. There is a space in between the actual site and its representation, which has a "metaphoric significance" that can be traveled. Smithson (1996) stated: "Everything between the two sites could become physical metaphorical material devoid of natural meanings and realistic assumptions. Let us say that one goes on a fictitious trip if one decides to go to the site of the *Non-Site*. The 'trip' becomes invented, devised, and artificial; therefore, one might call it a non-trip to a site from a Non-site." It is actually this space in between that nomadic human subject travels constantly and it is the non-site, the abstract representation of the site, where architectural intervention takes place. In this regard, the conventional understanding of site in architecture as an empty lot awaiting architectural intervention has to be questioned. Martin Hogue (2004), in his article "The Site as a Project" proposed an understanding of site not as an a priori given in architectural design but as a project constructed, invented, and made through architecture. The architecture of the placeless is therefore about a critical projection of non-sites on sites. How can then the non-sites be designed to address the displacements spatially?

4 TEMPORALITY AND PERMANENCE

Non-sites are used to be understood as temporary locations of inhabitation. In fact, an average stay even in a refugee camp, which is thought to be the most temporary place to host displaced people, is 17 years: almost one generation! In addition, repatriation can only be accomplished as a result of complex set of advancements in the place of origin in environmental, economic, social, and political terms. As stated in United Nations High Commission on Refugees' Global Appeal 2015 Report "UNHCR helps achieve durable solutions for refugees and internally displaced people (IDPs) around the world every year. But for several million refugees in protracted situations and a greater number of IDPs, durable solutions remain elusive." If more general condition of displacements is considered, constant movement of nomadic subjects – the spaces in-between – embody temporality, which lead to the establishment of normality or permanence constituted out of exception. This dichotomy of temporality versus permanency could be approached spatially in various ways. It's either been visited through the lens of infrastructure versus architecture. Infrastructures are often referring to a state of relative permanency, both concerning their territorial aspect and capital used for their constructions. For example, after the WWII, many German bunkers built during the war remained abandoned along the coast of France, which were beautifully illustrated later by cultural theorist Paul Virilio (1997) in his book *Bunker Archeology*. Losing their original context, these bunkers from the Atlantic Wall have become permanent objects in the landscape. Although ignored, these infrastructural elements continue to exist as the marker of permanencies.

Regarding the temporality of a camp, the permanency of infrastructure is often understood as being conflictual. In camps, infrastructures often operate as plug-in to the existing networks within their environments rather than constructing the space 'infra'. (i.e. the space beneath or below as an underlying layer supporting built environments) Furthermore, the binary of 'temporality versus permanency' can be looked through the lens of materiality. We can argue that in a camp, the architecture of which is almost absent, the presence of a certain material can rule the state of temporality or permanency. In an article titled "Assembling and Spilling-over," Nasser Anourahme (2015) raises an intricate discourse against this separation between the temporal and the permanent or as he calls it the contradiction between "symbolic-political" and "material-lived". By referring to a Palestinian camp, Anourahme (2015) argues that it has become extremely clear that the refugees would need to "negotiate an impasse between the political imperative to return (and thus remain temporary) and the material exigencies of life and the need, essentially, to build." (Fig. 1) Hence, what is negotiated is again this space in-between and in this case it is the material – cement – that mediates. Anourahme (2015) stated:

Cement, as both aesthetic and thing, mediates camp life in entirely unintended ways, breaching topological boundaries, spilling quotidian life–in all its uncategorized mess–into the political, and generating tension between the temporary and the permanent, return and

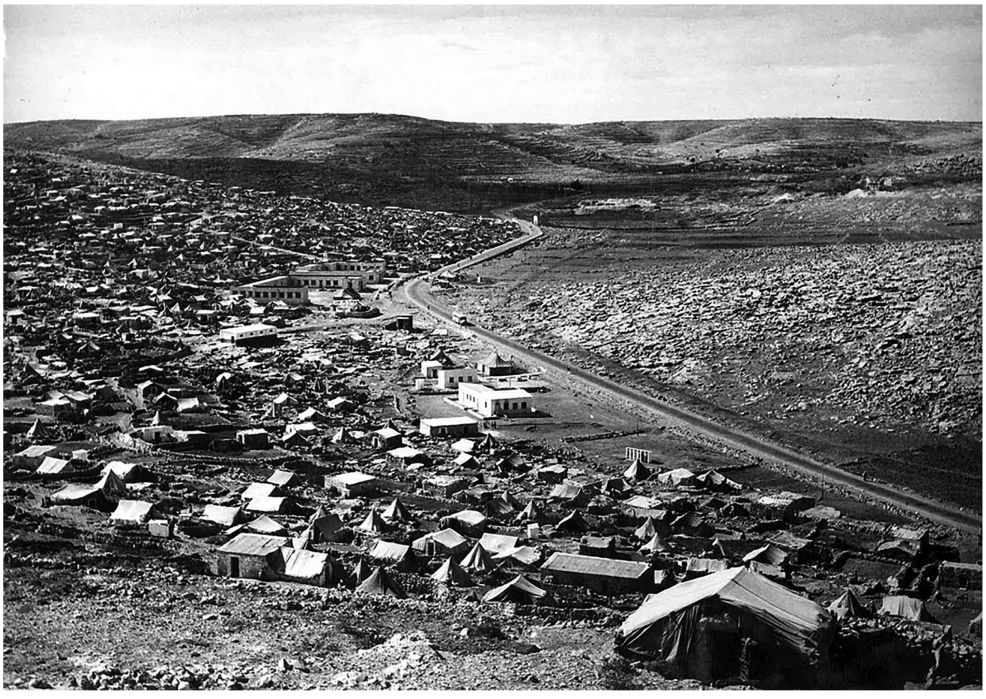


Figure 1. Deheishe Camp, Palestine, 1952. Courtesy of Ibdaa Cultural Center.

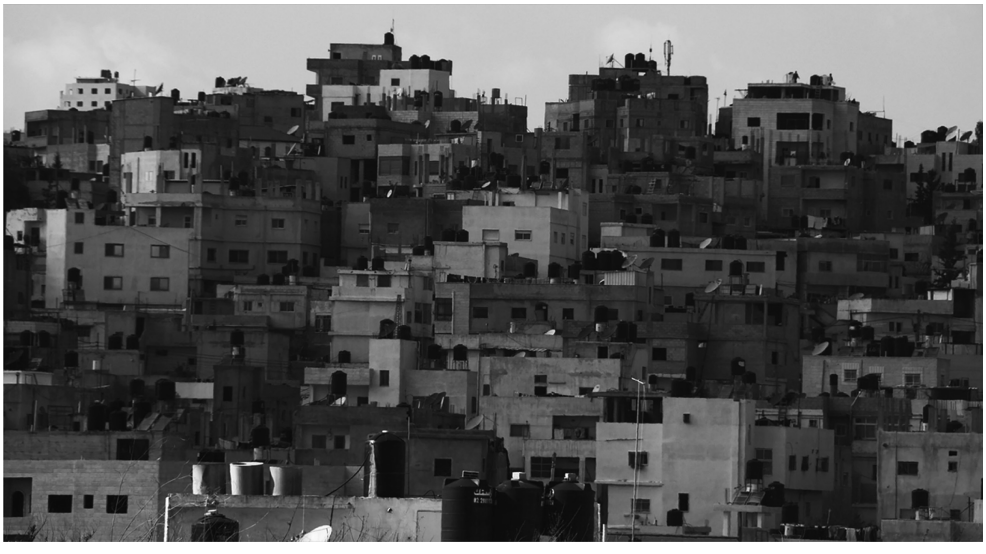


Figure 2. Deheishe Camp, Palestine, 2011. Photo by Nasser Abourahme.

the built. It is precisely in these tensions that refugee subjectivity takes shape; never simply as the directed actions of sovereign actors, but always as an everyday 'negotiation' of the in-between space of the spillover.

In the case of Deheishe Refugee Camp in Palestine (1949) located at the southern city of Bethlehem, the improved access to affordable cement in 1970 allowed for the expansion of housing and building beyond the boundary of the camp. (Fig. 2) The transition between changing materials is tightly related to the shift in political attitudes towards the idea of camp. As it is depicted beautifully in a passage of Khoury's novel, it is exactly this replacement between a zinc roof to a concrete one which constitutes this narrow space in-between temporality and permanency. Khoury wrote (quoted by Anourahme, 2015):

From the tent to the concrete room roofed with canvas, to the corrugated iron roof, to the 'roof of the

revolution'—-she had to wait twenty years until '68 to get a concrete roof. The concrete roof came with the revolution and the Fedayeen [freedom fighters].

Hence, it is the cement, which constitutes the relation between the political economy and power relations (as representation) and the built camp (as production), while the infrastructure operates as a posteriori, which plugs into the existing network. (i.e. the electricity network, sewage and clean water, roads and etc.) How the architecture of the placeless can be designed to embody the concurrences of both the temporalities and permanencies?

5 CONCLUSION

"What is the new role of an architect?" In fact, this question has never been posed as much as today within the scene of architectural debate concerning societal challenges. Besides lingering about the correctness of such a question, we might wonder if architects too have been partaking in the process of expulsion as argued by Sassen. In other words, the shift that has been occurring since the 1980s from Keynesian Welfare State to global capitalism also affected architects' role in relation to society. Does this mean that architects are disempowered actors within the mechanisms of globalization? Perhaps the call for the Architecture Venice Biennale 2016 by its curator Alejandro Aravena is an inviting alarm for a "battle field" in order to "improve the quality of life while working on the margins, under tough circumstances, facing pressing challenges." Therefore, for our concern, the question is how the architectural education not only participates but also engenders debates, questions, and interventions?

As it comes out from the paper, when the topic of displacements is considered, three main questions need to be examined carefully: How architectural design can serve to placeless subject rather than a predetermined and fixed user, how the non-sites can be designed to address the displacements spatially, and how the architecture of the placeless can be designed to embody the concurrences of both the temporalities and permanencies? In other words, to approach the architecture of displacements, it is not possible to be confined to the conventions of site, program and user as departure points of design intervention and research. Rather, there is this space in-between territorialization / de-territorialization of human subject, site/non-site, and permanence / temporality, when thematized critically, might provide new didactic tools for architectural design, education, and research.

We do think that *Chaharbagh* (The Persian Garden) is perhaps an intriguing promised space, which could work as a model with its capacity to negotiate with the space in-between territorialization / de-territorialization, site / non-site, and permanence / temporality. (Fig. 3) *Chaharbagh* is a place where the nomadic life meets the idea of inhabitation. Here the territorial movement of the nomad is folded within the architecture of the garden. The architecture of the garden becomes a tool for forming the life by delineating a piece of land. Eventually, it protects [the life] through separating the inhabited land from desert by means of a wall. It is interesting to note that in Farsi desert comes as *Biaban*, which literally means without water. Through the activation of infrastructures, the garden provides a permanent habitation where nomads can constantly move within its boundaries during the change of seasons. The garden reveals the hidden water resources by means of underground water infrastructures (*Qanat*). It manages the life through the organization of topography and plantations based on the grid of water channels and pools. In the end, *Chaharbagh* negotiates between the actual and virtual, the space of desert and paradise, and between architecture and territory.

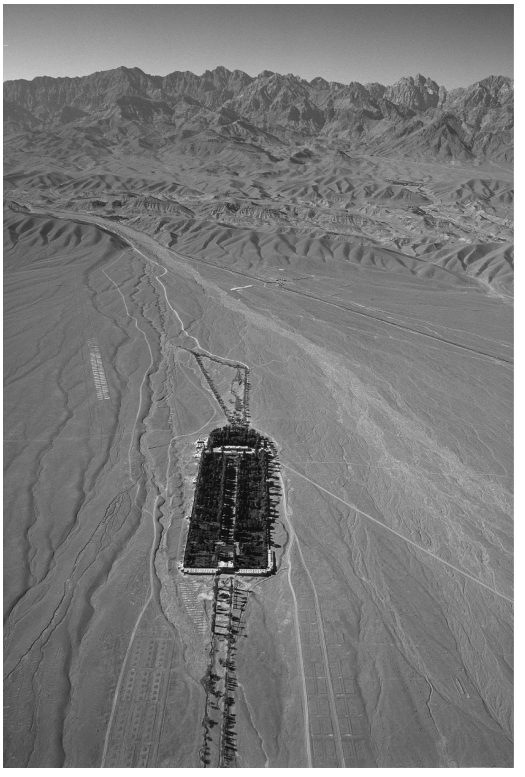


Figure 3. Bagh-e Shahzadeh, Iran, 1977. Photo by Georg Gerster.

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Architecture as interface: A constructive method for spatial articulation in architectural education

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ABSTRACT: This paper proposes a discussion of the problems with the conventional design process having representation as paradigm and argues for an alternative process based on architecture as interface. It then presents a design course proposed for twelve students at the School of Architecture, Universidade Federal de Minas Gerais, Brazil. The students were required to create a constructive method for spatial articulation to be used by different groups of people to produce spaces suitable for their wishes and contexts. The main discussion concerned the possibility of architecture as interface (process) instead of finished space (product), in which the role of architects is no longer that of controllers of a finished form but that of designers of interfaces with which people are able to engage in the production of their own spaces.

1 THE DESIGN PROCESS IN CONTEXT: FROM THE PARADIGM OF REPRESENTATION TO DESIGNING INTERFACES

Architecture students are socialised in their field by reproducing that which Pierre Bourdieu (1990) calls *habitus*. Architectural *habitus* might be described according to Reyner Banham (1999) as the reproduction of unsaid and unquestioned prescriptions, a black box that determines a *modo architectorum*. In the case of architectural education, Banham's critique applies to 'some secret value-system' that determines what architecture is, drawing it in 'the right style' (Banham, 1999). The main problem is that it is in schools that 'architects are socialised into the profession ... acquiring attitudes, work-habits and values that will stay with them for life' (Banham, 1999). In other words, architecture students reproduce the *modo architectorum*, which is nothing more than 'the making of drawings for buildings in the manner practised [sic] in Europe since the Renaissance' (Banham, 1999). This implies the division of labour, in which the architect is responsible for the conceived (abstract) space and builders and users responsible for the lived (concrete) space (Lefebvre, 1991). Architectural design is understood as merely conceived space and taught as a set of codes that aim to develop competences and skills to use drawings as means to represent and play with known solutions to problems. Bryan Lawson (2005) describes such a drawing practice as the puzzle trap, which reinforces the tradition of representation and formalism. Such a process praises the final appearance of buildings, separating design conception from building and use.

Looking back to a brief history of architectural representation it is no difficult to understand its main problems. Alberto Pérez-Gómez (1994) points out the importance of depth as the first dimension until perspective became a paradigm. With the perspectival paradigm length and width made depth become merely one among the three dimensions. The process of representation, then, reduces the three-dimensional object to a two-dimensional medium. In the case of representation of architecture, it is not just about presenting a three-dimensional object by means of a two-dimensional medium. The gap between architecture and its two-dimensional representation is not just of one dimension. We cannot take architecture as a three-dimensional object; we can be certain of at least two more dimensions – time and behavior – and, therefore, perspectival representation is three dimensions behind architecture (Baltazar, 2012).

Moreover, the problem of representation resides not only in its reductionist character but in its procedure. Olkowski says that 'the system of representation, whether in the realm of philosophy, psychology, social and political theory, ethics, or aesthetics, operates by establishing a fixed standard as the norm or the model' (Olkowski, 1999). Architectural drawings are no different. Although the devices used enable architects to freely draw whatever they wish, architectural drawings are not as free as the devices enable them to be. They reproduce the *modo architectorum*. On one hand there is a clear standard for technical drawings as the norm to be reproduced, which has not changed much. For instance, the plan drawings of Palladio or Durand are easily understood today as technical architectural drawings. On the other hand is a more inventive tradition of architectural drawings which, though not explicitly agreed, defines a sort of code. For instance, many architects today use collage in their drawings perhaps inspired by Archigram; others have as their models Zaha Hadid, Lebbeus Woods or other precursors of a certain kind of architectural drawing; a few

also try to establish their own style of architectural drawings. Because of the establishment of a standard to be followed, these drawings are recognised and accepted by the current *modo architectorum*.

The main problem with such modes is that they are not valid for minorities, as 'the very meaning of minority is associated with falling below the standard of that norm, failing to represent that standard in all its perfection and completeness' (Olkowski, 1999). Nevertheless, as de Certeau (1984) argues, contemporary society is made up of minorities, which he calls 'universal marginality'. He says that marginality is becoming universal, though the group or society composed by this universality is not homogeneous. In this view, what was before based on averages is now permeated by differences. Once the majority is composed of marginalities, it is no longer possible to represent the majority, as representation implies a homogeneous standard. So Olkowski's argument that the 'ruin of representation' is 'the ruin of hierarchically ordered time and space' (Olkowski, 1999) can be extended to most practices, including the design of buildings. A design process based on fixed norms of representation might therefore be replaced by a non-predictive, non-prefigurative, non-normative design process.

Olkowski (1999) links the ruin of representation to the practice of 'difference'. She stresses that difference is not the mere fact of being different, being part of a minority group, but a practice. She criticises the definition of 'individual' by generalisations in which any member of a minority is unrepresented and thus excluded. This definition presupposes equality rather than difference and fixes the nature of the individual. Even in a society that defines human beings primarily according to their sex, nobody would claim that all men or all women are the same. She draws from Gilles Deleuze's idea that representation, the dominant way of seeing and thinking in the west, 'has been constituted . . . in terms of the Aristotelian framework' (Olkowski, 1999) which implies the inscription of all difference in a general concept, as 'Aristotle is completely unwilling to count as differences those differences that . . . do not begin with something in common.' (Olkowski, 1999). This common ground of difference is similar to the standard of representation, based on the generalisation and crystallisation of what is otherwise particular and in movement.

The practice of difference proposed by Olkowski, brought about by difference itself, can be seen in a new inventive process which does not reproduce a fashionable standardised kind of drawing or even intend to establish a new standard. This new practice will have value not because it differs from others, but because it fits the intrinsic conditions of the project; it emerges from the project, and not from other drawings. We can think of difference in the architectural design process without attaching it to different styles of the same standard of representation, its current basis. As Olkowski states, difference is in fact a practice. Such a practice of difference presupposes the ruin of representation and points towards designing interfaces rather than finished spaces.

The ruin of representation, though, does not presupposes give up representation all together. Representation 'is a valuable tool and should not be excluded from the production of architecture as interface, but it should be seen as a tool, not a paradigm' (Baltazar, 2012). In other words, one needs to be careful not to conclude that representation is to be replaced by interfaces. The conventional representation-based process and the architecture-as-interface approach do not belong to the same logic and are not analogous. As I have written somewhere else:

> While the conventional design process is based on defining and solving problems, the architecture-as-interface approach aims at problematising situations, leaving it open for users to give continuity. There is no clear separation between design, construction and use, but the proposition of an interactive repertoire, which can either be a combination of physical, digital or hybrid parts, or a set of rules. The process of production of interfaces obviously uses drawings, but there is a shift in representation from its central, paradigmatic role and an emphasis on interactivity. (Baltazar, 2012)

The design of interfaces might be guided by that which Cedric Price (1996) calls 'value-free architecture', i.e., a structure with no meaning prior to users completing it temporarily. In other words, a structure which is carefully designed in order to enable users to decide the final spatial organisation. In this case representation is no longer inscribed in the building predefining its meanings. On the other hand, the design of interfaces might also let go of the European Renaissance manner of designing that gives continuity to the current *modo architectorum*. In this case representation is no longer that which Sérgio Ferro (2006) calls an instrument of domination, division of labour, and separation between design, building and use.

In order to develop further what is meant by architecture-as-interface, I draw from John Chris Jones, Vilém Flusser, Ivan Illich and Siegfried Zielinski (Baltazar, 2009). From Jones it is important to learn his proposal of designing designing (Jones, 1991), which started to be developed in his 1980s version of *Design Methods* (Jones, 1992). He proposed that modules, such as words, bricks and playing cards, 'is perhaps THE way of designing independently of any exact knowledge of aims, purposes, functions (the things which, in designing, as we've known it, get fixed at the start)' (Jones, 1992). In order to design the design process—designing designing—Jones emphasises process-orientated over product-orientated design, separating the logic of objects from the logic of use, focusing on the former. At first it might sound incoherent not to focus on use, as the aim is to enhance possibilities of use. However, if one is willing to open their designs for unanticipated uses one must not predict uses (design people's experience) but design objects for people experience.

So, one 'should look at the objects themselves and their intrinsic character in the context of open processes, designing modules as interfaces for people to keep on designing their worlds' (Baltazar, 2009). So, an interface, in the sense proposed here, must be object-orientated.

It is not enough to focus on the design of modules, which is a limited kind on interface, without making them dialogical and open to unanticipated uses. For Flusser (1999) every design is an object of use which is in itself an obstacle designed to remove a previous obstacle. 'And if this "object of use" is not to become a greater problem, it must be dialogical, intersubjective, proposing continuity and obstructing as little as possible those coming after us' (Baltazar, 2009). Flusser (1999) calls this 'responsible design', the one that responds to others. The main challenge is to escape from designing objects of use that obstacularises instead of opening possibilities for people. The concept of 'post-historical structure' (Flusser, 2002) is very useful to cope with this challenge. For him, we are now living in a post-historical world, 'in the midst of images that order concepts (in 'structure')' (Flusser, 2002). This is radically different from pre-history (the mythic world of images) and history (the world of linear conception). However, we are still designing our post-historical world with old tools: we base most of our designs on representation predicting their final appearances in a pre-historical manner (starting from the present towards a predictable future), or using representation to organise the uses of space in a historical manner (investigating past uses and crystallising a present possibility of use). We are not usually designing responsible 'structures' in a post-historical manner, open for those coming after us, as proposes Flusser (1999). The design of structures with open possibilities of organisation also defines interfaces as proposed here.

Illich (1973), on his side, adds to the discussion of object-orientated design and responsible structures, by proposing tools for conviviality. He is worried about how people will interact with each other and with the world considering that the tools used for that 'are never neutral but consistent with a certain mode of production and its corresponding social formation' (Kapp, Baltazar and Morado, 2008). The capitalist mode of production, which dominates Western culture, finds a prolific way to reproduce the social relations of production by means of the production of space (Lefebvre, 1976). Thus, the production of space is implicitly related to the reproduction of capitalism and its unfair distribution of wealth. In order to escape such a relation one should move beyond merely changing the ownership of the means of production (promoted by classical Marxism) and change its very constitution. For that Illich opposes industrial (manipulatory) tools with convivial tools.

> Convivial tools are those which give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her vision. Industrial [manipulatory] tools deny this possibility to those who use them and they allow their designers to determine the meaning and expectations of others. Most tools today cannot be used in a convivial fashion. (Illich, 1973)

Illich does not define how to design convivial tools, but indicates that one should avoid 'overprogramming' and should also 'simplify the tools' in order to 'enable the layman to shape his immediate environment to his taste' (Illich, 1973). So, the convivial constitution of the interface, as opposed to the manipulatory industrial constitution, is also a feature to bare in mind.

Moreover, for Zielinski (2000) 'an interface is something that separates and connects at the same time'. It works as a mediator without the presence of who designed it and without determining even the nature of the mediation it enables (separation or connection). It is a structure that depends on interaction to temporarily define spatial organisation. So, an interface in the sense proposed here is also a structure that mediates the organisation of spaces without determining them.

Drawing from such a discussion of interface and the design process that might give rise to it, a design course was proposed for twelve students at the School of Architecture, Universidade Federal de Minas Gerais, Brazil. The students were required to create a constructive method for spatial articulation to be used by different groups of people to produce spaces suitable for their wishes and contexts. The main drive for that was Segal Method (Mckean, 1989; Segal, n.d.), which is not a constructive system, but a method for self-production with which a single person or a couple of people are able to design and build a two stored house with materials found in a DIY shop. The main discussion concerned the possibility of architecture as interface (process) instead of finished space (product), in which the role of architects is no longer that of controllers of a finished form but that of designers of interfaces with which people are able to engage in the production of their own spaces.

2 EDUCATING ARCHITECTS AS INTERFACE DESIGNERS

2.1 *From didactics to mathetics*

Before discussing the structure proposed for the course I will introduce the pedagogical approach, based on mathetics (the art of learning), and also the students' motivation to engage in such a course. Seymour Papert (1980), a constructionist that defends mathetics instead of didactics (the art of teaching), was inspired by the Brazilian schools of samba. For him it was inspiring how people 'learned by doing' in the process of producing their costumes, their instruments and simultaneously prepared the carnival's big day by learning to sing, dance and play. There is no need for heteronomous teaching; Brazilian schools of samba set an example for autonomous learning (of course resorting to all kinds of information and material needed for that). In other words, there is a strong

structure supporting different possibilities of organisation, which encourages creativity and independence. Of course Papert romanticised the schools of samba's procedure, as it is in fact dominated by capitalism and not as free as it seems at first site. However, we might learn from Papert's insight regarding mathetics. Instead of working with didactics, teaching students predetermined contents, we can create a structure for students to develop and try by themselves their own critical perspectives on architecture. This is not an easy task, as the structure needs to be well designed to induce autonomous critical thinking and at the same time enable students to engage with contemporary historical and theoretical thinking (they are not supposed to invent the wheel). Moreover, the learning by doing approach, which is usually misunderstood with any sort of practical exercise, needs to be faced in the light of mathetics, in which the student 'learns how to learn' benefiting from a practical perspective, not only a discoursive one.

At our School of Architecture we have been running an introductory course based on mathetics for more than a decade. The students are required to learn by themselves having a carefully designed structure to orientate them in their learning process. In a cybernetic way, the pedagogical structure works as a meta-approach to be used in their design processes. After going through a range of information, they are required to propose and build an interactive intervention in an urban area, taking into account the current uses of the space, the shortages of the community and the features of the space. As this is their first exercise in architecture, they propose amazing interfaces with which people can play and modify the spaces temporarily. It must be said that representation only comes after the intervention is built and used, as their creativity must not to be limited by their initial lack of skills. After building their interventions, the students are required to develop their own language to represent them for future building without their presence. This is a clear learning of how to deal with representation as a tool, not as a paradigm.

However, this happens only in the introductory course. After that the students enter into the traditional design process mode, most times with a didactical demand, and are not able to formulate by themselves that the interfaces they produced in the first semestre might also inform other design processes. We came to realise that even if they experiment an alternative process which is usually quite successful, they are not able to oppose that to the traditional design process. First because they do not know such a tradition at the time; second because they are not encouraged to try it again in more advanced design projects; and third because architecture-as-interface is an attempt to move beyond normative conventional processes, which makes it non reproducible (each project needs to be invented from its own demands) and thus much more difficult to 'apply'. So, from this findings came the idea of proposing in the second semestre of 2015 an advanced design course based on designing interfaces rather than finished spaces, having as outcome a constructive method for spatial articulation in order to stimulate students to work with a practice of difference.

The twelve students who joined the course were already questioning, in different ways, the traditional design process. Eleven of them had already done our introductory course but were not able to discuss and overcome the conventional design process. They came from different years and all of them were enthusiastic to discuss and experiment a process that would not lead to a finished formal product. All of them were curious about participatory processes, as this word has been widely spread even if meaning anything but people's engagement in the whole process of production of space. In this context, the challenge of creating a constructive method for spatial articulation, treating architecture as an interface, was very well accepted.

2.2 *Deconstructing the brief of the design competition*

The course took as its theme the 'KYM Field Schools for Tropical Savanna Climate of Africa International Architectural Concept Project Competition' (kimfield-schools.com). It was proposed by the Turkish NGO *Kimse Yok Mu (KYM) Solidarity and Aid Association* to design a rural school to be placed in a variety of countries in Africa (they mentioned that it would be possible to build more than 1,000 schools in different countries in the tropical savanna climate). The brief of the competition was very conventional, presuposing a final product which would be also presented in a conventional manner. The architectural program predetermined that the school would occupy an area of 100 m2 (plus or minus 10%) with at least 200 m2 outdoor and semi-outdoor areas for surrounding landscape accommodating every outdoor activities and equipments needed (water well, sewerage, power supply, garden, playground, etc.). The brief also predicted indoor space for 60 students to be educated (divided in one, two or three rooms), a teacher room for two teachers (with toilet and shower), girl and boy student toilets and a small material storage. That is, the brief almost defined the pieces for the students to play with them in a puzzle (Lawson, 2005).

The aim of the design course was to depart from the brief of the competition and challenge the students to move beyond the puzzle making trap (which would possibly lead to amazing formalist results) towards questioning the design of a single project to be replicated in a variety of physical, cultural and social contexts. For that, the ideal would be a participatory process taking into account the physical features of the site as also the desires and constructive knowledge of local people. The challenge was then to join a replicable design with a participatory process accommodating local differences. In order to orientate the students the course was structured in an open way, but orientating their thoughts towards designing a constructive method for spatial articulation. This means, the students were not blind in their attempts

to overcome the conventional design process, but had a very open requirement to work with, proposing a practice of difference.

The course was set to work in two ways: seminars and design workshops. The seminars were very important in the beginning to make the students acquainted with different architectural alternatives to traditional design processes (ranging from Walter Segal, John Habraken, Yona Friedman, Cedric Price and many others) and also to understand the African diverse context (cultural, religious, climatic, geomorphological, etc.). In both cases, the students were induced to investigate by themselves, exchange information in small groups (up to three people) and present their finds in collective seminars to inform the design workshops.

3 ARCHITECTURE AS INTERFACE: DESIGNING A CONSTRUCTIVE METHOD FOR SPATIAL ARTICULATION

3.1 *Knowing the context*

Starting the course, the students were required to read a paper that synthesises a keynote lecture Silke Kapp and I gave in a conference on alternative practices in Sheffield in 2007 (Kapp, Baltazar and Morado, 2008). This paper presents critical exercise, design of interfaces and mediation as three alternatives to conventional architectural practices. Moreover, a range of participatory practices dealing with these alternatives were presented, both in the mentioned paper and in the site spatial agency (Awan, Schneider and Till, 2011) and the students were required to choose a practice to investigate further and present in a seminar for the whole group. The practices were chosen having in mind the main idea of the course, which was to propose a constructive method for spatial articulation. So, the students decided to investigate further the Segal Method (Mckean, 1989; Segal, n.d.), Habraken's support and infill (Habraken, 1972), the practice of Friedman (Friedman, 1986; Friedman, n.d.) and the practice of Price (Price, 2003; Obrist, 2003).

Segal Method was very inspiring, as already mentioned, because it is not a constructive system, but a method for self designing and building affordably. Segal developed a set of rules for people to decide on the design of a house and build it with materials found in DIY shops. Differently from the pillar and beam structure, Segal's method proposed a timber frame structure combining porches that worked independently, so anyone would be able to put it up with a simple foundation. One of the advantages of Segal Method might be seen in the self-built houses that are going through easy transformations over more than 30 years. The walls are not structural, so they are very easy to be displaced and assembled again, making it easy to expand the house or even rearranging its interior. As the porches work independently, it is also easy to give continuity to the structure, even with different materials, such as in one of the self-built houses that was expanded with metal porches. From that the students reinforced the idea that it is possible to design an interface, in this case having a sort of constructive method able to receive different materials and also enabling local people to decide on the spatial articulation.

Habraken was also an important contribution, as he deals with planning with future uncertainties enabling diversity in mass production. For that he separates support and infill, the support being not necessarily the structure of the building, but that which is of collective decision, and the infill being those parts that are left for individual decision. From Habraken the students learned the possibility of defining the support, which might be reproduced, and leave it open for local people to decide on the infill, which is specific for each space.

Friedman was also helpful for his general proposal of collective planning, even if it were more applied to the collective plan of the city and to his ideas of mobile architecture. The students investigating his works were more concerned, though, with his flatwriter, which proposed a machine programmed with parameters to enable users to define their own apartments and also check its placing in the urban environment. Such an interface was inspiring as it enabled the students to understand a structure, very carefully designed with a range of parameters, opening up possibilities for users to try by themselves their own spatial articulations and see the outcome of it.

The ideas of Price were also quite inspiring. For him architecture should not be faced as monument and should not be an instrument of power. He proposes that buildings be ordinary spaces to reconcile working and leisure with dwelling (a separation that was consecrated with Corbusian modernism). The students focused on analysing his 24 hour houses and the Fun Palace, designed together with the theatre director Joan Littlewood. The 24 hour houses are good examples of ordinary value-free architecture promoting a simple but carefully designed permanent structure enabling users to easily accommodate different activities in the spaces over the 24 hour period. The Fun Palace, a more complex structure, enables openness by means of cranes and mobile structures, with which the public might play and decide the configuration of the space for different days and performances. The students were very impressed by the concept of 'enabling', as it opens up a range of possibilities in architecture beyond foreseeing possibilities of use. They learned from him the possibility of proposing ordinary 'value-free' structures 'enabling' people to invent their own uses.

As the students had not gone through Christopher Alexander's patterns in the seminars, the Assistant Lecturer Guilherme Arruda has presented them with *The language of school design: design patterns for 21st century schools* (Nair, Fielding and Lackney, 2013), which is inspired by Alexander's patterns for school design. From that the students learned different patterns to enable a broader range of uses of school spaces, such as niches that work as intimate spaces or soft sitting areas inside rooms, which would also add to

inform the interface to be proposed opening possibilities for local people to engage in decisions regarding their local rural schools.

Giving continuity to the seminar series, the students were required to raise data on the African region subject to the competition. The brief only mentioned that the rural school to be designed was supposed to be reproduced in the tropical savanna climate, which encompasses ten countries from West to East of Africa (Senegal, Burkina Faso, Niger, Chad, CAR, Sudan, Ethiopia, Uganda, Kenya and Somalia). So the students divided themselves in groups to understand these countries diverse contexts (cultural, religious, climatic, geomorphological, etc.). From the point of view of objective features, even if considering the savanna climate, there is the dry and the wet tropical savanna, having different average rainfall. The wet tropical savanna rates 1,500 to 2,000 mm rainfall against a lesser rainfall in the dry tropical savanna. This is very relevant if one is required to propose a water supply system. Another important information raised by the students was the geomorphological map, showing the ground water table in different locations. Again, the variation was relevant, as in some places one can find water almost in the surface and in others they are very deep, needing a sophisticated harvesting system. The students also learned that people would build in very different ways in each place (even within the same country). They raised a range of types of spatial articulations and also the use of materials and constructive techniques. Apart from that, the students also found out that cultural habits are completely different. Sometimes in the same country they have identified more than ten languages being spoken and a variety of religions (ranging primarily from Muslim to Catholic). Moreover, the education is influenced by a range of issues. After colonisation an imported European system was implemented by missionaries, ignoring the local culture of the tribes in which the youngsters learn from the elders as they perform everyday tasks in a sort of 'learning by doing' natural pedagogy. In the urban areas the private system is nowadays based on Montessori and Feinet pedagogy, which even if reproduced in the rural schools is mixed with the missionary traditional system and with the poor conditions (it is said that a table supposed to accommodate two students in the formal educational European system, is sometimes used by four students, making it impossible for them to use the infrastructure as predicted in the educational system). Finally the distance from the house to the school (most children walk to school), seems to be responsible for the poor attendance and high rates of abandonment. From what the students have investigated, they were able to say that the diversity was so great that it would be impossible to replicate one single project in all contexts.

The findings of the seminars led to the discussions in design workshops. The students, then, were convinced that an interface was needed to articulate such a diversity and also to enable local people to engage with the design and building of their local schools. So, the design workshops served to trigger a process of discussion amongst the students under Guilherme Arruda's and my orientation. At first they thought of creating two or three groups and develop different proposals, as some of them were more inclined to emphasise locals's participation in the decision making (thinking of proposing a game and not an architectural project), as others were more inclined to propose structures that enabled a diversity of uses but were predefined by them (thinking of arriving at Habraken's idea of support and infill). As the ideas started to take shape, they realised that it would be possible and more fruitful to join their ideas in different stages of a single design proposal. The interface for a constructive method of spatial articulation started to take shape with the whole group (the twelve students) working on it.

3.2 *Proposing a constructive method for spatial articulation: a game-interface in three stages*

The students then agreed to design a game for local people to conceive and build their own school. Such a game starts by setting the plot and its context and then stimulates people to open their imagination about the future school with cards narrating different events for them to deal with articulating the spaces in plan and volume, internally and in its relation with the external space. It also proposes that people define the structure, openings and materials to be used, according to their constructive knowledge, traditions and climate. People are invited to experiment with a series of preset events proposed in a set of cards to finally be able to articulate their own school. At the end of the game, each community is expected to have one school designed specifically to meet its context and demands. The final outcome results from discussions arisen during the playing of the game as the players engage with the design of the school.

The first stage of the game was proposed as a quiz in which players are invited to acknowledge physical aspects of the site such as the size of the plot and climatic features that will determine water supply, sewerage, orientation of the openings of the building, etc. Players are then required to unfold the game board to fit the size of the plot and place the fixed elements, which range from water well, rain catchment system, septic tank, power supply system, garden and playground). The students defined that 'the sizes of the water well and rain catchment system will depend on groundwater storage and rainfall index. The definition of the septic tank depends on sewage, water access, geomorphology and possible reuse of water. It might be combined with a sinkhole, and/or an anaerobic filter, and/or an evapotranspiration system. The energy supply will depend on wind availability and solar incidence to locate pre-dimensioned residential wind turbine and solar panel' (Blind competition material, 2015). Moreover, players are also able to locate playground structures they wish (the quiz provides a set of structures inspired in Aldo van Eyck's structures designed for children's bodily engagement).

From that the board is ready to play with different spatial articulations.

The second stage of the game was set to open players imagination by trying out spatial articulations to accommodate different events that might happen in the school. This stage counts with five important instruments. First are the events' cards, presenting the players with fictitious situations that might happen in the school and inviting them to articulate spaces to accommodate such events in 2D, 3D and also thinking about materials to be used, structural system and openings. Second are a set of different modulated shape options for rooms supposed to match the competition brief and include circulation areas (that might also become meeting spaces between rooms), which combination is designed to sum between 90 and 110 m2. Third, directly related to the modulated shapes, is a spaces' catalog, presenting the main benefits of each shape to help players to decide on which to use. Such a catalog is based on patterns for school design (Nair, Fielding and Lackney, 2013). Fourth is the structure, which is an articulated 3D frame manipulable by players in angles of 30, 60 and 90 degrees in all of its articulations. This enables players to cover their plans with a flexible frame that can be thought of with different structural systems, use different materials to close and leave different openings, according to the event card. And fifth is a decisions's catalog, which is a *volvelle* (wheel chart) that presents tips for using different sorts of walls, roofs, openings and furniture. Such decisions are directed by the event cards concerned with spatial quality for shape articulation, its possible connections, thermal comfort and lighting and ventilation. At each event card taken, the player in charge needs to negotiate with previous players that had already set a design in the board to make changes according to the card's requirements.

After playing with the event cards players will have a final card, the third stage of the game, which asks them to design their own local school having in mind what hey have learned from the game. The main task is to define the main events that might happen in the school and respond to that having in mind the positive and negative aspects of the solutions they proposed during the game and also resorting to the same instruments used in the game (but the event cards).

4 CONCLUSION

The game-interface designed as a constructive method for spatial articulation of rural schools in Africa was an exercise that brought together a previous theoretical critique of the current design process and an inventive response from the students drawing from little pointers that appear in alternative practices. Such an interface started from Segal Method, having an articulated structure based on porches, but was developed further towards manipulating the modulated 2D room shapes and the 3D structure, inviting players to define collectively that which will become the support and the infill. Such a carefully designed interface is also inspired by Friedman's parameters programmed for collective decisions drawing from Price's 'value-free' and 'enabling' structure opening possibilities for different local organisations. The students have also orientated their design towards process (not product) observing the logic of the object not that of use (Jones, 1991). It also presented players not with industrial tools or preset decisions about techniques or materials but stimulated them to resort to their own constructive knowledge and materials in a convivial manner. As for Zielinski's definition of interface as that which separates and connects without defining the nature both, the game-interface is an attempt (not completely accomplished) as it is too much assertive regarding its aim to connect local people with its context.

The role of architects was certainly scrutinised by the students beyond the conventional design process and instead of producing a package of drawings representing the final appearance of buildings, they were able to propose a common interface to promote different outcomes. The feedback of the students after the end of the course was very positive, stating how secure they were with proposing interfaces, showing that 'learning by doing' worked properly. They said that before this course they already believed in a possible alternative to the conventional design process but were not able to put it in practice abandoning the formalist production of finished buildings. Now they are able to not only defend that architects might be interface designers but also to actually develop a practice of difference.

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The role of representations in architectural design learning

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ABSTRACT: In this study we aim to gain a better understanding of representations and reorganisation of the studio setting in design processes of the students in a studio context. To serve this purpose, we carried out a 15-week studio work in an urban architectural master design studio. We investigated how students use representations in relation with reorganisation of the setting. We analysed their design process by the development of representations, studio observations and a survey questionnaire. We found that reorganisation of the studio setting positively effect learning process and final proposals; whereas new ways of representation modes have a significant contribution.

Design process is comprehended as an interdependent combination of figural and visual reasoning (Goldschmidt, 2001, 12; Akin & Lin, 1995, 236). This duality is used for describing verbal-conceptual and visual-graphic representations. On the other hand, Schön's idea of reflection in the medium of representation included 'design reasoning', which is an explicit articulation of knowledge, as an essential part of reflection-in-action and reflection-on-action (Schön & Wiggins, 1992). This approach takes the complementary quality of design thinking further to an iterative and reflective understanding and in this paper, we specifically interested in this articulation.

Studio culture, as a principal focus of architectural design education, requires learning-by-doing (Schön, 1983) that is inherent in reflective practice of architecture. This culture coincides with the position against apprenticeship; and many pedagogical experiments advanced this position towards flexibility and interdisciplinarity. However, these open-ended approaches could not end the contradiction between liberation and discipline, autonomy and authority and they characterise regimes of transgression and resistance in higher education for art and design (Dodd, 2015). Therefore, established pedagogical aims and practices are found to be ineffective in promoting learning and social change (Froud & Harriss, 2015).

In literature, several references to representations and reorganisation of the studio setting can be found. In the following part of the paper (Section 1) these are elaborated in detail. However, there is not enough empirical research on how representations play a role in design studio learning.

Motivated with these observations, in this paper, we aim to develop a better understanding of this topic and address the following questions.

- *How can we collect and study representations proposed by students in an architectural design studio?*
- *What is the role of representations in architectural design learning processes?*
- *What are the implications for future practices and studies?*

In order to explore these questions, an urban architectural design master studio setting was used for an action research in Fall 2015. Self documentations of students' works were obtained through design diaries. They provided clues on their learning and design processes. Furthermore, the first author participated in the studio as an instructor and an observer for 15 weeks and made a survey with the students at the end of the design studio. We used a triangulation method which involves: 1) findings from the collected design diaries, 2) statistical analysis of the survey and 3) studio observations to address the research questions. In what follows, these will be reported in three sections.

Section 1 will introduce a background review of representations' role in architectural design. In the following section, (Section 2) research design regarding the learning process and the final proposals will be presented. Section 3 will reveal the studio work that was carried out and the obtained results. Finally, in Section 4, conclusion will be presented in which an overview of findings is provided and future research on the role of representations and reorganisation of

the studio setting in architectural design and design learning are suggested.

1 BACKGROUND

1.1 *The role of representations in design*

Design process is primarily associated with the creation of forms and visual imagery which are expressed by representations (Goldschmidt, 1994). In architectural design research, most studies about representation focus on the act of drawing. Design drawing, as an iterative and interactive act, involves recording ideas, recognising functions, and finding new forms and adapting them into the design. (Do & Gross, 2001, p. 136). This reflective action suggests conversations between ideas, functions, forms and interpretations. Representations also facilitate the examination and expression of architectural thought, filtered through the unique conventions that are embedded within each specific mode and technique of depiction (Simitch & Warke, 2014, p. 25).

Schon and Wiggins explains that the designer has a reflective conversation with the design (1992, p. 135); similarly, Lawson describes a conversation between the designer and the drawing (2006). We can say that all kinds of representations are included in this conversation. According to Do and Gross, this conversation does not merely communicate ideas to others but serve as a primary vehicle for thinking in design process (2001, p. 142). Thus, if the representation of final design is for communicating the ideas to others, drawing is certainly serve for thinking.

Representations are open to interpretations. Studies show that regrouping representations are associated with generating new interpretations (Suwa et al., 2001, p. 217). Furthermore, according to Gero and Kannengiesser, designers change their opinions about the design itself while generating and interpreting representations (2008). For instance, sketches serve as an external memory, a provider of visual cues for association of functional issues, and a physical setting in which functional thoughts are constructed (Suwa et al., 1998, p. 1047). Thus, construction of thoughts is associated with interpreting representations.

Architectural practitioners discuss the role of representations under a plethora of themes such as abstraction, function, urban scale, text and writings. They use the term 'diagram' for explaining these representation modes.

Anthony Vidler describes some of the key qualities of architecture as abstraction, reduction and geometrical simplicity (2000). He argues that both in history and in present, architects positioned their works with these qualities. He suggests that a new significance about the recent translation of the architectural vocabulary to production is almost simultaneous, so that processes between the representation and the architecture of itself disappears.

Representations' are also used for functional purposes and to redefine architectural design research and professional practice as having the technical authority (Pai, 2010, p. 64). In this context, Hyungmin Pai underlines weaknesses and limitations of representations and architectural diagrams that are developed as a problematic tool for control.

Diagrams in urban design scale are found especially useful and also dangerous. David Graham Shane argues that diagrammatic representations in urban design can reduce the complexity of the city which could create an illusion; whereas they can show individual paths, complex sections, and collective shared maps (2010, p. 87) to guide urban design processes.

Contemporary avant-gardes in architecture use diagrams dominantly. Somol argues that diagrammatic representations suggest an alternative mode of repetition and they are performative devices (2010, p. 89). He states that Koolhaas and Eisenman works diagrammatically instead of simply working with diagrams; displaying both social and disciplinary projects (p. 90).

According to Eisenman, diagrams can be traced and read in architecture. He explains this role within anteriority and interiority. Diagrams of anteriority traces the history of architecture in real buildings; whereas diagrams of interiority mediate other possible buildings within that buildings (2010).

1.2 *Representations in design learning*

Besides theoretical claims by quintessential design researchers, several empirical studies about implications of representations were carried out. Focus of these studies varies from thinking to manipulating during design processes. In this section, we will give examples of empirical studies on design learning processes.

In *Reflective Practitioner*, Schon draws a case study to explore the reflective conversation in an early phase of an architectural design studio with a studio tutor and his student. In this process verbal and non-verbal dimensions are closely connected. He names simultaneous drawing and talking as 'language of designing'; and he links it to a language for doing architecture. While the tutor and his student follow their conversation using the language of designing both verbally and graphically, the student reflects on her design. He claims that design actions can never be associated merely the effects intended for it; but materials are continually talking back to apprehend future potentials (1983). This study shows that there is a reflective conversation between representations and design process.

In another study, Oxman aims to study the way designers manipulate design drawings and to identify the knowledge and cognitive capability for re-describing design (1997, p. 330). She proposes a model for identifying and formalizing of re-representations in the interaction with graphical medium. She documented adaptation processes in graphic re-representation of an architectural design assignment. She claims that each new adaptation opens the possibility for further interactions. Study shows that manipulations of multiple re-representations is

crucial for design process and allows unexpected diversity and novelty in results (1997, p. 346).

Akin and Moustapha, in their study, aims to understand specific cognitive processes contributing to massing through strategies that facilitate a discourse between designer and graphic representation (2003, p. 31). They observed and collected protocol data of six design activities from early stages that lead to three-dimensional massing models. Their analysis shows that regulating elements are used for manipulating design process. These elements help them to understand and manage processes like part-whole relationships, design hierarchy, topology-geometry relationships, scaffolding the design process, structuring and restructuring parameters (2003, p. 34).

Bilda, Gero and Purcell conducts think-loud experiments to test if sketching is essential for conceptual designing (2006, p. 587). They compared two conditions of design activities including and excluding sketching. They defined sketching as a learned process including thinking with drawings, developing ideas, and solving complex design questions. However, their experiment shows that there are no differences between sketching and blindfolded design activity in terms of design outcome scores, total number of cognitive actions and overall density of idea production (2006, p. 604).

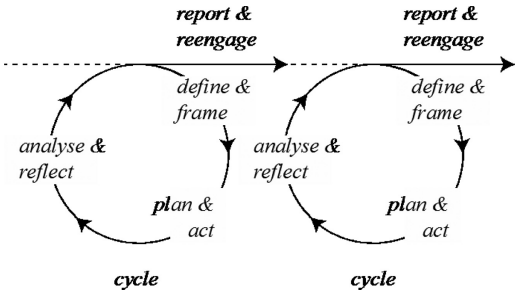


Figure 1. Four stages of an action research cycle.



Figure 2. An alternative representation like a marketspace.

2 RESEARCH DESIGN

2.1 *Studio setting*

In order to respond to research questions, an action research was set up in an international urban architectural master design studio at KU Leuven Sint-Lucas Architecture Faculty in Brussels during 15 weeks of 2015/2016 Fall semester. Tutors of the studio were Bruno Peeters, Asiya Sadiq, Laurens Bekemans, Maria Cecilia Chiappini and Ayşe Zeynep Aydemir. The participants were 68 international architecture students (47 females and 21 males, 15 exchange and 53 regular, 27 nationalities) in their first year of master studies, who were not told the research questions or goals. The studio theme was '*Kokumi'* which is the sixth taste after Salt, Sweet, Bitter, Sour and Umami; and in English, it's described as 'mouth-fullness', 'mouth-coating thickness' or simply 'heartiness'. Students were expected develop a comprehensive urban-architectural proposal conjuring their own interpretation of infusing the idea of *'Kokumi'* within a complex urban environment in dialogue with their Peer Assisted Learning (PAL^{e}) teams.

2.2 *Action research*

The enquiry employed within the method of action research which includes four stages that work in tandem, namely, defining and framing, planning and acting, analysing and reflecting and reporting and reengaging (Figure 1). Action research cycles were used as a research methodology for an ongoing PhD research; in which the study of this paper represents one of the cycles. Each action cycle has a range of qualitative and quantitative data collection methods and analysis with an initial motive for supporting the learning process. In this cycle, 1) findings from the collected design diaries, 2) analysis of the survey, and 3) studio observations were used for this purpose.

2.3 *Kokumi experiment*

Reorganisation of Kokumi studio employed different than traditional architectural design studios in terms of process. This process included a first day experiment, collective group works, design teams, roundtable discussions, lectures, reviews, open-ended briefs and design diaries. Reorganised structure enabled alternative representation modes of proposals such as exhibitions, performances, and experiences (Figure 2).

Studio started with an introduction and Kokumi experiment that includes meeting at Musée Science Naturelle Bruxelles, walking to Maison Antoine in Place Jourdan, eating French fries with mayonnaise and walking back to Schaerbeek to have a 10-minutes observation on the site, Liedts-plein. During the first discussions students used following concepts for describing their first encounter: chaotic, nobody cares, joint, different point of view from just one place, multi-ethnicity, active, not-quite, fabric invaded by different nationalities, hard to get a mental map, hard to get oriented, mazy feeling, public island, tram lines/mesh,

square is separating people instead of gathering them, there is not much activity, everything is kept inside beside traffic, closed spaces(night shops), there is a difference of level (slope), it is exposed to the elements, whole square is full of parasites, it's like a mess, confusing.

Study site was a complex urban environment which cannot be easily identified within common architectural vocabulary. For the question "Is this a street or a square?", they answered as, "It's a mesh, it's very unshaped you don't know the limits". After discussions on the first impressions on Liedts-plein, we decided to prepare a profound research on site including physical, spatial, social and empirical aspects. Students formed four groups namely, Digital Model, Spatial Analysis, Humanities, and Case Studies. Groups worked together during the first four weeks of the semester until the first review of the studio.

2.4 *Collective group work and design teams*

Digital Model group prepared 3D models of terrain, buildings and façades in a common format. Humanities group discovered social aspects of the area through research questions and objectives. Spatial Analysis group produced urban analysis on transportation, walking routes, land use, density etc. Case Studies group researched relevant cases that could be useful for studio works. All four groups were expected to prepare a booklet and a presentation for the fourth week; all collected data would be a guide for all students during the rest of the semester.

During their research Digital Model group used modelling software, building laws, regulations and personal evaluations; Spatial Analysis group used mappings, sections, notes and sketches; Humanities group used notes, sketches, interviews and recordings; and finally Case Studies group used literature and case reviews.

All groups prepared a booklet for the first review. In addition to booklets, Digital Model group made a projected presentation; Spatial Analysis group prepared an exhibition setting for their analysis in three main titled of Non-Fixed, Fixed and Semi-Fixed; Humanities group made a projected presentation on their experiences, observations, interviews and literature research with diagrams and mappings; Case Studies group prepared a research in three main themes of Motion, Appropriation and Transformation.

After the presentations, they were all asked to decide for team leaders. There should have been 14 team leaders that would be responsible for the communication between the tutors and their teams. Volunteered team leaders were asked to form their groups concerning PAL^e (Peer Assisted Learning) Composition Instruction rules with an additional rule of including at least three different analysis group members for each team. These rules were referring groups of 5 students with a wide diversity of skills and background. For instance, the distance between any team members' university of origin must have been at least 400 km.

2.5 *Lectures and reviews*

In parallel with studio works, during the third, fifth and sixth weeks, students received a lecture from experts. Firstly, Leeke Reinders (TU Delft) gave a lecture on space-syntax, privacy, interior and social class, public front, private backs, parochial space, notations and mapping. Secondly, Meriç Demir Kahraman (ITU) gave a lecture about squares, public spaces and private spaces. And lastly, Burak Pak (KU Leuven) gave a lecture about Schaerbeek, super-diversity, Brusselisation, Brabantstraat and immigrants. Futhermore, on the seventh week, they had a workshop week coordinated by Lilet Breddels (Archis). Leeke Reinders and Meriç Demir Kahraman were invited also for the following review sessions.

During the semester four review sessions were realised. Projects were reviewed the 4th week for analyses, the 8th week for initial proposals, the 12th week for developed proposals and the 15th for final proposals. For each review, briefs were delivered to students to organise the sessions. For analyses, they were asked to prepare a booklet and a presentation. For initial proposals, each group had 20 minutes to present with a total use of space not exceeding 2 times 4 m^2 and they were asked to send a postcard featuring a slogan with an image summarising their project by surface mail individually to their respective design-studio tutor. For developed proposals, teams received the brief as an expression, which was *"Architecture has landed!"*. For final proposals, all outputs were evaluated on basis of submitted materials only, and no oral presentations were organised.

2.6 *Data collection*

Students were asked to record their own verbal and visual productions with design diaries for us to follow their design process as well as our studio observations. At the end of the semester, they were asked to participate an online survey for their insights about representations and reorganisation of the studio setting in the context of their design process and final proposals. In this way, design diaries, studio observations, and online survey questionnaire a triangulation method for data collection.

Survey was prepared as two sets of questions regarding design process and final proposals respectively. It includes an identification question, 7 scalar questions and two open-ended questions, which make 10 questions overall. 52 students out of 68 participated in the survey.

3 FINDINGS AND DISCUSSIONS

3.1 *Define & frame*

Discovering the role of representations and reorganisation of the studio setting in design learning process by developing a comprehensive urban-architectural proposal conjuring the own interpretation of the idea



Figure 3. First review presentation of team Taste.



Figure 4. Final review presentation of team Kokumi Attack.

of 'Kokumi' within a complex urban environment and a playful studio setting were main objectives of this action research. During first 4 weeks of the studio semester 4 research group; and during other 11 weeks 14 design teams worked collaboratively. Teams named themselves as F5, Makka, Codes, Average, Taste, Nozomi, Flex, Karami, (Mt2Ge)3OBr+Mn, Place Needs, Ki, Jupiter, Tea-m, and Kokumi Attack, respectively. Teams were asked to find 'Kokumi' of Liedts-plein and develop their proposals for this place.

3.2 *Plan & act*

During the semester, eight main actions were planned and employed. These were first-day experiment, PAL[e] groups formation, collective research within 4 main themes, working in teams and with team leaders, round table discussions, lectures, open-ended briefs for reviews, design diaries, and survey. These actions were related to representations and reorganisation of the studio setting. Some of the groups responded actions associated with their design proposals. For instance, team Taste, built their design strategy on eatscape of Liedts-plein and presented their proposal within a designed setting of an eating act (Figure 3), whereas team Tea-m presented their cinematographic proposal as a movie in a local setup. Furthermore, team Kokumi Attack presented their proposal in an exhibition setting.

3.3 *Analyse & reflect*

We observed that our plans and actions had reflections to design process. The first day experiment enabled a playful setting for understanding the studio theme and experiencing the place with a new set of mind. This experience transformed into another game while they were forming their research groups according to the restrictions announced. Predefined research objectives helped them to organise and work collectively. Forming teams according to the rules and determining a team leader helped them to understand their responsibilities and division of works within their teams. Round table discussions enabled to develop their ideas

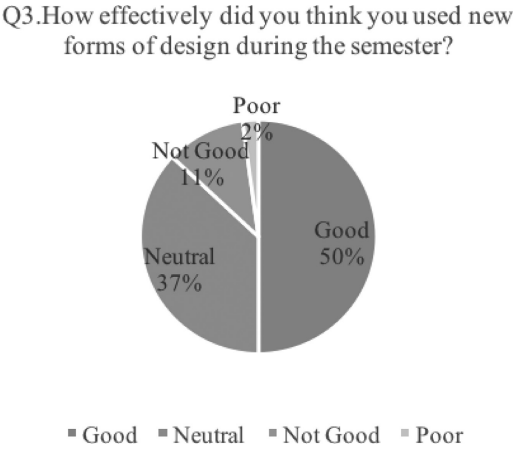


Figure 5. Use of alternative modes of representations.

with tutors collaboratively. Lectures elaborated the discussions. Open-ended briefs triggered new ways of representing their ideas. Design diaries helped us and them to follow their design process.

To support our observations, we needed opinions of students on these subjects. Therefore, we posed ten questions that evaluate design process and their final proposals regarding representations and reorganisations of the studio setting. Survey results show that 1) they used alternative modes of representations effectively (Figure 5), 2) reorganisation of the studio setting contributed design process positively (Figure 6), 3) alternative modes of representation contributed to final proposals (Figure 7), and 4) reorganisation of the studio setting contributed to final proposals (Figure 8).

3.4 *Report & reengage*

Based on students' comments to the open-ended survey questions related to representations and reorganisation of the studio setting, we realised that students find new ways of representation modes useful and beneficial during their design process and for their

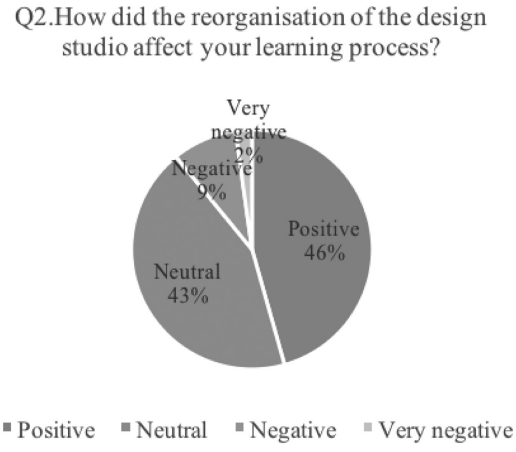


Figure 6. Contribution of reorganisation to studio setting.

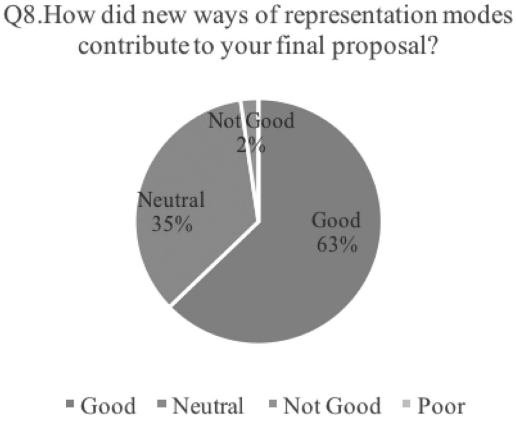


Figure 7. Contribution of alternative modes of representations to final proposals.

final proposals. They helped them to open up their minds for new ways of learning, to negotiate with others, to express their ideas freely, to discover new possibilities, to experiment, and to learn new skills. Nevertheless, they also remark that they needed more guidance and technical support. For this reason, they suggest that there could be more lectures, seminars and jury sessions.

4 CONCLUSIONS

The study presented here, considers the role of representations in design learning and how they relate with reorganisation of the studio setting. Studies on design learning are very crucial for understanding design process and it is suggested here that to develop a better understanding about design process, further studies on reorganisation of the studio setting should be followed.

Admittedly, representations in design and reorganisation of a studio setting can be approached and examined in a variety of way. However, this study

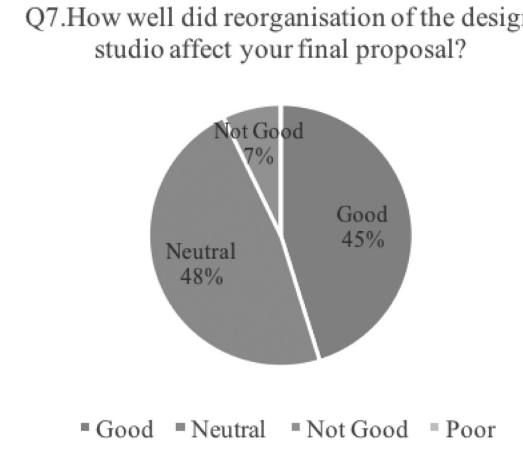


Figure 8. Contribution of reorganisation of studio setting to final proposals.

focuses on their effects on learning processes and final proposals in an architectural design studio setting. We used the setting of an urban architectural master design studio as a laboratory, design diaries for observations, and an online survey for collecting insights of students. In this study, the role of representations in relation with reorganisation of the studio setting in design learning are analysed based on an action research.

Even though majority of students found alternative modes of representation and reorganisation of the studio helpful for their design process; there were also opposite remarks. Some of the students indicated that they were not guided, they had problems with other team members, they needed more support on technical subjects and consult for a better process. These remarks should also be elaborated in further studies.

We believe that this study could be helpful to researchers on design education. We observe the role of representations and reorganisation of the studio setting intuitively but there is still a need to be ensure how they effect the process. Further research is needed for a discovery of their stimuli on different phases of design process.

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Curating and exhibiting architecture: Pedagogy in the gallery context

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ABSTRACT: MoMA's 2011 exhibition, *Small Scale, Big Change: New Architectures of Social Engagement*, featured eleven architectural projects located in underserved communities on five continents. The designs were not 20th century utopian gestures but instead represent "radically pragmatic" solutions that signal a deep reconsideration of the social responsibilities of architecture. A more recent exhibition, *City of 7 Billion: A Constructed World*, on display at Yale's School of Architecture during the fall of 2015, highlighted the worrisome implications of global development. The culmination of rigorous research, the findings were presented through the language of architectural representation – models, drawings, and digital renderings – to illuminate the roles of designers in confronting population growth and resource consumption. In both exhibitions, exigent subjects are addressed, critiqued, and evaluated within the space of the gallery.

Using a selection of socially-engaged architecture exhibitions as exemplar studies, this paper looks at the gallery and its potential value in architectural pedagogy. Intrinsic to the gallery experience is active questioning and enquiry. Playfulness and risk taking are also central when paired with reflection and critical thinking. Considering the various criteria and editorial choices that culminate in exhibitions addressing contested themes, specifically those shaping our understanding of societal challenges, the benefits of curation to the education of the architect are explored. With its immersion model of studio-based pedagogy and its emphasis on graphic and verbal presentations, architecture education finds a fruitful companion in the instructive tool of exhibition curation. When students actively curate their work – research and design – for public consumption, the capacity of architectural education is expanded. In the space of the gallery, architecture can be constructed effectively as a conceptual enquiry that embraces inspiration, critical thinking, and the building of meanings each of which is fundamental to the creative process.

1 INTRODUCTION

> *In socially engaged art … what is important is the process, and the process is inextricable from the experience*. (Helguera, 2012)

In her essay, "The Exhibitionary Complex of Architecture", Eszter Steierhoffer notes that in recent years architecture exhibitions featuring complex architectural themes linked to "questions of sociology, ecology, science, new technologies, cultural theory, or contemporary art" have emerged that connect architecture with a range of disciplines. (Steierhoffer, 5) Her observation of an "opening up" of the discipline and a re-examination of its social purpose is reflected in other commentary as well. There appears to be a growing consensus that while in the past the design process was "treated with the Hegelian legacy of genius and intuition … now the cultural and technological conditions have allied for architectural research to become less introverted. The opportunity exists for a new design culture, one rooted in research, openness, innovation and transferable knowledge …." (Adhya, Stevens, Plowright, 9) This new design culture would partner well with the architecture exhibition as a tool for teaching particularly when difficulty topics are addressed. Drawing from museology and a diverse selection of architecture exhibitions, this paper proposes that the curatorial and exhibition strategies used to confront difficult topics are valuable pedagogical tools that could more pointedly inform architectural education.

2 FROM MUSEOLOGY

The discourse emerging from Museum Studies and writings on museology support the use of the gallery space as a laboratory for exploration and experimentation, particularly when the exhibition addresses contested themes. In a keynote address to the International Council of Museums' annual conference in 2000, Barbara Kirshenblatt-Gimblett claimed, "a 'new honesty' has encouraged museums to 'open up for public interpretation the darker side of human society' and to do so more reflexively and self-critically." (Kirshenblatt-Gimblett, 1) Susan Pearce, another prolific scholar in the field, views exhibitions as performative structures composed of "objects in action"—that is, complex practices of language that attempt to communicate with those who engage them.

(Pearce, 19) Social anthropologists Sharon Macdonald and Paul Basu have characterized a similar approach in more recent practice as one of "exhibitionary experimentalism," noting that the exhibitionary apparatus is understood for its capacity to *generate* knowledge and information, rather than merely to provide the frame in which to represent knowledge. (Basu and MacDonald) According to these authors, the very processes of exhibition practice have become visible, resulting in "reflexive" creations.

The word curate derives from the Latin root *curare*, or "to arrange, attend to, undertake." While traditionally curators were tasked with delivering didactic content, there has been a shift in museum practice that emphasizes, instead, education in the gallery as an experience that fosters intellectual and sensorial engagement of many sorts. Graham Beal, former director of the Detroit Institute of Arts, noted that whereas the earlier curatorial approaches were technocratic, the current desire is to find ways to shift the voice of the exhibit to express different interpretations of the work. (Beal) Macdonald and Basu's observation identifies an epistemological change in our understanding of the exhibition space from one that is representational and didactic to one that is experimental and open-ended. Similarly, within the field of architecture, Eve Blau are argued that "by privileging forms of graphic documentation and representation produced in the process of imagining, designing, producing, recording, and thinking about architecture, the exhibition (perforce) shifts the focus of concern from finished object to process, from form to idea." (Blau, "Reviewing," 256) This shift from object to process is in keeping with a new approach to curatorship which sees the final exhibition as exploratory and experimental.

Looking at recent international architectural exhibitions in museums, galleries, and biennales, it is clear that the gallery or exhibitionary space is being used productively as an instrument for research that "forges links between architectural thinking and practice, addressing contemporary issues via historical perspectives and an engagement with social, environmental, and political themes." (CCA Exhibitions website) Retrospective and projective architecture exhibitions are expanding the field beyond mere representations of finished buildings to include materials produced during the design process. The biennales in Venice have focused recently on the wider social and political context of architectural practice. Linking these types of strategies more firmly to the education of the architect seems appropriate and timely. In Pablo Helguera's book, *Education for Socially Engaged Art*, he develops the term abstract education to distinguish between symbolic versus actual practice. According to Helguera, actual practice is where the designer and curator will get their hands dirty and make an authentic attempt at engagement. (Helguera, *Education*, introduction). He suggests that the academy can benefit from the curatorial process in terms of pedagogy because both realms have an "emphasis on the embodiment of the process, on the dialogue, on the exchange, on intersubjective communication, and on human relationships." (Helguera, "Bad").

The student curator must take a position, define an approach, create the materials, deal with the graphic design and formatting of the display, and consider the manner in which they position their ideas and representations for public consumption. The design of an encounter, requiring the consideration of audience, compels a student to consider points of view that are not familiar, challenging, and, perhaps, even uncomfortable. Since the exhibition "… is about an event and an experience; it is concerned with a way of looking at and constructing arguments about architectural subjects that is different from that of the book and the scholarly article." (Blau, "Reviewing," 366) Designing an exhibition enhances the skill set of the emerging designer by forcing the questions of audience and visual communication during their formative development. With the complex challenges facing the social-engaged designer, new strategies and methods are required "to cultivate an audience with the spatial sensitivity to engage with the built environment in a conscious and potentially more responsible way." (Chan) An examination of recent exemplar architecture exhibitions confronting social subjects reveals the benefits of *Curation and Exhibition as Research*. While these selections do not specifically feature student work, their diverse exhibition strategies provide an abundance of precedents for the student curator to consider. In these projects, several compelling and productive themes emerge: Experimentation, Advocacy, and Interdisciplinarity.

3 EXPERIMENTATION

> *Expositions and exhibitions have perhaps changed the character of American architecture of the last forty years more than any other factor … exhibitions are more effective than schools, newspapers, magazines … are more "public" than buildings.* (Colomina, 240)

Architects who curate typically have a specific research or design agenda. They are interested in using exhibitions as productive agents through which they can develop their architectural research and practice. "A museum or architectural center is not only a place for the classification, conservation, and presentation of objects and documents, but is also a place of production and a generator of activities." (Zardini, 82) As curators, these architects are charged with the task to make this knowledge constructive and generative for the field. "Exhibitions [have] become places of creative and intellectual production, of in-depth study and reflection, and of experimental design practice." (Van Gerrewey, Patteeuw, and Vandeputte, 1) The conception and surge of architecture and design biennales is also an effect of this desire to create potential

instruments for facilitating experimental and critical architecture production.

One way to look at the exhibition space is to perceive it as a laboratory, where it is not simply a place to display a finished product, but a place to produce new content as well. This concept allows curators and architects to overcome "the difficulty of all architecture exhibitions – the impossibility of showing what architecture is really like rather than merely elaborating the means of its representation." (Forster, 62) Installations provide architects with a way to express their designs physically and directly where they can experience the effect of the spaces that they are trying to create. These proposals can also advocate for particular causes or methods.

Home Delivery: Fabricating the Modern Dwelling mounted at MoMA in 2008 offered a survey of the history of the prefabricated houses in the Museum's Fifty-fourth Street lot. Overall, the exhibition attests to the diversity of procedural, formal, and technological innovation in prefabricated architecture, and illustrates that the prefabricated house is a critical agent in architectural invention, material and formal research, and sustainability. "[T]he challenge is to exhibit not simply the results but the very processes and the larger stakes-creative, social, economic, even ethical-of architectural practices in a world that demands radical change." (Bergdoll and Christensen, 9)

> *Exhibitionism looks at and thinks through the productive forces of display that go beyond mere knowledge production, although that remains an essential component. It proposes that the exhibition is a work of architecture and, as such, produces a disciplinarity tied to practice. Architecture – often publicly understood as merely built form – is expanded to include exhibitions as critical, spatial practice … Architecture, as a spatial apparatus, embodies an expanded praxis, articulated and performed through myriad mediums and the circulation of media – text, drawing, model, exhibition, building, film, video and so on. Its proliferation and circulation constitutes, and is constituted by, the spatial environment.* (DiCarlo, 39–40)

In this way, the space of the gallery is also an interactive field. "The exhibition represents a setup in which ideas can be tested in their purest form and on a 1:1 scale … as a research space, testing directly how spatial geometry can assist in the production of intersubjective encounters." (Mueller, 90) The exhibition space has become a quasi-laboratory that provides architects with opportunities to advance their research. As a research endeavor, installation design is integral to the practices of an increasing number of architectural firms because, like competition design, it presents an opportunity to explore ideas that can later be incorporated into built work. Furthermore, "many educators use installations to train future architects … to teach students about playing and building with materials, the collaborative nature of architectural practice, as well as the importance of social action and public engagement…and see installations as a form of creative expression situated within the discipline." (Bonnemaison and Eisenbach, 183).

At the 12th Venice Biennale of Architecture *People Meet in Architecture*, the principal agenda was to examine architectural agency in the creation of space and atmosphere. The emphasis of the Biennale was on experimentation and collaboration.

> *Many of the projects are collaborative and staged as controlled experiments – a cloud is generated, a working studio in Mumbai is airlifted to Venice, space is shaped with light, water vapor, sound, vegetation, fabric. Time is given substance through stop frame photography and stroboscopic light. The past takes its place with the present and reminds us of the dreams of different times and alternative futures. The interdependency of space and time are explored through projection, movement, and images (still and moving) that reveal both the complex subjectivity of perception and the intersubjectivity of experience that is shared-in the spaces of architecture as it is in the context of the exhibition itself. Throughout the exhibition the worlds of information and experience collide, intersect, and multiply their contradictions.* (Blau, "Agency," 40)

Experimentation is about discovery. The process of experimenting involves the investigation, reflection, and action. Whether describing a science, writing, or design project, the pedagogical process of experimentation intermeshes theory and practice in potentially fruitful ways. In architecture, drawings and models and full-scale elements "represent both developing thought processes and samples of parallel possibilities … all imagine actual structures, but their form differs depending on what (program, structure, message, etc.) is most central to the representation." (Hasegawa, 83). For the architecture student, "the architecture exhibition, in providing a spatial experience of architectural ideas, in fact produces architecture." (Chan).

4 ADVOCACY

Advocacy exhibitions address socio-cultural issues related to design practice. In these types of exhibitions, the curator – regardless of their status as an architect – plays a key role in the conception and execution of the exhibition because they set the theme and direct the course of discussion around the show. The student as curator is compelled to ask hard questions and, in so doing, develops an increased awareness of architecture and the social implications of design.

Exhibitions are also a significant medium for both expression and criticism in architecture, "suggesting renewed considerations on the work of major architects or bringing to light overlooked figures, pointing

to scenes or territories ignored by the main narrative, or signaling the emergence of innovative design strategies." (Cohen, 49) Beyond documenting history, exhibitions can be used to articulate a multitude of messages, from demonstrating noteworthy ideas on architectural design to advocating for environmental responsibility in building practices. (Lavin, 8).

MoMA's 2011 exhibition, *Small Scale, Big Change: New Architectures of Social Engagement*, featured eleven architectural projects located in underserved communities on five continents. The designs were not 20th century utopian gestures but instead represent "radically pragmatic" solutions that signal a deep reconsideration of the social responsibilities of architecture. With project ranging from vernacular-derived structures in Bangladesh to the transformation of a housing tower in France, "Small Scale/Big Change" is an attempt to reach backward in time, all the way back to the founding years of the modern movement in places such as the Bauhaus in the 1920s, to reconnect architecture with its early social idealism.

City of 7 Billion: A Constructed World, was displayed at Yale's School of Architecture during the fall of 2015, and highlighted the worrisome implications of global development. The culmination of rigorous research, the findings were presented through the language of architectural representation – models, drawings, and digital renderings – to illuminate the roles of designers in confronting population growth and resource consumption. Set within an academic institution, the exhibition used "shock and awe" display tactics to advocate for change and additional attention from the design fields for an increased sensitivity to population explosion and the dangers of excessive energy consumption.

The efforts of architectural curators are important because they are capable of producing developments that are aesthetically, politically, socially active and generative. These experiments are crucial not only because they are research tools, but they also respond directly to the societal issues at this moment, putting seminal topics on the table so that architects develop a critical understanding of these issues in relationship to what it means to build.

5 INTERDISCIPLINARITY

Interdisciplinary exhibitions are creative practices which feature cross-media perspectives. Often, where different disciplines and architecture converge, inquiries about new materials, technologies and media come into focus, making it fertile ground for discussions about design processes/techniques and discoveries of new generative networks. It is interesting to note that, as Kazuyo Sejima, curator of the 2010 Venice Architecture Biennale puts it, "space is no longer solely designed by architects and built forms are realized through collaborations with other professionals and also users of a building. So, curating here is a collective project involving the collaboration of design professionals as wells as exhibition visitors." (Blau, Curating, 21).

Exhibitions can be seen as a medium through which architecture can extend outside its disciplinary boundaries to explore wider territories. Anthony Vidler noted that "the foundations of the architectural discipline have been substantially redefined in relation to an 'expanded field' and a set of different disciplines." (Vidler quoted in Steierhoffer, 10) Vidler observes multiplicity and plurality in contemporary architecture and a widening interest in the 'non-architectural' to construct new answers for architecture's challenges.

> *In a milieu characterized by territorial and institutional deadlock, architects, urban researchers, and community activists increasingly must intervene in situations by questioning traditional architectural methods and "going beyond building." This does not mean dispensing with the value of architecture per se, but rather acknowledging each situation's unique complexity. Our exhibition explores the original ways that these actors are taking up the challenge of designing the conditions from which new architectures can emerge. They are becoming activists, developers, facilitators of a more inclusive urban policy, as well as producers of unique urban research.* (Menking, Levy, and Sturm)

As the official United States representation at the 2008 Venice Biennale, *Into the Open: Positioning Practice* highlights America's rich history of architectural experimentation and explores the original ways architects today are working collaboratively to invigorate community activism and environmental policy. "The curatorial logic behind this project highlights the ways that architects, urban researchers, and activists reclaim the ability to shape community and the built environment. It is our hope that this taxonomy produces a new understanding of American architectural practice and potential forms of social participation" (Menking, Levy, and Sturm). The sixteen, multidisciplinary practitioners in the exhibition include: The Center for Land Use Interpretation, the Center for Urban Pedagogy (CUP), Design Corps, Detroit Collaborative Design Center, Gans Studio, The Heidelberg Project, International Center for Urban Ecology, Jonathan Kirschenfeld Associates, Project Row Houses, Rebar, Rural Studio, Spatial Information Design Lab/Laura Kurgan, Studio 804, Smith and Others, The Edible Schoolyard/Yale Sustainable Food Project, and Estudio Teddy Cruz. The tremendous diversity of the exhibitors meant that the final exhibition was able to project many different interpretations of architectural practice and community engagement.

In recent years, the focus of the biennales in Venice have shifted clearly to the wider social, political and historical context of architectural practice. *Common Ground*, the 2012 Venice Architecture Biennale curated by David Chipperfield, "focused

on the expanded field of architecture, emphasizing its political, social, and public realms as well as the collaborative nature of architectural production." (Steirehoffer, 7). For this Biennale, the curator stressed the importance of including different working methods and the critical roles of other aspects of architectural culture. By working with methods used in allied fields, architects have gained insight into their own works as well as contributed to ideas in other disciplines, thereby creating fruitful relationships with different practices. For example, "emulating artistic practice has given architects a license to release themselves from the obligations of function, shelter, and permanence associated with architectural design. But, as architects adopted these practices from the art world, they also added expertise and perspective shaped by their own discipline, bringing architectural concerns to new audiences." (Bonnemaison and Ronit Eisenbach, 183).

6 CONCLUSION

> *The exhibition structures its arguments interactively with the viewer and is therefore also indeterminate, fluid, and constantly changing. This is a discursive structure that allows the curator to engage historical as well as theoretical questions in a way that is speculative and suggestive rather than conclusive. It also makes the exhibition an ideal format for tackling subject matter that is difficult, multifaceted, even risky*. (Blau, Reviewing, 366)

A new willingness to take on what has been described as "difficult subject matter"—narratives related to violence, loss, and conflict, among other themes—is increasingly evident in museum presentations. With this shift towards a design approach that fosters and encourages social engagement, a new pedagogical approach can be fostered within the academy to assist emerging designers in curating and communicating the many variables that make up our built environment. For the student, a "larger and less bounded conception of architecture as not primarily concerned with objects in the built environment but as a way of thinking about living in the world." (Blau, "Reviewing," 256) Exhibition development is collaborative, messy, and open-ended – a perfect complement to traditional instructional strategies.

In her book, *From Knowledge to Narrative: Educators and the Changing Museum*, Lisa C. Roberts presents the process of designing an exhibition at the Chicago Botanic Garden. Rejecting a simplistic view of pedagogy, Roberts defines education as entertainment, empowerment, experience, ethics, and narrative endeavor. (Roberts) Through these five lenses, each evident in the socially-driven exhibitions briefly explored in this paper, Roberts argues that the role of teaching and learning in the space of the gallery has changed. While her focus is on the role of curatorial and education staff, the emphasis on a multi-pronged pedagogical approach resonates with the interdisciplinarity of contemporary architectural education. The exhibition venue opens up many diverse possibilities for representation, and, consequently, for modes of reception and learning. (Carter, 47) When students actively curate their work – research and design – for public consumption, the capacity of architectural education is expanded. "New models of citizenship, changes in knowledge formations, and competing media environments have challenged museums to rethink both what they are as a medium and their role in society." (Kirshenblatt-Gimblett, 1) The benefits of curation to the student of architecture can, indeed, be empowering, by providing new immersive experiences, promoting critical, ethical thinking, and entertaining those who participate in the narrative endeavor.

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An investigation of building systems education in architecture

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ABSTRACT: A survey was created to evaluate the influence of building systems education on architects' career. 667 received responses indicate only 77% architects believed engineers communicate their requirements clearly and they understand engineers' requirements, and less than 60% architects agreed their education at school was sufficient to understand the technical design principles of building systems. Traditional "lecture – example – homework – exam" approach is widely used in teaching building systems. But many students have difficulties in demonstrating their understanding of design principles in their studio projects. This issue could be addressed though integrating experimental learning into building systems curriculums. Students will be motivated to actively participate in experimentation, reflectively experience and observe experimental phenomenon, and conceptualize the fundamental concepts. Experimental learning projects are integrated in structural system courses in the College of Architecture and Environmental Design at Kent State University. Assessment shows positive effect of experimental learning projects has had on students' knowledge.

1 BACKGROUND

Climate change, depletion of natural resources, environmental degradation, and other "buzz" words arose from the complex interactions between humanity and the natural environment. Architectural design must address these challenges to meet the Architecture 2030 Challenge (http://architecture2030.org/) as well as fulfill its purposes of commodity, resilience, aesthetics, and sustainability. This would require Architects to increase their knowledge in the areas of science, ecology, engineering, technology, sustainability and integrated building systems design. Historically, many architects' creative designs were "killed" by engineers for reasons of structural and financial realities. However, amazing architecture projects are made possible by mutual understanding, excellent communications, and collaborations between architects and engineers. To explore the relationship between architects and engineers, and to evaluate the influence of building systems education in the college on architects' career, a survey was created by the authors in order to improve the teaching approach on building systems in the College of Architecture and Environmental Design at Kent State University, which is located in the State of Ohio, United States. Traditional "lecture-example-homework-exam" teaching model, originated in civil engineering programs, is widely used in building systems courses in the Colleges of Architecture in the United States. But it is observed that many architecture students have difficulties in applying basic design criteria and demonstrating their understanding of design principles in their studio projects. An innovative approach to integrate experimental learning into building systems curriculums is proposed and discussed in this paper. Motivated Architecture students will actively participate in experimentation, reflectively experience and observe experimental phenomenon, and conceptualize the fundamental concepts as well as building design principles.

Experiential learning techniques are already commonly accepted in various aspects of architecture education as well as the profession (Archnet, 2014). Many institutions use experiential learning models in their design studio, and the U.S. National Council of Architecture Registration Board model for professional development is fundamentally an experiential learning model. Perhaps, the most famous example of an experiential learning model is Samuel Mockabee's Rural Studio (MackIntosh, 2014). Not all experiential learning models need to be as immersive as the Rural Studio; there are examples in almost every institution of experiential learning practices many of them taking the form of community involved design studios and research projects. The key to experiential learning is creating an environment where the student is an active participant in the learning process, whereby the student's context and understanding of the material is built around their experience exploring the content area. This method of learning is common in the studio environment and is recognized by the American Institute of Architects (AIA) through its internship program. However, it is uncommon to see experiential learning methods employed in the technical courses that makeup the engineered building systems curriculum.

In late 2013 and early 2014, a survey was administered to practicing Architects and Architectural interns, mainly in the State of Ohio. The intent of this survey

was to gauge how architecture practitioners feel about their architectural education in engineered building systems. The information gained in this survey was used to better understand teaching methods and teaching priorities as it pertains to engineered building systems at the university level. The four engineered building systems surveyed were:

- Structural
- Mechanical
- Electrical
- Plumbing

The survey was disseminated using a variety of social and professional networks. The vast majority of respondents received the survey via an invite from the AIA Ohio chapter. AIA Ohio sent the survey to every registered Architect in the state.

2 SURVEY DEMOGRAPHICS

All respondents to this survey were either registered architects or architectural interns. The survey produced 667 valid responses, which were used for analysis in this paper. Respondents were asked a variety of demographic questions. Of these respondents, 537 self-identified as being 16+ years practicing in the industry, this represents 80.9% of the total responses. 24 respondents (3.6%) identified themselves as being 1–5 years in the industry and 103 respondents (15.5%) self-identified as having 6–15 years of experience.

Architects and engineers engage in a variety of contractual relationships that help frame the working environment and expectations. Respondents' were asked to identify the typical contractual relationship that they engage in with engineers. Respondents were asked to select one of the three following contractual relationships with their engineers either: subcontractor, in-house, or partnership. In a subcontract relationship, the engineer is hired by the architect to perform engineering services on a project. An in-house relationship refers to design firms where the engineer and the architect are both employed by the same entity; these entities are commonly referred to as A/E (Architecture and Engineering) firms. The final option for the respondents is partnership. A partnership refers to when the engineer and architect pursue a project together either as contractual equals. As shown in Figure 2, 71.0% of the survey recipients indicated that the engineer is typically a subcontractor of the Architect. 17.7% have contractors in-house and 11.3% are typically engaged in a partnership with the engineers. This means in the building industry in the United States, architectural design and engineering design are two critical interdependent professions especially in this age in need of resilient and sustainable design and development, which requires mutual understanding and excellent communications between architects and engineers.

Respondents were also asked to identify the project types that they have engaged in over the last 24 months. Commercial had the greatest number of responses at 514, followed by public works at 307, Educational at 263, single family residential at 247, Industrial at 224, and multifamily at 189 (Figure 3).

These numbers indicate the architectural design industry in the United States relies on condition of the economy, and it is most influenced by private and

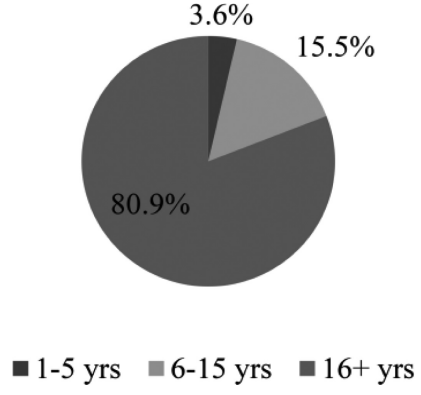


Figure 1. Survey demographics.

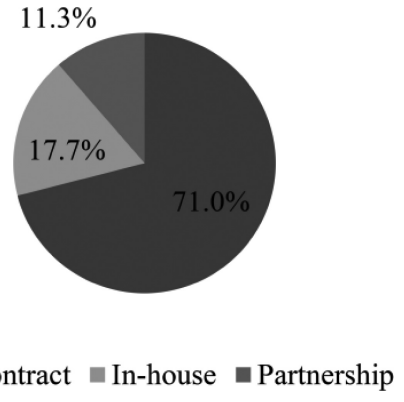


Figure 2. Typical project relationship between the Architect and engineers.

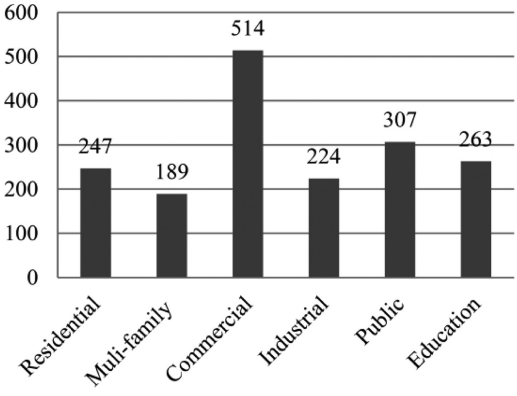


Figure 3. Over the past twenty-four (24) months, what types of buildings have you been involved with.

public investments. In the recent economic recession in the United States, the profession of architects was affected a lot. But the building industry is one of the most important driving forces to turn the economy around in the United States. Architectural design is a profession with both challenges and opportunities. Architecture students need to be ready through training at school and in practice to grasp opportunities and address challenges.

3 SURVEY RESULTS

There were three main objectives of this survey. The first was to identify how Architects self-identify their working relationship with engineers. The second was to determine if architects feel that they are sufficiently competent in the subject matter, and the third was to determine if Architects believe that additional university education (during college) on engineered building systems is desired.

3.1 *Relationships between architects and engineers*

In order to understand how architects feel about integrated building systems design, and how architects communicate and collaborate with engineers, respondents were asked to respond to the following three true/false statements:

- Engineers and I collaborate well together
- Engineers generally appreciate architectural requirements
- Engineers communicate their requirements clearly, and I understand their requirements

97% of the respondents indicated that the engineers and architects collaborate well (Figure 4). This response was consistent regardless of the respondents' years of experience (varying from 95.5% to 97.1%), contract type (varying from 95.9% to 98.3%), or project-type (varying from 94.7% to 99.4%). These results illustrate the strong professional and working relationship that exists between architect and engineers within the building industry in the United States.

Despite Architects identifying that they work well with engineers, only 77% believe that engineers appreciate architectural requirements and engineers communicate those requirements clearly. The discrepancy between collaboration and understanding may indicate that despite a strong professional working relationship (which might be compromised), there are still communication issues between architects and engineers, which may be caused by structural and/or financial realities.

The collaborative environment between architects and engineers can be further understood when the contractual relationships were examined in conjunction with the collaboration questions. Here it is indicated that the professional relationship may influence the collaborative environment. 80.3% of architects who typically partner with engineers believe that engineers communicate their requirements clearly, with only 76.8% and 76.9% for subcontract and in-house respectively (Figure 5). The architects and engineers in partnership relationship have a much better mutual understanding than the other two contractual relationships. This may be because of their equal positions in the project contracts, which requires more frequent open and honest communications between the architects and engineers.

Similarly, 71.8% of architects with in-house engineers claim that engineers appreciate architectural requirements while 78.8% and 76.7% of architects with subcontract engineers and in a partnership with engineers respectively feel engineers appreciate architectural requirements (Figure 6). It is a little surprising the see the architects with in-house engineers have the lowest percentages to feel their work effort is appreciated by engineers. This is may be caused by the potential conflicts of personal interests in the same entity.

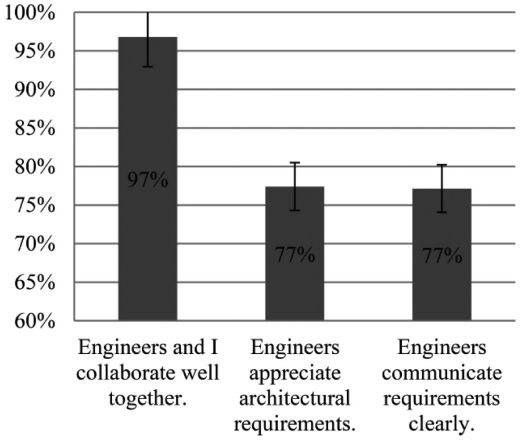


Figure 4. Relationships between architects and engineers.

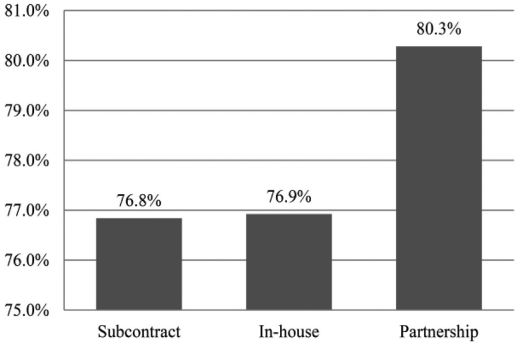


Figure 5. Engineers communicate their requirements clearly.

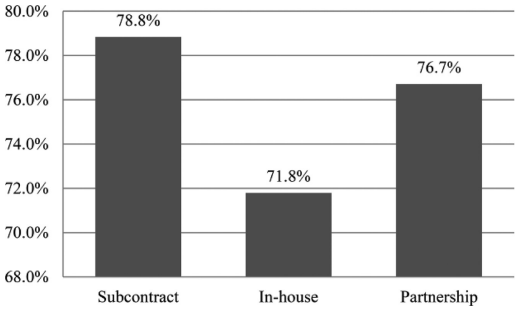


Figure 6. Engineers generally appreciate architectural requirements.

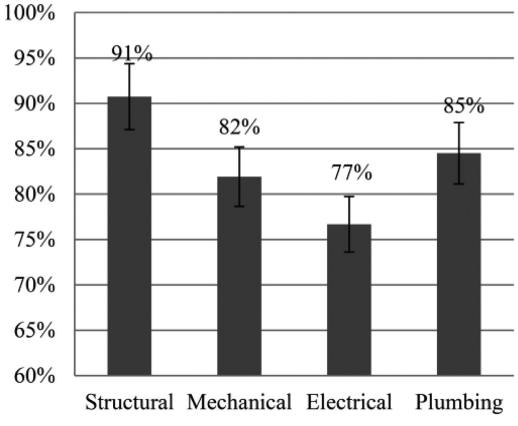


Figure 7. I understand the technical design criteria for the given engineering field.

3.2 *Architects comfort with technical criteria*

The second objective of this survey was to gauge the architects' comfort with the technical criteria for each engineering discipline. When asked whether architects understand the technical criteria for more about a particular discipline, it is shown in Figure 7 that there is a spectrum of architects' comfort with each discipline. Structural: 91%, Plumbing 85%, Mechanical 82%, Electrical 77%. The results above indicate that the majority of architects are comfortable with technical criteria for engineered building systems. However, when asked if they wanted to understand more about the technical criteria, 57.4% of respondents wish they learned more about structural, followed by Mechanical at 64.1%, Electrical 62.9%, and Plumbing 54.0% (Figure 8). This indicated that even respondents that are comfortable with the technical criteria have a desire to learn more. Comfort with technical criteria does not indicate if the professional is content with what they know.

3.3 *Architects learning objectives*

The architecture profession is one with constant learning and growth. The expectation of the university is to prepare young architectural professionals for the

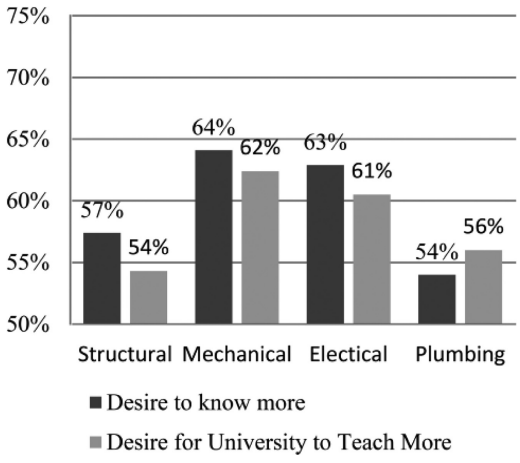


Figure 8. Architects learning objectives.

building industry. Once engaged in the building industry, there is an intern requirement followed by yearly continued education. It is not uncommon for architecture students to make statements similar to the following:

"While it would have been good to learn more in school, there are other aspects of Architecture are best learned in school. The engineering focus may be best during internship."

The above statement may be true if the fundamental engineering design principles are well understood in school. Having identified that the majority of architects have a desire to know more about engineered building systems, the final question was to establish if that learning should take place in the university environment. When respondents were asked whether they wish they understood more about engineered building systems, the majority answered yes, and the majority also believes that the university is the appropriate place for that learning as shown in Figure 8. Based on the survey results, it is important to emphasize students' understanding of the fundamental design principles of engineered building systems at school and make sure students acquire life-long learning skills.

4 EXPERIMENTAL LEARNING – CASE STUDY

The Architecture program in the College of Architecture and Environmental Design, Kent State University balances art and science, and humanity and technology. Like the majority of Architecture Schools, design studios are the central pillars of the program, and other humanistic and technological courses support the design studios. The teaching method for architectural technologies and building systems was traditional "lecture – example – homework – exam" approach, which originated in civil engineering programs. However, based on authors' observation, many students were not able to demonstrate their understanding of

fundamental design principles in their design studios. One reason might be the traditional engineering teaching method does not trigger their curiosities and interests in learning architectural technologies considering design studios take most of their times and efforts. To address this issue, experimental learning is proposed to be integrated into the curriculums of building systems. It is expected that architecture students enrolled in these architectural technology courses will actively participate in experimentation, reflectively experience and observe experimental phenomenon, and conceptualize the fundamental concepts, and fundamental design principles. Taking structural system as an example, this paper introduces the experimental learning projects developed to enhance structural courses in the College of Architecture and Environmental Design at Kent State University.

4.1 *Case study – architectural structures*

The basic goals of structural education for Architecture students should include but not limited to:

- Understanding of form synergy and building structures
- Understanding selection criteria for appropriate structural systems
- Conceptual design of structures for gravity and lateral loads and integration of structural design with architectural objectives
- Basic hand and computer-aided structural analysis
- Understanding of structural design principles, and capability of seeking practical design solutions for building structures
- Effective communication with structural engineers

There are three required structural system courses for architecture students at Kent State University. *Introduction to Building Structures* emphasizes fundamental concepts of building structures. *Structural Systems I* and *Structural Systems II* discuss structural design principles for steel, timber, concrete, and masonry structures. However, many architecture students struggle to apply basic structural design principles and demonstrate their understanding of these principles in their studio projects. The authors concur with Professors R. Gary Black and Stephen Duff from University of California, Berkeley that *"a higher aim (of architectural structures education) is to enable (architecture) students to use structure as a creative design force throughout all phases of design,……. To do this, students must understand buildings at the level of their detailed structural behavior."* (Black, R. G. and Duff, S., 1994).

4.2 *Experimental learning projects*

Experimental learning projects were developed to enhance the lectures of the three structure courses. These projects include:

- Hands-on lab experience to learn fundamental concepts
- Computer modeling using free educational programs RISA 2D and 3D
- Constructing structural models using the 3D printing and/or laser cut technologies

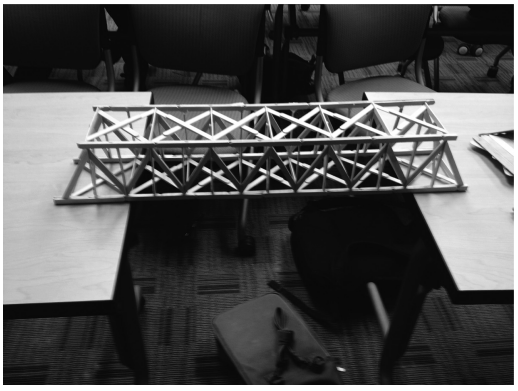


Figure 9. Truss structure.

Integrating these experimental learning projects into structure curriculum requires changes of students and instructor's roles. Students are the center of the classroom, and they must be willing to actively get involved in the experimentations, capable of using analytical skills to reflect on and conceptualize what they see, and apply what they learned from structure courses in their design studios. The instructor must motivate students or get them self-motivated, and assist them in conceptualizing new knowledge.

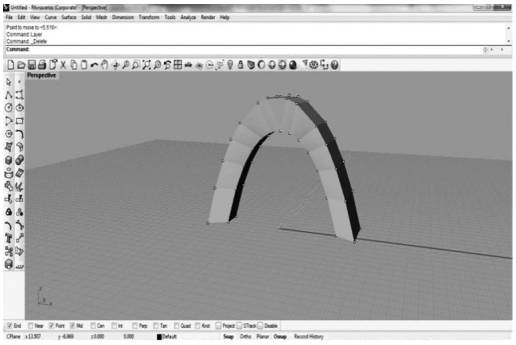
The following experimental learning projects have been developed:

- Truss structure
- Building catenary arch structure
- Concrete frisbee
- Summation of forces
- Measurement of strains of a cantilever beam
- Stable vs. unstable, redundant vs. non-redundant truss structures
- Buckling of columns
- Axial, shear, and moment diagrams developed using computer modeling
- "Zero reactions" using computer modeling
- Deformation of frames with various boundary conditions under lateral force
- Analysis and construction of building structures

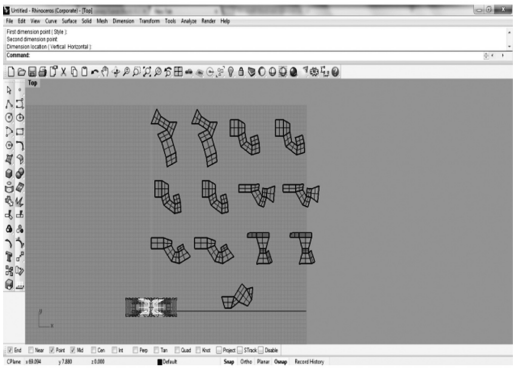
The following contents were included in the write-ups of the developed experimental learning projects:

- Overview
- Objectives
- Materials
- Preparation
- Classroom Activity
- Questions
- Answers
- Note

Three projects i.e. truss structure (Figure 9), building catenary arch structure (Figure 10), and concrete



(a)



(b)

Figure 10. Cantenary arch.



Figure 11. Concrete frisbee.

frisbee (Figure 11), have been implemented in *Introduction to Building Structures*, *Structural Systems I*, *Structural Systems II* respectively. Students enrolled in my classes started to learn fundamental concepts, behaviors of structures, and design principles through reflections on participating in these projects. It took approximately 15 minutes for the instructor to explain each project and perform a classroom demonstration after the new fundamental concepts are introduced in the class. Instructions are provided for students to work on their own during the class and after class

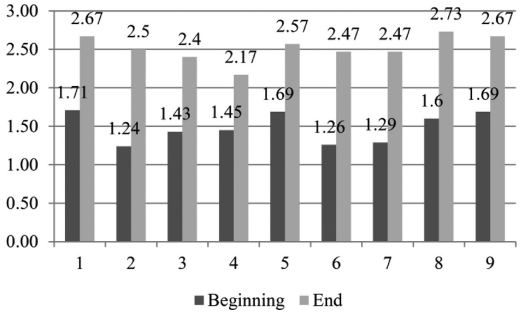


Figure 12. Course outcome assessment.

to continue learning structural design concepts and principles through reflections.

Course outcome assessment was created to evaluate how the experimental learning projects help improve students' overall understanding of structural form selection and structural behaviors in the long term. Students are encouraged but it's not a mandate for them to participate in the evaluations. The purpose of the "course outcome assessment" is to evaluate the effect this course has had on students' knowledge. The survey is given twice, one at the beginning of the semester and the other on the last day of the class.

The following discussion took *Structural Systems II – Design of Reinforced and Masonry Structures* as an example to explain to the evaluation process. Figure 12 shows the results of course outcome assessment of this course. Forty-two surveys were returned at the beginning of the semester and thirty were returned at the end of the semester. Students ranked 9 questions using the following criteria:

- 1 = I cannot solve this problem at this time
- 2 = I can (moderately/50%) solve this type of problem if given adequate time and supporting material
- 3 = I can solve this type of problem with EASE if given proper supporting materials

The lowest rating at the beginning of the semester is 1.24 for the second problem, which is to draw the stress and strain distributions for the rectangular reinforced concrete beams when the section is cracked. It is important for students to understand the basic assumptions made for the reinforced concrete design. The highest 1.71 is for the first problem, which includes questions about the material properties of reinforced concrete. The survey indicates students generally were not capable of solving the problems at the beginning of the semester. With the concrete frisbee project implemented, students had a better understanding of properties of concrete materials and performance of the reinforcing in the concrete. In addition, the project triggers their interests in learning reinforced concrete design. At the end of the semester, the survey indicates all problems can be solved by the students with adequate time and supporting materials. The improvements of ratings range between 0.71 and 1.26. Problem 4 is the one with the lowest rating 2.17 and least

improvement 0.71. This is the question to define the three steel reinforcement ratio conditions: balanced, under-reinforced, and over-reinforced. The students were also asked which condition should be considered to design reinforced concrete beams. The three conditions were discussed at the beginning of the semester. Some students might not have very good understanding of these concepts when they learned the topic. This helps instructor identify the problem and this may be a potential experimental learning project to develop in order to help students gain a better understanding in the future.

5 CONCLUSIONS

A survey was created in this study to identify how Architects self-identify their working relationship with engineers, gauge how architecture practitioners feel about their architectural education in engineered building systems, and determine if Architects believe that additional education on engineered building systems during college is desired.

The survey concluded that although a strong professional and working relationship exists between architect and engineers, there are still communication issues between them. Majority architects are comfortable with the technical criteria, but they have a desire to learn more. University is the appropriate place to facilitate that learning.

Based on the information gained in this survey, teaching method was adjusted by integrating experimental learning in architectural structure curriculums at the Kent State University.

A series of experimental learning projects and a course outcome assessment have been developed to be implemented in the architectural structures curriculum at the Kent State University. Students' active participations, self-reflections, and conceptualization of structural behaviors have been observed in the successfully implemented experimental learning projects. The developed evaluation indicates these projects have played important roles in improving students' understanding of architectural structures. Due to lack of data, there is no information on how the experimental learning enhanced lectures perform compare to the a traditional "lecture-example-homework-exam" approach. But according to several studio professors, students who participated in the experimental learning projects start to demonstrate their better understanding on structural design criteria and principles in studio projects. It has been planned to collect data to confirm it. The course outcome evaluation will be used to monitor the long-term effect of these experimental learning projects on students' performance in structure courses. The successfully implemented experimental learning projects have inspired the authors to develop more projects to be implemented in other engineered building systems courses.

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Structure in architecture – A definition in the poetic tectonic age

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ABSTRACT: Praising structure in architecture reveals its importance as a physical, symbolical and metaphorical expression of its most basic formal syntagma, the minimum architectural significant unit. The present article seeks to determine the meaning and value of structure as a conceptual determinant of architecture. What is *structure in architecture* in the poetic tectonic discourse? The methodology of analysis is based on *Complexity theory* (Morin, 1991); on architecture as a *Pattern Language* (Alexander et al., 1977); and on the *Structure of scientific revolutions* (Kuhn, 1962) in order to detect paradigms and paradigm changes. This cumulative reconstruction of data, in a global and structuring concept, possesses a four-dimensional meaning, understood as universal invariants: space, technique, thinking, and time. The (re)construction of the concept as an open map of patterns searches for order, acting as a theoretical/practical mnemonic for knowledge. It allows its operability as an auxiliary of divergent thinking by raising consciousness.

1 STRUCTURAL SYNOPSIS

1.1 *State of the art*

Rizzuto (2010) concluded that the discourse on tectonics is presented as a Historical invariant, a philosophical pattern of architecture as a discipline. Architecture as a physical reality depends on the *techne* because structure is part of architectural truth in its essential condition of support. Tectonics is the intellectualization of thought about the technique. Tectonic symbolizes the connection between chaos and order which requires a process of know-how for the technical construction. Putting into order is the mythological connection associated with the concept, from which arises architectural meaning.

The critical discourse on tectonics reveals a cumulative and interconnected thought from antiquity to actuality, which can be praised. The tectonic arises as a critical vision of History, emerging in this context as a strategy of know-how linked to architectural form. The tectonic epistemology in Rizzuto analyses detects three key periods in 2500 years of construction: Classical, Rational and Poetic.

Classical tectonics corresponds to the Classical period and it is related to its philosophy. The tectonic philosophy has its origins in ancient Greece mainly in the dialectic between art (*techne*) and *phronesis.* The *phronesis* with its origins from Aristotle is associated with a sense of practical wisdom understood as an intellectual virtue: “common sense”. The etymology

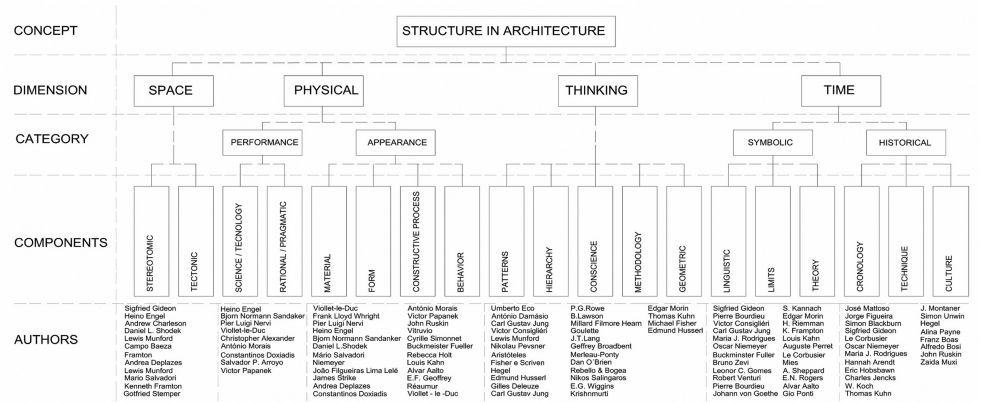


Figure 1. Structure in architecture.

of the word *architekton* symbolizes a network of interconnections between theory and practice used in the design, assumed as a prior idea of what we want to build (Rizutto, 2010).

Rational tectonics has correspondence with the early-modern period and receives influences of epistemology of science while maintaining the general principles of classical tectonics. Renaissance is analyzed in this context with a structural epistemology linked to science and metaphysics. The Baroque is an epistemological change of Vitruvian concepts through the critique of mimesis. The Cartesian thought is changed between mind and body, between artistic subjectivity and technical objectivity (Rizutto, 2010).

Poetic tectonic arises in the late modern period and incorporates the rational enlightenment thought along with poetic Romanticism via a dual conception. The poetic tectonic presents itself as a new epistemological framework that links to the notion of structure concepts such as "nature" and "truth", allowing new scientific conceptions of tectonic analyses in architecture. The poetic tectonic does not reject the rational tectonics but rejects the notion of mimesis. Architecture is understood in this "deep structure" as an individual artistic expression. Freedom of action is enhanced by developments in technology associated with new materials (Rizutto, 2010).

The Vitruvian principle of *structure as architecture* related to the nature of materials in the search of savings and constructive rationality is one of the oldest and long-lasting theoretical/practical traditions of an ideal architecture that still persists. Within the poetic tectonic age different authors have spoken critically on this topic. The historical and global understanding of different perspectives of the concept of "structure" in its relationship between theory and practice, allows an understanding of what is structuring in architecture and how it has changed over time.

Ruskin (1849) discusses the logic of materials within the concept of structure, while adornment is linked to the symbolic and artistic expression of architecture. Viollet-le-Duc (1877) refers to *truth* and *nature* of structure as a ruler component of architecture. Le Corbusier (1927) argues for structural truth interconnected to nature of new materials and the aesthetics of the engineer. There is in Le Corbusier a clear distinction between art and technique as a result of complexity of specific knowledge associated with new building materials. Kahn (1955) develops the idea of a metaphysical school of architecture around the concept of *Order*. Nervi (1956) argues about truth in construction associated with the constructive process. Heino Engel (1967) defines *Structural System* and presents a compendium of organized structural models based on properties materials. Venturi (1977) incorporates structuralism in his philosophical discourse of architecture and demonstrates how structure in architecture has a double meaning: symbolic and functional. The "deep architectural structure" is associated with the symbolic expression that seeks to communicate through language patterns. Alexander (1977) incorporates complexity theory into theory of systems and defines architecture as a pattern language. Patterns are seen as archetypes, primary principles that are comprehensive enough to enable different perspectives. There is a need for obtaining the natural order of things, understanding their internal logic, related to "nature." Eisenman (1984) shifts the concept of deep structure towards linguistic away from the classic concept associated with nature and truth in architecture. Structure in this perspective is understood as a tool for control of architectural discourse. It is the autonomous theoretical discourse that validates the architectural form, into a deliberate distance between art and technique. Prix (1991) considers structure as a *metaphor for forces that* are independent of gravity but depend on energies. The architectural form is designed independent of material because it depends on the logical response of technological tools: the computer. Tschumi (1994) considers that in a project there are three different logics: the logic of words associated with the concept; the logic of design into creating space; and *logic of materials*. The logic of materials depends on the decision of software, independent of architectural design.

2 PROBLEMATIC

By being *structure in architecture* the object of study it is important to define structure and architecture. The starting question is simple and yet complex: What is structure in architecture in the poetic tectonic discourse?

Structure in a broad sense defines a system. A system is a set of cross elements connected to form an organized whole. Accordingly, Structure is a set of items, a collection of interrelated components or services. Structure implies a logical thinking (convergent) through hierarchy, a cascade relationship of one-to-many, or an analog thinking (divergent) in which there is a relationship between various entities via a network. Structure is by definition a system, understood as a set of connected elements according to logical thinking (hierarchy – one too many) or analog interconnections (network) that seeks to form an organized whole (Encyclopedia *Luso-Brasileira da Cultura*, 1970, Vol. 7, p. 1655).

Architecture, in its first and broader sense, refers to the art and technique of arranging and configuring spaces. For Vitruvius, the architectural practice was related to experience, which resulted from consciousness of architectural own structural grammar that sought construction put into order. He added that practice without theoretical sustain of work, did not give moral authority to the author. As a social art and principle of human condition (dwelling space), it is an extremely complex activity because it is a multidisciplinary field covering areas as diverse as: mathematics, art, science, social sciences, technology, history, philosophy, among others. Producing architecture results of a process of synthesis of all these aspects

interpreted accordingly the spirit of its time and place (*Genius Loci*).

A holistic view is essential for understanding the concept of *structure in architecture*, because architecture is an indivisible practice (fig. 1). Therefore, it cannot be understood from a separate analysis of its parts: Art and Technique. Their understanding requires the application of system theory, an open system in continuous interaction, in order to understand its complexity. Complexity realizes that the whole is greater than the sum of its parts and that focusing on particular, can cause blindness (Morin, 1991). Eunice and Carlos Abascal (2010) in an article in the Vitruvius magazine refer the need "(. . .) *to reveal a specific scientific condition of Architecture, within the framework of so-called human sciences"*

3 METHODOLOGY

The supporting theoretical framework is based on the Complexity Theory (Morin, 1991). A global understanding as opposed to specific knowledge can create a wider perception of how architectural theory relates to practice. It allows a holistic vision of architectural knowledge in the search for multidisciplinary analyses.

The theoretical framework is what sustains the perspective to analyze the problem. According to Quivy & Campenhout (1988) the: *"Conceptualization is more than a simple definition or terminology convention. It is an abstract construction that aims to account the real. It does not retain all aspects of a certain reality, but only those that expresses the essence of that reality (. . .) it is, therefore, a construction – selection".*

4 STRUCTURE IN ARCHITECTURE

The concept of Structure in architecture seeks to define the underlying structural lexicon that leads to architectural design, from which it is possible to study language in architecture, by being a *pattern language* (Alexander, 1977).

This cumulative reconstruction of useful data, in a global and structuring concept, possesses a four-dimensional meaning, understood as universal invariants: space, technique, thinking, and time (fig. 1). The dimensions make up the totality of views on this reality intertwined with architect's fundamental knowledges. The clarification of the four distinctive dimensions with its specific categories and components allows their operability as a theoretical/practical mnemonic, extoling their useful value.

Know how to be is the ontological perspective of the object. Ontology is the science of being. Anything that exists and it is seen as something that it is. Knowing how to be architecture refers to spatiality, therefore, within the concept, this leads to the space dimension, the way it is structured, organized and composed.

Know how to do are the abilities and skills applied to solve a characteristic problem of specialization. Knowing how to do architecture refers to its technical dimension linked to practice. Therefore within the concept this corresponds to physical structure, what sustains form. This dimension is divided into two different categories: physical performance and physical appearance.

Know how to think is the theoretical perspective within the global knowledge. This has correspondence with the thinking dimension, the way we reason and structure thinking when producing an object.

Know how to communicate is inherent to the architect's condition of being creative throughout a dynamic learning process. In architecture this is linked to time. Time dimension is divided into two different categories: the symbolic, representing how physical structure carries meaning, and how that meaning has changed; and another related to the historical perspective of physical structure, throughout history, understood as a compendium of evolutions and revolutions (Kuhn, 1962).

5 SPACE DIMENSION

The ontological dimension of *structure in architecture* is spatiality, the set of predicates and qualities attributed to the being. Spatiality is inherent to physical structure as a reality, because it evidences from the very first moment its essential existence. Without structural support there can be no materiality.

Structure as a physical reality can be regarded as a primary form of organization of space due to placement of structural elements (fig. 1). This relationship between elements, arranged in a logical (calculation) and intentional (idea) way attributes a relational and rational nature to the conceived space. Munford (1952) and Engel (1967) concluded that structure and architecture belong to the domain of art because they refer to human spirit as intentional decisions.

Frampton (2002) defines two different categories of structure regarding to its spatial and existential genesis: stereotomic and tectonic. About structure Framton defines "(. . .) *structural unit as irreducible essence of architectural form".*

5.1 *Stereotomic*

Alexander (1977) refers to stereotomic architecture as an example of an efficient structural design defined by a supporting structure that runs continuously and through compression. There is a continuity of material and form, applied in repetition according to a three-dimensional system.

This category of spatial construction defines the space limits with a clear indoor/outdoor separation, understood as a spatial and structural unit. The concept of spatial cells provides outdoor addition to architecture with additive or inner subdivision growth, based on the subdivision of a large initial volume. According to its nature there is no structural hierarchy, because

all structural elements (bearing wall, for ex.) booth support and define spaces. The materials applied are mainly- masonry, brick, adobe and concrete (Deplazes, 2005).

5.2 *Tectonic*

Tectonic architecture is based on a space reticulum due to a structural skeleton. In architecture the structural elements are parts of a bigger whole associated with lightness. In terms of structural performance it is defined by possessing moments due to tension stresses to which it is subjected.

Deplazes (2005) stated that the lightweight construction composed by horizontally and vertically arranged bars, when exploited in their aesthetic sense, provides to space: movement, metrics, rhythm, simplicity, randomness, complexity, proportion and scale. The structural elements are arranged hierarchically according to their behavior in an open system that searches for light in architecture. In terms of openings, it allows the void as a part of the structural reticulum, as we can see in curtain façades, independent of structural plot. The materials applied are mainly- brick, concrete, wood and steel.

6 PHYSICAL DIMENSION

The physical dimension linked to technique is associated with practice, the know-how in terms of building knowledge. This dimension is divided into two separate but interrelated categories with their respective components and indicators: Physical Performance and Physical Appearance (fig. 1).

6.1 *Physical performance*

Physical performance is the set of characteristics achieved through structure that are linked to optimization. It is essentially the field of engineering made from a strictly rational analysis of structure, followed by an approach which makes use of mathematical models for comparative analysis. This category is divided into two components: a scientific approach applied to technology and rationality connected to pragmatic.

Science and Technology covers mathematics applied in calculus, chemistry associated with materials and ultimately, physics related to structural behavior (Engel, 1967). As a manifestation of technology within structural performance we can find software applied to structural calculus and cost.

The rationality and pragmatic components are linked to economy achieved through structural syntheses of functional and aesthetic capacity. The mechanical efficiency emerges as a compromise between the lowest expenditure materials facing a higher yield (Sandaker, 2008). Structural maintenance, durability and ecology are rational and pragmatic concerns. Constructive efficiency and speed (economy of scale) which gives rise to a business plan, also belongs to the act of planning.

6.2 *Physical appearance*

The physical appearance emerges as a category associated with the know-how, the physical structure as an architectural and constructive reality that contributes to the cause of architecture from the perspective of its appearance. This category is subdivided into four interconnected components that affect its physicality: material, form, construction process, and structural behavior.

6.2.1 *Material*

The material has a decisive role in physical appearance of structure for its interconnection with form, the construction process and the behavior. Each material has a constructive logic inherent to its nature that affects structural endurance, its mechanical behavior and durability. There is an intrinsic poetic linked to materials that provides expression to architecture understood as a whole. This is achieved through material application in which values such as: image, identity, plasticity, texture, color and stereotomy take a decisive role (Deplazes, 2005).

6.2.2 *Form*

Structural form belongs to the category of physical appearance by being a real and visible phenomenon that establishes an interactive relationship with Man.

Engel (1967) stated that: "*structure is the first and only tool for generating form and space in architecture*". Structure is an essential mean to model man's building space. Engel's structural systems constitute a set of structural principles in the form of diagrams arranged in structural families. This analysis provided five families of structural systems arranged as a structural genealogical tree: active – Form; active-Vector; active-Section; active-Surface; and lastly, active-Height.

Morais (1997) argues that, conceptually, there are two types of structure: structural forms and structural skeletons. Structural forms have an inherent plastic potential because they depend on specific shapes that optimize force behavior through matter. In this sense, architectural form is also structure.

Charleson (2008) contributes with a third distinction in the relationship between architectural form and the structural form. Structural shapes are *syntheses* (shell structures; textiles; catenary; ribbed; pleated; arches, porches; and supporting walls). *Skeleton structures* have a relationship of agreement with architectural form. Finally, a *contrast form* refers to a hybrid relationship between structural form and architecture, by using the unexpected in order to achieve plasticity.

6.2.3 *Constructive process*

Viollet-le-Duc (1877) suggested that the various elements that made up architecture were related and prioritized according to a logical system. He connected this idea with the notion of truth. The author concluded that builders should be faithful to architectural program and constructive process.

Kahn (1955) refers to the constructive process as a connection between the developments of an idea that gives rise to syntheses in the form of a plan.

Papanek (1995) by analyzing vernacular architecture concluded that a building has an empirical nature, in the sense that knowledge, also plays through experience, trial and error. The author defended a methodological explanation, in which "(. . .) *the method is a combination of material, tool and process*".

Architectural expression varies for the same material once revealed from different constructive processes. Architecture has evolved and perfected from the domain of construction process, from which also draws its own expression. James Strike (1991) detects a breakthrough in terms of building processes within each material, having in common, the inevitable notion of prefabrication, normalizations of measures associated with standardization.

The construction process is the management of tasks in order to achieve a goal with maximum efficiency, throughout a dynamic and evolving process. This notion of construction planning has to do with the know-how by the awareness of strategic options in a given context, such as the material-tool-process.

6.2.4 *Structural behavior*

Engel (1967) defines architecture as the "total" depending on three factors: function, form and technique. The structure for Engel acts as a technical determinant. Structure is the result of another triad, consisting of forces – geometry – material. The concept of structural system is defined as a model projecting structural principles focusing on the flow of forces and geometry. Engel's structural system is based on the fundamental principles of theory of structures: the balance of forces. In order to achieve balance of forces, architects must be aware of structural behavior through concepts, such as: strength; own weight; moment; tension; stiffness; and balance.

Schodek (1992) considers that a structure functions as a whole whenever the parts work together to influence each other, in which the qualities and properties of a system are checked. Verification of the system is demonstrated by structural behavior.

Morais (1997) argues that basic balance of forces is crucial to understand the need for the existence of a reaction force (internal forces) contrary to external forces exerted on a given structure, allowing it to stabilize. In order to decrease the moment, decomposition of forces is needed, usually related with the plastic capacity of structure. This basic equilibrium of forces can be achieved through three types of equilibriums: direct; indirect and nonlinear. Direct equilibrium can be achieved throughout two principles: form and triangle.

7 THINKING DIMENSION

The architectural structure of thought is a dynamic process involving organization of knowledge, in order to achieve synthesis. Although there exists multiple approaches to architectural design (epistemology, praxis, axioms, and hermeneutics), the emphasis is based on the epistemological study of *structure in architecture*. In order to understand the relationship between architecture and structure, it is necessary to underline what's common: the structural lexicon. The architectural vocabulary is the result of a choice from the existing structural lexicon.

The knowledge of structural lexicon allows its subsequent applicability in architecture, understood as a technical useful value, since structural elements assume themselves as syntagms of architectural language. The separation between art and technique is harmful to architecture because it reduces the architectural vocabulary. It's conscience allows sustained evolution of architecture, understood as a language.

The meaning of creation in architecture contains uncertainty in the discovery process, in the search for synthesis. In this perspective architects are by definition voyagers of uncertainty. As Umberto Eco points (1968), this sense of discovery, of mental structure, comes from the capacity to absorb information through memory, subsequently applied into new ideas, when facing new problems. Memory does not come as a source of knowledge, but rather as a faculty that allows us to remember experiences gained through perception, witness and a priori reasoning (Damásio, 2010).

Accordingly to Damásio (2010) thought is considered the most tangible expression of human spirit, because through images and ideas it reveals precisely the conscious will. The author describes human mind as a unique fingerprint, since each one of us has different ways of doing brain connections. Philosophically, thought depends on language because this determines the concepts, judgments and reasoning (Rodrigues, 2000).

Architecture is a universal language that communicates ideas through agreed archetypes (door, window, beam, podium, etc.). It is through architecture that concepts, judgments and reasoning underlying architectural thought, materialize and physically manifest. Although it is an axiom that there is no architecture without structure (principle of sufficient reason), the diachronic mechanisms associated with the creative process go beyond pure logic.

Structural lexicon understood as an architectural technical language depends on the conceptualization of thinking as a form of mental organization, with two distinct approaches: the analog and logic. Divergent thinking and convergent thinking. The way thought is structured comprises: patterns, hierarchy, conscious, methodology and geometry, the invariants detected in different types of thought associated with architectural design (fig. 1).

8 TIME DIMENSION

The time dimension associated with the concept attempts to understand how architectural system evolves. Giedion (1941) considers that the useful

character of architecture can be considered as a factor of communication. The relationship between time and construction, time and ways of thought, time and space, demonstrates that architecture as a discipline is inseparable from communication. It is divided into two categories: the symbolic, associated with the way architectural structure as part of a system of values, carries meaning and how that meaning changes; and finally, the historical perspective of physical structure as a time tool in the evolution of architecture (fig. 1).

8.1 *Symbolic*

The category associated with the symbolic is studied by semiotics. Semiotics seeks to understand the signs as cultural phenomenon's that allow communication. Signs express a sense of belonging to a particular culture and its use revitalizes architectural own culture.

The "architecture of spirit" developed by Levi-Strauss (1962), seeks an understanding of human structural spirit, perceiving that communication is linked to the social domain. The foundation of the symbolic category is the structure of unconscious mind, articulating unconsciously, symbolic and social. Man is a symbolic being that manifests symbolically through language (E. Cassirer, 1944).

The symbolic dimension of structure in architecture explores the duality of the concept. Structure is presented as a constituent of architecture understood as a language. In this sense the structural form has a dual function: the constructive logic (logos) and the symbolic capacity expressed through signs. As Venturi stated: "*There is no way to separate form from meaning".* Architecture, understood as an art of representation, has this symbolic capacity of communicating the ruling power, usually political, religious or economic. The symbolic category comprises the following components: theory; linguistics; and limits.

Whereas theory explores the evolution of meaning associated with the concept of structure, linguistics analyzes the tectonic understanding of "architecture as petrified music" (Goethe, 1839), a discursive pattern. Music and architecture are considered performing arts, whose meaning varies according to culture and time. However, both grow out of immutable and independent internal structures of their own culture and time. This apparent contradiction reveals sensitivity to an implicit order (language), which guarantees universality, independent of communication analyses (speech).

Finally, *limits* as a component of structure represents the overcoming of man against of laws nature, which can be seen through structural spams, high and thickness, as symbolical representations of *sublime.* Economic constraints can also be considered as a *limit* depending on common sense and technical cunning, the Greek "phronesis".

8.2 *Historical*

The historical method applied to the analysis of data has three distinct operations: heuristic related to source collection; critique related to evaluation of pertinent data; and, hermeneutics, the theory of interpretation which seeks the validity of the first issues raised. The category of history encompasses: chronology, technique and culture.

Chronology is a time structure in which different time "scales" might coexist, allowing order into historical events, assuring its scientificity and working as a "*reading machine"*. Therefore, it is essential to rank chronologically, architectural history in terms styles, the aesthetic patterns detected by other historians. It is important to understand alongside communication means in terms of dissemination of knowledge and evolution of transport in order to understand the relationship between space and time. It is also essential to understand: the means and modes of production; military conflicts while epitomes of crisis; evolution of social structures; philosophical ages; and finally, the most influential literature through thematic areas, that can be defined as cultural and civilizational manifestations (Architecture, Politics/Philosophy, Science, Religion, Novels, Economics/History).

Technique is the perspective focused on structural paradigm shifts, its development according to building materials. A perspective on technical developments (structural lexicon) interconnected with materials allows the understanding that architectural evolution and technical evolution are distinct. In architectural history the (r) evolutionary leaps, comes whenever there is a new paradigm associated with technique. Changing to new materials can be considered as a scientific "revolution" because it leads to a new constructive process connected to empiricism. The further development of technique according to a new materiality that becomes recurrent is part of the same paradigm and it is based on evolutionary logic (Strike, 1991).It is possible to find patterns in history from a selection of works that represent the best know-how of their time, the constructive limits of each period focused on technique. In order to analyze technical evolution according to materiality it is necessary to focus on structural paradigms, historical invariants, such as: domes, arc bridges, and height structures.

Culture emerges as a component of structure in architecture because architecture and structure are inseparable entities. Both fields are product of their social, economic and political context. Using historical materialism, focusing on the means and modes of production, it is possible to understand the interrelationships between architecture and its historical time. There are two distinct but intercrossed approaches to the concept: scientific culture linked to *techne* and architectural culture. One is dedicated to the development of constructive solutions in a cumulative process of knowledge, usually related to the field of engineering. The other, of social nature, is related to the set of solutions adopted through history according to specific context (zeitgeist and volksgeist), translated into works or projects that are part of architectural culture.

9 CONCLUSION

The original contribution to knowledge of this manuscript is based on the (re)definition of the concept *structure in architecture* as a theoretical/practical invariant. The concept of *structure in architecture* is achieved after a holistic analysis using the complexity theory (Morin, 1991) as a way to achieve a multidisciplinary approach. By applying the complexity theory it is possible to detect pattern detection (Alexander, 1977) associated with tectonic discourse. Resorting Kuhn's notion of *Structure of Scientific Revolutions* (1962) it is possible to detect paradigms and paradigmatic changes. Paradigms are important because they reveal knowledge patterns. Paradigmatic changes reveal displacements of the concept. The tectonic discourse is interconnected with the architectural philosophy in terms of design.

Different perspectives were then (re) grouped into dimensions creating a wider perception of the concept, understood as a rational gear. By defining structural multiplicity understood as patterns, it allows us to comprehend a particular complex world, anticipating actions and reactions. Establishing a parallel with automotive design, Porsche stands out with a strategy: evolution instead of disruption. In the tectonic discourse it is possible to evolve by having the same structural DNA off all its antecessors.

This cumulative (re)construction of useful data, in a global and structuring concept possesses a four-dimensional meaning, understood as universal invariants of architectural knowledge: space, technique, thinking and time. The clarification of the four distinct dimensions with their specific categories and components allows their operability as a theoretical/practical mnemonic, extoling their useful value.

This (re)construction is an exercise of order linked to cumulative knowledge in its distinctive dimensions, treated at the same level, in a non-hierarchical logic (fig 1). The construction of a mental map allows its operability as an auxiliary of divergent thinking associated with the creative process. The expanding of tectonic consciousness in the act of project extolls the useful value of theory, in its relationship with practice.

Accordingly to Michel de Montaigne (1580) it is preferable to have a well-made head over a well-filled head. This paper contributes to research on architectural education because it works as a compendium of different structural perspectives, organized as a global concept. The whole is bigger than the sum of its parts, by clarifying traditions and putting into order architectural knowledge. The advantage of categorization facing pluralism is related to the expansion of consciousness in the act of designing and top clarification of theoretical/practical ideals (Jencks, 1973). The use of theoretical diagrams as syntheses of complex though allows a deeper understanding of architectural practice extolling the useful value of structure for the continuous evolution of architectural field. By raising conscious that architecture cannot exist without structure this diagram will reinforce a basic, but out of fashion, critical tradition – Tectonics discourse.

Structure in Architecture must constitute a physical syntagma in which space, thought and communication are mingled and together reinforce architectural form, the way of living and economy. Praising structure in architecture is also extoling the rationality linked to architectural intentionality as a useful art, markedly social. Vitruvius already stated that the proper use of the structure was a compliment to architecture.

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Architectural responses to societal challenges via design-build programs in architectural education

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ABSTRACT: The aim of this paper is to introduce public interest focused design-build programs in architectural education. The architectural education programs that embrace both designing and building/constructing of a project are commonly called 'design-build programs' in literature. Design-build programs have the potential to make architecture students think and play an active role to overcome societal challenges. In this study, nine different public interest focused design-build programs that are both curricular, and extracurricular are studied by reviewing the literature to comprehend what design-build programs are, how they emerged, the elements and organizations of these programs, their content, their application formats in architectural education, their goals and contributions in architectural education. When it comes to understand the process of design-build programs, the author of the paper participated in the workshop called Design-Build for Public Interest, which is organized by Yestermorrow Design/Build School in the state of Vermont in the USA in August 2012, making good use of the observations and experience gained there besides comments of the participants who joined different design-build programs. The paper presents findings of above mentioned studies.

1 INTRODUCTION

1.1 *Design-build programs*

The architectural education programs that embrace both designing and building/constructing of a project are commonly called 'design-build programs' in literature. Design-build programs present an educational atmosphere in which students are offered not only the chance of designing but also the opportunity of learning about construction site, structure, building construction, material and material processing within practice. In these programs, building is an essential part of design process. The primary purposes of these programs are learning how to build a construction and experiencing the things exposed during building by participating in the building process actively. The main learning methods of design-build programs are as follows: experiential learning, experience based learning, hands-on learning, learning by doing, learning by making, learning by building, 1:1(full size) learning, learning by serving (service-learning) and cooperative learning.

'With their emphasis on experiential education, collective effort, and community service, design-build studios have some resonance with the educational theories of the American Pragmatist philosopher John Dewey (1859–1952), who placed experience at the center of learning' (Hayes, 2012: 287).

Design-build programs offer a process in which building is inseparable from designing. In design-build projects building is a learning tool and students use building as a catalyst for design decisions (Carpenter, 1997). Thinking and building feed each other constantly and the decision-making process always continues (Fig. 1).

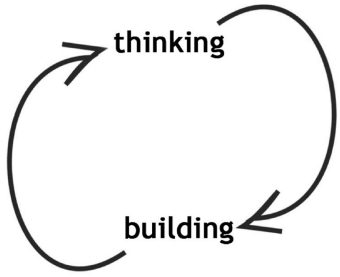


Figure 1. Cyclical process of thinking and building.

The process of design-build approach consists of communication with users, programming, designing, budget allocation, documentation and building. However these processes feed and affect one another continuously rather than a linear process in which one finishes and another begins (Fig. 2).

Tanju (2013) expresses this subject as follows 'Design process cannot be concluded. Despite of the standard practice in which design and its implementation is separated sharply every decision in each step is examined continually and a door is always left open for change.'



Figure 2. Process at design-build programs.

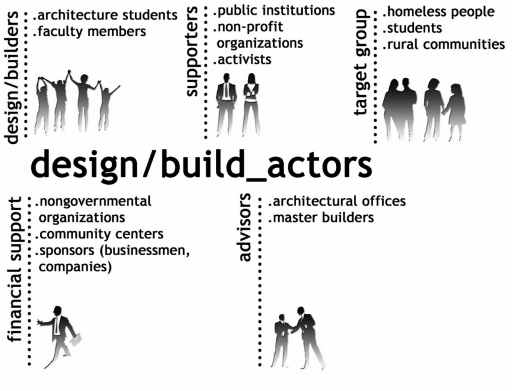


Figure 3. Actors of design-build programs.

In design- build programs, many actors take place such as students, project coordinators, project requirers (activists, civil society organizations, non-profit organizations etc.) professional architects, public institutions, and sponsors. As it is seen in the Figure 3, these partners are classified into five titles, which are design builders, supporters, target group, financial supporters and advisors.

According to Carpenter (1997), design-build approach is a combination of following four points: 'Thinking and making, collaboration, giving back to community and communication skills.' Besides that, design-build programs have the potential to make architecture students think about societal challenges. This makes it possible for architecture students to produce projects that promote the public interest by participating in design-build programs. From this aspect design-build is a hybrid approach in which design and its implementation is integrated by fulfilling a social aspect as well. Hereby in design-build programs, the ethic of giving back to society can be encouraged (Fig. 4).

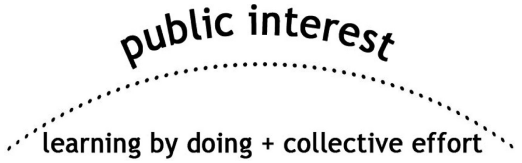


Figure 4. Objectives of design-build programs.

1.2 *Design-build programs from past to today*

The idea of 'design-build' emerged early 20th century and was championed by architects like Walter Gropious at the Bauhaus in 1919, as well as Frank Lloyd Wright with his Taliesin West School in 1938 and followed by Paolo Soleri's Arcosanti in the 1960s.

If we take a glance at the history of design-build programs in Turkey, the Summer Construction Practice at the Middle East Technical University (METU) having designed by the department of Architecture in 1958 has a great importance, being the first design-build study of Turkey. This program got involved in curriculum of the department of Architecture in METU as a mandatory internship. While the first year-internship was practiced at school between the years 1961 and 1968 after that the internship practice, which was funded by the Provincial Bank with governmental support, was based on students' hands-on experience with building in different parts of the Anatolia. Here, the significant point is that students both learned how to build a construction literally, which is also compatible with the principles of Bauhaus, and they achieve a social goal by contributing to the mission of improvement of Anatolia. With regard to this, the schools, guest houses, government offices, and dorms that are constructed in different villages in every summer term have the quality of a community-oriented education (Artun & Aliçavuşoğlu, 2009: 385). METU Summer Practice Program continued without interruption during the period 1958–1974 including the time between 1999 and 2007, but this program is no longer going on.

'First Year Building Project at Yale School of Architecture, the oldest continuous design-build course in North America. Founded during the 1966–1967 academic year, Yale's program originated in a context of student activism and volunteerism during the 1960s and reflected the idealism of President Lyndon Johnson's Great Society program' (Hayes, 2012: 286).

Yestermorrow Design/Build School was founded in 1980 as a summer camp for non-architects who wanted to design and build their own house by Yale University graduate John Connell in the state of Vermont, USA (Carpenter, 1997: 30).

Student activism and volunteerism in 1960s following the World War II, the social politics of the era and improvement projects had an effect on the outbreak of the design-build initiatives.

'In the 1990s, design-build programs expanded. Steve Badanes program at the University of Washington along with the now iconic Rural Studio under the

direction of Samuel Mockbee emerged at this time. Both are still in operation and continue to influence programs. The themes of alterity, community service, and experimentation that define this history remain and provide a sketch of the activity overall' (Canizaro, 2012: 21).

According to Gjertson (2011) there are approximately 100 design/build programs throughout the 123 NAAB accredited architecture schools.

Today it is impossible to assume the number of design-build programs in the world. There are both continuous programs such as Rural Studio and intermittent initiatives by faculty members or students.

1.3 *Methodology*

Within the scope of this study nine different public interest focused design-build programs that are both curricular, and extracurricular, that is to say, the ones which are disincluded in architectural education and carried out in the forms of workshop and, summer school are studied by reviewing the literature to comprehend the content, the elements and organizations of these programs, their application formats in architectural education, their goals and contributions in architectural education.

When it comes to understand the process of design-build programs, the author of the paper participated in the workshop called Design-Build for Public Interest, which is conducted by Yestermorrow Design/Build School in the state of Vermont in the USA in August 2012, making good use of the observations and experience gained there besides comments of the participants who joined different design-build programs.

2 ARCHITECTURAL RESPONSES TO SOCIETAL CHALLENGES VIA DESIGN-BUILD PROGRAMS

2.1 *Public interest focused design-build programs*

According to Canizaro (2012: 23) the most prevalent characteristic of design-build programs is their organization around and intention to provide service to local communities. This is done for both pragmatic and aspirational reasons. In pragmatic terms, it is more reasonable for institutions to support and offer services to those in need when using the labor and talents of students. This keeps them out of competition with local professionals as they tend to work on projects with no potential for profit and it sidesteps the conflict between students paying fees so that they can in turn provide services to others. Virtually every program designs and builds as a public service and as such, engages in service-learning.

Thomas Dutton, who runs Miami University's Center for Community Engagement, and focuses on supporting the Over-the-Rhine neighborhood, sees a further role. 'We're not just trying to help a community, but we're trying to deconstruct students' privilege. We're trying to get them to be better citizens, better community advocates, and to understand the complexity of urban areas' (Sokol, 2008: 125). The six-week Over-The-Rhine Design Build Program creates a well-rounded experience where students engage with the community on many levels—as designers, advocates, and neighbors.

Samuel Mockbee who was a co-founder of the Auburn University Rural Studio program in Hale Country, Alabama, calls Rural Studio as 'classroom of the community' (Dean, 2002: 3) and states that 'Architectural profession has an ethical responsibility to help improve living conditions for the poor and it should also challenge the status quo into making responsible environmental and social changes. Hence architectural education should expand its curriculum from paper architecture to creation of real buildings and to sowing a moral sense of service to the community' (Dean, 2002: 1).

Design Bridge is a multi-disciplinary student organization and states its mission as: 'The focus is to bring the resources and energy of students to communities and organizations that don't have access or resources to acquire professional design services. We focus on projects that have a mutual benefit to us as design students and to the community.' (Url-1).

In this study to be able to understand the content of public interest focused design-build programs a table is designed (Table 1). At the table nine different design-build programs are examined under the heads of affiliation, project types, project's target group, project duration, materials and classroom size.

When we analyze the position of design-build programs in architectural education we observe that each program is constituted in a different shape both in the architectural curriculum and as an extracurricular activity. These programs can be involved in almost every stage of architectural education which includes curricular subjects, which are in the forms of compulsory and selective courses or summer internship for undergraduate and graduate students, and extracurricular activities such as workshops and studies generated through students activism and volunteerism.

In design-build programs projects are mostly prepared for low-income communities living in rural and urban districts, majorities deprived of architectural service and the societies affected by the political and natural disasters. In these projects, with an average class size of 20, the subject of sustainability, which is among the aims of architecture is emphasized by utilizing local products, sustainable and recyclable products easy and cheap-derived products and salvaged materials. Within design-build programs, in addition to indoor and outdoor restoration and extension projects, which can be concluded in a short time, more complex projects that continue for a long time and necessitate infrastructure are also designed. However the primary objective of design-build program is not the size or dimension of the project. Actualized projects are the tools to reach the targeted pedagogical and social goals.

Table 1. Public-interest focused design-build program examples.

Program name	Affiliation	Project types	Project's target group	Project duration	Materials	Classroom size
Rural Studio	Auburn University	Affordable housing	Rural communities in Alabama, USA	1 year	Timber, Steel	4 to 20 Students
Design Bridge	University of Oregon	Sustainable and green building practices	Non-profit organizations	1 year	Wood, Stone, Concrete, Metal	8 to 10 Students
Basic Initiative	Portland State University & University of Texas	Elementary schools, clinics, libraries, houses etc.	Rural communities in the world	15 days to 4 years	Locally-sourced materials	11 to 45 Students
Urban Build	Tulane University	Affordable housing	Deteriorating neighborhoods of urban New Orleans	1 semester	Timber, prefabricated materials	11 to 20 Students
Over-The-Rhine Design Build	Miami University	Redesign & renovation of historic buildings	Non-profit organizations	1 semester	Timber, steel, concrete	12 to 16 Students
Learning by Making A	University of Tasmania	Playgrounds, compost toilets, bus stops, mud-brick domes etc.	Community groups in Tasmania, Australia	1 to 2 semesters	Sawn timber, plywood, concrete, steel, mud-brick	9 Students
Summer Construction Practice	Middle East Technical University	Small scale houses, dispensary, computer workshop etc.	Rural communities in Turkey	2 months	Timber, stone, concrete	1st month: 30 Students 2nd month: 30 Students
Architecture for All (AfA)	AfA is Istanbul based nonprofit organization	Redesign and renovation of old school buildings.	Rural communities in Turkey	10 days to 8 weeks	Timber, stone, concrete	10 to 40 Students
Design-Build for Public Interest Workshop	Yestermorrow Design/Build School	Bus stop, pedestrian bridge, compost toilet etc.	Non-profit organizations	2 weeks	Timber	6 to 12 Students

According to Schuman (2012: 256) 'Interest in humanitarian work in recent years has been quickened by a series of political and environmental disasters starting with the attacks of September 11, 2001, and continuing with the Indian Ocean tsunami in 2004, Hurricane Katrina in New Orleans in 2005, and earthquake in Haiti in 2010. After the attacks in 2001 Architecture for Humanity, founded by Cameron Sinclair and Kate Stohr in 1999 and promotes architectural solutions to humanitarian crises, reported a fourfold increase in membership, with upticks following each of the succeeding catastrophes. These events constituted a call to conscience, prompting people in all fields to reevaluate their priorities in the face of human suffering. Because the reconstruction needs so directly involved architectural skills, however, many architects felt a special sense of urgency to respond. Professionals and students volunteered in rebuilding efforts, from weeklong stints cleaning debris in New Orleans to design-build projects in affected areas.'

Urban Build Program organized by Tulane University was founded in 2005 after Hurricane Katrina and within the scope of this project; low-cost housing projects were conducted for hurricane victim New Orleans Region in cooperation with a nonprofit organization called 'Make It Right'. Another example is that Portland State University organized a summer school in 2011 in Haiti to design and do the projects such as solar kitchen, clinic, canteen, agricultural production gardens for earthquake-victim communities.

Urgent architectural solutions are needed for societies influenced by the 21st century wars in today's world such as 2011 Syrian Civil War, besides political and natural disasters. Design-build programs can be potential to meet such immediate architectural need.

Design-build programs depend on the willingness of the actors such as executives, participants, taskmasters and users. Executives' taking the responsibility of the conduct of design-build programs, students' designing and doing a project by laboring and devoting time for love, taskmaster's supporting the project in progress financially, users' requesting the project willingly are all based on the principles of volunteerism and in the meantime the communication that have an important place in architecture is also put into practice.

In design-build programs in the form of a workshop and the programs working in the form of associations based on volunteerism and activism, the participant profile has variety, for such programs are open to participation of national and international volunteers. In this case, people having different perspectives, who don't have acquaintance before, come together and so an environment of rich communication and information exchange is provided.

2.2 *Yestermorrow experience and student comments*

'Yestermorrow Design/Build School in Waitsfield, Vermont trains students in the arts of design and craftsmanship as a single integrated process. Through experiential learning in the design studio and workshop and with an emphasis on designing in partnership with the natural world, students develop critical thinking skills and technical know-how, expand perception and perspective, and deepen their creative assets for living and building resourcefully through the work of their own hands.' (Yestermorrow Design/Build School, 2012/2013 Catalog: 4).

Within the scope of the study the author of the paper participated in the Design-Build for Public Interest Workshop at Yestermorrow Design/Build School in Vermont. With guidance from Steve Badanes, Jim Adamson and Bill Bialosky. a group of six students, including myself, designed and built a composting toilet for Shelburne Farms, a century old educational farm outside Burlington, Vermont. Utilizing consensus design and natural building principles, we built our structure with materials sourced from the farms property. The first week of two-week Design-Build for Public Interest Workshop was devoted to investigation of the land on which the construction was going to build, creation of the budget and requirement list by meeting the client, improvement of the project, presenting the project to the client and time planning; the second week was left for the construction of the project.

The experience gained during the design and implementation of the project in question will be attempted to be expressed under the titles given below. Additionally, comments of the students who participated in other design-build programs are going to be given in terms of providing insight about design-build process.

2.2.1 *Learning by doing*

During the study of Design-Build for Public Interest Workshop organized by Yestermorrow School of Design/Build, the state of acting simultaneously, the formation process, and the inversion process always continued. Design and practice's feeding one another is experienced with this workshop.

Regarding this issue, Rural Studio participant Josh Cooper expresses 'Rather than drawing a window and not having a clue what I was drawing, there was now a client standing there and that window had to work for him. On a different level, I gained a lot of confidence knowing I could make that window work' (Dean, 2002: 3).

Likewise a student from University of Tasmania states 'We all learnt things that can only be realized through experience, no amount of lectures could have taught us as much' (Wallis, 2005: 182).

2.2.2 *Details*

The workshop was also very useful to get the grips of joint details. I realized that I used to draw some details rotely, without understanding completely in my construction sciences and construction project courses at university. To sum up, drawings in construction sciences course, which was blurry for me most of the time, formed in my mind better.

Concerning this issue a student from University of Tasmania expresses, 'Gave good knowledge of basic detailing which enhanced understanding of construction in general' (Wallis, 2005: 125).

Similarly Rural Studio participant Andrew Olds states, 'Samuel Mockbee had made me understand that where things come together provides a detail opportunity. He taught me about economy of materials, to compose a building without excess' (Dean, 2002: 157).

2.2.3 *Team-working skills*

A lorry full of timber, which was going to be used in the implementation of project during the workshop, was brought to campus. We experienced the power of teamwork by piling the timbers in materials area in a short time like forty minutes with six participants and three executives together.

Regarding this issue, Rural Studio participant Jen Stanton states 'The fact is, architecture is teamwork, and this is the first time most students have worked with someone else. We do everything as a group and learn to compromise. Sometimes we yell at each other, but we learn to figure things out together' (Dean, 2002: 3).

2.2.4 *Realization of scale*

In the course of workshop while working on compost toilet project, one of the striking points was the difference of scale. We used a full size scale in this project, so the mistakes we made in the previous steps had an effect on the next steps. Although it is unrealistic to expect everything to be perfect, a more careful study was required. Because of the fact that spaces widened, we needed scaffolding materials to support construction elements continuously. We could feel how much the construction would be heavy. We weren't able to

carry alone some construction elements. Therefore we asked for help.

Similarly Rural Studio participant Jen Stanton expresses that working construction has taught her that a built design often feels different and functions otherwise than she imagines in a drawing and continues, 'A five-foot space isn't the same in your mind as in reality; your mind can play tricks' (Dean, 2002: 155).

A student from University of Tasmania states that with the participation of design-build program he becomes more aware of the materiality of building elements, their physicality and realization, that it is far more than lines on paper. Making offers possibilities that may be unknown in a drawing (Wallis, 2005: 120).

Another student from University of Tasmania states 'Looking at the design models and drawings, then exploring the finished building, my sense of scale changed' (Wallis, 2005: 181).

Likewise another student from University of Tasmania expresses 'Experiencing design-build process enables you to realize any errors whereas drawings tend to allow more mistakes go unseen' (Wallis, 2005: 182).

2.2.5 *Social responsibility*

Shelburne Farms is a century old educational farm and works as a nonprofit organization outside Burlington, Vermont. Designing and building a composting toilet for such an organization and, to know that our design will be used by community, provides us, the participants, with the senses of social responsibility and working ethics.

Similarly Rural Studio student Jen Stanton was attracted to the studio, she says by 'the opportunity to design something and actually see it come to life, be used, and be part of a community' (Dean, 2002: 155).

2.2.6 *Learning from each other*

I suppose arising from inexperience, the feelings of fear and doubts stood out about how it could be to experience constructing a building, which I had never tried. In this step, I grasped the drill for the first time in my life and with the help of my group friends I learned how to use it smoothly in a very short time like ten minutes. Some participants in group who had construction experience before eased the burdens' of executives about helping the inexperienced ones, as they had an idea about how to use the tools.

Regarding this issue, Rural Studio participant Jen Stanton states 'The assigned task was to help fifth-year thesis students build a little cottage. We got to interact with the thesis students and create a family atmosphere. They shared what they'd learned. I think of them as models for us architecturally and socially' (Dean, 2002: 155).

Another Rural Studio student Andrew Olds says considerable learning happens through doing and from other students' mistakes (Dean, 2002: 158).

2.2.7 *Lifestyle*

In design-build programs by going out of the studio in spatial terms, that is to say, working in different places during construction process apart from the offices or university campus, the opportunities of learning in the open air at the same time building relationships with local people and knowing about different cultures are provided. In design-build programs in the case of doing a project out of the campus area students and executives lives together in construction site by this means, close relationships feeding both student-student and executive-student rapport are built. This intimacy gives way to asking questions without fear and learning freely. The culture of living in learning community contributes to build close relationships to a great extent.

Concerning this issue Rural Studio student Jen Stanton expresses 'We lived, breathed, slept, and ate architectural school there. We didn't have a break from it. At the studio home is school and school is home. It's a lifestyle; it's not just education' (Dean, 2002: 156).

2.2.8 *Lifelong learning*

About lifelong learning subject, Madeleine Claire Hahn, who was a participant of Design-Build for Public Interest workshop expresses 'I did learn some basic construction rules that are important in the design process. Knowing the basics of construction will also help inform my future designs.' (Şahin, 2013: 167).

2.2.9 *Time exceeding*

About timing issue Rural Studio participant Jen Stanton states that her team accomplished less than she had hoped because everything took longer to build than she had expected (Dean, 2002: 156).

Regarding to this subject one of the hardest things for Steve Hoffman, who was a participant at Rural Studio, is accepting the slowness of the building process (Dean, 2002: 159).

2.2.10 *Limited kind of material*

With regard to usage of limited kind of material a student from University of Tasmania states 'The level of understanding construction/structure in this school of architecture is very limited to only one material – timber' (Wallis, 2005: 120).

Similarly, at Yestermorrow Design/Build School's Design-Build for Public Interest Workshop, the material we used while building a compost toilet was also timber like the material used in previous studies of the same workshop. The reasons why wooden elements are utilized predominantly in projects are the ease of working with wood, enabling carrying out small size projects and its easy transportation.

3 RESULTS AND DISCUSSION

The building, which is a part of design process, is a creative action, at the same time a learning tool

that plays an important role in improving the design idea. The experience gained in design-build program causes the participants to think the designing activity again. As a result of this rethinking, participants figure out that designing and building are processes feeding one another rather than being apart from each other, because in the learning environment of design-build programs it is possible to trying full size scale, to head for a different idea when you feel your mistake and to experience by doing.

Construction's taking a long time, but academic calendar's comprising a short time, design-build program's need for budget on the other hand funds' being limited, perceiving the implementation of design-build projects as a vocational training rather than an academic and intellectual education can cause design-build programs not to be supported by the university administration. Inexperienced participants and limited time can cause the executives to take the role of master and lead the students to take an inactive role in design-build process. All of these are the leading obstacles preventing design-build programs from being a part of the architectural education, its foundation and sustainability.

Although working in design-build programs bring certain limitations such as budget, time, and lack of knowledge of construction it is very important in pedagogical terms to experience a process in which design and build feed each other, to touch what you design, to deal together with certain subjects such as structure, material and details from the very early phases of design.

The faculties of architecture have to enrich their programs, make them flexible and personalize them according to their students. For this reason, in the curriculum of architectural education there should be enough variation in terms of courses. There should also be courses that give importance to teamwork, material, touching the design, understanding the details, enabling communication and dealing with abstract and concrete, imaginative and the real together. Even if these courses are not compulsory in the curriculum they should take place in the form of selective courses.

4 CONCLUSIONS

In the design-build programs, students can gain awareness about topics such as research, environment-friendly designs, salvaged construction materials, building construction methods, passive building techniques, public relations and communication with people by doing projects for people in need. In design-build studios the necessities of projects' implementation, utilization and delivery in due time provide the participants with the senses of responsibility and working ethics. In addition to this, the practice of projects for people in need contributes the growth of awareness of social responsibility in participants. Public interest focused design-build programs see architectural practice as based in an ethical commitment to others. Because of the fact that the projects are designed and built labor intensively for a specific aim they help the participants to understand how important the team work is in architecture. The participants of design-build programs comment that the knowledge they obtained in the process of design-build is going to affect their future designs, too. From this perspective, the fact that the knowledge and experience gained through design-build programs is going to be adapted to architectural situations encountered in professional life which makes a contribution to lifelong learning.

According to Gjertson (2011: 24) 'design/build projects directly address the National Architectural Accrediting Board (NAAB) criteria of collaboration, project management, leadership, legal responsibilities, ethical and professional judgment, and community and social responsibility.' Besides that participants of design-build programs become skillful at communication skills, sustainable design, financial consideration, client role in architecture, building materials and assemblies integration which are also included in NAAB criteria.

Architecture is a discipline in which theory and practice go hand in hand. Therefore, in architectural education, application should also find its place besides theoretical teaching. As design-build programs are a hybrid approach in which design and its implementation is integrated by fulfilling a social aspect as well, covering these programs in curriculum will enrich the architectural education.

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Modeling architecture design studio on practice-based integrated "ways of working"

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ABSTRACT: This paper focuses on an architecture design studio aimed at preparing students for their transition to a professional context and encouraging them to explore and embrace the complexity inherent in contemporary design problems. The studio used five pedagogical methods to simulate professional practice-based integrated "ways of working:" workshops at regular intervals; design teams to promote collaboration and enable individuals to assume "expert roles;" tools and technologies to inform and guide design decisions; the use of a detailed precedent that illustrated how another design team made design decisions; and performance targets used as ways of evaluating the effectiveness of design concepts and ideas. These methods were successful in stimulating the student teams to think holistically about the design process and may serve as an effective model for future design studios at other design schools. A number of recommendations are offered as ways of improving upon the methods discussed.

1 INTRODUCTION

1.1 *Background*

Contemporary buildings are more complex and technically sophisticated than ever before. Addressing code requirements, performance targets, sustainability goals, and user needs during the architectural design process now necessitates the involvement of a wide range of specialists. Gone are the days of the "hand-off" where architectural teams worked sequentially in silos passing information and changes back and forth. Emerging integrated design processes (IDPs) demand early, active, continuous, and collaborative involvement of all design team members to achieve a consistent integration of myriad project components into a unified, holistic design outcome that meets increasingly stringent client expectations and goals (Elvin, 2007; NIBS, 2015). Yet most students in design schools still complete projects independently, a "sole practitioner" model that is increasingly rare in professional contexts (Nicholson, 2005). Such a model is antiquated in an era of emerging integrated design practices. Some schools have responded by moving design studios off-campus to professional contexts (Crosbie, 2012).

Buildings now account for approximately 40% of total primary energy use in the US and the EU and 40% of carbon dioxide emissions in the US and 36% of carbon dioxide emissions in the EU (DOE, 2015; European Commission, 2015). These staggering figures demonstrate the critical role of buildings in addressing broad-scale global climate change issues and have spurred tremendous interest in sustainable design practices and standards (e.g. LEED, BREEAM, and Passive House) as well as building performance targets (e.g. net-zero energy, carbon neutral buildings, etc.) aimed at reducing overall building environmental impact. The 2010 Imperative advocated for, among other things, instructors at design schools to include language in design studio projects requiring students to dramatically reduce or eliminate the use of fossils fuels in their design solutions (Mazria, 2007). Clearly, the goal was to prepare students in school for addressing the kinds of complex environmental issues, targets, and requirements they will face in professional practice, but few design studios at schools of architecture appear to be meeting the goals of the 2010 Imperative.

The ways in which building designers work together in professional practice settings are rapidly changing and differ significantly from the ways in which architecture students are accustomed to working on design projects in school. If we wish to get students excited about emerging trends in professional design processes and to prepare them for future professional work once they leave the academy, a critical question emerges: how can we align the design curriculum with emerging models of design practice to provide our students with stimulating and useful design experiences that address real-world conditions and problems? This paper presents one approach to addressing this discrepancy through the design and implementation of an architecture design studio course.

1.2 *Goals*

The four goals for the ZEB House design studio were: (1) to simulate innovative professional design processes on a smaller scale with architecture students and select visiting experts in lieu of a large and diverse assortment of building design professionals (e.g. landscape architects, sustainability consultants, engineers, and many more); (2) to train design students to handle integrated "ways of working" through the complexity and apparent chaos inherent in real-world design problems and to use the expressive power of design to address a range scales from regional-level considerations to building performance to fine-grained (and often "softer") end-user experiences; (3) to focus on site-specific qualities (e.g. view, macro/micro climate, local material resources, walkability, and transportation) and client-specific considerations (e.g. user needs and lifestyle) prevalent in professional practice that are critical to market acceptance, adoption, and success of sustainable design; and (4) to help students feel comfortable working with the types of numbers, calculations, and metrics common in high-performance building design as a way of informing and guiding their design explorations.

This paper describes a series of pedagogical methods employed in an intermediate-level design studio with undergraduate and graduate students at the University of Oregon in the United States in Spring Term 2015. The design studio was co-taught by a PhD candidate with teaching and professional practice experience and a visiting instructor working in international professional practice.

Five primary pedagogical methods were used in the course: workshops, design teams; tools and technologies; the use of a precedent; and performance targets. For each method, we describe the connections or links with practice-based integrated "ways of working;" how the method was adapted to suit the design studio course curriculum and format; and specific examples of outcomes from the ZEB House studio project, which focused on the design of a zero emissions single-family house in Oregon. In addition, we will address the challenges, practical implications, and recommendations resulting from our pilot test with this specific design studio course.

1.3 *Ambitions*

The studio project example relied on the ZEB (zero emission buildings) sustainable design concept and procedure developed in Norway, which is arguably the most ambitious sustainability standard or target being used in the building design industry today. We chose to have students focus on a zero emission building: to introduce them to ZEB as an emerging research and design mindset, to encourage them to deal with sustainability issues on an advanced level, and to get them to consider/rethink the standards and methods required to fuel innovation in the design professions.

This paper is not concerned with the ZEB concept per se, but rather with how a ZEB-focused project can illustrate specific pedagogical methods employed in the studio. A number of excellent papers already describe the ZEB concept and outcomes in detail (Houlihan et al, 2015; Good et al, 2015; Goia et al, 2015; Kristjansdottir et al, 2014). A ZEB-focused project is not a prerequisite for adopting or applying the methods we describe in this paper. However, for us, ZEB represented one of the most complex types of integrated design processes we know of and, as such, it served as a useful target or ambition for student design explorations.

2 PEDEGOGICAL METHODS

2.1 *Workshops*

Workshops are a cornerstone of integrated design processes. Sometimes called by other names such as "eco-charrettes, team meetings, planning sessions, etc., the basic premise of workshops are to get the design team members in the same room at the same time to work through concepts or problems collaboratively. Workshops are not so much about designing something together or by consensus, but rather about talking through the range of ideas and/or issues that can inform the way specialist team members approach their specific design task. Designing happens in between the workshops. Also, workshops are less about *how many* people are present and more about *who* is present. All voices are heard. Diversity of representation is a key element to the success of the process. Finally, workshops happen at intervals, which helps provide structure to specific design phases and are often successfully used to launch the next design phase and to plan ahead.

In this studio, we used three workshops as a way of dividing the 10-week project into phases with the workshop acting as the kick-off event for the next phase of design development. We addressed the lack specialists among the architecture students by assigning roles (or "hats") and by inviting visiting experts to join-in on the discussions to help fill in the gaps in student knowledge or experience. Each workshop was one 4-hour studio class period and entailed a combination of different kinds of activities: breakout groups, all-class discussions/presentations, and feedback from visiting critics. (See Figure 1).

A goal for the ZEB House project in particular was a strong connection between indoor and outdoor space as a way of connecting occupants with local climate, extending occupant comfort during cold/warm times of year, and reducing primary energy demands for heating and air-conditioning. The first workshop addressed this goal by asking the students to role-play different perspectives on the design of outdoor living space and to develop a set of design criteria and ideas. Visiting experts from NUTU in Trondheim, Norway, a visiting practitioner from San Francisco,



Figure 1. A Workshop where invited experts provided feedback to facilitate activities in which students played a specific role on a design team and work through concepts and ideas collaboratively.



Figure 2. Students worked in 3–4 person design teams for the entire project. Here students work collaboratively on their ZEB House design during studio class time.

and the instructors provided feedback on specific architectural responses to climate considerations and the emerging student design ideas. The role-play activity was organized such that one-hour role-play activities were separated by all-studio check-in meetings, where the groups presented ideas and received feedback before moving on to the next workshop activity. The workshop initiated the first phase of the design project and helped to emphasize the importance of the outdoor space as a key programmatic component early in the conceptual design process. The workshop allowed students to focus on one type of space in some detail and the final projects at the end of the term, perhaps unsurprisingly, had strong and developed outdoor spaces represented in their design concepts and schemes.

2.2 *Design team*

Professionals most often work in teams, not alone. Design team composition reflects the skills and competencies needed to address the project scope, goals, and ambitions of particular design projects. The more sophisticated or elaborate the aims of the design project, the greater the need for specialty expertise on the design team. For example, a ZEB project addressing embodied material emissions, life-cycle of material assemblies, and carbon pay-back strategies using renewable energy will likely include team members with expertise in life-cycle analysis (LCA) and renewable energy system design and production, roles that may be absent in standard design projects with no stated carbon emissions or renewable energy goals. Of course, these specialties are *added* to the design team (making it larger) and the traditional design team members remain and their role in the design process is in no way diminished.

For large, elaborate integrated design teams, it is crucial to identify, define, and agree upon a project goal at the very first team meeting. Since large teams often have overlapping competencies, it is also critical that team members know their role on the team and which deliverables they are expected to furnish at each phase. A design process leader will coordinate the work in the early stages and plan the team workshops where architectural concepts will be evaluated with respect to the project goals.

The traditional model of design studio in many schools of architecture is predicated on the idea of the student as the singular designer who deals with a variety of project considerations from a "generalist" perspective. Rarely do students truly work collaboratively on teams composed of "specialists." The Solar Decathlon design teams may be one notable exception to this rule, where architecture students may work with students in marketing, engineering etc. We wanted to give students the experience of working in teams of experts to address design challenges collaboratively (DOE, 2016).

In this studio, students worked in small teams of 3–4 people. Since all team members were architecture students, we introduced expertise roles into the teams in two ways. First, we had had students interview each other prior to creating their design teams to discuss individual skills, interests, and strengths to ensure that the group composition would include members that could fill specific roles (e.g. concept development, 3D modeling software, sustainable design strategies, etc.). The team member selection process was modeled on the idea of speed dating where each student in the studio interviewed his or her classmates for 2–5 minutes each. Second, where skills or expertise were lacking in all team members (e.g. use of energy modeling software), we asked someone from each group to become the de facto expert in that area based on their level of comfort and previous skills. This "expert" could then share their new skills and knowledge with the teammates as needed to satisfy the workload.

A goal for the ZEB House project was to assemble strong design teams that could endure and succeed throughout the course of the 10-week term. The speed dating-style interview exercise resulted in groups with shared interests, good group work dynamics, and a variety of skills needed to complete a complex design project. Only one of the five groups struggled with poor group dynamics, but this situation gradually improved over time. We were impressed with the level of collaboration among the design teams. (See Figure 2) In effect, the teams self-organized their

own collaborative workshops between the all-studio workshops described above.

The "expert" roles on the teams also worked surprisingly well with those students having previous interests/skills in various technical aspects of design filling those roles. For example, one student used Multiframe structural design software—a program she was learning in a structures class she was taking that term—to refine the structural system design for the project and to demonstrate the viability of reducing the quantity of materials to address embodied material emissions issues.

2.3 *Tools & technologies*

Contemporary building design relies heavily on digital tools and technologies to facilitate the design process and negotiate the complexity inherent in design problems. These tools are many and include software applications for building information modeling (BIM), 3D parametric modeling, energy simulations, daylight analysis, structural design/analysis, computational fluid dynamics modeling (CFD), climate analysis, and more. Specialists use tools to analyze and explore conditions, synthesize the results, and report the information back to the project team. No single project team member is fluent in all of the digital tools and technologies necessary to produce a modern building—it is a team-effort that relies on skills and competencies that specialists bring to the table.

Digital tools are an integral part design education and most architecture curricula teach basic software skills to students early in their education. However, architecture students are routinely exposed to a small number of basic tools comparatively speaking and they have varying proficiencies using these tools.

To address this difference in tool exposure and skill-levels between students and professionals, this studio asked students to ensure minimum levels of software proficiency and skills learning new applications on each design team. This arrangement helped to compensate for the fact that some students had less developed skills or confidence using certain tools or technologies. A student, who was not as confident with software, would be paired with others who were. This equalized the groups and facilitated peer teaching among the team members. In addition, students with more developed skills using digital tools assumed an "expert" role on the team. We also paired analog and digital tools (e.g. building physical daylight models tested using digital photometer sensors) to enhance the learning experience. Thus, the goal was to have students use a wider range of tools in their design process than they ordinarily would use in a typical design studio.

The ZEB House project was specifically designed to necessitate the use of myriad technologies and tools to address the complexity inherent in contemporary high-performance building design. Rather than taking a "use what you know" or "use what you like to use" approach, the studio employed a set of basic digital design tools that students all had

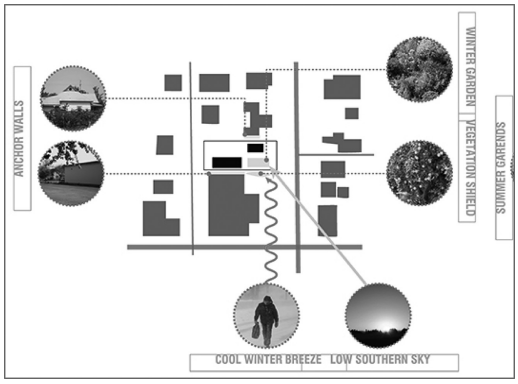


Figure 3. Students analyzed climate data using Climate Consultant software, synthesized specific climate attributes, and illustrated how the climate conditions relate to their project site.

preexisting experience with (e.g Adobe Creative Cloud, Rhinoceros, Revit, Sketch-up, etc.) as well as new tools that built-upon their previous skills (e.g. Sefaira for energy modeling, Climate Consultant, PV Watts calculator, etc.). At each stage of the project, we introduced select new tools necessary to inform the design process and assist the student teams in satisfying stated building performance goals and ambitions.

The new tools acted as specialty consultants in the design process. Whereas an integrated design team would likely have an engineer developing a sophisticated energy model, members of the studio teams acted in that role using digital tools (e.g. Sefaira) to provide basic level analysis. In this way, the studio used tools in concert with team member roles to simulate what would, in real life, be a more sophisticated expert perspective in a practice-based design process.

Climate Consultant—a free online application that translates standard TMY weather data for thousands of locations worldwide—was used to analyze site climate conditions and to explore potential passive and low-energy strategies suitable for the Pacific NW region of the US where the ZEB House project site was located. Information from this tool was then synthesized, illustrated graphically, and incorporated into design processes or considerations through other tools. For example, Climate Consultant helped the students understand prevailing wind conditions and opportunities for natural ventilation. These patterns were then documented using graphic site plans and the prevailing wind information was used to influence building orientation, aperture sizing/placement, etc. (See Figure 3).

2.4 *Using a precedent*

Although each design project is unique, professional practitioners often have the benefit of precedent projects that they worked on previously to help guide and inform a current design challenge.



Figure 4. ZEB Multicomfort House pilot-project in Larvik Norway as a precedent for a way of working through a complex design process. Photo courtesy of Snøhetta.

Precedent studies are common in design studio projects. However, the information available on most completed design projects is typically limited to a few overall drawings describing plan layouts, program distribution, design concept, sectional properties, and facades and sometimes basic descriptions of how the completed building is being used or satisfies user needs. While useful, such information lacks the detail and specificity to effectively inform other designers of how to solve technical or fine-grained issues in their designs.

In this studio, students had access to very detailed information related to a precedent project similar to their project—the ZEB Multicomfort House pilot project in Larvik, Norway—that one of the instructors recently completed in professional practice. (See Figure 4).

The ZEB pilot house was completed in 2014 as a demonstration project showcasing innovative approaches to the design and construction of zero-emission buildings and was a collaboration between the design firm Snøhetta, the ZEB research center at the Norwegian University of Science and Technology (NUTU), and other industry partners. The project relied on a unique, iterative, and integrated design process with a large and highly specialized design team. Since the project was part of a ZEB research initiative, there was copious documentation of the design process and the technical solutions. The pilot was intended to be a model for residential construction and to catalyze market transformation toward zero emissions residential design in Norway and abroad. As such, design and aesthetics were as critical to achieving market acceptance of the concept, as were the performance goals.

Having the pilot house as a precedent allowed the students to see how specific design challenges were addressed in a completed building. However, the students were not asked to duplicate the pilot house on a different site in a different climate. The student projects had different overall areas, program elements, orientations, material choices, and aesthetic sensibilities from the pilot house that responded to how each team understood the project goals and the unique characteristics of their sites. However, the pilot house was a useful litmus test for students to ask questions such as "how did the team fit enough PV panels on the roof to achieve a net-positive energy performance target" and "what was the overall embodied carbon of materials per unit area for the house." In some cases teams chose to make different decisions than were made in the pilot house, but in other cases the decisions made in the pilot house served as a useful tool to help the student teams move forward or take a shortcut where time was limited.

2.5 *Performance targets*

In high performance buildings, design teams set specific performance targets at the outset that guide and inform the design process. These targets are based on a host of real-word requirements and/or project goals including: health, safety, and well-being; energy and resource use; accessibility, costs, durability, environmental impact, and sustainability considerations, etc. These targets are not satisfied at the end of the design process, but are introduced at the beginning and serve as benchmarks or goals that the design ideas, concept, and solutions must satisfy. In some cases targets are based on user needs, client expectations, or design team ambitions. In other cases, targets are based on code requirements or voluntary standards. In either case, project success depends on the extent to which a design meets the established performance goals.

Design studio curricula tend to address real-world dimensions of design projects—like performance targets—in a piecemeal fashion. For example, the 3rd year undergraduate studio may incorporate accessibility requirements that students must meet through more detailed restroom layouts or stairway designs or a design-build studio may incorporate material cost considerations. Higher-level performance criteria are often too complex for students to tackle during a single semester project. However, as mentioned previously, initiatives such as the 2010 Imperative (Mazria, 2007) have advocated for stronger, clearer performance targets even in hypothetical design studio projects.

The design team arrangement of this studio allowed the students to tackle multiple performance targets together in one 10-week design project—many hands makes lighter work. In addition we leveraged data and information from the ZEB Multicomfort House precedent when time was limited or specific information for our project site/location was difficult to find.

The primary performance target for the ZEB House studio project was that it was to be a zero emissions building—zero emissions from annual primary energy demand for operations and zero emissions from materials to be offset over a 60 year life cycle period—through the use of site-sourced renewable energy systems. These performance targets allowed students to better understand that energy and emissions impact their design just as much as end-user needs and behaviors do and that design must account for durability and maintenance concerns over a building's

Table 1. An example of the types calculations the student teams performed to determine embodied carbon profile of a window assembly and how to off-set this carbon through sizing an appropriate amount of renewable energy (Solar PV) on the roof.

1	Window volume = 0.3419 m^3
2	Window mass: 0.3419 m^3 × 2,579 kg/m^3 = 881.8 kg
3	Window embodied carbon: 881.8 kg × 700 g CO_2/kg = 617,260 g CO_2/1000 = 617.26 kg CO_2
4	Utility emissions: 0.0272 kg CO_2/kWh electricity
5	Total payback: 617.26 kg CO_2/0.0272 kg CO_2 per kWh = 22,693 kWh
6	Annual payback: 22,693 kWh/60 yrs = 378 kWh/year
7	Replacements over 60 yrs: 2 = 378 kWh/yr × 2 = 756 kWh/yr
8	A 0.75 kW PV array at 15% efficiency with a 38° tilt angle will generate 897 kWh/yr on the site
9	0.75 kW/1 kW/m^2/0.15 panel efficiency = 5 m^2 roof area

lifespan—considerations that design students rarely have the time or opportunity to think about in their projects. See Table 1 below for an illustration of the kinds of simple calculations that students performed to validate that their designs could meet or exceed the zero emissions performance targets set for the project.

3 COURSE OUTCOMES

3.1 *Challenges*

There were several challenges we faced in simulating an integrated design process for a project with complex performance objectives.

Time was a significant limitation for the studio. Less than 10-weeks were available for small groups of 3–4 students to work through a design process that took a much larger ZEB pilot house project team many months of design and development. What this meant for the studio was that we were unable to get anywhere near the same level of detail with certain design considerations. Additional time would have allowed for a greater number of exercises focused on isolated topics and related tools/strategies.

Instructors and students do not have the same access to resources as professional practitioners. For example, we asked students to perform basic calculations on embodied material emissions, but environmental product declarations (EPDs) are still hard to find for most products. In the absence of good information, teams had to scramble to find rules of thumb or placeholder information. Having additional resources and research on topics including materials, technologies, and user behavior would have improved the accuracy of the student responses to the project requirements and goals.

When time and resources are limited, precedents can be useful tools to help inform the design process. However, our precedent was quite different from our studio project in a number of ways: location, culture, climate, units of measurement, etc. It was not always easy use the precedent to directly inform the design studio project for all project considerations, which meant that we were in the position of having to tell the student teams which information from the precedent was applicable and which was not. For example, the carbon content of local electric generation varies considerably and we lacked a baseline or methodology for estimating the impact for our specific project site. Thus, having necessary information at the beginning of the term would have saved time and energy once the student projects were underway.

Workshops benefit from visiting experts. There were a number of other faculty that could fill this role for our studio. However, bringing outside guests to campus is costly and most design studios do not have a budget to support these expenses.

3.2 *Practical implications*

The ZEB House design studio demonstrated that it is, indeed, possible to simulate aspects of complex integrated design team processes in an academic design studio setting. The hallmarks of integrated design are team collaboration, iterative design thinking, and evaluating design ideas against project goals. The attributes may look different in a design studio context than they do in professional practice, but they effectively approximate the important elements of emerging practice-based "ways of working." The process gets students excited about design possibilities and prepares them for the kinds of team design experiences they will face when they leave the design school. In this way, the design studio becomes a vehicle for building stronger connections between the practice and the academy.

The focus of our studio project was a zero emission building—perhaps one way of introducing a high-level and ambitious design challenge. However, the methods employed in the studio are not specific to ZEB-focused studio topics by any means. The studio serves as a flexible model that can accommodate a variety of design projects, team sizes, and academic calendars. In fact, a 16-week semester may provide an ideal fit for this studio model, a time span that we did not have available to us.

3.3 *Recommendations*

The ZEB House studio may serve as an effective model for future design studios. As such, we offer a number of recommendations for instructors considering adopting our methods and approach:

– Design students feel empowered when they work through the numbers and determine that their designs meet or exceed targets or goals for performance or use. All design students are capable of doing basic mathematical calculations (e.g. sizing a PV array, converting between SI and IP



Figure 5. We observed strong camaraderie and impressive levels of productive collaboration among the carefully composed student design teams.

units, etc.). The idea that consultants do these calculations for architects in unhealthy and interferes with the learning process.

- It is easy for design students to lose motivation over the course of the academic term. Using workshops as a "kick-off" event for the next phase of the design process helps to re-energize students. Likewise, working in groups can help students stay involved and motivated. The design student as an isolated island can be overcome with activities that get students to work together collaboratively.
- We learned in this studio that, if you set the bar high, students could meet incredibly ambitious expectations. It is not impossible for students to design a building that produces more energy than it uses annually or pays back embodied carbon from materials while working on a design studio project—these are not concepts or processes that only professionals or experts can achieve.
- Precedents are useful, but can be especially valuable when they provide detailed information such that students can understand how the designers intended the building to work, how it is actually working, etc. Finding such a precedent or access to information for such a precedent is a worthwhile activity for an instructor preparing to teach a studio following our model. However, be aware that differences between projects and precedents can make comparisons challenging.
- Design students are fairly adept at learning new tools and using them in basic ways. However, limited knowledge, experience, or competence with these tools can result in primitive or under-informed design responses. For example, energy analysis tools can lead students to eliminate or resize apertures in simplistic ways that improve performance at the expense of other design considerations. It is important to use tools, but to use them cautiously.
- Make the end-user part of the design process. In practice, architects often have the benefit of working with the future users of the building or, at the very least, knowing something about the user needs. In the absence of defined users, design students make decisions that can have a significant influence on the user experience. Finding creative ways to bring hypothetical "users" into design studio projects adds a realistic dimension to the process. For example, we may have to discuss comfort and the possible lifestyle changes at the same time as we are calculating energy use and carbon emissions, which introduces complexity that challenges students and allow them to see a multiplicity of possible solutions or design responses.
- It is important not to lose track of the larger-scale implications of specific design responses at the project site scale. Again, this adds a level of complexity to the design process. For example, our students understood that there task was more than simply satisfying program requirements such as net-zero energy and zero emissions for materials in their designs—holistic issues related to climate response, sustainability, life-cycle implications, etc. were always hovering in the background.

4 CONCLUSION

The design professions are moving away from traditional modes of project design and delivery and toward integrated design processes that emphasize diverse design teams that meet early and often to collaborate and evaluate ideas against performance goals and project ambitions. The ZEB House studio aimed to introduce design students to this emerging practice-based "way of working" in a 10-week intermediate design studio project.

The studio employed five pedagogical methods or innovations to simulate the integrated design process in an academic setting: workshops, design teams, tools/technologies, use of a precedent, and performance targets. Overall, the methods were quite successful in stimulating students to think more deeply and holistically about their design processes, and this assisted them in generating compelling design solutions by the end of the 10-week term.

Our experience teaching this studio demonstrates that the pedagogical innovations employed in the ZEB House studio may be an effective model for future design studio instructors and can accommodate a variety of different types of design projects aimed at better preparing design students for future experiences addressing real-world design challenges.

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Quest for "openness" in architectural pedagogy from 60's onwards

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ABSTRACT: In the last century of creative culture, the notion of "openness" came into prominence in particular thresholds such as: "open work" discourse charged by 1960's radical socio-cultural paradigm shifts, and "open source" debate, enabled by 1990's emergent digital modes of co-production and sharing. Although spatial practices are pluralistic by nature, open culture implied a number of challenges against the long-lasting conventions of architectural discipline, yet inspired a number of architectural design studios to tackle this challenge. This paper focuses on architectural pedagogy's response towards open culture via design studio experiments that were stirred by these motives to explore openness in their peculiar design methodologies, processes and outcomes. By critical examination of selected design studios, it is aimed to survey and compare various conceptualizations of openness in architectural pedagogy, discuss their reflections on architectural knowledge, and speculate on design studio's potentials in provoking an open architectural culture.

1 ON ARCHITECTURE AND OPENNESS

1.1 *Open culture vs. architectural culture*

In the past decades, a number of revolutionarily instances were staged against the rigidity of authorial power and control mechanisms that has been dominating creative cultural production for the last few centuries. Emerging philosophic and socio-technological paradigms, such as 60's open work discourse and 90's digital revolution fueled the spurring of an open culture of production and sharing. In various disciplines including architecture, number of practices started to challenge the ossified rules, control mechanisms, structures, roles and relationships assigned to the creator, his means of control over the production, role of the recipients (or the users) and the value system these cultural practices dwell in.

Changes in the discourse brought in a new vocabulary aiming towards the rigid disciplinary norms and mark new potentials in creative cultural modes of production. During this paradigmatic transition, the notion of "openness" appeared as a critical discourse with implications on a number of practices including architecture and pedagogy, with respective influences on architectural design studio education.

Hereby, this paper aims to focus on architectural pedagogy's response towards open culture via a selection of design studio experiments from 60's onwards, exploring notions of openness through peculiar design methodologies, processes and design outcomes, and finally to critically reflect on future potentials for an open architectural culture.

1.2 *Thresholds of "open" 60's onwards*

Openness being a highly interpretable concept, its antonymous qualities such as rigid, fixed, suppressed, over-controlled, pre-determined, linear, authoritarian, nonnegotiable, etc. render more helpful in grasping it. In certain intervals, a range of creative cultural fields embarked on critical explorations on various conceptualizations "openness" and its unfolding into various theories and practices.

Notably Eco's seminal book "Open Work" brought the notion of "openness" into prominence in late 1960's, emanating concepts from literature, art, music, language and semantics. Eco explained that a work of art is: "a complete and closed form in its uniqueness as a balanced organic whole, while at the same time constituting an open product on account of its susceptibility to countless different interpretations which do not impinge on its unadulterable specificity"(Eco, 1962). He asserted that openness is not necessarily an intrinsic quality of the work but driven mainly by interpretation and performance. In the introduction of 1989 edition of the book, Robey states that "Open Work" remained significant for its "insistence on the element of multiplicity, plurality, or polysemy in art, and emphasis on the role of the reader, on literary interpretation and response as an interactive process between reader and text".

During the 60's, rebellious and optimistic spirit of free culture blended with contemporary discourses regarding the birth of the reader, the "open culture" shed reflection upon various architectural ideas and experiments. Possibilities of open-endedness,

open-work, open-form, open-city, open university, etc. inspired architectural explorations on self-generated, bottom-up, participatory design modes in architecture, which examples like Fun Palace, New Babylon, Rural Studio and some others broadly epitomize.

1990's digital turn bought "openness" into a novel ontological framework. Possibilities, which before were only theoretically possible, or limited to the mediums at hand, earned new grounds of exploration. Mainly in fields like software design, music and digital arts, new strategies of production, ownership and sharing emerged, such as: open source, open data, open knowledge, open educational resources, leading to practices such as distributed intelligence, crowdsourcing, peer-to-peer production and open licenses like copy-left by Creative Commons. The essay "The Cathedral and the Bazaar" (Raymond, 2001) originally presented in 1997, epitomized the era's discussions on emerging notions of ownership, distribution and intellectual property with the spatial analogy that contrast two design models in software engineering: the bazaar (open-source software model) and the Cathedral (closed-source model employed by commercial software vendors).

Architecture's interest in commons discourse as well as collective data sharing and processing, network practices, digital co-design platforms like BIM(Building Information Modeling) and alternative licensing are expanding fields of research with experimental qualities to be explored.

Despite of the multi-layered and pluralistic nature of spatial practices, implications of open culture have been and are still puzzling for the long-lasting conventions of architectural discipline, therefore are worth examining for what they have to offer to architectural practice and pedagogy.

2 ARCHITECTURAL DESIGN STUDIOS ON OPENNESS

2.1 *Three architectural design studio explorations on "openness"*

The architectural and pedagogical investigation on the idea of "open" has been translated into a number of diverse design studio practices during the last decades. However, because openness is a quality that is difficult to define and capture, this paper will only pay interest to some of those studios from 60's onwards that claim an "open" quality either in the studio's name, brief or discourse as a clear and visible statement.

Henceforth, in the scope of this paper, three cases of "open" architectural design studios are selected that apply a notion of "openness" through their design studio methodology, and are inspired by 60's and 90's openness discourses. The selection of "open" design studio cases are not considered as representatives of the total spectrum, but as epitomes of discernible and divergent efforts in architectural pedagogy that may allow further discussions on the topic.

Through the critical examination of selected studios' peculiar pedagogies built on "openness", it is aimed to compare and survey the various conceptualizations of open architecture and related design studio theories, methodologies and tools that intend to facilitate it.

Briefly, architectural design studios' inquiry into "openness" will be examined over three cases: open form, open city and open source.

2.1.1 *Open form*

"Open" notion in Hansens' design studio methodology is a manifestation of Open Form theory, formulated by Oskar Hansen in late 50's against Closed Form, which he characterized as "subordinated subjectivity" that is "dominant and hierarchical" in nature. Presented in 1959 CIAM congress in Otterlo, the theory was rooted in the conflicts particular to late modernist debates and standardized housing construction in postwar Poland, which neglected human individuality and uniqueness. It aimed to democratize the conventions of any scale or form of social-spatial practice to include the experience of individuality and explore new modes of subjectivity in design.

The architectural school for Hansen was both a fortress of Closed Form empowering the conventions through "education", and a great atmosphere for experimenting new possibilities. Together with Zofia Hansen, alongside their artistic, architectural and urban design practices, they applied the idea of "open form" in their studio teaching in Warsaw Academy of Fine Arts, Faculty of Sculpture from 1954 to 1981.

Hansen related Open Form to the interaction and connection between people, hence to social conditions, more than the technical openness regarding the transformation of the build environment. In this regard, a series of recurrent themes and concepts marked the infusion of Open Form theory into architectural education.

The "figure-background" narrative was one of those recurrent concepts that emphasized binary analogies such as individual-collective, public-private, natural-artificial. In this duality, architecture was sought to function as a backdrop for life to take place within its vicinity, and the architect as a background provider on which users will be included in the process of creating the build environment. Instead of imposing his/her subjective influence or aesthetic choices, the architect would act as a facilitator who's responsible for performing a dialogical mode of design, in collaboration with the recipient-co-authors. Hansen & Hansen (1961) rejected the Closed Form aesthetics with an urge to reveal the Open Form's -the art of events- own methods of study, means of expression and its own aesthetics. Notion of "scalability" was utilized through any given set of procedures or techniques that could be applied equally well to a piece of paper or to a fragment of the public space of a larger city, to provide an operational language that provokes experimentation and highly complex (trans-individual) collective projects. (Ronduda et al. 2007)

In 1973, Hansen proposed an "Adaptation Project" for the Sculpture Faculty building according to the Open Form conventions, in order to pressure the didactic process of the studio work and cause new spatial relations to develop. The project spurred from Hansen's interest in housing studies as 'a form of protest against the idea of "optimized" architecture for the "average" user. (Obrist & Parreno 2004) Students were given a large building block as a "backgrounds" for their design, and asked to design their own apartments in given frames, in collaboration with colleagues and teachers. By the individual authorization of students the housing projects were exercised as an exploration of subjective design adaptations for each housing, yet framed by the totality of the collective apartment block. Hansen's called this the expression of a group form, "the form of the sum of events -of the sum of individualities of a given group." (Hansen & Hansen, 1961)

The underlying design principles were paralleled in the organization of the studio space. Hansen's strong opposition to the "chapel" model of a professor "preaching" to the students (Hansen 2005) spur collective modes of learning particularly through active participation of students in the studio and collective games (mostly open-air) where students and teachers participated and performed collaboratively in the search for new design possibilities through different mediums in inter-changeable scales. Paralleling the figure-background narrative, a large white background was placed in the studio to exhibit student work and reorganize common (public) space for work and relaxation according to students' own will and participation.

2.1.2 *Open city*

"Open City" in Ritoque, the open-air laboratory of the Institute for Architecture of the Pontifical Catholic University of Valparaiso, Chile, is an ongoing radical field of experiment for architectural education since late 1960's. Guided by Alberto Cruz, the head of architectural school at the time, a group of poets, philosophers, sculptors, painters, architects and designers, also known as e[ad] community, came together to bring into fruition an alternative conception for architectural practice and teaching.

The e[ad] community was critical against contemporary architectural practice and education dominated by commercialism. In its place they proposed an architecture originating from, and understood as, a poetic act. (Cordua et al. 2015) The school's mission was manifested in the form of a poem called 'Amereida' that portrays a poetic vision of America, and is performed in a format what they considered to be the origin of architecture; Phalène, a group act of generating a collective poem by its participants. For e[ad] concretizing the poetic image of a 'Phalène' into buildings was an essential base for architectural thinking and performance.

For this purpose, the e[ad] group, who are also teachers from Catholic University of Valparaiso privately bought a site in 1970's, to be named as the "Open City". Spanning onto 270 hectares area and stretching 4.8 kilometers along the Pacific coast, the site was comprised of dune fields, wetlands, a river, pine forests and a diversity of flora and fauna.

The Open City became a site of thinking, research and experimentation for architecture that doesn't emanate from didacticism, but from the concept of discovery, improvisation, performative acts and constant negotiation between individuals on proposals for new works. "It is to become a town, collectively owned and governed, with no private property, constructed for, and by, 'hospitality and speech' and following Amereida's poetic vision of America." (Cordua et al. 2015) In the absence of a master plan or hierarchical infrastructure, the city was self-governed by "creative acts of discovery and its particular experience and perception of the site" (Pendleton-Jullian 1996) Characteristically, all projects initiate with a poem. Inspired by French modernist poetry, chiefly by Mallarmé, the belief was that the world's real torment lay in the human condition much more so than in the social condition. Therefore the poetic influence in architecture was demanded to be much more radical and extreme, but primarily transcendental in nature (Pendleton-Jullian 1996).

The Open City continues its experimental role in architectural education after many decades. Among various pedagogical experiments with hands-on, design-built projects, one commitment endures in the inauguration of each process: the use of poetry as a guide to design.

The pedagogical methods based on poetic acts can be seen as a replacement of conventional formal compositions that depend on stylistic concerns, historic precedents, drawing norms or academic discourse. In terms of teaching, the triggered design endeavor by ever-changing perceptions of the site and poetic improvisations is considered more important than the result itself. In this sense sketches and words became essential instruments to apprehend the relations between space and phenomena: "We find [in these sketches] the sensual dimension of the habitable space which has been captured at that moment, as well as the dimensions of knowledge that presented themselves on that occasion." (Jolly 2012).

Pendleton-Jullian (1996) describes how poetic acts guide a design process, stating they are not only applied to discover sites of construction, but also to determine strategies for the making of space. There may be a series of poetic acts that occur simultaneously, or at different stages of the conception and design of the project. Accordingly, in some cases the work is done by a complex collaboration between professors and students, whereas in others, individuals may lead portions of the work. Constructions proceed in their own pace, sometimes depending on the availability of scavenged material from demolished buildings, with no outside time pressures, since the only funding is by the Faculty of Architecture. Chance and improvisation are welcomed in the

process, with no dependence on construction documents or no clear definition of a "finish" for the structure, opening the buildings to endless addition and transformation.

2.1.3 *Open source*

Columbia Building Intelligence Project (C-BIP) & The Integrated Design Studio (IDS) was carried out in New York, Columbia University GSAPP in 2010, as part of an experimental three-year pilot project that explores "new forms of technology-enabled collaboration within and between the various sectors of the architecture, engineering, and construction industry." (http://www.arch.columbia.edu/files/gsapp/imceshared/tct2003/CBIP-Studio.pdf, p.3)

Neglecting architectural education's conventional "single critic, single student, single project" model, the studio's research interest leaned on embracing new modes of collectivity and design collaboration in education, for its increasing potentials in architecture's role in the total process of realizing a project.

With this concern, besides other research interests, the studio attended to "open source" as a critical and operational field of exploration, in search for cumulative and communicational platforms that might better embrace the design potentials embedded in the complexity of projects. The studio brief launched following questions on "open source" potentials in architectural design: "Can open source design method pioneered for software development be applied to or reformulated for architectural design? Could modules of buildings and 3D files be "checked out," revised, and "checked in" by different architects, fabricators, and contractors over time durations that exceed a single project? If complex building components could be designed, documented, and released into a broad architectural community, how would authorship and intellectual property be handled? Might an open source model start to change the one-off nature of buildings and reduce inefficiencies in the construction industry?" (http://www.arch.columbia.edu/files/gsapp/imceshared/tct2003/CBIP-Studio.pdf, pg.20)

The studio developed by Laura Kurgan, Scott Marble and David Benjamin was entitled "Energy + Adaptation", and proposed to design adaptation strategies to enhance the quality of urban life while reducing energy consumption in existing buildings in New York City by %30, as the city authorities envisioned for 2030.

To embrace the potentials of "open source" in the studio's workflow, "design-and-release" model was located at the core of the organizational scheme, in coordination with the studio's research progress into energy mitigation in existing buildings. In a highly integrated model, 36 students worked interactively on specific parts of a larger problem in collaboration with peers, critics, consultants and experts through an array of integrative, simulative, digital and physical design and communication tools.

Each student was responsible for designing a generic building component to reduce energy consumption in existing buildings, using CATIA software and document it with an instruction manual, and then release it to the open source library to make it available as "a tangible research product that others can download, re-configure, and utilize". In the next step, students were asked to form teams to collectively develop a "Building Strategy" for specific buildings in NYC. To achieve that, teams were requested to pick, use, adjust, test and re-use the available components in the open source library. Meanwhile, if they had any feedbacks or modification requests they would send them to the original author who is solely authorized to make changes to the component. The suggested changes would be considered by the author of the component, refined, re-documented and released back to the library in its updated version, available for future use. (http://www.arch.columbia.edu/files/gsapp/imceshared/tct2003/CBIP-Studio.pdf,p.19)

Along the progress, collectivity and interaction was enabled by the use of design and communication platforms such as Building Information Modeling (BIM), Integrated Project Delivery (IPD) for legal structure, CATIA for the design, parametric modeling and fabrication, and other software for managing complex information, environmental data, simulating building performance etc.

In the process, components and building adaptation strategies were rigorously tested through digital building simulations or physically fabricated mock-ups, presented, discussed and revised in above mentioned platforms as well as face-to-face dialogues and studio reviews. "By the end of the semester, the IDS offered dozens of individual design components, as well as several more comprehensive design strategies, that were both flexible and re-usable." (http://www.arch.columbia.edu/files/gsapp/imceshared/tct2003/CBIP-Studio.pdf, p.14)

The "design-and-release" model endorsed a critical break from the typical studio in which students produce their designs in spatial and mental isolation. With the help of sample building elements, wireframe BIM models and complementary open source software, all students become capable of experimenting with and suggesting specific updates to each component, allowing each author to continuously improve her components' design without refraining it from the use of others.

Concurrent and common use of design elements, allowed the development of complex architectural ideas with variation and feedbacks in a progressive rather than competitive environment, which added up to increase the total quality of the design library for such a purpose. However, the sophisticated use of open source didn't completely remove the conflicts over the ownership and rights on the designed elements. Because the protocol only authorized individual authors whether or not to apply the feedback or allow suggested changes in the use of their elements, it was observed that harsh negotiations took place between the authors and groups

who suggest changes, and not all ended up with agreements.

2.2 *Critical review on "open" architectural design studios*

Although the selection of 1960's on architectural design studios in this paper only represents a small portion in the wider spectrum of inquiry into open culture, they are insightful in displaying the diversity in the conception of architectural "openness" and its respective translations into pedagogical methods, tools and modes of organizations in design studio. In common they share an experimental effort to incorporate open culture into the disciplinary confines of architectural education, and abandon the idea of closed, finite, fixed, singular work or processes, through a range of counter possibilities made available in a design studio setting.

The aforementioned design studio cases operate through a number of openness strategies, not only rhetorically, but also directly, provoking non-conventional design performances by digitalized or physical platforms of co-designing, individually or collectively, simultaneously or successively. The scope of design tools that urge "openness" range from performative games, to poems, graphic representations, parametric models or hands-on constructions. Despite of these variances among the strategies, there appear certain tendencies in affording "openness" in architectural design studio.

In order to understand these tendencies, a relational chart has been devised to trace recurrent motives, themes, concepts or tools that are explicitly stated in the studio manifestations. (See Figure 1.)

This brief diagrammatic chart displays that some motives appear to be more frequently addressed than others. Among them, performativity, collectivity, collaboration and subjectivity emerge as common notions that mark all three studios and broadly define a framework for how "open" is commonly preconceived in architectural design studio.

However looking deeper into how these motives unfold in each studio's specific context, divergences and peculiarities become more visible.

Hansenian "openness" is formulated as a structured philosophy, encompassing a set of instructions and tools for a more democratic and pluralistic design behavior. Using the language of "open form", one is encouraged to take a position towards a reality through the given theoretical framework, and apply open form principles in scales from elementary to urban design. It is an oppositional and universal worldview that celebrates performativity, subjectivity and collectivity in all designerly acts.

Yet both notions of subjectivity and collectivity in "Open Form" are mostly performed in the confines of the suggested framework; a stack of subjectively designed elements collected in parallel compartments, side-by-side, composing what is called as the "group form". In other words, by emphasizing subjectivity and

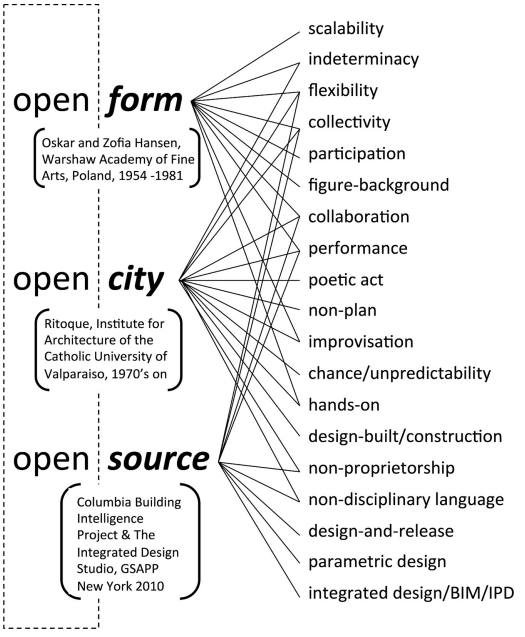


Figure 1. Relational chart representing recurrent openness motives in selected architectural design studios.

user's right for adaptation, what is advocated is a sense of individual and independent proprietorship under a larger scheme, with less emphasis on the designerly negotiation amongst concurrent, convergent or fluxional subjectivities.

The sense of "open" in Ritoque, Chile, giving its name to the actual site, is more concerned with celebrating the performative and poetic aspects of architectural thinking in education. Rather than restricting the design process into the overly controlled and rationalized relationships of the studio environment, the in-situ, poetry-guided design practice invited the impulsive dynamics into architectural learning, revealed from the material and immaterial realities such as geography, climate, material performances etc. as well as chance, improvisation, feelings, inspirations and dreams.

Compared to similar design-built educational programs of its time, such as Rural Studio, set to meet the needs of an impoverished user group in harsh socio-economic conditions, or Arcosanti implying a top-down design philosophy and aesthetics for a sustainable architectural vision, Open City is less occupied by a pre-set agenda, except for the commitment to poetry and material constraints of the land, equipment or human resources at hand. The agenda of the project is open to oscillations with changing moods of experimental wills in the service of architectural and artistic research.

In the following sense, the subjectivity notion in Open City differs from the one in Open Form, because the transcendental nature of poetic act doesn't necessitate the immersion of social concerns or collectivity as

in number of actors in a group. Subjectivity relies on the artistic liberation of individuals' minds, activated by poetic performances, which can also be collectivity performed in a group act such as "Phalène". Yet, the act of discovery lies beyond the inner dynamics of a structured collectivity. It is the immediacy of momentary, sensual impulses in a poetic performance that is anticipated to guide one's way in thinking about architecture.

Lastly, in CBIP&IDS, the idea of "openness" reveals itself as a platform for organizational and operational affordances, aiming to investigate highly integrated and trans-disciplinary pathways for architectural production. Exchange of design ideas, interactions and negotiations between numerous actors and actor groups were carried out via "open source" platforms, which perform in a directly operational level, rather than representational.

Different from Open Form's design games, or Open City's poetic acts, "performance" suggests a different connotation in the case of CBIP&IDS. In the exploration of open-source, the emphasis on "open" expands from the performance of the designer/architect/student person or group, towards the performative qualities of the design element itself. When the design element is translated into a fragment of digital information, its performance becomes much more tangible and accessible to a variety of users, simultaneously, without limitation. It can be received, processed and designed individually and collectively, by disciplinary and non-disciplinary parties, can be formulated, simulated, shared and tested via a combination of digital and analog design tools.

Hence, in the context of this studio, due to the setting of authorship protocols, groups and individual students were still responsible for making critical judgments and evaluations for their design action, even after they released an element into the library. The open source library was accessible by a combination of high-end software tools and parametric models, but particularly when designed elements from library were placed in a context, urgent architectural and urban issues still needed to be discussed and evaluated in person, face-to-face. Therefore, it can be said that this studio blended an array of performative actions that are both defined by parametric nature of the design item, as well as personal and subjective authorial judgments for design. This blend of simultaneous performative design modes and tools brought in an unconventionally layered, complex, entangled notion of collectivity in the design studio.

Questions on the compatibility of open-source for an open architectural culture bear its predicaments. The fact that, in order to be placed in an open-source database, an architectural idea needs to be seized in the scale of an element, decontextualized, formulated and parameterized, therefore cleared from any attached meaning, ideology or stylistic concern is a subject that has to be discussed in its equivocal consequences.

CBIP&IDS may have carried the investigation on open source at an experimental stage, via cutting edge design tools and software, but the foundation of the idea has been seeded long before the emergence of digital tools. Neufert's Architects' Data was also famously born from his teaching practice in Weimar, with a shared interest on the future of building industry and concerns on efficiency and speed in realization of design process in 1930's. Clearly today, the advancements in the open source debate and technologies offer much wider perspectives, yet its socio-cultural-economic consequences are yet to be born in the foreshadow of centuries old establishment of authorship norms and power mechanisms.

Compared to other pedagogical explorations of openness, "open-source" may bear concerns that are less oppositional or political, but more practical and pragmatic at first. However, the newly available authorship, ownership and sharing protocols brings into a whole new level of socio-political issues to explore with burning discussions on ethical, cultural and economic reflections into architecture and architectural pedagogy that are radical in nature.

3 PROJECTIONS ON OPEN ARCHITECTURAL EDUCATION

One being a *theoretical framework*, other referring to a *land shaped by poetry* and third constituting an *operational medium*, all three "open" architectural studios embark on radically various facets of the idea of openness in architecture and its education.

All three cases of "openness" represent a conscious refrain from stylistic concerns and elevate other aspects that are often suppressed by the established modes of architectural thinking and production, which lay the foundations of conventional design studio education.

They also showcase that in proportion to the angles to architectural production and thinking, there may be as many potential "openisms" in the pedagogy of architectural design studio, through the selection of design subject, location, assignment of roles, studio's physical or digital setting, relationships among the actors, use of design tools and targeted design outcomes, etc.

60's onwards transformations in the intellectual, technological and social paradigms have clearly been influential in architectural pedagogy and provoked experimental intentions to incorporate open culture into design studio education. Meanwhile the question of openness continues to puzzle the enduring conventions of architectural practice and pedagogy.

In this regard, new approaches may be vital in assessing what openness entails for architectural praxis and education.

Firstly, the typical dichotomy between openness and closedness, marked by the contrast of political poles, needs to be put into reconsideration. Instead of a blatant opposition, openness can also be argued as a continuum, which prompts evolution in any progressive praxis either by breaking the norms or creating

new ones. For example, instead of limiting the possibilities to binary dualities such as individual or collective, new design modes that blend individually in a collective manner may suggest a more comprehensive approach. Hence, "openness" discourses should be critically reviewed in the larger context of historical continuities, and acknowledged for the equivocal suggestions that may broaden the perspective over the notion of openness.

Another point can be made via Eco's reminder on openness not being an intrinsic value. This statement broadly implies a shift of focus from the architectural object into its immediate forces, that both are disciplinary and beyond. Architectural design education should esteem non-disciplinary, non-architectural aspects into central consideration, to incorporate the practices that dwell outside architecture's disciplinary limitations. Studio's communicatory and representational language could be reconsidered to increase chance encounters with the unbridled forces of open culture merging into architectural culture.

Till (2007) emphasizes that architecture is a contingent practice despite the discipline's persistent claim for autonomy and a self-referential historical account. Therefore it is critical to address the conditional circumstances that contextualize "openness" in regards to socio-economic, cultural, political and technological frameworks that shape the state of architectural production.

Technological advancements from 90's onwards undoubtedly enabled open culture possibilities into a whole new ontological level. Yet the orthodoxy regarding the dominance of power structures, ownership and control mechanisms, which have been challenged in late 60's are still issues that need to be thoroughly debated under emerging circumstances.

It can be said that the biggest barriers to openisms in architectural culture are neither legal nor technical ones, but mostly cultural, organizational, and psychological habits and admittances that endure trough the formation, primarily in architectural schools.

Quest for "openness" is a continuously growingly potential as well as a struggle for its ethical, cultural and pragmatic predicaments in architectural knowledge. Schools and architectural design studios in particular, are foundational environments that explore, facilitate and question both the dilemmas and opportunities in this field. Therefore, the crucial role of design studio education in stimulating and questioning openness for an ethically responsible and open architectural culture remains to be a critical ground for exploration.

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Trading our ivory towers for ones made of wood: Models for solid timber research and education in the US

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ABSTRACT: Advances in the development of cross-laminated timber panels and other engineered wood products have renewed interest in non-residential uses of wood as well as in the use of mass timber in mid- and high-rise residential buildings. Engineered wood is being successfully used for multi-story construction, large span structures and complex architectural forms. Architects and engineers are beginning to reconsider this very old material in new and exciting ways. Universities in the United States charged with the training of future design professionals have unfortunately not kept pace with ensuring that students are equipped with the skills to fully leverage the recent advancements in wood product innovations. This paper examines a sampling of wood research and education efforts currently underway by universities around the world in order to identify commonalities and indicators of success that can inform and help shape future wood research and education efforts in the US.

1 INTRODUCTION

According to Alex de Rijke, founding director of the London based architectural practice dRMM, the relationship between material technology and architectural expression can be summarized as follows: "the best 17th century work can be characterized by stonework, the 18th century to be the refinement of brickwork, the 19th century to be the heyday of the steel frame, and the 20th century as the era of concrete. This leaves the 21st century open for the successor to concrete. My prediction is timber" (de Rijke 2011). While some might consider de Rijke's assessment of the history of architectural technology to be slightly reductionist, it is hard to argue with his prediction of the 21st century being the century of timber in the face of growing number of mass timber buildings around the world pushing the limits of what was previously thought possible.

2 CLT AND THE RETURN OF MASS TIMBER

Advances in engineered wood manufacturing and products have resulted in the development of new wood buildings systems that have elevated wood from its use predominately in light-frame residential construction to rival the use of steel and concrete. Since the development of cross-laminated timber in Europe in the 1990's, worldwide interest in mass timber construction has been revitalized. Cross-laminated timber (CLT) panels are made by compressing alternating layers of boards, typically finger-jointed 2x6s, into panels to be used for large-scale construction. Panels are being produced that are as strong as concrete and steel, but more sustainable and efficient to use (Mayo 2015).

Advances in the development of CLTs and other engineered wood products have renewed interest in non-residential uses of wood as well as in the use of mass timber in mid- and high-rise residential buildings. Engineered wood is being successfully used for multi-story construction, large span structures and complex architectural forms. Architects and engineers are beginning to reconsider this very old material in new and exciting ways.

2.1 *The international year of forests*

The United Nations (UN) declared 2011 as the International Year of Forests. The goal being to create an important platform to educate the global community about the great value of forests as well as the extreme social, economic and environmental costs of losing them. This effort sparked new interest around the world about the inherent value of forests in their ability to help to reduce greenhouse gas emissions, serve as a carbon sink as well purify drinking water for humans and wildlife.

2.2 *The push in the United States*

As part of the UN's International Year of Forests, the Agriculture Secretary of the United Stated, Tom Vilsack, announced a strategy led by the United States Department of Agriculture (USDA) to promote the use of wood as a green building material. Vilsack directed the US Forest Service to favor wood in new building construction; maintain commitment to certified green

building standards; examine ways to enhance research and development projects using green building materials; and actively work to identify innovative nonresidential construction projects that use wood as a green building material.

An important part of the strategy laid out by Secretary Vilsack included a study published later that year titled "Science Supporting the Economic and Environmental Benefits of Using Wood and Wood Products in Green Building Construction" (Ritter et al. 2011). This study clearly summarizes the scientific findings that support potential economic and environmental opportunities of promoting the use of wood products in the building industry. The study also identifies the barriers currently in place that limit wood's widespread acceptance as a viable building material. The barriers outlined in the study include:

- A lack of information on the life-cycle environmental impacts of wood and alternative construction materials is incomplete.
- Research and development of wood product and building systems is significantly lagging behind that of other materials.
- Most codes and standards related to green building do not include adequate provisions to recognize the benefit of a life cycle environmental analysis to guide selections of building materials.
- Insufficient education, technology transfer, and demonstration projects are hindering wood as a green building material.

In September 2015 the USDA, along with the Softwood Lumber Board and Bi-national Softwood Lumber Council, awarded two projects a total of $3 million to help construct tall wood buildings to serve as demonstrations that wood can be the principal building material for multistory, nonresidential buildings. Also in 2015, CLT was incorporated in the International Building Code (IBC). The IBC recently also adopted ANSI/APA CLT Standard PRG 320, in order to provide an avenue for design teams to seek approval via an alternate material, design and methods (AMM). The ANSI/APA standard covers the manufacturing, qualification, and quality assurance requirements for cross-laminated timber and serves as a means for certification of material to be produced domestically in the United States. D.R. Johnson Laminators in Riddle, Oregon are the only producer of CLT in the US to have been certified by the APA to manufacture building-ready panels. While CLT panels imported form Canada have been used on a few building projects in the US in the past few years, these domestically produced panels have recently been installed in a project under construction in Portland, Oregon designed by one of the firms that recently won the USDA tall wood competition.

2.3 *A long way to go*

The rising awareness of the often-negative environmental impact of the building industry has motivated architects, engineers and clients about the need to be more thoughtful about the materials with which we build. In the light of increased governmental support it is clear that efforts will continue to be made to help facilitate the use of wood as a more sustainable building material. Much of the immediate efforts have been focused on revised building regulations and the education of current design professionals in order to spur short-term successes. While these short-term efforts are admirable, in order to ensure that wood becomes a viable competitor with more energy intensive materials such as steel and concrete, long term shifts to university research and education must be made. This is necessary to produce the next generation of design professionals that are better equipped to push the boundaries of what is possible with wood and seek further material innovations.

3 WOOD EDUCATION IN THE US

Schools charged with the training of future design professionals have unfortunately not kept pace with ensuring students are equipped with the necessary design skills to fully leverage the recent advancements in wood product innovations. In architectural programs, the use of wood as a structural material, other than light wood framing in residential projects of four stories or less, is not common. This can be traced to a limited understanding of engineered wood as a structural material and the perception that it lacks durability and flexibility in form and has low fire resistance qualities. However, recent conservation efforts and sustainability concerns have appropriately elevated wood as one of the most sustainable structural materials.

While there have not been exhaustive studies about wood education in architecture, and the information tends to be more anecdotal, the challenges facing wood engineering education have been well documented by Gupta and Gopu (2005) with the factors contributing to the current state of affairs being identified as follows:

- The decline in the number of credit hours required for graduation and mandated by accreditation criteria.
- Decline in research funding in the area of wood engineering
- Lack of coordinated industry support for training wood engineering educators and keeping them abreast of new developments, technologies and teaching tools.
- Lack of faculty qualified to offer wood design courses.

These issues outlined by Gupta and Gopu, as well as more general changes in the educational landscape as the generation raised in a digital world, poses difficult challenges for the future of wood education in the United States.

The lack of knowledge of a material can often cause reluctance to use it by the design professionals, or,

when used, result in improper use and subsequent disappointment with its performance. It is important that architects and engineers are well educated in the strength and weaknesses of materials and work collaboratively to ensure their proper and effective implementation. Most, if not all, of the learning related to collaboration between the two professions currently occurs in the workplace. It would be valuable to provide engineering and architecture students with an educational experience that will launch them on the path of mutually beneficial collaboration as they enter the professions.

4 INTERNATIONAL MODELS IN WOOD RESEARCH AND EDUCATION

European countries have had an almost twenty year head start compared to the US in finding a successful model of academic research and education that helps facilitate material innovation in wood products. Therefore, it is helpful to examine some of these models in an attempt to identify common themes and threads that might be beneficial in developing a framework for a successful model for the US. This study is a work-in-progress and is part of a larger, more thorough analysis being undertaken by the author. What follows are a few case studies of successful efforts at European universities that begin to highlight some of factors that lead to successful efforts in the balance between research and education focused on innovation in wood buildings.

4.1 *Swiss Federal Institute of Technology in Lausanne (EPFL), Switzerland*

One cannot discuss wood research and education without mention of Julius Natterer and The Laboratory of Timber Constructions (IBOIS). IBOIS is a laboratory that undertakes research and teaching within the civil engineering program at the Swiss Federal Institute of Technology in Lausanne (EPFL). The laboratory grew to prominence under the leadership of the prolific German timber engineer Julius Natterer. Natter headed up IBOIS for almost 30 years and during that time was involved in many advances that helped to shape the current timber industry both in Switzerland and globally.

Among several other advancements, Natterer was responsible for the invention of Brettstapel in the 1970s, a massive timber construction system, fabricated exclusively from softwood timber posts connected with hardwood timber dowels. It is a relatively simple method of construction that exploits low grade timber, not normally suitable for use in construction, to form load bearing solid timber wall, floor and roof panels (Haller 2008). Brettstapel is a glue-free solid wood panel that was a precursor to the developments that led to cross-laminated timber.

Natterer's research served as a vital link between his teaching and practice. He worked closely with both students of civil engineering and architecture instilling in them concepts of structural engineering and construction meant to inform their conceptual designs. He was very active in the design and construction of various demonstration projects, which served as vehicles for the new technologies he was developing at IBOIS. The Hannover Expo Roof, designed and constructed in collaboration with architect Thomas Herzog for the 2000 World Expo, is probably the project he is best know for.

In addition to his teaching and research, Natterer is one of the authors of the Timber Construction Manual (Holzbau Atlas), considered to be the definitive reference for wood design and engineering. Natterer has been retired from the IBOIS lab for several years, but he continues to practice and advocates for the environmental benefits of timber construction (Haller 2008).

4.1.1 *Hannover Expo Roof*

The centerpiece of the Hannover Expo 2000 was the Expo Roof designed to remain as a permanent marker. The structure consisted of ten roofs in the shape of umbrellas that hung from 26 meter tall timber towers. Each umbrella consists of four timber shells covering an area of 40 square meters. The shells are made up of crisscrossing glue-laminated ribs that form doubly curved shell surfaces. Four large cantilevered trusses support the shells of each umbrella. In the middle of each umbrella is a large steel cap that transfers the forces onto the towers. The umbrellas are connected at the outer edges of the shells and the ends of the cantilevers. The structural components were mostly manufactured in the plant and in an exhibition hall near the site. Large cranes were required to assemble the completely pre-manufactured construction parts (Berger et al. 2000).

The design and construction of the Expo Roof afforded Natterer the opportunity to test several technologies and types of construction that were unregulated by existing codes and standards at that time. A few of the innovations Natterer and the rest of the design team were able to explore included the design of the stacked-plank ribs, various glue and mechanical connectors, 3D computer-aided design (CAD) and computer-aided manufacturing (CAM), as well as the BVD system connector. German building authorities had only recently approved the BVD system connector, now fairly prevalent throughout Europe. Natterer worked closely with laboratories at the University of Technology in Munich to perform testing to verify that the connectors would perform as intended in their application in the roof (Herzog 2000).

4.1.2 *Chapel of Saint-Loup*

The IBOIS laboratory has been under the direction of Yves Weinand, engineer and architect, since Julius Natterer's retirement in 2004. Under Weinand's leadership, IBOIS has continued to push the boundaries of timber construction through research that challenges the perceived typologies possible in wood. A project that showcases the current direction of IBOIS, grew

out of research undertaken by an interdisciplinary team investigating new methods of designing folded plate structures built with cross-laminated timber panels (Weinard 2011).

The Deaconesses of St.-Loup needed a temporary structure for their community's religious activities during an extensive renovation of their motherhouse. A folded plate structure built in cross-laminated timber panels provided an ideal solution. The use of a form generation tool developed by IBOIS allowed integrating structural as well as production design right from the beginning into the planning process. Because of this, the entire project took less than six months from start to finish and the chapel was built in less than two months.

Interpreting the traditional layout of protestant churches with their variations in width and height between transept and nave, the design creates a space whose horizontal and vertical dimensions vary via a series of origami-like folds, which give rhythm to the interior and exterior of the building. Transparent plastic panels in the gable side facades, covered with fabric, allow natural light to enter the chapel and their framework evokes qualities of traditional stained glass.

4.2 *Aalto university, Finland*

The Department of Architecture at Aalto University offers a one-year intensive program focusing on wood and wooden architecture. The Wood Program, partly funded by the Finnish wood industry, explores the ecological, technical and architectural properties of wood, providing a thorough and complete view on the whole chain of wood construction, beginning with the tree in the forest and ending up with the construction of an experimental wooden building.

Architect Pekka Heikkinen runs the Wood Program with the help of additional tutors. The program includes lecture courses on topics including the ecological importance of forests and wood, technical properties of wood, as well as the study of traditional and contemporary wood architecture. These lecture courses are intended to provide students with a theoretical background in wooden architecture. Design projects are a critical part of the program as do field trips to connect with the local wood industry. Students also benefit from visits to various examples of Finnish wooden buildings. The success of the program relies on collaboration with the Department of Forest Products Technology's Wood Material Technology Laboratory as well as the Department of Civil Engineering. In addition to lectures and research in wood construction, the Wood Program culminates in the design and construction of an experimental structure in wood, often using digital design principles and tools.

4.2.1 *Liina transitional shelter, 2011*

The Liina transitional shelter is a temporary building to be used in cold climates during crisis situations anywhere around the world. Designed and built in 2011 by the students of the Wood Program, Liina is made of mostly Finnish wood and wood-based materials. As Liina is designed to be quickly and efficiently deployed, it utilizes a simple flatpack system of prefabricated timber panels. The panels are simple enough to be fabricated almost anywhere in the world, and all components for two complete Liina shelters fit within a standard International shipping container.

As a transitional shelter it is intended to be a secondary response after a crisis. Two adults in six hours with only common non-electric tools and a cartoon diagram can assemble the shelter. It is designed to house a family of five for up to five years during the post-disaster reconstruction phase and then can be upgraded, relocated, resold or recycled. The Liina concept is based on a series of prefabricated sandwich panels. Each panel is 600 mm wide (half the dimension of a piece of plywood) to cut down on waste and to be easily carried by one adult. The modularity of the design allows for the addition or subtraction of frames in order to increase or decrease the size of the shelter to accommodate the needs of the inhabitants.

The panels are comprised of a laminated veneer lumber (LVL) frame sandwiched between two sheets of plywood and filled with wood-fiber cellulose insulation pads. Six panels are joined together with simple, repeated wooden-dowelled joints to form a frame and tightened using nylon straps, 'liina' in Finnish, like those used for the transportation of cargo. The strap creates airtight joints without any metal fasteners or the use of electric-powered tools on-site.

The exterior and interior surfaces of the panels are identical in nature and make use of a plywood Birch solution for the prototype. A foldable waterproof canvas protects the shelter from rain, snow and UV damage and can be easily replaced if needed. The canvas is pulled taught over a series of battens affixed to the exterior of the panels, thus creating a ventilation gap between the two skins.

4.2.2 *Säie pavilion, 2015*

The Säie pavilion is an open-air covered space located in the plaza space between the Helsinki Design Museum and the Museum of Finnish Architecture. The structure is the most recent project designed and built by students of the Wood Program. It was created to be an event space where activities such as lectures and workshops could be held.

The inspiration behind the pavilions concept came from the covered canopy structures that are scattered throughout public parks and gardens in the area. An idea of creating a sense of a forest within the heart of the city influenced the tectonics of the form. The columns recall tree-like trunks that branch out to carry the translucent roof cover.

The form was achieved by using active-bending wood members that are twisted into shape. Each "branch" is made up of two planks of pine with plywood sandwiched intermittently between the two outer planks. The roof structure uses three planks that are sandwiched together. The engineering for this structure was quite complex and required that the

students worked closely with students in the Department of Civil Engineering to assist with the structural design.

The wood platform of the pavilion is constructed out of thermally modified spruce decking boards. A local company called Lunawood, which specializes in heat-modified wood, produces the product, Thermowood, used for the platform. The process involves compressing and heating the wood to an extremely high temperature. The end result is a very durable, dense wood material that has zero organic content or sugar, in order to eliminate the issue of rot. This process also serves as an alternative to using chemical laden wood sealers. The product is used mostly in cladding and decking, but has more recently used as a framing material for doors and window fenestrations.

4.3 *University of Stuttgart, Germany*

The Institute for Computational Design at the University of Stuttgart is dedicated to the teaching and research of computational design and computer-aided manufacturing processes in architecture. The Institute of Building Structures and Structural Design (ITKE) also based at the University of Stuttgart is a leading institute in the research of innovative structural systems and high performance materials.

Architect Achim Menges is the head of the Institute for Computational Design (ICD) and his research and practice focuses on the development of integrative design processes at the intersection of morphogenetic design computation, biomimetic engineering and digital fabrication. Structural Engineer Jan Knippers is head of the Institute of Building Structures and Structural Design (ITKE) as well as a partner at Knippers Helbig Advanced Engineering. Knippers teaching, research and practice focus on new materials and efficient structures for architecture. While the primary research focus of these two institutes is not exclusive to wood, the partnership they have developed over that past five years has yielded cutting edge research on the design and fabrication of demonstration pavilions that explore the new wood typologies.

4.3.1 *ICD/ITKE research pavilion, 2010*

In 2010, the ICD and the ITKE designed and constructed a temporary research pavilion. The innovative structure demonstrates the latest developments in material-oriented computational design, simulation, and production processes in architecture. The result is a bending-active structure made entirely of extremely thin, elastically-bent plywood strips.

The research pavilion demonstrates an alternative approach to computational design where the computational generation of form is directly driven and informed by physical behavior and material characteristics. The structure is entirely based on the elastic bending behavior of birch plywood strips. The strips are robotically manufactured as planar elements, and subsequently connected so that elastically bent and tensioned regions alternate along their length. The force that is locally stored in each bent region of the strip, and maintained by the corresponding tensioned region of the neighboring strip, greatly increases the structural capacity of the system. The work is contemporary while evoking qualities of traditional Mudhif houses of the Madan people of southern Iraq (Fleischmann et al. 2012).

4.3.2 *ICD/ITKE research pavilion, 2011*

In summer 2011 the ICD and the ITKE, together with students at the University of Stuttgart realized a temporary research pavilion made of wood. The project explored the architectural transfer of biological principles of the sea urchin's plate skeleton morphology by means of computer-based design and simulation methods, along with computer-controlled manufacturing methods for its building implementation. A particular innovation consists in the possibility of effectively extending the recognized bionic principles and related performance to a range of different geometries through computational processes, which is demonstrated by the fact that the complex morphology of the pavilion could be built exclusively with extremely thin sheets of plywood (Menges and Schwinn 2012).

4.3.3 *Landesgartenschau exhibition hall, 2014*

Through work on the 2011 pavilion as well as additional research in robotic fabrication in timber construction), the ICD and ITKE institutes developed a robotically fabricated lightweight timber construction system sourced from regional wood products. The building system and its computational design methodology were successfully tested through the design and construction of a large-scale prototype building for the horticultural exhibition of Baden-Württemberg in 2014. The Landesgartenschau Exhibition Hall uses a digital chain from design to fabrication of both structural and non-structural building parts resulting in a geometrically highly differentiated and efficient construction system. Its flexibility allows for adapting to diverse and complex boundary conditions while ensuring high structural performance and resource efficiency. Additionally, the developed system expands the application of regional timber products in accordance with future foresting strategies in Baden-Württemberg (Schwinn and Menges 2015).

5 OPPORTUNITIES IN THE US

The case studies highlighted in this paper are part of a larger effort by the author to examine more thoroughly wood research and education occurring outside of the United States, where advances in the use of mass timber have been more rapidly developing over the past several decades. A few insights that can be drawn from this study include:

- Beyond just building big, new systems and typologies must be explored through the use of computational design and advanced manufacturing.

– Developing a holistic view from forest to building is necessary to understand and appreciate the full potential of the material innovation.
– Experimental demonstrations projects serve as ideal test beds for implementing research ideas with minimal financial burden. These projects also serve as an effective means for dissemination of new knowledge.
– Success in these efforts relies heavily on interdisciplinary teams working with close industry partnerships and support.

The recently formed National Center for Advanced Wood Products Manufacturing and Design is an ideal location where these types of activities might occur in the US. The center was created in 2015 as a partnership between the College of Forestry and the College of Engineering at Oregon State University (OSU) as well as the School of Architecture and Allied Arts at the University of Oregon. It aims to feature research and educational programs focused on the unique intersection of design, engineering, and construction using innovative wood products. One of the primary goals of the center is the development of research and education programs targeted to strategically support and grow the competitiveness of the US wood manufacturing sector and building design profession.

6 CONCLUSION

Advances in the development of CLTs and other engineered wood products have renewed interest in non-residential uses of wood. Architects and engineers are beginning to reconsider this very old material in new and exciting ways. Universities in the US are unfortunately not properly equipped to prepare students with the design skills to fully leverage the recent advancements in wood product innovations. By examining institutions in Europe, where innovation in advanced wood products have been more widely adopted for the past few decades, US universities can base future efforts in wood research and education on successful models adopted from abroad and adapted to the unique conditions of the US buildings industry and economy.

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Intermediate landscape regeneration. Implications on architectural education

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ABSTRACT: Architects in urban planning and design are mainly devoted to providing piecemeal, instant, expert-driven solutions rather than systemic, long-term, co-produced ones. Such reductive approach compromises architect's capacity to guide the transformation of the suburban landscape towards a sustainable city. Against this backdrop, techniques geared towards taking advantage of the inner capacities of the suburban landscape for incrementally increasing urban life should find their place in architects' curriculums. In this regard, the Regenerating Intermediate Landscape studio of the UIC Barcelona School of Architecture deploys three complementary approaches with significant implications on architectural education: (1) systemic analysis focused on the identification of networks of places with collective meaning; (2) evolutionary analysis addressed to the discernment of regenerative tendencies such as unplanned development of systems of public open spaces; and (3) participatory analysis aimed at propelling communities' involvement in the definition, materialization and maintenance of civic spaces.

1 INTRODUCTION

The environmental, social and economic impacts of sprawl are well known, and the need to alleviate such negative effects is widely accepted. In the USA, this field has gained momentum since the 1980s and a wealth of proposals to repair sprawl at a regional and community scale have been implemented (Calthorpe, 1993, Dunham-Jones & Williamson, 2009, Tachieva, 2010). In Europe, retrofitting suburbs has also appeared on the agenda of national and supranational institutions as an important issue (Bruegman, 2005, EEA, 2006, Indovina, 2009). Against this backdrop, landscape-based approaches are essential for reframing contemporary urban regions (Shannon, 2006) and have to consider the "intermediate nature" of the suburban landscape (Rowe, 1991, Sieverts, 2000): 1) the middle position, between city cores and greenfields; 2) the hybrid morphology, between urban and rural; 3) the inter-scalar scope, between regions and communities; and 4) the ongoing transition, ranging from initial single-functional subdivisions to sustainable urban fabrics. According to these characteristics, the technical and political agendas of the 21st century should undertake the incremental dissemination of urban life in large-scale suburban areas, conceived as dynamic physical and social organisms.

However, this challenge may be compromised by a reductive interpretation of the role of architects in urban planning devoted to providing piecemeal, instant and top-down urban design solutions (Dunham-Jones & Williamson, 2009) rather than systemic, long-term and co-produced ones (Magnaghi, 2000). In this respect, major efforts to update academic programs in architecture schools are required, mainly in Europe, where the tradition of compact cities might explain the lack of undergraduate courses on retrofitting suburbs. A response to this is the Regenerating Intermediate Landscape (RIL) studio of the UIC Barcelona School of Architecture, which contributes conceptual and technical grounds for intermediate landscape regeneration covering every level of design practice, including: landscape architecture, urban design, and architecture. Below, we introduce the RIL studio with the aim of highlighting its educational implications.

2 REGENERATING INTERMEDIATE LANDSCAPE STUDIO

For the last fifteen years, the Regenerating Intermediate Landscape studio has required students to undertake the field research needed to comprehend the urbanization processes of a large-scale suburban area, and then propose planning and design solutions for its retrofitting from regional to community scale. The studio combines landscape architecture and urban design, involving an analysis of the intermediate landscape, a

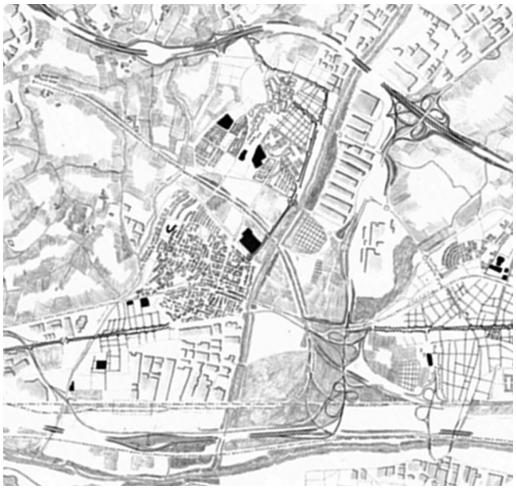


Figure 1. Student map of the built-up areas, main mobility networks and ecological matrix of the Caldes Stream South Sector. Map by Cristina Coll, Domènec Massuet and Anna Perramon (Course 2013–14).

proposal for a physical structure for landscape regeneration, and a proposal for intervention in a specific retrofitting site, developed in both text and graphic format. Students must grapple with the physical components of the intermediate landscape such as urban agriculture, rural-urban interface, activity corridors, sprawl types (commercial strips, industrial parks, residential subdivisions), infill and redevelopment sites, and public transport systems. The analysis of these materials requires not only standard cartography for understanding the current technical conditions (aerial photographs, topographic and zoning maps), but also historical cartography for illustrating the complexity of the urbanization processes over time; and qualitative data collection in order to capture public landscape perception. Because intermediate landscape regeneration encompasses so many issues and requires an interdisciplinary approach, the studio has focused on repairing the suburbs of the Metropolitan Region of Barcelona (MRB) close to the UIC Barcelona campus where expert and lay knowledge is available. We select areas whose scales can be grasped by teams of three to four students and are suitable for data collecting and analysis (typically river corridors approximately 5–10 km long with surrounding suburban areas covering 10–50 km^2). Urban rivers are compelling sites for studio projects that have been identified by current metropolitan planning as strategic areas for MRB's sustainable development, and have increasingly attracted public attention, as demonstrated by the large number of local organizations involved in their protection.

The course is organized into three distinct phases: inventory/analysis, regional planning, and urban design. First, students conduct urban transects and map distribution of built-up areas and potential infill and redevelopment sites, document traces of heritage,

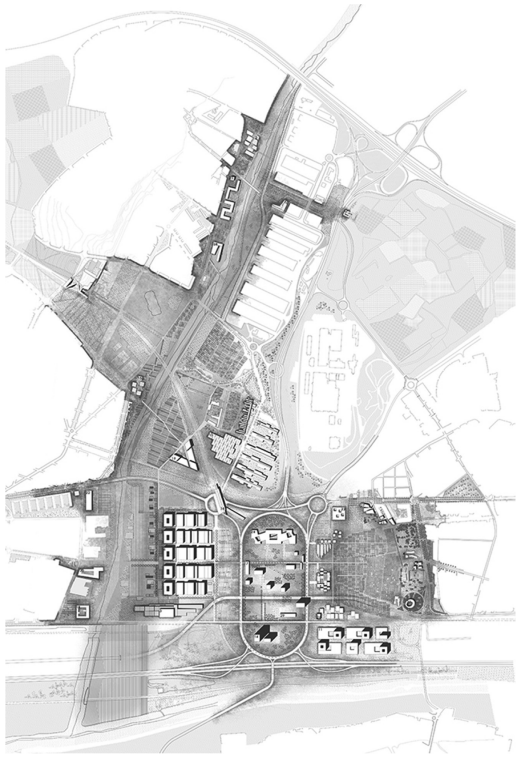


Figure 2. Final Master Plan for the Caldes Stream South Sector. Map by RIL studio students 2014–15.

and map the mobility networks, including arterial and local roads, pedestrian trails and public transport systems. Students also analyze the ecological matrix of the landscape, drawing upon green infrastructure maps including riverbanks, forests, agricultural land and local features such as public open spaces and facilities (Fig. 1). For this purpose, students take field trips to the project area and learn about ongoing issues from public agency staff and nonprofit groups.

Next, in the master plan phase, teams of three to four students work at the scale of the entire study area (10–50 km^2) for designing civic networks, i.e. cohesive and meaningful systems of significant collective places aimed at contributing to the visual understanding of the intermediate landscape and making it more livable. With this aim, the teams tackle issues of particular interest to them, such as enhancing open space systems along the length of the stream, reprogramming surrounding obsolete residential and productive areas, generating new urban centralities and improving public access from them to the riverbanks. Next, a final course proposal which includes the best contributions of all the teams is developed jointly by the students (Fig. 2).

In the third phase, students develop individual retrofitting projects for specific sites consistent with their master plans, making tangible the overall concepts. For example, to develop a new urban center, students have designed hybrid typologies of buildings

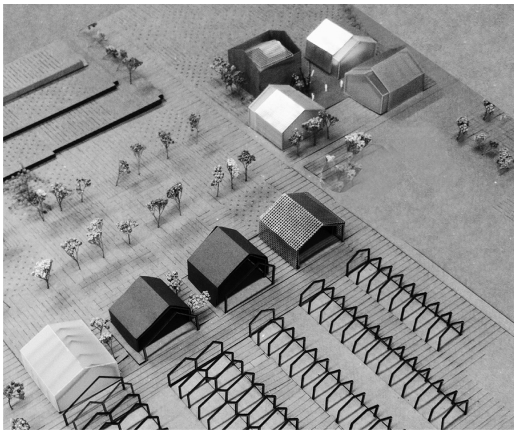


Figure 3. Student proposal for R&D Urban Allotments in the urban fringes of the town of Mollet del Vallès. The project is set in a rural environment and is based on the existing geometry of the agrarian plots. Made by Cristina Coll (Course 2013–14).

and public spaces that reconcile urban intensity and the rural environment (Fig. 3). To retrofit a commercial strip, students have developed conceptual designs to progressively replace large containers by small-scale, dense and mixed-use urban blocks. Students have also proposed new designs for urban parks and riverbanks to remove obstacles blocking public access and enhance the civic network.

Early on in the class, students are provided with conceptual frameworks, models, tools and methods for intervening in the intermediate landscape. Students make presentations to panels of professionals, government agency staff and community groups, who raise real-world concerns. After refining their work, the students present to the final jury with an external referee. The students' analyses and projects are assembled into reports which are then presented to city councils and non-profit advocacy groups.

3 CASE STUDY

In the Regenerating Intermediate Landscape studio, students are challenged to develop innovative design solutions for the transformation of urban rivers into legible civic corridors (Lynch, 1960). Beyond their high ecological value as "bio-highways", urban rivers deserve special attention due to their growing social use after decades of intense degradation closely associated with urban pressure (Warner et al. 2013). In fact, urban rivers are essential infrastructures for the sustainability of suburbs (Vall-Casas et al. in press), and for this reason they are a fundamental issue for the RIL studio. The Besòs River, which is one of Barcelona's two connections with inland Catalonia, has been studied for several courses. Six main watercourses with over a million inhabitants living around its flood plains flow down the slopes of the Coastal Mountains north of the city of Barcelona. The Mediterranean climate results in highly seasonal precipitation, with occasional flash floods and very little flow during much of the year.

Here we present a representative case study of the Besòs River Basin streams, formerly devoted to providing irrigation, energy and raw materials in a rich agrarian landscape. All of them, in the 1960s and 1970s, were subject to overexploitation of water resources, contamination of ecosystems and flooding due to the uncontrolled development of riverbanks. Natural cross sections have been highly modified and flood plains have become areas of growth; spaces for road and railway communications; and channels for drainage, waste, and energy supply. In the process, major stretches of the riverbanks were neglected and left to decline, leading to the dwindling of local riverside residents' feeling of belonging that had been characteristic of the first half of the twentieth century. However, this condition underwent a reverse in the 1980s as a result of significant efforts to reappraise social and environmental assets (Benages-Albert & Vall-Casas, 2013).

In this context, the goal of the RIL design studio is to recover the civic, ecological and economic value of the River Besòs space, combining effective urbanism and healthy ecological systems. In particular, the studio advocates alleviating the impact of mobility infrastructures, relocating polluting activities such as cement factories, stimulating connections between the existing residential fabric and the mosaic of riverside farmlands and woods, enhancing the river's urban embankments and facilitating public access. For this purpose, students design a system of selective repair scenarios interconnected by public open spaces such as avenues, plazas, allotments and parks, the objective being to reinforce the physical and social cohesion of suburban river stretches and contribute to their legibility. To achieve this, students are asked to consider the intermediate condition of the landscape, as regards: 1) the scale of work involving simultaneous local and regional decisions, 2) its hybrid urban-rural nature which questions the traditional concept of public space and suggests the incorporation of new functional programs such as urban agriculture, and 3) the ongoing urbanization process.

3.1 *The case of the Caldes stream*

The concept for "re-envisioning" the Caldes stream resulted from the agreement signed by the Catalan government and the UIC Barcelona with the aim of offering technical advice to the Department of Territory and Sustainability (DTS) for planning supramunicipal areas that have a role to play in boosting the Catalan economy and need new methodological bases in order to be developed. Specifically, the students' work supported the Master Plan for the Caldes Stream South Sector, directed at transforming currently expectant spaces around the 7 km lower stretch of the Caldes

stream in a metropolitan sector that constitutes a point of reference for its economic, ecological and social potential. This contribution took the form of an integral project comprising collective proposals for urban and territorial structures and individual proposals for urban design (Fig. 4).

The Caldes Stream South Sector covers the urban cores of Mollet del Vallès, Santa Perpètua de Mogoda, Martorelles, Sant Fost de Campsentelles and La Llagosta, set in large extensions of peri-urban open space that is often residual with limited accessibility. The transformation of this sector into a new metropolitan center involved three main issues: (1) structuring and re-assessing the peri-urban open space fragmented by the forceful footprint of road and railway infrastructures; (2) the environmental and social recovery of the lower stretch of the Caldes stream as a full-blown river park to contribute to the improvement of adjacent residential and industrial fabrics in Santa Perpètua de Mogoda and La Llagosta; and (3) reassessing the urban outskirts of Mollet del Vallès South and the adjacent peri-urban open space by means of facilities and public spaces with added value.

With this aim, students dealt with: (1) the recovery of the ecological and cultural values of the existing agricultural substratum by means of the civic consolidation of historic roads connecting Mollet del Vallès, Santa Perpètua de Mogoda and La Llagosta, strengthening links along the embankments of the Caldes stream, and the preservation and respectful recycling of agricultural heritage; and (2) the reinterpretation of metropolitan road junctions by means of projects that combine infrastructure and landscape, incorporating innovative economic activities with high added value. Students presented their results to the Catalan Government in an exhibition held in Barcelona's Museum of Modern Art. The resulting model of the master plan was exhibited in the DTS offices, helping to influence the urban planning of cities along the Caldes stream.



Figure 4. Aerial view of the Caldes Stream South Sector, a tributary of the Besòs Basin in the metropolitan region of Barcelona.

4 IMPLICATIONS ON ARCHITECTURAL EDUCATION

From our experience of teaching regeneration of intermediate landscapes on a number of river corridors in the MRB, and in light of the relevant literature, we propose three complementary techniques that deserve special attention due to their implications on architectural education: (1) systemic analysis oriented to the design of civic networks ; (2) evolutionary analysis addressed at identifying regenerative tendencies such as the incremental development of systems of public open spaces; and (3) participatory analysis aimed at propelling communities' involvement in the definition, materialization and maintenance of daily life spaces. These techniques will provide methodological support to identify and take advantage of the inner capacities of suburban landscapes for building civic networks while increasing citizens' involvement in them.

4.1 *Systemic analysis*

The systemic analysis is essential to transcend intermediate landscape complexity and build operational narratives for understanding and designing its shape. In particular, the systemic analysis supports the design of the civic network through three stages (Cuéllar & Carracedo, 2011, Elinbaum et al. 2013) (Fig. 5).

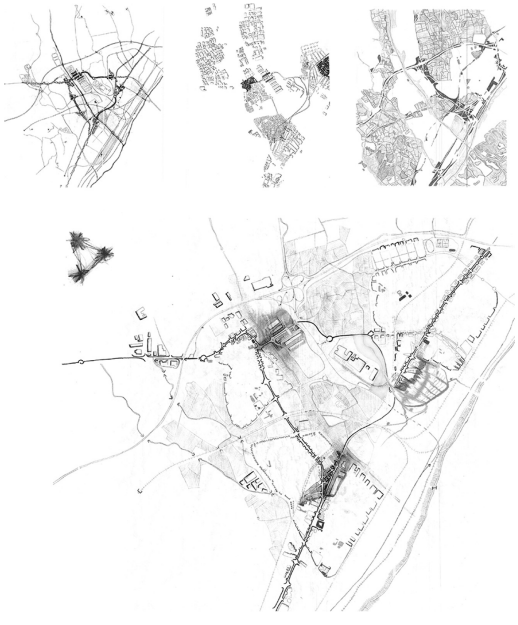


Figure 5. Example of systemic reading. At the top, morphological layer analysis maps. At the bottom, from left to right, landscape model scheme and landscape structure map. Made by: Cristina Coll, Domènec Massuet and Anna Perramon (Course 2013–14).

4.1.1 *Morphological analysis of layers*

The first stage makes a morphological analysis of the Caldes Stream South Sector landscape, following the methodology of Ian McHarg (1969) for assessing landscape capacities. Specifically, the students map several thematic layers such as green and grey infrastructures and built-up areas. In addition, each working group suggests new complementary thematic approaches according to their particular interests, such as: cultural heritage, ecological values, current planning regulations, etc. Once students become familiar with the morphological analysis of layers, they develop two types of synthetic vision, a specific one (landscape structure) and another abstract one (landscape model).

4.1.2 *Landscape structure*

Designing the landscape structure implies an inductive operation based on the selection of the most important elements of each thematic layer and their articulation in a synthetic representation. Among other results, students determine: the consistency and diversity of the system of open spaces, the fluent interconnection of the arterial road system and local road system, and the appropriate interface between built-up areas and green areas. At the same time, the design of the landscape structure is a deductive operation aimed at assigning a new regional role to the Caldes Stream South Sector, and thus giving a new meaning to its urban fabrics, open spaces and infrastructures.

4.1.3 *Landscape model*

The landscape model is an abstract expression of the landscape structure that allows us to clarify and communicate its basic principles. Unlike the landscape structure, which is directly related to one specific case study, the landscape model consists of an abstract diagram that might fit with multiple cases. Thus both analysis and design converge in the model, reflecting the duality between reality and utopia, or reasoning and intuition, characteristic of the practice of urbanism. At this stage, the students de-construct the landscape structure, identify a number of linked parts, and rebuild the whole forming a new, more efficient, clear and communicable entity (the model).

The three phases of systemic analysis do not follow a linear development but rather an iterative path. The identification and comprehension of new layers, the redesign of the landscape structure according to these layers, and the subsequent reworking of the landscape model build a complex back-and-forth design process, along which a number of sprawl repair opportunities emerge. Students then select the most strategic ones and determine guidelines for their development consistent with the landscape structure and model.

4.2 *Evolutionary analysis*

An improved understanding of how historical layers contributed to the evolution of the intermediate landscape provides better opportunities for effective regeneration strategies (Secchi, 1994, Corboz, 2001). In this sense, there are a number of relevant experiences of urban stratigraphy addressed at uncovering the genesis of metropolitan regions with deep historical roots such as Barcelona (Font et al. 1999) and Milan (Boeri et al. 1993). According to this background, the present educational proposal seeks to incorporate a comparative analysis of historical cartography as a standard tool for designing historic-based civic networks by identifying pre-urban patterns that undergo processes of cumulative collective meaning.

4.2.1 *Identifying pre-urban patterns with civic potential*

Pre-urban patterns are spatial structures with the capacity to prevail in the face of the pressures of the urbanization process and to determine the form of the intermediate landscape. Roads and paths, agricultural plots, old villages, farms and churches, and irrigation and drainage infrastructures built traditional networks that structured the productive and social activity of farming communities. These types of historic materials embedded in suburban areas help to improve functional diversity, connectivity and pedestrian accessibility, while promoting citizen participation in retrofitting suburbs (Vall-Casas et al. 2011). Within this conceptual framework, students select individual elements from different historical layers and reconnect them in specific sets. The resultant conjunctions of historic roads, main streets, abandoned rail tracks and paths, farms, parks and urban centers, watercourses and canals, create cohesive and meaningful civic networks. In particular, entities such as old roads and streams are redesigned, taking advantage of their intermediate scale, with the goal of reorganizing the fragmented metropolitan puzzle, and interconnecting a broad spectrum of isolated retrofitting projects (Fig. 6). We believe that rather than imposing an ahistoric design, helping students to find a plan that builds on historic patterns is preferable.

4.2.2 *Analyzing processes of cumulative civic value in pre-urban patterns*

Watercourses and historic roadways of contemporary urban regions are becoming channels of collective significance (Vall-Casas et al. in press). For this reason long-term processes of the transformation of roads and rivers into civic corridors, which have increased the sense of belonging of local residents and improved the legibility of large suburban areas, must be considered carefully. In our case study, the accumulation of public open spaces along the riverbanks of the Caldes stream and the intensification of their social use is an important issue that deserves to be acknowledged. For this purpose, students deploy chronological assessments of the urban river corridor aimed at verifying the incremental development of a supra-municipal open space system. This evolutionary approach provides an enhanced understanding of the significance of the present moment and allows us to align past and future strategies for regenerating the intermediate landscape.

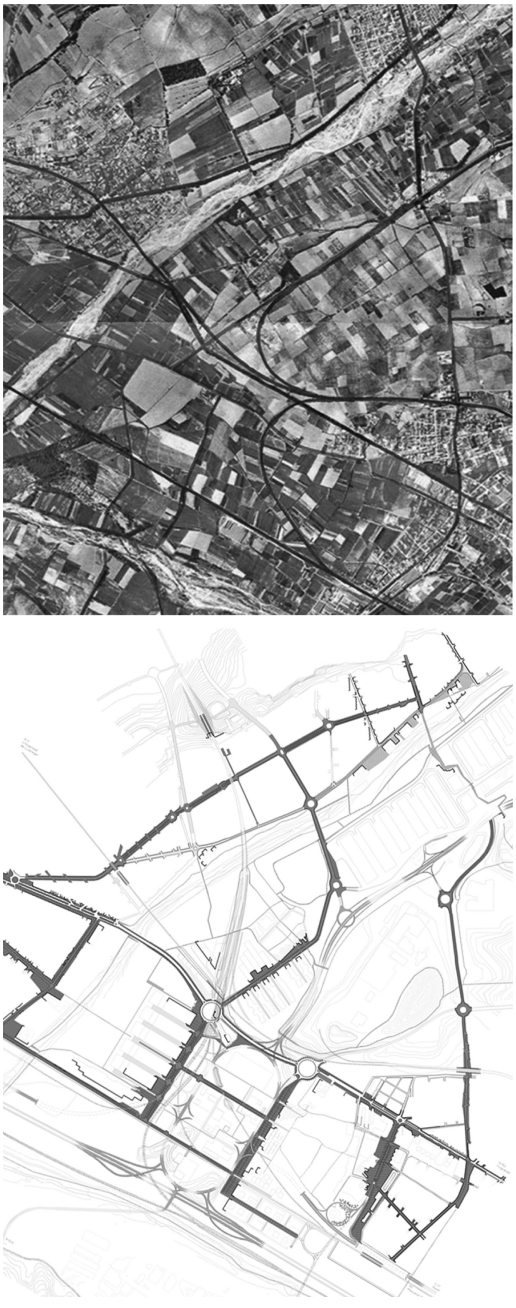


Figure 6. Design methodology of a historic-based civic network. At the top: mobility infrastructure of the pre-existing rural landscape drawn on a 1956 aerial photograph of the Caldes stream. At the bottom: historic connectors transformed into boulevards or main streets of the Master Plan for the Caldes Stream South Sector. Map by RIL studio students 2014–15.

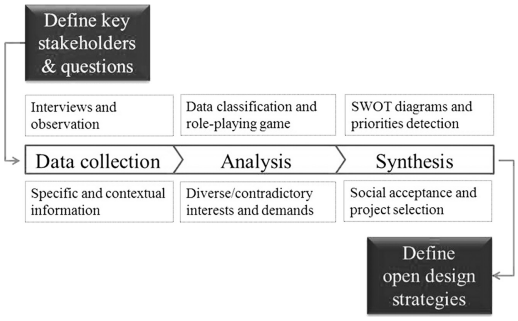


Figure 7. Participatory analysis. Conceptual framework.

4.3 *Participatory analysis*

The move from the design of a landscape structure towards the design of a civic network calls for the integration of experiential knowledge in spatial design, with the aim of transforming abstract systems with civic potential, developed in previous expert analyses, into socio-physical structures. To access the experiential knowledge of local stakeholders and integrate it in the design process, qualitative techniques are developed following three main phases (Benages-Albert & Elinbaum, 2014) (Fig. 7).

4.3.1 *Data collection*

The first phase consists of identifying key stakeholders related to the case study and interviewing them to access the social component of places (*civitas*) (Delgado, 2004). This process of qualitative data collection provides *hic et nunc* knowledge of places based on the stakeholders' experiences, requests and interests that students incorporate as a complement to the morphological approach. In particular, each group of students defines an interview guideline with specific questions depending on the previous spatial analysis and the interlocutor expertise to recognize places with special value and tackle sprawl repair projects from the perspective of real needs and expectations. All the information gathered is analyzed and synthesized in the following phases to obtain a balanced socio-physical structure in which the systemic, evolutionary and participatory readings complement each other.

4.3.2 *Analysis*

The analysis of all the qualitative data provided by different actors allows the emergence of diverse and sometimes contradictory perceptions and demands that the designer need to study and prioritize in an on-going dialogue with the other actors involved in the design process. After examining and classifying the data obtained in the previous phase, students participate in a role-playing game with the whole class to discuss the perception and conception of reality according to the different stakeholders interviewed. During this phase of collaborative learning, students understand the complexity of the project beyond its morphological dimension and feel encouraged to continue with the design process when discovering new project ideas linked with the local stakeholders' needs.

4.3.3 *Synthesis*

The synthesis of the stakeholders' demands by means of open design directives (Binnekamp et al. 2006) allows the definition of a socio-physical structure attuned to public landscape perception. To do so, based on *in situ* knowledge the students validate or refute the project hypotheses that have emerged from the morphological analysis, adding any new opportunities provided by the stakeholders and calibrating the social response in terms of the specific projects identified. A SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) then facilitates the proposal of flexible guidelines for the design of the civic network and its particular components. In this way, rather than general proposals arising from an independent process of the architect/urban planner, a much more profound practice-based reflection is the result of a wide variety of intellectual approaches commensurate with the singularity of the different contexts and situations (Innes, 1995).

The use of this methodological tool provides three key elements for defining a participatory project which facilitate its materialization, social acceptance and maintenance: (1) knowledge of the place as a social space of life and interaction, which is impossible to achieve by studying maps; (2) a better understanding of the complexity of urban planning in relation to the conflicts of interest of the different stakeholders involved; and (3) the identification of specific ideas for the urban design and landscaping with a more solid social basis. This approach introduces a new way of understanding urbanism as an open process – an imperfect, contentious, contradictory and ambiguous process, if you like – but one which also embraces the complexity of opinions and processes to allow more realistic, robust and operational designs in the long term.

5 CONCLUSIONS

The regeneration of intermediate landscapes will always be challenging. It requires systemic, evolutionary and participatory analysis to know how to activate smart regeneration processes committed to the incremental production of local networks of public infrastructure with civic value. In teaching students how to approach the design of such socio-physical structures, we try to instill a respect for citizens' attachment to their daily life environment as a powerful force for sustainable development. Similarly, we encourage students to learn from pre-urban patterns to build a solid foundation for evidence-based design. This approach questions the traditional problem-solving structure of most design studios based on individual, instant, and expert-driven solutions, proposing instead the co-evolution of the intermediate landscape as a question-driven approach that emphasizes an understanding of the collective processes of transformation.

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Typo-morphology: From research to architectural education

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ABSTRACT: The contemporary city presents itself as an urban organism of great complexity, consisting of an increasingly number of elements, systems, dynamics and extracts, which makes their reading an equally complex task. The method of typo-morphological analysis, it is assumed in this context, as an important reading tool of the city, giving order to what is naturally disordered through a classification process of the different elements that structure it – streets, squares, urban blocks, buildings, plots, among others. It is precisely from the reading of two structural elements of the city urban fabric, the urban block and the street, that we seek to illustrate the applicability of the methodology and its usefulness in the academic education and as a tool in the (re) design process of the city.

1 INTRODUCTION

The urban fabric, both in its public and private component, reveals in the diversity of its shape the tension between transformation and resistance. This is the result of constant need for man to reinvent the place where he lives. The systematization of knowledge relating to this process of change and to interventions that have occurred in the built fabric is the key in decoding the physical and spatial structure of the city and in its own consolidation/design process.

The complexity of this process makes the articulation of the architectural education with research activities increasingly significant and even directly with the architectural practice. The method of typo-morphological analysis, as a classic reading tool of the city, can contribute to strengthen the link between these different fields of action. It presents itself as an important tool for the apprehension of the urban phenomena, to stabilize and consolidate ideas but also to check the adaptability and consolidation of some concepts, in periods of disciplinary uncertainty.

The article aims to show that this articulation is a reality and it offers added value in the moment of thinking and designing the contemporary city, mainly in the academic context. Its therefore important to explain that this study is related to the development of two parallel researches – "The Lisbon Urban Block: from Shape to Type" and "Emergent Streets. A morphological interpretation in Portuguese urban context" –, whose methodological basis is strongly influenced by the research laboratory FORMA URBIS Lab. This lab to which we belong is composed by professors of the University of Lisbon – Faculty of Architecture, research fellows, masters and Phd students developing studies related to the thematic of city urban form. The presence of a productive research environment with a common focus – the city – understood from tested and stabilized methodologies – the typo-morphology – makes available both to academics and students useful tools for the process of reading, interpretation and design of the city.

The article shows, at first, the developments of both researches by using the method of typo-morphological analysis, applied to two structural urban elements of the city public and private component, the street and the urban block, analyzed in different urban contexts of Lisbon. Secondly, it tries to show through the work done by university students the utility of this methodology in the understanding and design process of the city.

2 THE TYPO-MORPHOLOGICAL READING

2.1 *Studies and approaches*

The typo-morphological studies have assumed since the mid-twentieth century an important role to understand the dynamic of the urban fabric. They reveal their physical and spatial structure based on detailed classification by types of the elements that shape its urban form – open spaces, buildings or streets (Moudon, 1998).

It's composed by an analytical and a classification process that is important to explore according to the studies and approaches of the different urban morphology schools with particular focus on Italian, Anglo-Saxon/German and French.

The morphological analysis is framed within the analytical process of reading, being realized from a common procedure in this field – the morphological decomposition. Reading the city from the decomposition of the urban system in morphological elements – streets, squares, buildings, plots, topography, etc. – connecting them to each other and relating them to the context, can be seen in the work of authors

such as Lynch (1960) and Cullen (1961) as a way of perception the built environment. If the morphological elements compose and organize the urban fabric, study their mutual relations contribute to the explanation of the city.

The typological analysis as a classification process aims to differentiate the Types, recognizing and systematizing its characteristics, differences and their relationship with the urban context, historical period and the society that originated it. This allows us to build a typological framework that makes easier the interpretation of the different elements that shape the city. The construction of the Type, and its corresponding typology, should not be seen only as a systematic act of classification, but also as an important design tool, as advocated by Carlo Aymonimo (1966).

The initial studies of typological analysis, linked to urban morphology were conducted by the Italian school, which is characterized by understanding the city as an "architectural organism" (Muratori, 1959). Taking the present as a starting point, the study begins with an interpretation of the urban fabric as a result of an evolutionary process shaped by the changes of the architectural typologies.

The work of Muratori (1959) is an important reflection about the physical component of the Italian city, especially for the definition of analytical tools based on the concepts of urban fabric, type and typology. In this study, Muratori stabilizes the concept of typo-morphology, based on the reading of physical form as a result of an evolutionary process. The concept of Type (Building-type) is understood as a theoretical and abstract exercise, a kind of interface between the real object and the man mind. This is an exercise that allows us read, but also conceive. The Type is a starting point for the creative and design process. These settings were at the genesis of several works in Italy and Europe.

On the other hand, the Anglo-Saxon and Germanic school is based on the analytical characterization of a particular space in a certain time or over several times. M.R.G Conzen is probably the main reference with several morphological studies of small towns or British urban areas, especially the analytical reading of Alnwick in 1960. In this study, Conzen mainly uses the plots structure, but also the street and the buildings, as basic elements for understanding the urban form. This methodology would have a significant impact on the Anglo-Saxon world, on authors such as Jeremy Whitehand or Ivor Samuels, Micheal Conzen and Anne Vernez Moudon in the North American continent.

The French school as the Italian arises in the 70s in response to the modernist principles and models, with important methodological contributions. Issues such as the evolution of the urban fabric and the organization of the plots structure (Castex; Celeste; Panerai, 1980); the fragmentation process of the closed urban block to the modern building (Castex; Depaule; Panerai, 1997), and the relationship between the built element, plot structure and public space; or the urban form classification by different deformation processes (Borie; Micheloni; Pinon, 1978), are all issues worked by a large group of authors who belong to this school.

In this context, it is important to refer two essential and complementary studies for understanding the city. The first – "Analyse Urbaine" – reveals the city form through its decomposition by extracts, fragments or samples. The second one – "Projet Urbain" – Panerai and Mangin indicate a more operational sense. The analysis of the different urban elements, and its diversity and classifying processes, reveals indirectly some projectual suggestions that can generate new systems of urban production.

The French school introduced a new methodological dimension, a more refined critical sense, differentiating the design theory "as an ideal" from the design theory "as a practice". Thus, the French school studies provide essentially working tools to guide the project design (Panerai, 1999b). It makes more valuable the role of typo-morphological method in the city understanding and project.

3 URBAN BLOCK

3.1 *From shape to type*

A reading that addresses the issue of the urban block, through a typo-morphological study, allows us to stabilize in a ordained way the knowledge about the processes, rules and models that build the private city. More than that, it is relevant for the understanding of the multiple design possibilities that this element offers to the contemporary urbanism, a result of its different evolutions and changes over time and space.

The city of Lisbon presents itself as an exemplary space of practice and manipulation of the urban block design. It is evident the tension between diversity and unity; urban fabrics that have suffered long processes of sedimentation (Alfama) and others designed as an integral unit (Baixa Pombalina); operations who reject the idea of urban block (Olivais); others more recent representing the recovery of urban block as an element of urban composition (Parque das Nações); between different development phases of the city; and even between different natural supports (hills, valleys, river front). It is in the actual city shape and its evolutionary process that we recognize their different dynamics of urban production.

The aim of this topic is not to find the types of Lisbon urban blocks, being that the purpose of one of the PhD thesis in development, but rather to reveal the methodological framework that will contribute to its identification.

The typo-morphological study of the urban blocks unfolds in two different phases, complementary and essential to read this element: the morphological analysis – individual approach to the subject of study; and the typological analysis – comparative approach. It's the aim of this topic to explain with more detail each of these stages, using some representative examples of Lisbon urban blocks.

3.2 *Morphological approach*

Two types of readings – the Decomposition and the Evolution, will support the morphological characterization of each urban block selected as representative of Lisbon urban fabric.

The first reading seeks to decompose the urban block through the study of the different elements that gives it shape and the relationships established between them: the building relationship with the plot; the plots structure with the shape of the urban block; the relationship of the dwelling organization with the built fabric; the relationship of the built fabric with the urban block shape; the urban block relationship with the shape of the city.

Assuming these relationships, six elements were considered as able to reveal their complexity – the Topography, the Perimeter, the Plot structure, the Built Fabric, the Courtyard and the Building.

The Topography, because it is repeatedly the constraint and generator of the urban block design and the urban fabric diversity, established in the combination of different natural supports – hills, valleys, river fronts, among others. The Perimeter, by the definition of the urban block boundary and the physical form of public and private city, organizing the buildings from the street and articulating built and empty spaces, public and private domains. The Plot Structure, because it is one of the main supports of the urban block dynamic and organization. It is shaped from different plot aggregation types– regular or irregular – regulating the form and density of occupation. The Built Fabric as a result of the buildings aggregation that defines the built shape of the urban block and at the same time the nature of its interior space – Courtyard – which can be public or private, built or empty. Finally, the Building – singular or common -, by the relation between the interior organization of the architectural typologies and the shape of the urban block built fabric.

For each of these elements we will find the rules that define their own shape, size, that explain their location within the urban structure and, above all, the rules that influence the shape of the urban block.

The second reading – the Evolution – is related to the action of time on the urban block, understood as the result of a dynamic and continuous process of urban production, a space where the elements that give it shape, move in time at different velocities. Therefore, the urban block will be analyzed and interpreted not only in the actual crystallized state but also over time through the reconstitution of its evolutionary process. It can have a very variable time cut, depending on the period of the urban block production.

In this regard, four main phases were identified in the urban block evolution process – the Production, the Sedimentation, the Transformation and the Resistance.

The Production refers to the first moment of the urban object, the moment of its creation. This process can start from very different principles, for example,

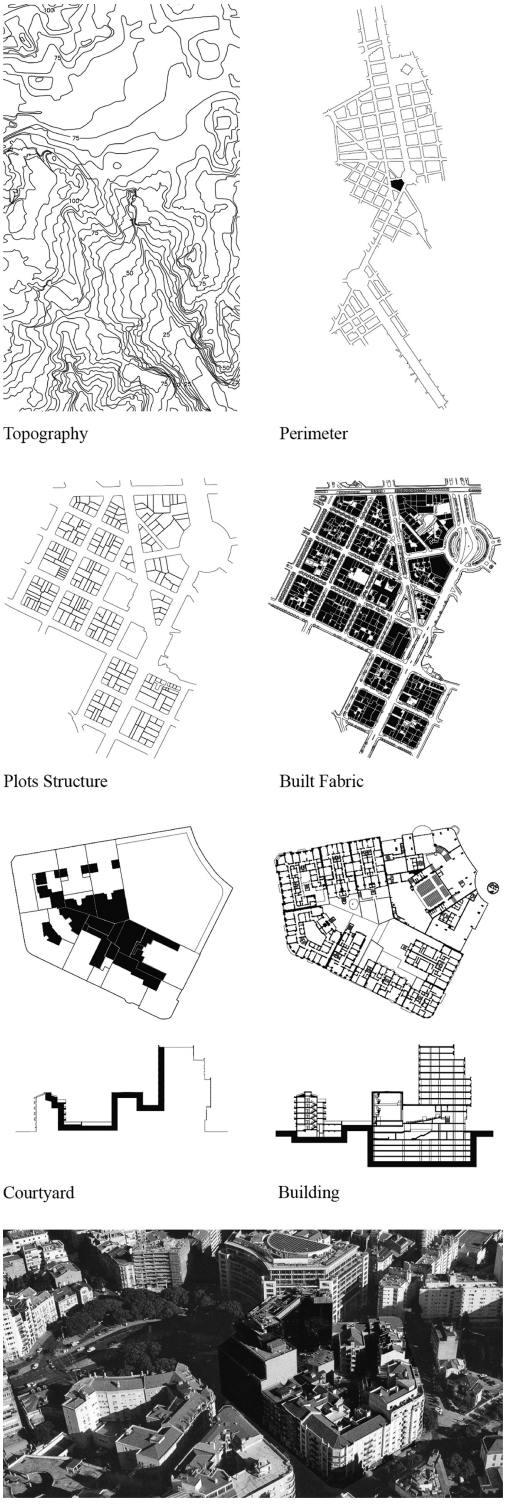
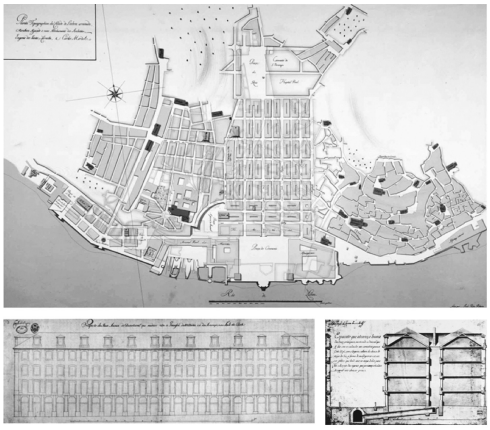
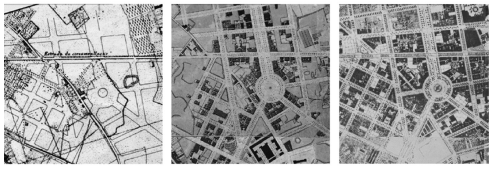


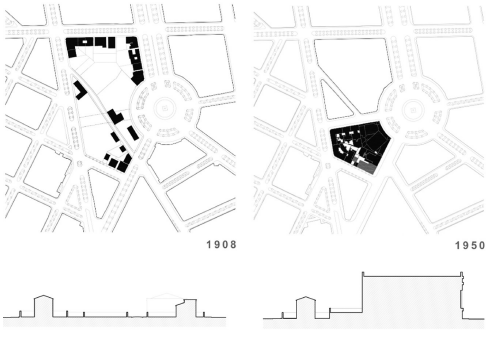
Figure 1. The six urban block elements. The urban block decomposition in Avenidas Novas.



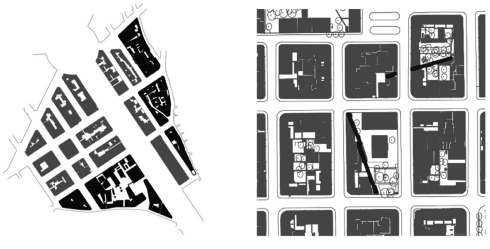
Production . Baixa Pombalina



Sedimentation . Avenidas Novas



Transformation . Monumental urban block in Avenidas Novas



Resistance . Avenidas Novas Campo de Ourique

Figure 2. The urban block evolution phases.

the Baixa Pombalina plan in Lisbon, drawn up following the 1755 earthquake, was created with a clear idea of urban production based on a compositional logic of urban layout, plots structure and building. The Sedimentation, in turn, is connected with the urban block development processes that follow the original principles of composition. The densification process is an example of it, because there is no structural change in the shape and organization of the urban block, only an integration of new buildings within a consolidated structure. The Transformation, however, has to do precisely with changes that are structural and are easily recognizable in the reconstruction of urban fabric evolutionary process. The urban block of Monumental, in Avenidas Novas, reproduces clearly this process, taking into account that between the late nineteenth/early twentieth century and the mid-twentieth century suffered a significant change in its morphological structure. This it was driven by a reorganization of the road system that included the removal of a street and the opening of another. Finally, the Resistance refers to elements that survive the urban block transformation process. In the examples, we recognize clearly the influence of pre-existing structure had, in the case of the Avenidas Novas urban blocks, in the definition of their perimeter and, in the case of Campo de Ourique, in their plots structure.

Therefore, for each of the evolution development phases we will identify the processes that are representative of the urban block dynamic in Lisbon.

These two types of reading – the Decomposition and the Evolution – that support the morphological analysis of the urban block in Lisbon, will produce a set of essential results for the type identification.

3.3 *Typological approach*

The typological analysis gives meaning to these results through a comparative reading of the worked urban blocks. Knowing the specificities of the study objects we can compare them and aggregate them to common morphological matrices that show particular characteristics of their nature.

In this sense, the Types are established according to the morphological reading, allowing the support of a comparative study between urban blocks that are very different from each other. However, they can be understood together when reduced to their essential elements, making the understanding of particular characteristics of the urban object clear and objective. This means that after defining the Types, you can explore relationships of different nature between them, an ordering procedure of isolated types that reveals the urban block typology.

This methodological construction based on a typo-morphological reading of the urban blocks does not end in a typology definition, because it is supposed to develop an interpretative and conceptual framework that gives it a more operational sense. This is useful to the actual discussion about the urban production, allowing us to inform the emerging issues about the intervention on the urban fabric. In this (re)design process of the city, the urban block may have an important position, because it assumes an extraordinary versatility and allows increasing the existence of new models, new spatial concepts and new production

processes. It assumes an essential role in the urban fabric restructuration or even as a conceptual support on the sedimentation process.

4 STREET

4.1 *The emergence of others configurations*

The consolidation of the major mobility axis as essential elements for the structuration and aggregation of the urban fabric causes big changes in actual urban paradigms.

One of the issues it takes, in recent times, has to do with the (re) interpretation of some linear urban systems as emerging forms of streets. The existing accessibility and the strategic positioning within a network, enables the urbanization development along certain infrastructure mobility axis, reconfiguring your identity. The established dynamics between this marginal urban fabric and its own formal characteristics generate transformation processes on the previous infrastructure, modifying and creating another urban element.

The characteristics of these linear urban elements that emerge, brings us to some features normally associated with the urban element Street, for example: the urban fabric support; the connection between at least two locations (Panerai, 1999b) and the regular compactness of a building fronts (Bohigas, 2004).

In this sense the use of the typifying process in these elements allows us to decode them, identifying their main characteristics and thus allow a deeper understanding of these emerging urban settings that assume an increasingly and an ever greater importance in the structuring and referencing of the contemporary urban territory (Mangin, 2004).

4.2 *The case of the Strip N117*

The case of the road N117, located in Lisbon Metropolitan Area illustrates a type of street configuration that emerges in the actual Portuguese urban context. This road initiated in the late 80th of the twentieth century an intense metamorphosis process, becoming during the following decades in a *Productive Strip*[1].

One of the urban components that most has changed over this evolution process was the urban layout. Starting from a filamentary base with some connections to the territory, it presents nowadays with a great complexity and composed by two systems: the primary



Figure 3. The road N117.

circulation channel and a roads complementary network. The symbiotic relationship that is established between these two systems enables the maintenance of high velocity, through the central corridor, and the support of the plots and building structure. The surrounding buildings, which colonized the margins of this infrastructure, produce this secondary network and through it connects with the central structure of the element.

4.3 *Composing the urban layout type*

In order to confirm the characteristics observed in the road N117 reading was used the methodological principle of typo-morphological analysis.

For this, it was made a comparative analysis between the N117 and other two elements of the same typological family, the A44 in Vila Nova de Gaia, and the A25 in Aveiro area. With this process we were able to identify the common features between the three urban layouts.

So, observing the urban layout of the three elements we could see that, despite the own deformation of each infrastructure, all shows a consistent network that intertwine the main axis. This network, not necessarily structured and rationally designed, serves as an access to the plots around the main axis and at the sometime introduce more complexity to the urban layout as a whole.

The central circulation axis is segregated, connecting specifically itself with the same type of roads, mobility infrastructures with higher territorial relevance. The connection nodes are configured avoiding the level crossing of driving lanes, preserving a more fluid movement. The conservation of car traffic as its main function in the central axis is the dominant concern. In all cases, N117, A44 and A25 can be seen on the major axis the use of different height levels. The strongest situation is in A25 where the main corridor is always develops at lower level than the adjacent margins apparently immune to what it happening in the surround area. In contrast, the A44 presents the infrastructural axis most of the time at the same topographic elevation, but using occasionally some barrier elements for separate the centre channel and the other roads.

The different complementary network present an irregular shape, result of different kind of urban processes but without compromise its main function, the supporting of the plots. In the N117 and A25 roads the

[1] The Productive concept it is associated to new principles and to some contemporary activities, which are able to generate economics values. In the actual pos-industrial period some urban paradigms changed and another urban condition appears. The industrial production move to other fields, related to high technology where robotics and electronics prevail. On the other hand, it is possible to identify in the actual productive spaces activities linked to commerce, finances, services, knowledge and technology.

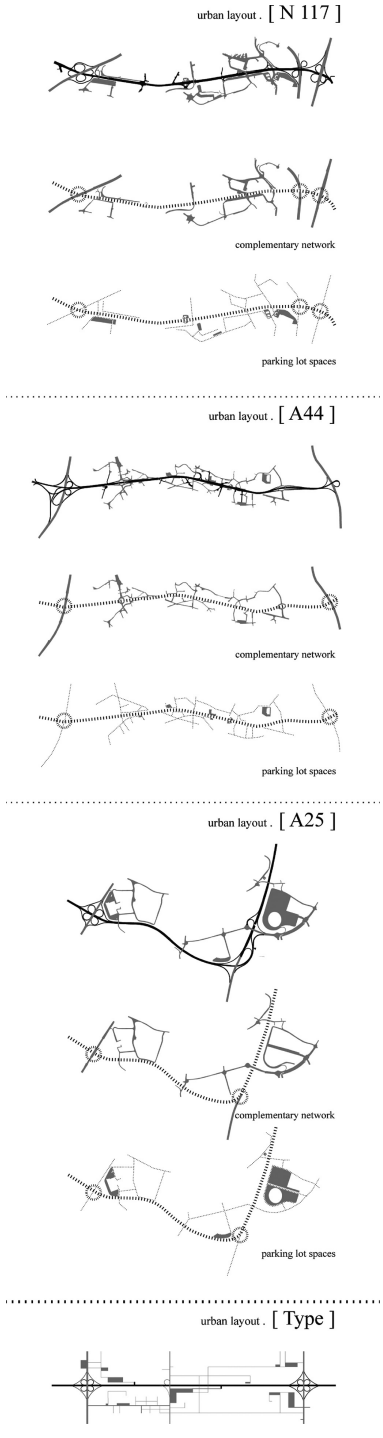


Figure 4. The urban layout type.

complementary network is a response to the access needs of big architectural objects and functions that are implanted nearby. This may be a consequence of an industrial or specialized plot subdivision or simply a result of a building construction that immediately create its own access to the infrastructure. The road A44 has a complementary network that is mainly formed by the pre-existing road structure with a rural nature, presenting some parallelism with the main channel. Over the pre-existing structure were being introduced new parts, with wider sections, seeking to serve as interlocutors between the two circulation scales. These added elements make cross-connections between the two sides as well as with the main infrastructure.

In a second moment of analysis we can see on the three case studies the presence of large open spaces, voids associated with parking lots, which supports different types of commercial spaces such as shopping centres; retails or mega-stores. These parking lot areas assume itself as a kind of plateaus showing the attractive power of each big architectural piece and functions, which are associated a long of these urban elements.

The urban layout type emphasizes the existence of two relevant extracts: the first, more basic and fundamental with a infrastructural nature and the second corresponding to the irregular network of roads that suture and link the several urban components, which confers a greater cohesion to the element.

5 TYPO-MORPHOLOGY: A TOOL FOR CITY EDUCATION AND DESIGN

5.1 *The experience of Campolide analysis*

The use of typological analysis is not confined to a decoding tool of the basic characteristics of urban elements and its formation processes. The understanding of this methodology, for one side, as a didactic tool to understand the urban and architectural form, and for other side as a tool generate new forms, is in our perspective something increasingly essential.

In this sense the inclusion of this analysis process in architectural education becomes more relevant, providing more tools to the students and with that improve its creative and design process.

As an example of this process we can use the work of 4th year students, from the Master course in Architecture with specialization in Urbanism at the Faculty of Architecture of the University of Lisbon. They were challenged to make on the first exercise a site analysis and on the second a design project, using as reference the typo-morphological analysis to identify types and urban changing process that were at the origin of a specific territory.

Therefore, taking as a case study the Campolide area in Lisbon, the students[2] were asked to look at the evolution of this territory in 4 periods: 1856; 1911; 1950; 2009. These times correspond to cartographic surveys produced by public services and design by

[2] The Campolide schemes presented in the article (figure 5) were made by the following students: Giada Spana, Inês Montes, João Mapão, Nuno Pereira, Tomás Nunes.

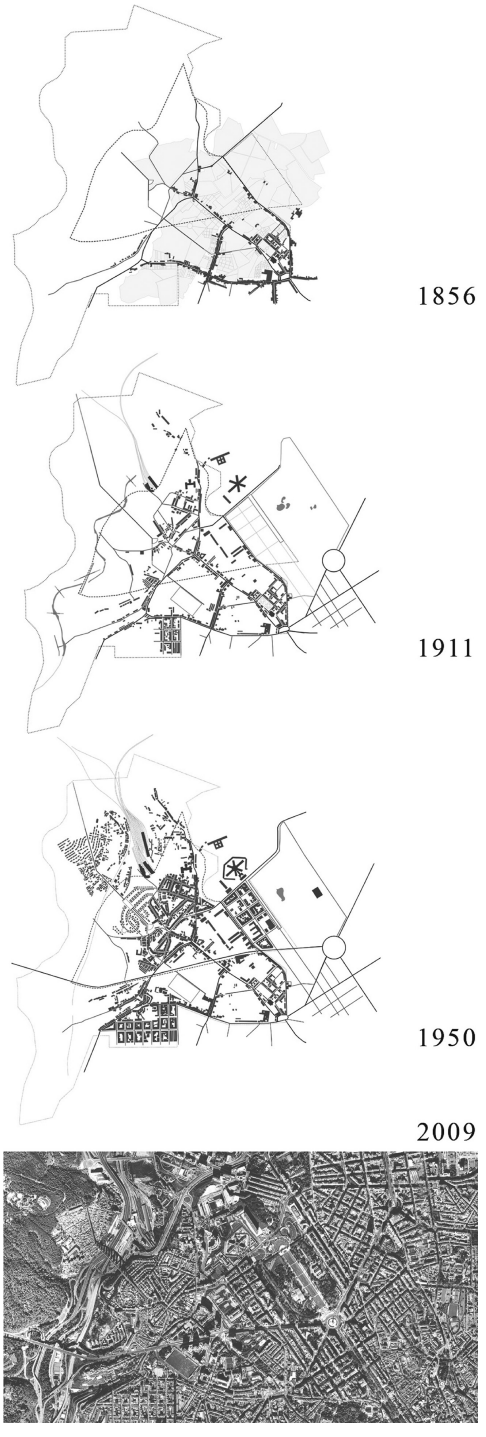


Figure 5. The urban structure evolution *[student schemes]*.

Filipe Folque (1856), Silva Pinto (1911) and Lisbon Municipality (1950 and 2009).

The exercise allowed students to become aware to the urban structure changes, particularly in the urban layout and the building fabric, but also the resilience of some elements over time. They also identified some morphological transformation processes such as: a street opening; integration of pre-existing elements in the urban design; development of architectural typologies and plots structure.

Thus, it became possible for the students understand the site, its history and its evolution process, building a more appropriate and adapted reference frame to the site. This information could be used for the next phase of the exercise – the design. Issues such as the preservation of certain elements or structures are now included in the propositional speech of students. However, it is significance mentioning that such concerns did not mean a copy or reproduction of pre-existing elements or an obstacle to creative and inventive process of an urban design able to dissipate weaknesses or some urban ruptures.

6 FINAL REMARKS

In times where the city and its physical space live moments of some formal and conceptual uncertainty, it is important to look at the typo-morphological reading process as a tool in the systematization of a set of elementary principles (urban and architectural) that could help in futures design processes.

The exercise of elementary decomposition, as well as the understanding of the formation process allows in a first moment to understand the genetic code of a particular object or urban system.

In a second moment, however, is essential to look for this exercise of typo-morphological analysis as a compose tool of new urban elements which are prepare to answer the needs of the contemporary city. The systematization of types, and it understanding, allows a deep knowledge of the main morphological characteristics of a particular urban system. They become, consequently, more evident certain structures and elements to preserve, as well as fundamental weaknesses to correct.

For this, the type generated cannot be seen as a model to repeat. The type should be an elementary abstraction that allows the development of other objects. These tend, on the one hand, to respect the characteristics and pre-existing compositional principles but, on the other, to work with the object's potential exploring new configurations that could connect different urban objects, or elements, with different kind of times and with that contributed for the urban fabric sedimentation process. It introduces a practical sense to the analytical and criticizes process of classification. In this sense, the urban production and its creative act, is grounded in a tested and stable methodology that makes safer and appropriate the design options.

We understand that is important to share this methodology and theoretical statements in the architectural and urbanism education as a support of a sustained creative process, able to answer the challenges

that the contemporary city puts us, as well as in consolidated and non consolidate areas.

The actual urban and architectural design should, in our view, be able to articulate different fragments or spaces, promoting the sedimentation of the urban fabric in all of its dimensions, public and private, while that build spatial references in order to create spaces more legible and usable by everyone.

This methodology is not intended to restrict innovative solutions, but show that the design process should combine new paradigms and configurations with typological/genetic characteristics of the site. In this sense is recovered the sediment city as educational object of conceptual and compositional reference.

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Unveiling the city_the case of Aeolou street

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ABSTRACT: The research addresses the understanding of the urban fabric in the center of a particular Mediterranean city like Athens, focusing on the analysis of the borderline of public and private space. Studying the properties of the boundaries between public and private is introducing the concept of *in-between*. Hence we have the opportunity to register typologies of great significance for the education of young students of architecture. The ongoing research in School of Architecture in Athens complements the introductory courses in Architectural Synthesis and simultaneously assists teachers and students to clarify the concepts describing the city and the social relationships that grow in it.

1 INTRODUCTION

This paper communicates a part of an ongoing research which addresses issues of analysis and identification for spatial qualities of the city centre which are critical in the process of architectural and urban design.

Furthermore our research focuses on certain characteristics of the Mediterranean city such as the interface between *private* and *public*, inner and outer space, as the field which engulfs and also generates a range of encounters between inhabitants and visitors, individuals and collectivities (groups), varying from informal – spontaneous to formal – deliberate ones.

Exploring the "key" question, on the role of Architectural Research addressing Societal Challenges, we will employ a range of analytic tools, as there are applied both in our research and educational activities, having Aeolou Street as our case study.

The research focuses on the importance of recognition and understanding of a place in its spatial and social context. Moreover in a case of this particular street bearing important spatial characteristics and a history entrenched in public consciousness, we propose methods for observation and transcription of the elements of space, related to geometry and configuration issues, by means of permeability and visibility. One primary issue emerging from the research is the existence of the transitional spaces between public and private, and their transformations.

For this reason, one could introduce the notion of *in-between* aiming to distinguish the common features of Mediterranean urban landscapes. This intermediate state is expressed primarily by the size, the openness and the mutation of spatial boundaries through time.

In conclusion, we argue that societal changes are being continuously imprinted in Mediterranean city centres, especially in the modes of interconnectivity between private and public sphere and they are affecting every-day life both spatially and temporally. By unveiling spatial relations of the Mediterranean city, research may contribute to the education of young architects and their awareness for the urban environment.

2 THE NOTION OF "*IN-BETWEEN*" IN MEDITERRANEAN CITIES.

Stavridis commenting on porosity of urban space argues: "Instead of thinking of social identities as bounded regions one can consider them as interdependent and communicating areas" (Stavridis, 2007: p. 1).

Since ancient times the Mediterranean cities constitute specific characteristics, as a result of favorable climatic conditions, that allow the development of outdoor life (individual and collective spontaneous daily activities).

This resulted in the evolution of building types and urban typologies that allowed the development of loose interior and exterior relations as mainly a variety of transitional spaces – *in-between – closed* and *open*.

Thus Urban everydayness is surrounded by a plexus of transitional spaces such as "stoas", galleries, atriums, courtyards, staircases and passageways, allowing both the infiltration of public space in the interior, as well as planned or unplanned expansion of private on open public space.

The building boundary of traditional Mediterranean cityscape and here in Athens has been characterized by openness and alterability. The introduction of the New Greek capital after the mid-19th century in neoclassical style, especially in emblem-atic public buildings gradually led to a change of the image of the old city center with an emphasis on rig-id impermeable boundaries.

The architectural movements of the 20th century, as modernism and the contemporary architectural trends

of the last decades, with the introduction of new materials and the increasing use of glass facades, brought several changes in the material expression of the building envelope, but largely the element of *in-between* space is maintained in its various forms.

3 RESEARCH SURVEY: AEOLOU STREET

We were intrigued by the idea of investigating Aeolou Street as the oldest and perhaps one of the most important streets of Athens. The street is oriented to Parthenon, connecting Omonia square (second most central square of Athens) with the remnants of Roman Agora underneath Acropolis. Aeolou street was designed as one of the central axes in the first plan of contemporary Athens. Since 1833 it has been a part of the commercial and cultural centre of the modern city bearing important historical references, also connecting ancient monuments and sites, such as the Roman Agora, the Acharnean Gate, traces of ancient roads, walls and fortifications, important churches etc.

Until the beginning of the 20th century the area preserved characteristics similar to Oriental bazaars. After the Fifties the street gradually accommodated a mosaic of uses including central administration, retail, workshops, crafts, services and recreational uses. At present, most of it is pedestrianized, and is one of the most well known and crowded shopping streets which gathers a multitude of uses, such as administration, services, retail, street vending, recreation activities and various urban functions.

Through a sequence of socio – economic transformations in the late twentieth century the center of Athens, like most Mediterranean cities was emptied of its population. The model of the urban growth failed to address the emerging needs for spatial commodities and an upcoming life style, leading most of middle class strata to the suburbs.

In recent years the migration of the larger part of the population, previously located in the city center, towards the suburbs was intensified. The migrating in-habitants of the city center gave their place to immigrant and refugees seeking shelter in cheap apartments.

Most of the central uses (administration and services) retreated to the suburbs, leaving their empty edifices as grey scenery to a degrading city.

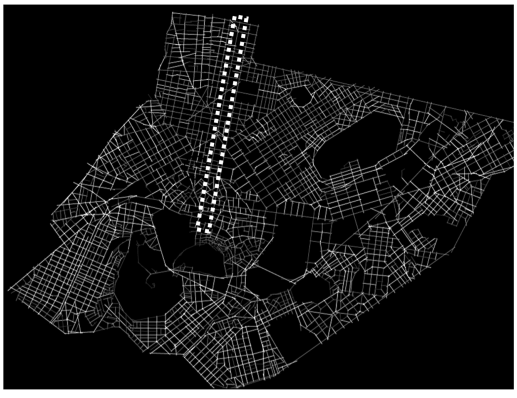
The deepening crisis that began in 2008 led many small companies and retail shops to extinction, while their position occupied large department stores, chain stores from abroad and recreation centers that cater to foreign tourists.

The importance of Aeolou Street lies in the variety of old and new interventions and in the range of different types of interstitial space. This research aims to highlight the most characteristic typologies of *in-between* space as the most significant area of human contacts.

4 METHODOLOGY OF UNVEILING THE "*INBETWEENESS*"

4.1 *Analysis from global to local level*

Primarily the analysis was intended to investigate the manner and the degree of integration of Aeolou Street in the wider urban fabric. The survey covered more specifically the analysis of the configuration of the urban grid, using syntactic tools developed at the University College London. (Hillier B, Hanson J, 1984). This topological analysis shows that in the entire Municipality of Athens Aeolou Street is the most integrated axis (see next figure).



Then we focus on the analysis of *boundary lines*. The map of *boundary lines* contains the lines of urban blocks, the transitional areas and internal passages which are perceived at the pedestrian level and incorporates geometrical characteristics of the urban layout. This new map focuses on the surrounding urban tissue of Aeolou Street and thus constitutes an intermediate level of analysis that we call *glocal*. We argue that the geometrical analysis of the *boundary lines* contributes to the awareness of scale, prioritize and set up the public space into a recognizable whole, designating the field for human encounters (See next figure).

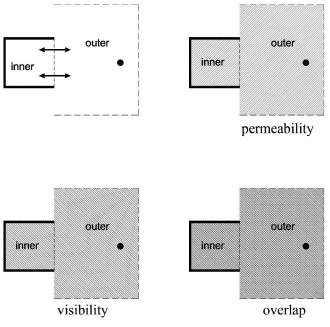


4.2 *Spatial embodiments of the in-between*

In order to proceed our investigation from *local to global level*, first of all we examined the interweaving of public and private sphere by employing conceptual diagrams of permeability, visibility and their overlap at the street level. What mostly intrigued us was how people move, stand and interact and how deep they can get in space. We classified boundaries regarding their material status (solid - transparent: walls, columns, colonnades, parapets, glass facades), their permeability status (openness – closeness) and their alterability (permanent – ephemeral). The existence of *in-between* spaces is indicated in each different diagram. In most cases we examined galleries, staircases, passages and recesses, but there are also identified *in-between* zones in the open space that form the transition between discrete areas.

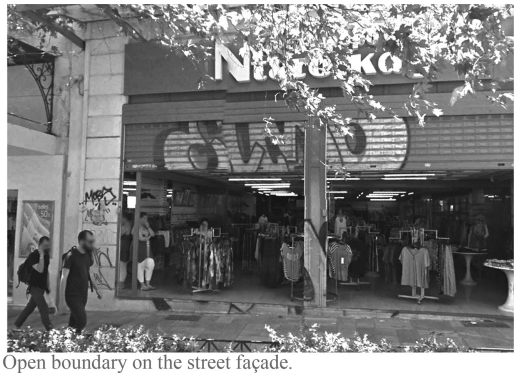
Here are some indicative diagrams from the survey showing: the permeable areas, as well as those visible from an observation point frontally positioned towards the facade and finally their overlap.

Open boundary diagram.



Absence of in-between space
full visibility = permeability = overlap

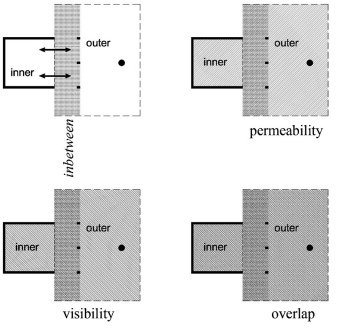
Absence of *in-between* space facilitates direct and spontaneous contacts. The public space penetrates deeply into private. This typology has references to traditional Greek flea markets.



Open boundary on the street façade.

The intermediate space acquires gravity attracting and gathering peoples contacts. In most cases an extension of private is using the intermediate space for stacking. This typology has references to the oriental markets.

Open boundary with in-between space diagram.

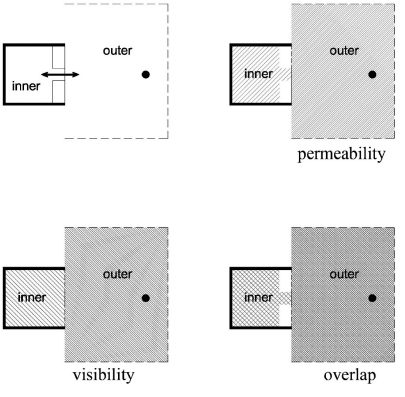


Private <----- ---> Public fully
connected / In-between / fully connected
Full visibility = permeability = overlap



Open boundary with in-between space

Transparent boundary diagram.

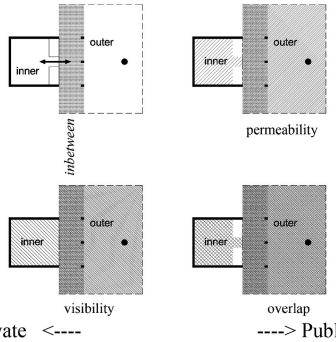


Absence of in-between space
permeability ≤ overlap < visibility

The transparent boundary with limited accessibility, e.g. the shopping windows, inserts between the interior

and public space a zone that ultimately prevents direct contact.

Transparent boundary / in-between space diagram



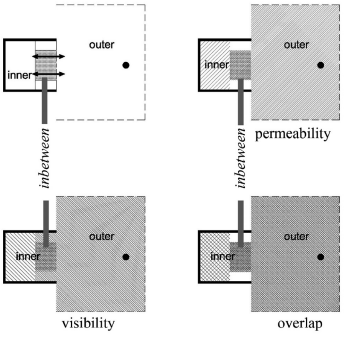
Private <---- ----> Public
fully connected / In-between / partially connected
permeability ≤ overlap < visibility

The intermediate space acts as a zone of observation towards the interior, creating a distance from public space and keeping away eventually inhabitants and visitors.



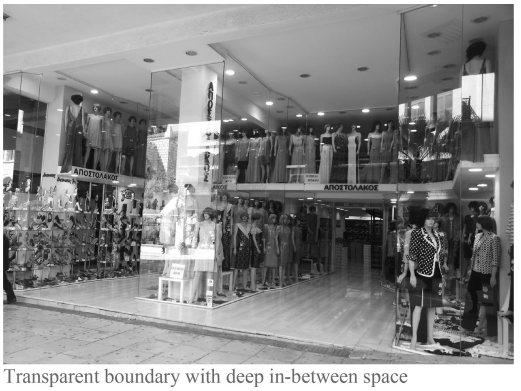
Transparent boundary with in-between space

Transparent boundary / Deep in-between space



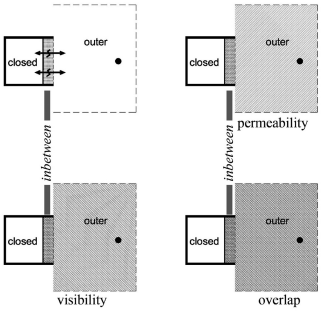
Private <---- ----> Public
connected / In-between / connected
permeability ≤ overlap < visibility

The deep penetration of public space to the private is mediated by the lengthening of shopping windows. The intermediate space acts as an extension of the public and also as a passage to the interior, attracting the observer deep inside. The *in-between* space acts as vestibule of the private, expanding the distance from public space and keeping away eventually inhabitants and visitors.



Transparent boundary with deep in-between space

Closed / abandoned inner space / in-between.



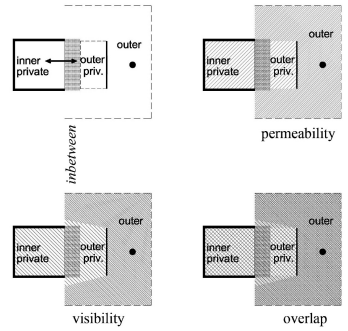
Private <---- ----> Public
connected / In-between / disconnected
permeability = overlap = visibility



Closed /abandoned inner space with in-between space

In between space in front of an abandoned interior, although privately owned is open to the public use, acting as a recess of the street. Due to the lack of care, space is either a homeless shelter or fills garbage.

Private perforating public diagram.



Private <---- ----> private
Connected / In-between / connected
Permeability = overlap = visibility

The expansion of the private space to the public is carried out either through the unorganized and spontaneous diffusion of objects and equipment, or the demarcation of space through temporary or permanent elements. In the first case, the area attracts a variety of contacts and assemblages of individuals or groups, while in the second case the contacts are limited within the certain area.



The penetration of the interior towards the inside is limited visually, while accessibility is fully controlled. Mainly public premises and banks endeavor to impose total control at the entrance of passers generating a hard borderline on the street level.

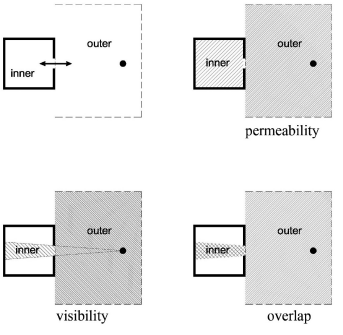
Evaluating the diagrams one can conclude that visibility and permeability overlap only in the case of open boundaries. The degree of the boundary openness is of particular importance to the interrelationship of public and private space and determines the function of the *in-between* space as an integral part of both regions.

In the case of transparencies visibility prevails, while accessibility is more significant in the case of more opaque boundaries.



Private use of public space

Solid boundary diagram
Restricted visibility/ permeability diagram



Absence of in-between space
visibility ≤ overlap < permeability

As Jan Gehl asserts “Visual opportunities are another important requirement for close encounters.

It is desirable to be able to see out of buildings – and preferably into them – so that the activities inside the buildings and outside in public space are connected visually and thus can enrich and in-spire each other” (J. Gehl et al, 2006, p. 30).

But although it seems that the existence of transparency is opening the interior to the gaze of passerby



Solid boundary facing public space at the street level

by creating a sense of visual integration, it doesn't necessarily ensure the creation of conditions for direct and spontaneous contact.

Further on our study focused on investigating the mutation in the relationship between public and private regarding the mutation of activities and uses. This revealed interesting patterns of expansion and contraction of space that people perceive.

4.3 *Mutations of the in-between*

The diagrams presented above make clear the relationship between closed and open space in relation to accessibility and permeability. But they exhibit a static aspect of the existence of public space. During the day the relations of public and private constantly are changing from morning hours till evening.

Through an extensive and systematic series of observations, that was carried out by our team in the context of a research laboratory in Aeolou Street during spring of 2015, we were able to detect the mutations of boundaries caused by the urban uses and activities during the daytime and their effect on space occupancy patterns. (Open/Closed/from 7.00 am to 10 pm).

When there is an interaction between public and private sphere, then we have an expanding perceptual space. This highlights the importance of *the in-between*, since it constitutes an extension of the public and in parallel an expansion of private space, becoming the field for stasis and continuous contact for individuals and groups.

We also discovered that when there is an interruption of permeability and accessibility (when the shops are closed and the shopping windows are shut), various marginal groups and homeless people are using in-between as their refuge.

This means that even in the absence of the space use in-between acquires a different but important role in the city's function.



Diagrammatic boundary of the overall mutation through the day.

4.4 *Analysis from local to global level*

Our aim was to investigate, at a level in-between Global and Local (that we call *Glocal*), the relationship between the public and private by means of visibility and accessibility diagrams and their overlap in order to highlight centralities, integrated or isolated areas, spatial continuities and discontinuities.

Under the 9th semester in the School of Architecture in Athens we organize a special course for understanding the city using various digital tools. In this course we investigated a transformational technique that we employed to convey the importance of transparency enriching visibility fields than in turn advocate space syntax values influencing the probabilistic spatial patterning of movement.

The technique is based on an idea found in Bill Hillier's book "Space Is The Machine". Hillier's idea is to introduce the architectural plan first as a shape. "[…] It is clear that any shape can be represented as a regularly constructed mesh of cellular elements, or tessellation, provided we can scale the mesh as finely as we need. This can then be treated as a graph, and thus expressed as a pattern of universal graph distances.[…]". (Hillier 2007 p. 80).

Hence Bill Hillier applies the syntactic analysis he introduced together with Julienne Hanson (Hillier, B. & Hanson, J., 1984) calculating "[…] the mean depth of each cell from all others, and express the results in a distribution of dot densities for the square elements in which the higher densities, or darker colours, stand for greater integration – that is, less depth – graded through to lightest colours for the least integration, or greatest depth." (Hillier 2007 p. 81).

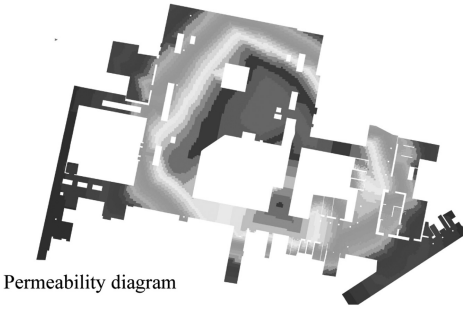
The following figures are some of the examples studied, showing the probabilistic importance of visibility fields overlapping on a syntactic permeability diagram. Top figure is based on calculations based on a permeability diagram of Kotzia square in Athens, which is the first prominent urban space along Aeolou Street; the figure in the middle is based on a visibility diagram alone and the bottom one is the overlapping contribution of visibility diagram to permeability.

It is important to stress out that through the comparison between the overlap diagrams with the observation data of space occupancy patterns, there is a strong relation of the integration core with the flows of pedestrian movement.

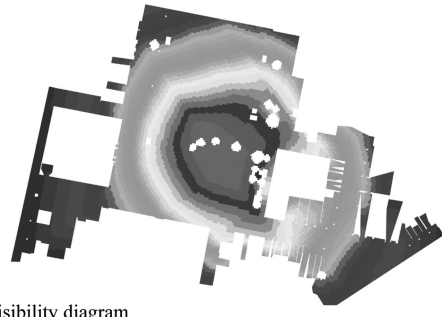
Below are some figures showing the diagrams of permeability/visibility and their overlap in a certain part of Aeolou Street during midday and evening hours.

As expected, in a system which analyzes a narrow zone (street – shops) without the surrounding urban fabric, the integration core lies in all cases in the geometric center. But nevertheless one can find very interesting and considerable differences between the diagrams in both periods.

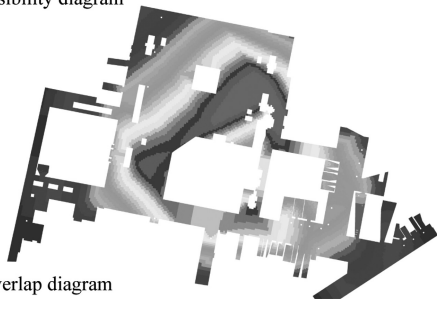
There seems a clear expansion of the space, regarding permeability during the midday, when shops are



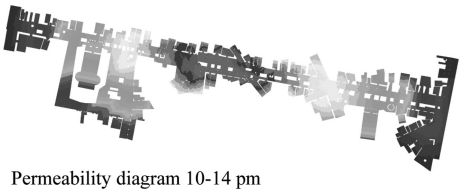
Permeability diagram



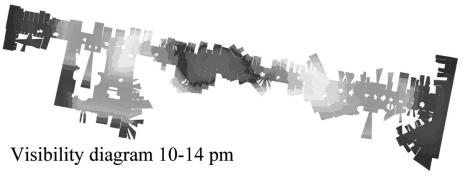
Visibility diagram



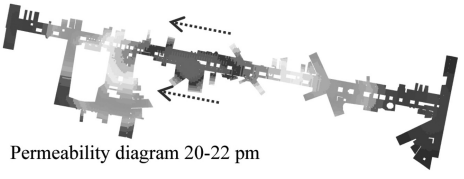
Overlap diagram



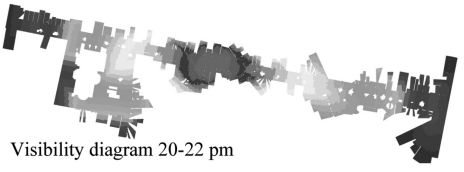
Permeability diagram 10-14 pm



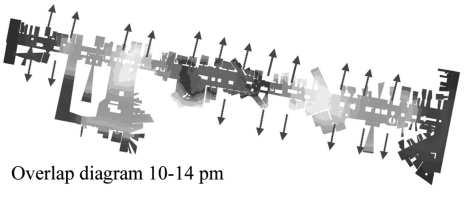
Visibility diagram 10-14 pm



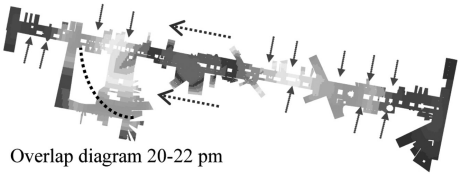
Permeability diagram 20-22 pm



Visibility diagram 20-22 pm



Overlap diagram 10-14 pm



Overlap diagram 20-22 pm

open, whereas during late evening hours space is contracting. Through diagrams also it seems that a large part of the inner space remains visible during evening hours, since many of the closed stores retain their storefronts lit.

Observing the permeability – visibility overlap diagram, one can detect a shift in the integration core towards the area, where during the evening hours operate bars and restaurants.

Overall comparisons during daytime, among the overlap diagrams of the entire Aeolou region with the space occupancy observations data, revealed a strong correlation between the static co presence of individuals and groups (mostly preferring in-between areas), and the high degree of accessibility and visibility, as well as the *glocal* integration values (Boundary lines analysis).

Evening observations though revealed an inversion of the space occupancy patterns. Thus along highly integrated boundary lines, when permeability and visibility are absent, most of in-between spaces are occupied by destitutes and marginalized groups. On the contrary, regardless the degree of integration of the boundary lines, where a multitude of recreation uses exists, ensuring both visibility and permeability, the static co presence of various individuals and groups is multiplied. Spatial configurations, and more conclusively the views from spaces, are critical factors influencing the probabilistic spatial patterning of movement, *stasis* and, through this, of human interaction.

5 CONCLUSIONS

The city is the most appropriate context in order to comprehend space as the imprint of society through time. Unveiling the city's features is an important process in architectural education and presupposes both the understanding from global to local and local to global level.

Hence our research was based on a multi-faceted analysis tools to investigate the issues of urban space that is subject to constant transformations (some-times slow and sometimes rapid) through the social changes and challenges. It primarily focused on spatial issues in relation to everyday life patterns in the Mediterranean cities, through the case study of Aeolou Street in the center of Athens

Athens "[…] has been traditionally mixed and porose—a palimpsest where land uses and activities, as well as spaces of social groups and classes, have interpenetrated each other […]" (Leontidou 2012, p. 300).

In particular this paper has provided information about an ongoing research which investigates the various ways public and private, inner and outer space intertwined both spatially and temporally and also the different aspects of in-between spaces.

There is evidence that the degree of openness and the materiality of spatial boundaries define the level of visibility and permeability, contributing to either the expansion or the contraction of perceptual space.

Transitional spaces complement both private and public space and acquire different roles during daytime depending on the urban uses. In-betweenness becomes the determinant element of urban space for the variety and quality of encounters between inhabitants and visitors, individuals and groups.

As J. Gehl et al. argue "[…] It is precisely these edges and transition zones between buildings and city spaces that become the natural place for the wide variety of potential activities that link the functions inside the building with street life in general: recreation, play, seating, standing, exhibitions, trade, banking, smoking breaks and so on. The more irregular the facade, the more it invites and supports activities." (J. Gehl et al, 2006, p. 30).

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The place of architectural design studios in Portugal in response to the Bologna agreement

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ABSTRACT: The curriculum harmonization of European university courses, converging for a *European Higher Education Area* by the so called *Bologna Process* (1999–2010), relocated the debate about the specificity of education in architecture, and its traditional methodology of learning by design, within the University environment. This paper approaches the structural, organizational and curricular developments of a group of Portuguese architectural schools, describing the changes driven by the *Bologna Process* and inquiring to what extent they present a change to the organization, the contents and the significance of traditional teaching of architectural design.

1 ARCHITECTURE AT THE UNIVERSITY

In Portugal architectural education achieved "higher education" status with the 1950–57 artistic education reform, leading the way for a new social and economic recognition, nevertheless still far from the status of "stronger" disciplines like engineering. Within the only two schools in the country, the fine-arts schools of Lisbon and Porto (ESBAL and ESBAP, since 1836), it was a moment of institutional transition, from the old "beaux-arts" system to a "modern" model of education, in which the vocational and artistic issues were mitigated in favour of social and exact sciences, more alike "modern" ideals of social, technological and economic progress.

Just before that, in 1948, the 1st *National Congress of Architecture* had criticized the concept of "architect-artist", demanding a change in education towards the principles of a "modern" conception of architecture: technical knowledge; the spirit of collaboration; the spirit of research and the cult of an autonomous discipline.

With the 1950 reform, the two schools experienced the "implementation of a method of analytical design in the pedagogical act" (Silva, 2011:30), developing an interest for design methodologies and "real context" exercises, introducing real local problems, in which the traditional conservative and formal culture could give way to a more experimental and methodological culture, advocating the need for research (Fig. 1) and for trans-disciplinary collaboration to ensure the assertiveness of the "why and how" (Le Corbusier, 1938).

In the sixties, pro-democracy movements increased and gained growing expression, mobilized by the post-war environment and the overall rejection of the Colonial War in Africa (1963–1974), but also by the consolidation of an expanding middle class and the rise of the consumer society. The students turmoil of the sixties since 1963 with the war in Africa lead to curricular autonomy, the so-called "Experimental Procedures" (1970), allowing a certain self-determination among both schools of Lisbon and Porto, both in curriculum composition and staff composition. Therefore the school of Porto proclaimed the objective of "development of the student's personality, their critical capacity, autonomy and responsibility through working groups, participation in school management and control over their own education" (Moniz 2011:10). It was also time for a distrust in all scientific and analytical contents separated from the disciplinary tradition, growing the need for an epistemological clarification of the "territory of the architecture", defending a disciplinary autonomy against any technocratic derive that would weaken the traditional humanistic dimension of architecture.

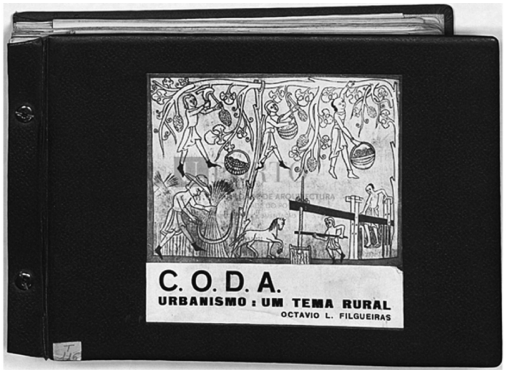


Figure 1. Octávio Lixa Filgueiras (1953). First mainly written research graduation thesis. Porto: ESBAP.

With the democratic revolution in 1974, Lisbon and Porto became independent schools (FAUTL and FAUP in 1979), losing their connection with fine-arts schools of both cities. These new institutions would go on to "teach the basic education leading to bachelor" and "conduct and stimulate scientific research" (statutes, 1979), but again, not without fear of losing identity, as the passage of the old "beaux-arts" regime to an "over-technical" context could "impose a technocratic logic over an educational heritage" (Silva 2011:43).

In the 1980s the Portuguese university system opened up, expanding the number of institutions and students. In Lisbon this was the decade of postmodern incursions and "didactic dispersion", while Porto confirmed its historical and methodological legacy, strongly instrumental, "without any theoretical losses" (Alves Costa, 2013, pers. comm.) and gathered around the work of Álvaro Siza (Silva 2011:74).

In the 1990s Architecture gained a new social recognition, as the country was transitioning into democracy, circumstances like the UE admission (1986) or an enormous investment in infrastructures, simultaneously regulated and expanded the profession. It was also time for international recognition (Alvaro Siza obtained the *Mies Van der Rohe Award* in 1988 and the *Pritzker* in 1992), leading architecture to a visible place in the social, economic and political agendas.

Therefore, in the 1990s, the number of architecture students rose from 1800 to about 9000 (*Jornal Arquitetos* n.º 201, 2001:8). New schools opened, both public and private, ending the exclusivity of the two "historical" schools of Lisbon and Porto. The vast majority of schools and courses was now university level, and the new framework for teaching career (ECDU, 1979) required a PhD to access the highest rungs of the career. Thus, university research arose slowly, and at Porto (FAUP) and in the new public school at Coimbra (d.ARQ-FCTUC, 1989) the final graduation evaluation switched to a theoretical work (1994), reinforcing the written component in the architect's basic training.

However, the massive expansion of architectural education raised a concern within the profession. Hence in 2000 a system of courses accreditation and graduates admission were implemented by the Portuguese Institute of Architects (*Ordem dos Arquitectos*, OA), therefore finishing the regime of direct access from the academia to the profession, and creating the first overall evaluation procedures.

With the Bologna process and *European Higher Education Area* (EHEA) adequacy beginning in 2006, the evaluation of all higher education would be congregated into a national *Assessment and Accreditation Agency* (A3ES), leaving to the OA the process of admissions into the profession, in the shape of a post-graduate internship and a few more pre-professional training through thematic seminars. Consequently, just a few years after finishing the direct admission to the profession, the mismatch between university education and the traditional professional training and practice was somehow institutionalized.

In parallel, the national legal framework of the Bologna adequacy confirmed the "binary" nature of the Portuguese higher education system, separated in universities and polytechnic institutes, where the first ensured a "solid scientific training, joining efforts and skills of teaching and research units," and the second focused in "vocational training and advanced technical training, professionally oriented" (RJIES 2007, Article 3). As for the faculty, universities required a minimum PhD / pupil ratio of 1/30, while the polytechnics would fill up to 35% of its faculty with professional "experts". Therefore the ECDU was reset (2009), with the PhD becoming the "basic-grade" for universities, and exclusive dedication became the "regime-rule", accompanied by a periodic compulsory evaluation of teaching, research and other academic activities. As the preamble of the ECDU states, the faculty devotes itself to "scientific research as a central element of the university career."

The development of research, required by the profession in the fifties in order to support the conversion from the "architect-artist" into "technical-architect", appeared now to gain autonomy in itself, mainly due to the professionalization of the teaching-research career.

The great economic crisis of 2008 further exacerbated the condition, dramatically reducing the practice among an overcrowded profession and exposing a scenario of two decades of built uselessness. Hence, there was an increasing attractiveness in the academic career and a new demand upon the necessity of the "how and why".

And yet again the debate: how can architecture be useful in a situation of crises? Can it survive without building? What to do with the disciplinary heritage? How to react to different expertises within the profession? Do the traditional design classes still maintain their pedagogical centrality? And, how can the project – design courses, as an empirical practice, representing architecture as material culture, be taught and investigated away from the material conditions of their own production? Given the productive imperative of research, within the "research-university" domain, architects questioned if "research in design means the passage of the field of architecture from a physical, real and pragmatic world, to an academic one, working on itself" (Jorge Figueira, 2013:205).

Back in 2004 the "architecture area" preparation report towards Bologna (Domingos Tavares, 2004), portrayed an architectural education focused on training to design practice. But, that was not totally reflected in the schools' adequacy (2006–2008), the circumstances of change were bigger. Underpinned by the curricular structures and design programs of five public schools of architecture in Portugal – Minho (EAUM); Porto (FAUP); Coimbra (d.ARQ-FCTUC) and two schools in Lisbon, FAUL and ISCTE-IUL (see Table 1) – we may perceive the changes operated by the schools facing the overall observed circumstances, trying to foresee the place of the design studio culture within these set of changes.

Table 1. 5 Portuguese schools of architecture – Structural data.

	University Students	School Since	Type	Students	Faculty	Products – Courses
EAUM	18.490	1997	School	374	53	3 Bachelors/1 Master/1 PhD
FAUP	31.352	1836	Faculty	990	100	1 Master/1 PhD
d.ARQ-FCTUC	22.741	1988	Department	548	39	2 Bachelors/3 Master/1 PhD
FAUL	48.147	1836	Faculty	2.700*	140	3 Bachelors/8 Master/3 PhD
ISCTE-IUL	8.600	1999	Department	330	34	1 Bachelors/1 Master/1 PhD

*The FAUL Integrated Master in Architecture has about 1167 students. There are different Bachelors, Masters and Integrated Masters, all data gather in subsequent tables relates only to courses in Architecture. In 2014–2015 there were 22 different schools of Architecture in Portugal (*Jornal Arquitectos* nº252:2014).

2 TRANSITION TO THE BOLOGNA AGREEMENT

2.1 *Curricular changes*

The "architecture knowledge area" report, coordinated by Domingos Tavares in 2004, proposed a double cycle reorganization for Bologna, articulated in a first 5 years cycle, giving access to the profession, and a second one of 2 to 4 semesters, intended "to strengthen the professional preparation and training, leading to the disciplinary investigation" (report, p. 2.3).

This division maintained the distinction between general professional training and expertise or research, according to the traditional progression of bachelor-master. It also viewed the profession as it was specified by the OA statutes of 1998, mainly divided into designers and public administration technicians. Also noteworthy, the report was silent about the concerning international debate, and although consistent with the EAAE 2001 Declaration of Chania, it was not related to the ACE Report/CEA of 15 October 2003 or the defined since 1996 by the UIA/UNESCO architectural education charters.

Nevertheless the profession was changing. It was recomposing and specializing at a rate apparently unaccompanied by its institutional representation. Maybe given its strong professional *ethos*, mainly focused on the material and symbolic resources around families and networks of traditional practitioners, making it hard to face the dynamics of transformation (Villaverde Cabral & Vera Borges, 2006). At the same time, recent graduates showed a relative satisfaction with the courses, enhancing their ability to present a cultural *ethos* but also criticizing the scant preparation for professional practice (idem, 2006). So, expressing a growing difficulty in deciding between a more professional training profile or a more general and cultural one, leaving the university unsure between the poles of teaching a pure science or professionalizing its teaching.

The Portuguese legal reform towards the Bologna Agreement acknowledged that training in architecture should be an "integrated cycle", accomplishing both two cycles in basic training, with an overall duration that could go through a six-year work course. But it persisted in determining a first cycle with six semesters, making it impossible to maintain the pre-Bologna models and the recommendations of the Domingos Tavares report (see Table 2).

The public schools of Minho, Porto, Coimbra and Lisbon (EAUM; FAUP, d.ARQ-FCTUC; FAUL) launched informal contacts between 2005 and 2006 to devise an integrated curriculum with 11 to 12 semesters (Pedro Pinto, 2014). At least FAUL (format $3+2+1$ years) and EAUM (format $4+2$ years) succeeded in producing documents for accreditation. Nevertheless this effort was rather fruitless, given the speed with which other schools advanced to the double cycle of $3+2$ years and given the apparent government unwillingness to accept any curricular arrangement longer than a total of 5 years. Therefore, rapidly between 2006 and 2008 all courses adopted the format of 10 semesters and 5 academic years, in $3+2$ years curricula, giving rise to a hegemonic model in Portugal.

2.2 *Architectural design teaching*

The Bologna Agreement adequacy also accompanied a crucial mutation in the mission of universities, as they refocused on the production of knowledge and in a growing financial autonomy (Neave & Amaral, 2012:2). Factors such as the knowledge fragmentation and specialization, the hyper-transformation of production conditions and the weakening of the political and social context, for the benefit of growing and expanding economic markets, provided a broad sense of indeterminacy, in which individuals perceive adaptability as a condition for survival. This instability pressed the traditional model of education, centred in the unitary transmission of a set of technical and professional knowledge, to a more differentiated and diversified offering, that could emphasize the development of individual and systemic skills.

In their curricular adequacy reports (2006–2008), the schools defined their ends in preparing the future architects for a profession that was spanning into a range of activities from planning, building design, construction and maintenance works, urban and real estate management, and, it should be noted, the ability to develop "disciplinary scientific studies" (FAUP adequacy report, 2008:8). Yet, despite the identification

Table 2. Courses and Learning Cycles in Lisbon (L) and Porto (P). 1837–2014.

	Admission	1st Cycle Designation	Years	2nd Cycle Designation	Years	Internship
1837–81	10 Years old	Drawing Course	4–5	Civil Architecture Course	5	–
1881–1911	12 Years old	Preparatory Course	3	Civil Architecture Course	5	2 Years
1911–31	12 Years old	Preparatory Course	3	Civil Architecture Course	5	2 Years
1931–39	7° Grade	Special Course	4	Superior Course	2	–
1957–69*	7° Grade	–	2 + 4	–	–	6 Months
1969–83 (P)**	High school	Bachelor	1 + 3 + 1	–	–	6 Months
1984–91 (P)	High school	Bachelor	1 + 3 + 1	–	–	1 Years
1968–75 (L)	High school	Bachelor	–	–	–	–
1975–90 (L)***	High school	Bachelor	5	–	–	–
1991–08 (P)	High school	Bachelor	5 + 1	–	–	–
1990–08 (L)	High school	Bachelor	5	–	–	–
2008–(…)	High school	Bachelor	3	Master	2	–

*In 1957 ceases the preparatory and special courses sequence, yet there was an implicit division inside de learning sequence (Silva, 2011), reflected in the format "n + n + n" years. ** The curricular differences between Porto (P) and Lisbon (L) increased from 1968, with both schools having curricular autonomy. *** From 1975–90 the Lisbon school had 9 curricular plans, but the overall 5 years formation without internship would persist.

Table 3. Curricular areas (2008).

Areas	Intervals	Average
Design	31,6% (FAUL)–37,8% (ISCTE)	35,1%
Urbanism	3,5% (FAUL)–12% (FAUP)	7,8%
Theory/History	8,6 (ISCTE)–24,6% (FAUP)	16,8%
Final Thesis	5,0% (FAUP)–14% (ISCTE)	8,58%
Representation	8,0% (FAUP)–13,1% (FAUL)	10,3%
Building Tech.	11,0% (FAUP)–22,6% (FAUL)	16,9%
Human Sciences	0,0% (FAUP)–6,8% (FAUL)	3,4%
Exact Sciences	–	–
Optative's	3,0% (FAUL)–6,6% (EAUM)	5,6%

Including both cycles (bachelor and master). The Final Thesis is diversely organized in different areas; therefore it could have further interpretation.

of expertise profiles and the explicit incorporation of research in the architect's basic training, teaching "by design" would remain central to many adapted curricula (see Table 3). This centrality reflected the methodological persistence of "learning by doing", but also the persistence of a seminal dialectic between the overall training finality and its main pedagogical tools, the architectural design courses. Although the mutation of both graduating profiles and institutional structural framework question the conditions of this centrality.

A major structural change was the compression of the academic rhythms: since one of the Bologna Agreement paradigms was of learning as an active self-driven construction, in which individuals were able to contextualize theoretical and expertized knowledge with practical work, therefore opening and breaking the vertical, one-way, curricular structures, benefitting individual choices and different interconnections. Thus, the direct teaching load was reduced for the benefit of individual work and research, forcing a compression of individual units and correspondent curricular time (see Table 4). There was consequently a double curricular compression: the total years of learning and the weekly hours load, transferring time of direct tutoring, often in design and drawing classes, to the overall student's independent work, with a much greater distribution by various units. This pressure can however be considered equivalent to the compression experienced in professional practice, reflecting a sign of the times, which influences both the conditions of the profession and its teaching.

Moreover there has been a change in the academic calendar. Even considering that in Portugal the Bologna Agreement adequacy framework did not explicitly determine a single temporal model, rather noting that the organization of different "units" could be annual, half-yearly, quarterly or other. However, the semester regime was widely implemented, allowing an increase of rhythms and enhancing the flexibility of curricular pathways. Not coincidentally, the semester regime was originally the standard unit for elective courses (see Table 5).

The schools have therefore semi-adapted the old curricular structures to a semester regime, adjusting themselves to the general academic calendars. While the design classes would be a bastion of annual temporality, either by maintaining the annuity or imposing curricular precedence between subsequent design units, unifying paths in double semesters, the "integrated master" dual-cycle would maintain a hierarchical curricular path. This "almost-annual" order would be pressured by the "half-yearly" pace of the academic calendar, which led to regular interruptions in the examination periods at the end of each semester, reducing the semesters from 12 to 14 weeks of classes, thus with 3 and 4 months of effective duration.

These conditions resulted in an accentuation of the pedagogical nature of the evaluation, either by the imposition of end-semester examination periods or through the generalization of public presentations at

Table 4. Curricular Weight – transition to Bologna.

	Pre-Bologna		Post-Bologna (2006–2008)	
	Units/Years	Hours/week	Units/Semesters	Hours/week
EAUM	6	32	5	26 (1°c), 20 (2°c)
FAUP	5,5,6,6,8	32, 36 (4°, 5°y)	6	26 (1°c), 23 (2°c)
d.ARQ-FCTUC	6	32, 30 e 22 (4°, 5°y)	6	27 (1°c), 27 (2°c)
FAUL	–	–	6	28 (1°c), 24 (2°c)
ISCTE-IUL	9,10,10,10,10	34, 36, 36, 34, 31	6 (1°c) – 5 (2°c)	26 (1°c), 23 (2°c)

(y) years; (c) cycle.

Table 5. Curricular rhythms and precedence after Bologna.

School	1st Cycle	2nd Cycle	Precedence
EAUM	ANNUAL Design, Drawing, SEMESTRAL	SEMESTRAL	Design I to Design V; Design II to Design VI Research Project to Research Lab (final thesis)
FAUP	ANNUAL, except electives	ANNUAL, except electives	All Design and Drawing courses. Need to complete all units from the previous year.
d.ARQ-FCTUC	Design, Drawing, Geometry, History, Theory, ANNUAL Others SEMESTRAL	Design, History, ANNUAL Others SEMESTRAL	There is no official precedence regime, although a hierarchical sequence is strongly advised in Design
FAUL	SEMESTRAL	SEMESTRAL	Design
ISCTE-IUL	SEMESTRAL	SEMESTRAL except Thesis	Design. 24 ECTS are needed to change year.

the end of each design unit. Some say that the appreciation of autonomous work by the Bologna learning paradigm matches the traditional teaching method of learning-by-design. However, facing the pressures of time compression and shorter academic rhythms, the Bologna Agreement adequacy triggered a debate about the need to change the pedagogical conditions and didactics of design classes (Spencer 2012:120; *Joelho n.º 4,* 2013).

This debate was extended to include the lecturer's competence for tuition in design classes, a debate which had been intensifying with the twofold effect of professionalization of the faculty and mass limitation of the teaching conditions (Graça Dias, 2001). This is a still an ongoing debate, which accompanies a rapid change in the faculty profiles (see Table 6). Yet, this change did not necessarily correspond to the abandonment of practitioners, having also given rise to a category of teachers that are both academic and practitioners, thus entangling this framework. At the same time, the centrifugal effect of the ECDU (teaching statutes) combined with unemployment in the profession increased the attractiveness of the academic career and created a momentum for academic production that is progressively encompassing the area of architectural design, encouraging multiple expertise in architectural design teaching: the practitioner, the theoretical and pedagogical specialist and the researcher.

With respect to the content of the design units, one can find a relationship between the curricular organizational structure variants and a range of pedagogical principles. Such a situation also reflects a certain position facing Bologna, i.e.: differences concerning the pedagogical structures: (a) Hierarchical and continuous programs, organized in a growing sequence of programs and scales, that one can entitle as a "canonical approach", whose most significant example is the school of Porto (FAUP); (b) Semi-flexible and two-cycle programs, organized either in a sequence of programs and scales or by different themes, which can be called an "experimental approach", whose main example is the school of Minho (EAUM).

Nevertheless, there are similarities between the courses, such as the weight, significance and centrality of the design studio, and the overall organization of the design classes, with regard to conditions like the ratio lecturer/students and the layout and material conditions of the working spaces.

As for the curriculum sequence, there is a common structure of learning as well as the general adoption of a final graduation thesis, with a strong theoretical nature, which recently tends to incorporate, or somehow relate to, the design classes, i.e.: (i) There is a common legacy in the design studio: (a) There is a general sequence that somehow all courses follow; (b) Emphasis on methodological aspects and housing programs in the 1st cycle; (c) Emphasis on complexity, equipment and urban design in the 2nd cycle. (ii) Design is being introduced in the final graduation thesis: (a) Testing a relationship between design and research.

The abovementioned "canonical approach" corresponded also to a vertical hierarchical sequence with an identical program for all design classes within the

Table 6. Architectural design teaching profiles (2008–2015).

	2008			2015		
	PhD Career	No PhD Career	No PhD Invited	PhD Career	No PhD Career	No PhD Invited
EAUM	3	4	7	10	3	6
FAUP	4	21	6	19	1	10
d.ARQ-FCTUC	5	10	4	13	1	4
FAUL	–	–	–	–	–	–
ISCTE-IUL	4	1	6	8	1	4

There is no consistent data available from FAUL.

Table 7. Curricular contents in the Design Studio – FAUP vs. EAUM.

FAUP			EA-UM		
Semester	Unit	Content	Semester	Unit	Content
1	Project I	Propaedeutic, Abstract	1	Project I	Propaedeutic, Abstract
2			2	Project II	Methodological
3	Project II	Consolidated Urban Area	3	Project III	Dwelling, city
4			4	Project IV	Dwelling, city
5	Project III	Dwelling, Repetition	5	Project V	Equipment, city
6			6	Project VI	Equipment, city
7	Project IV	Equipment, Exception	7	Atelier 1	Design as Research
8			8	Atelier 2	Design as Research
9	Project V	Urban Design	9	Atelier 3	Design as Research
10			10	–	(Thesis)

In Porto (FAUP) the final thesis runs in parallel with "Project V" in the second semester of the 5th year.

Table 8. Sequence of major issues by "curricular area" at EAUM.

	Semester 1 + 2	3 + 4	5 + 6	1 + 2 + 3	4
Design	Propaedeutic, Abstract. Program, Context	Dwelling, City	Equipment, City	Options	Thesis
Urbanism	–	–	Urbanism	Seminars	
Theory	Culture, language	Methodologies	Methodologies	Seminars	
Form Visualization	Manual expression. Geometry	Conventions. CAD		Seminars	
Building Technologies	–	Tectonics, Materials	Processes. Structures	Seminars	
History	Contemporary Theory and History	Antiquity and Modern times	Portugal	Seminars	

same curricular year or semester. This sequence started with introductory and conceptual issues and developed in a hierarchical sequence of progressively complex programs, scales and levels of achievement, gradually reaching the practice protocols.

Otherwise, the "experimental approach" admits some curricular fragmentation, including the possibility of different curricular paths and choices, as well as a more diverse organization of the design units around specific design, urban or technological subjects or questions, related to research issues followed by the faculty, rather than the traditional homogeneous sequence of design programs (see Tables 7–8).

In any case, there is an implicit specification of each learning cycle: the first being more instrumental, methodological and general; and the second being more professional or exploratory, introducing the subject of research related to architecture, even if it is mainly a pedagogical tool rather than an end in itself. This change is represented by the final thesis format and a set of preparatory units. Although there are more exploratory courses – like in Minho and Coimbra

(since 2015) –, the structure of the design units mostly remains cohesive and continuous between cycles, and there is not, nevertheless, a clear assumption of inter-cycle learning outcomes related to the design classes sequence.

As a whole, with the general compression of the curriculum there is a depuration of the core learning contents, which are interrelated more closely (theory-history-technology-representation-design). There is also an urge for methodological and theoretical contents inside the design units, enhancing pedagogical aspects of design practice, accelerating the learning outcomes (Spencer, 2012). Design classes therefore gain a dimension that is no longer a simple extension of ordinary practice. Also against a scenario of temporal compression the issues concerning the organization of the teaching space gain more expression. Concerns such as the average size of the design units and the equipment of the educational spaces arose. Altogether these issues are once more related to the type of lectures in the design classes, contributing somehow to a mosaic of relationships that would "tune" the schools identities.

3 CONCLUSIONS

In Portugal, the changes driven by the Bologna Agreement adequacy framework gave continuity to the continuous adjustment of architecture as a discipline within the "university", following a line of epistemological delimitation which arose from the transition from the "beaux-arts" system to a "modern" model of the architect as a professional, with a technical and researcher profile. These changes also followed the recent upgrade of the university's mission into research and "managerialism", which simultaneously recycles the discipline heritage, including its very own generalist and humanistic syncretism as a cultural act, as an artistic whole, in which the material culture and design as methodology are traditional references. Factors such as the curricular compression, the fragmentation of the academic calendar, the valuation of the teaching productivity and research, or even the drive into specialization within the profession, all exerted pressure on the traditional conditions of learning-by-design and increased the gap between academia and the material tradition of architecture and its practice. The response of the Portuguese schools of architecture to this scenario was somehow ambiguous, as epitomized by the format "integrated-master". The curricular changes introduced in the Bologna Agreement adequacy rehearsed (again) the reconciliation of vocational training and research, linking methodological, instrumental and general contents with more thematic and speculative contents, particularly at the 2nd cycle level.

A resistance against the fragmentation of learning cycles and curricular dispersion was observed, particularly in design courses. Struggling to maintain a core of generic education, the schools not only held out against the curricular dispersion but also maintained the design courses as connectors, bringing together different subjects, disciplines and individual interests, thus rebalancing the compressed and fragmented theoretical units around the design, still understood as an operative tool of knowledge application and recognition.

Therefore the design studio is simultaneously a learning tool and an expertise, as well as a sort of disciplinarian translator, which methodologically allows an architectural specificity (and disciplinary heritage). This leads us to the idea of architecture as being both autonomous and contingent. Autonomous in its own mechanisms and propositions, dependent on the set of knowledge areas that helps to give sense and evaluate the complexity of the real on which architecture intervenes as well as the impact of architecture on the built environment. Hence one condition of autonomy lies in the design as a methodological approach to architectural problems, a guarantee of syncretism, since the humanistic wholeness of the built architectural object can only be projected by the methodological totality of the design process.

Nevertheless, the basic requirements of the design studios faculty have also changed and the pedagogical and didactic issues have gained increased relevance, facing the abovementioned structural constraints. Teaching practices are somehow more academic and likewise the architectural design rehearses its own autonomy and relevance within the university.

The relationship with the practice became more complex, in keeping with the complexification of the profession in itself. The recent professionalization of the faculty is paradigmatic. Therefore, the very distinction between "theoretical practices", "critical practices", "architectural practices" and "material practices" is blurred by the advent of both "practical" and "academic" individuals. The balance between academic, practical and guests-scholars could be achieved according to different strategies and school cultures.

Inside the "research university", the traditional learning-by-doing is also a field of knowledge and research. Hence design could be a dual device of learning and research, whose methodologies and applicability are still to be explored and "tuned" (Providência, 2013). The breakup of the "integrated-master" format, which changed the pedagogical environment of design units between cycles, as well as the combination of theory and practice in the final graduation thesis are signs of change.

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The drawing school in Christiania – architecture education into modern times

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ABSTRACT: Norway got independence from Denmark in 1814. The *Royal Drawing School in Christiania* was founded in 1818, in Norway's capital city, Oslo, then called Christiania. The school educates craftsmen, artists and architects. The author discusses the role of drawing schools and education of architects as a major factor in nation building in Europe in the 19th century. It also discusses the development of architecture education as a result of new requirements for the architecture profession raised by the industrial revolution and the changes into modern society.

The majority of European countries established their own art academies in the 18th century. The academies were closely connected to the King, and meant to promote knowledge, a purified taste and the country's economy (Pevsner 1940/1973, p. 140–159). The art academies also trained architects. In the 19th century the polytechnic schools occurred. This had implications for the education of architects.

Norway became a sovereign nation in 1814. This sparked the quest to found a national Norwegian art academy, which first emerged in the form of a drawing school in Christiania. The conditions in Norway can be used as an illustration of Europe, and how the ideals of the Enlightenment, the French Revolution and industrialism shaped the modern architect's profession and imposed new requirements in training of architects.

1.1 *The Royal Drawing School in Christiania*

The Royal Drawing School in Christiania was founded as the first public school for aesthetical education in Norway. The founders of The Drawing School were all part of the patriotic movement at the beginning of the 19th century, a group of intellectuals whose main aim was independence from Denmark, and to see Norway as an autonomous nation with its own constitution. When Norway gained its independence from Denmark in 1814, the country was facing big tasks with regards to reconstructing the nation. Important public buildings had mainly been located in Copenhagen, but now Norway had to build its own royal palace, university, parliament, prison and hospitals. The demand for craftsmen and architects was huge, and the Royal Drawing School in Christiania was founded in an effort to meet that demand.

The ambitions of The Drawing School in Christiania were to be a Norwegian art academy, similar to other national art academies established in Europe during the 18th century. The Drawing School never achieved an academy status, however, and the *Norwegian Art Academy* was founded nearly a hundred years later, in 1909. But in spite of this, The Drawing School in Christiania was the aesthetical centre in Norway throughout the 19th century.

1.2 *Art academies in Europe – towards the modern society*

Public schools for aesthetic education, art academies, were not exclusive for Norway and the crucial years around the independence in 1814. Norway, as a small country on Europe's fringe, was nearly a hundred years behind the rest of Europe. The majority of the European art academies were established in the 18th century. This was closely related to the development from the feudal social order to the modern society with the trade citizenship as a leading factor. It was advantageous for each country to be self-provided with craftsmen, artists and architects.

The word *academy* can be traced back to the Greek antiquity and the philosopher Plato's school, where he was teaching philosophy. The teaching took place in a park near an exercise track devoted to the mythical hero *Akademos*. Today the term signifies fellowships of intellectuals, scientists or artists, and schools for higher education in art. Academies as schools for training in art goes back to the Italian Renaissance, during which the *Accademia del Disegno* in Florence (1563) and *Accademia di S. Luka in Rome* (1577) were regarded as the leading and influential academies. These later became a model for the *Acadèmie Royal de Peinture et de Sculpture*, founded in Paris in 1648. Acadèmie Royal was crucial in establishing a modern academy tradition (Goldstein, 1996).

The art historian Nicolaus Pevsner published his book *Academies of art. Past and present* in 1940. This became a fundamental work on the European art academies. Pevsner analyzes the foundation and

development of European art academies and shows how the academies develop in near contact with social changes in the society. He outlines the development in three stages. From supplying the state with skilled artists and architects in the first stage, with Acadèmie Royal in Paris as a model, to educate good craftsmen as the main goal in stage two. Part of this was related to the growing trade, and the need for products of good quality, which do well in the increasing competition. In the third stage the education of craftsmen was phased out and handed over to specialized schools for craftsmanship. The art academies were thus mainly reserved for training of artists and architects (Pevsner, 1940/1973).

1.2.1 *The academy training*

From the first European art academies drawing was established as the basic ingredient in the academy teaching. The Renaissance artists and teachers used the term *disigno* for describing drawing and knowledge in drawing. The term has an abstract meaning, and includes a basic feature every artist needs, a form of visual awareness. This was a common knowledge for all of the three arts: painting, sculpture and architecture. This disigno (drawing) includes the art of sketching, an observation attached to paper, a "thought", or a part of the prosess as opposed to the completely finished artwork.

Lessons in drawing were an important component at the early academies. *Accademia di san Luca* (Academy in Rome) stated in the regulations from 1593 and 1596 that the students should get basic knowledge in drawing by copying patterns from what they called the "alphabet in art" – initially in the form of the human body's individual parts like head, foot and hands, before they could draw the entire human figure (Goldstein, 1996, p. 30). Acadèmie Royale in Paris developed and established this form of teaching, based on the teaching from the early Italian academies. This included training by copying patterns, in the next level the student should observe and copy plaster casts, before they in the highest level produced drawings based on observations of living models. Drawing lessons were mandatory for the architecture students teaching too. In the same way as the artists, they also had an alphabet, an architectural vocabulary they were schooled in. For the aspiring architects the human figure was replaced with architectural components like entablatures, pediments, columns, and not to forget: studies of the three orders *Doric*, *Ionic* and *Corinthian*.

The rediscovery of the classical architecture during the Renaissance was based on studies of European antiquity through two main types of sources: Written sources, with Vitruvius' ten books of architecture being the most important, and studies of ancient ruins. The Renaissance architects studied the ruins by drawing them. In that way they managed to harvest detailed knowledge about the architectural expression, the material and the architectural details. The discovery of the printing technique in the 15th century gave the Renaissance architects and theoreticians opportunity to publish their work, both in text and illustrated books. Alberti's ten books of architecture is a well-known example, but it was Sebastian Serlio, Vignola and Andrea Palladio which published illustrated books with drawings and a set of rules that architects could transformed and use in their work. These illustrated books were also the beginning of a significant tradition with architectural drawings being utilized in the education of architects.

In Paris, King Louis XIV (1638–1715) founded *Acadèmie Royale d'Architecture* (Academy of architecture) in 1671 for educating French architects. The Acadèmie d'Architecture was in 1816 part of the art academy, *Acadèmie Royale*. As part of this process the academy changed its name to *Acadèmie des beaux-arts*. The teaching provided here evolved into a distinct direction in architecture education known as *beaux-arts*. This denotes architecture based on the classical vocabulary with rich ornaments (Kostof, 2000). The architect and theorist Jacques-François Blondel (1705–1774) taught at Acadèmie d'Architecture. He also founded the private architecture school *Ècole des Arts* in 1742. Blondel wrote the capture about French architecture to *Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers* (*The French encyclopèdie*), a work which was a prerequisite for Enlightenment, and in the years towards the revolution in 1789. Blondel also wrote the book *Architecture françoise* (about French architecture), and he published his lectures in his *Cours d'architecture* in 1771 and 1774. In his book about French architecture he explains how he incorporated elements from Vitruvius, Alberti, Vignola and Serlio into his own theories (Struges, 1952). For Blondel the architecture was based on the classical principles, on geometry and harmony, and of studies on the classical orders (Picon, 1992). Around 1750 Blondel reorganized the education at Ècole des Arts, and he also brought with him this organizational structure to Acadèmie d'Architecture. This meant that the training was split into three stages: Stage one was elementary course were the student practiced drawing and basic principles of architecture. This stage was for all students. Stage two was for those who aspired to become architects, painters or sculptors. Stage three was more geared towards the science of engineering (Picon, 1992, p. 122–129).

Blondel's theoretical approach, and studies of classical architecture, was soon challenged by contemporaries and teachers from the next generation at the Acadèmie Royale, and soon at Ècole Polytechnique. Julien-David Leroy (1724–1830) was member of Acadèmie Royale in 1758, the same year as he published his book *Ruines des plus beaux monuments de la Grèce*. The book is important because it moved the discussion on classical architecture from an abstract form to concrete studies of the ancient monuments and their dimensions, and how this could be used in contemporary architecture (Villari, 1990, p. 9–11). Jean-Nicolas-Louis Durand (1760–1834), professor at Ècole Polytechnique from 1795, followed Leroy, and Durand was even more concrete. In 1799 he published the book *Recueil et parallèle des edifices de tout*

genre, anciens et modernes. Here he presents architectural components and principles of construction of the building volumes, based on the doctrine of proportions and symmetry (Villari, 1990).

The change, from an abstract approach to the classic architecture to concrete studies, had consequences for the teaching material used in the education of architects. Both Leroy and Durand's books consisted of architectural drawings collected in a large-format hardcover book. As already mentioned, the training of architects, particularly at art academies, was drawing after patterns. This type of training would also dominate the drawing lessons at the polytechnic schools. Books like Leroy and Durand's were soon used in the training, supplemented by a large number of similar books published in France and Germany in the 19th century.

1.3 *The polytechnic schools – France*

Modern European society, with the industrial revolution as an important factor, created a need for specialized knowledge to solve new tasks for modern agriculture and factories, to establish roads, canals, bridges and preparing maps for the regions. In addition, the emergence of railroads meant that someone had to provide rails and adjacent buildings. As a result of these technical inventions and social changes the polytechnic schools occurred in the 19th century, and thereby offered an alternative form for training of architects.

Ècole Polytechnique was founded in Paris in 1794 and is considered as the first polytechnic school. The foundation of this school came as a result of the French revolution and the ensuing societal conditions. The French republic was supposed to be a modern society, which took a greater social responsibility than previous governments. There were need for technical expertise to solve public tasks related to infrastructure as roads and railway. In addition to this there were also building projects such as roofed halls for markets, railway buildings, factories, modern housebuilding, schools, hospitals and prisons (Pfammatter, 2000, p. 51). Ècole Polytechnique was built upon the Enlightenments ideals with an expressed desire for a school separated from the traditional university education. At Ècole Polytechnique the philosophical studies, which had precedence in the universities, were reduced, and studies of science and techniques were instead given priority. The study program from 1794 reflects this with lessons in subjects such as mathematics, physics, geometry, drawing, chemistry, mechanics and architecture. At the school the architectural teaching was also split in two – civil architecture and fortification architecture.

Despite the focus on civil tasks in the French society after the revolution, Ècole Polytechnique become a school for the military with production of army arsenal and fortifications as its main tasks. When Napoleon Bonaparte came to power in 1804 he strengthened the military aspect of the school's curriculum, and in the years 1806–1813 85 % of the students went directly to military assemblies (Saint, 2007, p. 438). Despite the military aspect, Ècole Polytechnique become important for the development of education of the modern architect in the 19th century. The school's teaching based on practical assignments adapted to the modern society, represents an alternative to the art academies studies of architecture history. Central teachers at Ècole Polytechnique were important for this teaching, and here they developed new working methods for the modern engineer and architects like descriptive geometry and technical drawing.

The situation, where Ècole Polytechnique was a school mainly for the military, persisted also after Napoleon. Civil engineers and architects were therefore needed. Consequently, *Ècole Central des Arts et Manufactures* was founded in 1829 (Ahlstrøm, 1978). Here the teaching in architecture was influenced by the interaction with engineering sciences, and lessons were given in topics like turbine technology, steam engines and railway technology (Pfammatter, 2000, p. 118). This combination of engineering science and architecture grew to become important for the development of the modern architecture towards the twentieth century. The American architect and engineer William Le Baron Jenney (1832–1907) is an example of this trend. He was a student at Ècole Central in the years 1853–1856. This education brought him knowledge of construction systems that involved an internal iron skeleton in the buildings, thereby enabling him to design some of the earliest skyscrapers – what would later be called the *Chicago-Frame*. These principles were developed further by his assistant, Louis Sullivan – construction principles that had an enormous impact on twentieth century architecture (Pfammatter, 2000, p. 170).

1.4 *The polytechnic schools – Germany*

Despite the fact that the foundation was laid in France, Germany became in the 19th century important for the polytechnic training. Germany is also particularly important for Norway and the Norwegian architects for two reasons: 1) many of the Norwegian architects were trained at the German polytechnic schools, 2) teaching material used in the training of architects at The Royal Drawing School in Christiania were imported from Germany.

For most part of the 19th century Germany was not a properly united nation. Rather, it consisted of a loose confederation of 39 independent states. The national territory currently known as Germany did not appear until 1871. The industrial revolution happened early in this area, and the first polytechnic schools were founded as early as the 1820'ies: The polytechnic schools in Karlsruhe (1825), Darmstadt (1826), München (1827), Dresden (1828), Stuttgart (1829) and Hannover (1831). In Berlin the art academy, *Die Königliche Akademie der Künste zu Berlin*, had been founded back in 1699 for training of artists, sculptors and architects. Similar to the situation in France new social tasks from the end of the 18th

century gave new challenges for the architects. These tasks were more closely related to the engineering profession than traditional architectural training. In 1799 *Die Berliner Bauakademie* was founded, for teaching building technology with lessons in subjects like mechanics, hydraulics, machine learning and design principles for the construction of roads, bridges and canals (Mislin, 1999). The education of architects in Berlin was then divided between the Academy for training in drawing and studies of architecture history, and for the technology teaching at the Bauakademie. The separation between the Academy and Bauacademie seems however to be less successful and soon the Bauakademie took responsibility for all aspects of the education. Bauakademie was in 1879 part of *Königliche Technische Hochschule in Berlin*.

The two polytechnic schools in Karlsruhe and Hannover were both among the early polytechnic schools, and they serve to demonstrate how the emergence of the modern society laid the foundation for the creation of polytechnic schools, in Germany as well as the rest of Europe in the 19th century. *Karlsruhe Polytechnische Schule* was founded in 1825 in Karlsruhe, a city near Rhine and the border to France. At the beginning of the century the city had a drawing school led by the architect Friedrich Weinbrenner (1766–1826), as an academic sort of training (Brownlee, 1986). In 1808 Johann Gottfried Tulla (1770–1828), who worked as an engineer connected to locks on the Rhine, started a private engineering school in Karlsruhe inspired by Ècole Polytechnique. The city council decided in 1820 to establish a public polytechnic school. This assignment was then given to Tulla (Pfammatter, 2000, p. 376–378). At Karlsruhe polytechnic school basic training in mathematics and crafts were given over three years. After this the students could go to engineering studies lead by Tulla, or study architecture at Weinbrenner's drawing school. Ulrich Pfammatter, (professor at *Hochschule für Technik und Wirtschaft* in Switzerland), defined the training at Karlsruhe polytechnic schools as the *Karlsruhe-model*. In his doctoral thesis he shows how these principles for polytechnic education were continued at the other German polytechnic schools in the 19th century (Pfammatter, 1995).

I Hannover the polytechnic school, *Hannover Polytechnische Schule*, was founded in 1831 as a school for teaching craftsmanship. The railway came to Hannover in the 1840'ies, and a need for skilled work force for the railway soon became a necessity. Therefore, in 1847, the teaching at Hannover polytechnic school was reformed. A report from the school in 1856 shows that the craftsmanship subjects were replaced by lessons in mathematics, geometry, machine learning, chemistry, technology and architecture (Die Polytechnische Schule zu Hannover, 1856). In 1863 the training of architects was organized over five years and included higher mathematics, technology, geometry, mechanics, architectural ornaments and machine learning (Program der Polytechnischen Schule zu Hannover, 1863–64).

1.5 *Summary – two ways for architecture education*

The education of modern architects emanated from the French society in close connection to the revolution in 1789, the Enlightenment era and the technical development that came along with the industrialization from the end of the 18th century. It was also in this country that two different forms of architecture education occurred – the Beaux-aux tradition and the polytechnic schools. The industrial revolution and the technological innovations were however not reserved to France. The rest of Europe also underwent these changes, and after France, Germany soon became the leading country for polytechnic schools.

The two forms of architecture education differed both in the content and the form of the training. Both educations taught drawing based on the classical architecture. The academic tradition combined this training with extended teaching in perspective and extensive studies of architectural masterpieces of the past. Jacques-François Blondel was an important figure in the academic tradition both as a professor at *Acadèmie Royale d'Architecture* in Paris and as the founder for *Ècole des Arts*. He structured the training into different levels where the elementary courses, mainly training in drawing, were for every student, both architects and craftsmen. At the higher levels there were lessons in architecture history and theory. This level was only for those who aspired to become architects. The teaching at the polytechnic schools was, in addition to drawing, increasingly reserved for technical topics. The subjects changed in parallel with technological development, and included topics like railway knowledge, steam machinery, mechanics, hydraulics, machine learning and principles for construction of roads, bridges, canals, ports and buildings (Picon, 1992, p. 130–133).

1.6 *The Royal Drawing School in Christiania – building the nation*

When The Royal Drawing School in Christiania was founded in 1818 the main goal was to educate craftsmen. This appears in the school's first regulations adopted in 1822 (Kongeligt Reglement 1822). Most of the students were apprentices in craft, who attended the school in order to get lessons in drawing. When the Ministry chose to prioritize craft, this must be seen in relation to the development of the art academies varying focus on craftsmanship versus art (more below), but also as a conscious choice with national interests in mind. Norway was a young nation that wanted to mark its independency from Denmark and the Danish culture, which had influenced Norway's sense of identity for more than 400 years. In addition to this came the increased focus on Norwegian language and identity, its history and national traditions in craft. Skilled craftsmen were therefore in demand. Another aspect was the many public building projects, which meant that there was a need for architects.

The regulations from 1822 stated that those who wanted to become artists and architects should be

offered lessons in drawing at The Drawing School. My research on the school shows that despite the Ministry's decision to give crafts priority, The Drawing School also provided high quality lessons in architecture. As a matter of fact, many of the Norwegian architects in the 19th century were educated at the school. That the school actually educated architect does not however necessarily means that it was a full architecture education on a full European scale, but it was good enough for the Norwegian conditions – a small country with many building tasks to be solved in order to recreate the nation.

The Royal Palace was the first public building raised in the independent Norway. Thereafter followed the University, the Observatory, the Bank Building, Hospital and Theater. All of those buildings were in classical style. Except from the palace, they were also all tribute to one architect, Christian Heinrich Grosch (1801–65), who became the city architect in Christiania in 1828. His background and education is however symptomatic for the early architects in Norway. Grosch started his training at The Drawing School in Christiana. After finishing Drawing School he went to the *Academy of Art in Copenhagen* and the academy's school of architecture. In Copenhagen the German classicism dominated, and this architecture also influenced the Norwegian architecture in the first half of the 19th century.

Around 1870 there was a change in the architectural landscape in Norway – both in the building tasks, architectural expression and the Norwegian architecture profession. The main public buildings were already completed at this stage. But while the public buildings were few in numbers, the 1870's marked a major change in the amount of building projects. The industrialism has established and the populations of civil and working class in the main Norwegian cities grow extraordinary. These sparked a marked for building speculations and a demand for architects, who were need in order to create residential buildings and commercial buildings. A large part of Oslo (Christiania) as we know it today, was built in the period 1870–1900, in form of 3–4 level buildings in block structure. The architecture had developed from classicism to historicism. Part of those blocks were also commercial buildings, and like the architect Jenney used the iron skeleton to design the early skyscrapers, the Norwegian architects used it to create large display windows on two floors to promote the shop's goods.

The building tasks changed toward the end of the 19th century, as well as the development of the architecture and it's style. But also the Norwegian architect profession changed at this epoch. The task of creating the official buildings erected in the first half of the century was solved by limited group of architects. Toward the end of the century the number of architects increased considerably. This must of course be seen as a result of the increasing building projects, but also in conjunction with a national education for architects, erected in the mileu at The Drawing School in Christiania.

1.7 *The Royal Drawing School in Christiania – in a European context*

There was an explicit wish among the founders and early teachers at The Drawing School in Christiania that the school soon ought to take form as a national Norwegian art academy. Back in 1818 the school's founders had delivered a draft provision for The Drawing School to the Ministry of education. Here it emerges that one of the school's tasks was to educate Norwegian architects, similar to the academic tradition (Forslag angaaende en offentlig Kunstskoles, 26. April 1818). Because of the poor economic conditions in Norway at the beginning of the 19th century, there was only money to establish a drawing school. But despite the economic realities and its implications for the school's teaching program, we could also relate The Drawing School to the European context when it comes to the development of art academies.

If we use Nicolaus Pevsner's analysis as a template: The Drawing School gave priority to craftsmen from the beginning, as warranted in the regulations from 1822. This placed the school in the second stage of the development of the art academies. At this time most of the other academies had reached stage three, and the craftsmen were taken out of the academies and transferred to specialized schools for craftsmanship. Norway was lagging behind in general development, and this applied to several aspects of the Norwegian society. First with our independency in 1814 followed the need for public buildings, raised by Norwegian craftsmen, but also for national architects. In a review of the teachers who gave lessons in architecture at the school, it emerges that they all were leading architects in Norway through the 19th century. These architects saw the need for a national architecture education, located at The Drawing School.

If we follow The Drawing School's history throughout the 19th century it transpires that the regulations were geared towards technical education when the industrial revolution came to Norway around 1840, and the first factories were establish in Christiania around 1850 (Plan for den Kongelige Tegneskole i Christiania, 1869). The dream of The Drawing School as a Norwegian art academy was however alive, and in the 1870's a new regulation for the school was adopted, with increased focus on artists, sculptors and architects. One can thus say that The Drawing School developed in accordance to the last stages of the art academy tradition (Forslag og Plan for den Kongelige Kunstog Haandværks-Skole i Kristiania, 1875). This regulation was however short-lived and another reform in the 1880'ies again gave crafts priority. But still, in conflict with the regulations, the school continued the training of architects. A question therefore emerges: what kind of architectural education was offered?

1.8 *The Royal Drawing School in Christiania – training of architects*

The Drawing Schools regulation stated that the school was supposed to teach drawing. The training of

architects consisted mainly of drawing lessons in the architectural vocabulary, like the classical orders, and studies in architecture history. The students drew according to patterns, in the first decades after classical architecture. These principles of teaching architecture could, as well known, been traced back to the art academies in the Italian Renaissance, and thereafter developed at the French schools of architecture erected in the Enlightenment era.

The preserved teaching material after The Drawing School is mainly French or German. Most of the French material is published around 1800, and sustain prints, engravings, of classical architecture. The German material marked a change, both in the architectural style, and in content. With the publications of classical architecture were presentations of the antiquity and had detailed engravings of architecture components like the columns and entablature. The material shipped in from Germany was published around 1850 and onwards. The classical vocabulary was here replaced by the historicism style, and the engravings were also concentrated on technical solutions in the architecture, like construction of the cornice, gutter and arched walls to name a few.

1.9 *Summary and conclusion*

The teaching material and The Drawing School's training of architects, based on drawing after patterns, place the school in the academic tradition of architect training. The use of the large format hard-cover books as patterns for the architect students, confirms the academic approach to the education. Most of the teaching material was shipped in from France and Germany. While the French material mainly was concentrated on the antiquity, the German teaching material focused increasingly on technical solutions. This reflects an influence from the German polytechnic schools and there priorities of techniques.

The large collection of preserved teaching material after The Drawing School, tells us that the teachers were well updated on European architectural currents, and it confirms their ambitions for the school's architecture education – to create a Norwegian school built on the ideals from the European art academies.

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Transforming architectural education at the cross roads of the world

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ABSTRACT: Located at the intersection of Europe and Asia, Turkey is constantly facing both societal changes and challenges. Major cities like Istanbul and Ankara are booming with construction of modern high-rise buildings, while historic Ottoman architecture often seems to stand in the background, observing the race to modernity. While architectural education is at the core of this evolving transition, concerns similar to that of Rafael Viñoly about people coming to the profession without knowledge of construction are being raised. Schools of architecture, particularly in the United States and Europe, are re-evaluating their curriculums and discussing the reinvention of the role of the architect as a master builder. In this paper, we discuss our efforts to transform Turkish architectural education through the establishment of the first design/build lab at one of the leading universities in the country. We describe our built project and compare it to both traditional and contemporary precedents. We develop our argument through an experimental and qualitative method.

1 INTRODUCTION

> *"It's a crisis for the profession. In the last 20 years, people have come into the field without knowing what construction is. In architecture, construction is the medium."*
>
> – Rafael Viñoly in an interview with Fred Bernstein. *Architectural Record*, Feb. 26, 2014.

Despite criticism, design/build academic programs around the world have become a prevalent model for architectural education. The many facets of the hands-on experience gained from such activities could potentially address not only Viñoly's concerns, but also other issues related to the role of today's architect, the role of architecture schools in their communities, and the increasing gap between design and making. The exact number of design/build programs in the United States is not known, but according to Gjertson, there are approximately 100 design/build programs throughout the 123 National Architectural Accrediting Board accredited schools (Gjertson, 2011). The Association of Collegiate Schools of Architecture underscored the recent increase in design/build programs in North America with the introduction of a design/build award in 2012, noting that design/build is now included in over 70% of its curriculums. On the other side of the world, and based on the model of American endowed private universities, Bilkent University in Ankara, Turkey, has distinguished itself as one of the top 100 universities in the world under 50 years of age. The Department of Architecture, which was founded in 2012, is the newest addition to the university. In its recent evaluation report, the university defined itself as follows: *"Since its beginnings in the early 1980s, Bilkent University has defined its core mission and portfolio in relation to its national and international context, wanting to help instill the highest international standards in Turkish higher education and offer teaching and research areas which 'were not yet offered in the country"'* (IEP, 2010).

1.1 *Architectural education culture in Turkey*

According to the Turkish Ministry of Higher Education, there are currently at least 25 universities in Turkey that offers architectural degrees in various specializations. Building technology, building assembly, and building materials and construction are, by default, required courses in the curriculum of most of the undergraduate programs. At Bilkent University, a two-semester sequence in building assembly/building materials and construction is required for undergraduate students, along with an additional laboratory component. Architectural education in Turkey, as is the case with many higher education institutions in the Middle East and the Gulf region, suffers from the absence of the culture of 'making' and has long overlooked the importance of understanding 'how buildings are put together'. This educational approach reduced architecture to flat representation of manipulated images and construction drawings that do not convey the depth of understanding building assemblies including structure, construction and tectonics (Sekler, 1965). In his book, *Architecture Depends*, Jeremy Till argues that traditional architectural studios failed to provide any tangible outcomes beyond simulation of preconceived exercises (Till, 2009). According to Bilkent University curriculum, the objective of the 'lab' component in the required building materials course was to offer students a computer lab where they

could produce construction drawings for two hours per week. The introduction of our design/build lab was a paradigm shift for the department and its students, many of whom expressed both enthusiasm and also anxiety in not knowing exactly the nature of the pedagogical experience awaiting them.

1.2 *Challenges and opportunities*

Design/build programs all across architectural education are having a significant impact on a large number of areas: by developing experience and skills in future architects, by contributing to local communities through their efforts, and by exploring the integral relationship between architectural design and building construction, to name but a few examples. Establishing a design/build program at any school of architecture is indeed a daunting task, especially when the architecture department itself is relatively new and the unknowns are many. It is further compounded by the absence of a culture of 'making' and the existence of an undefined fear of offering direct contact between students and machinery. The case study presented in this paper was part of a required two-semester undergraduate course sequence in architectural building systems and building materials and construction. The lab was the first of its kind in the university and perhaps in the country. The lab focused on issues of pre-fabrication, prototyping, and construction, as well as subsequent testing and analysis of fabricated assemblies and materials. An important goal was to demonstrate building assembly, process innovation, and multidisciplinary research while emphasizing the importance of collaboration with other disciplines, especially structural engineering. The lack of a dedicated indoor fabricating facility and a start-up fund required minimizing onsite building time. Three important principles were valued: pre-fabrication, optimization, and sustainability. The built project incorporated ideas of flexibility, disassembly, and reconfiguration and utilized a zero-materials waste strategy by adhering to standardized off-shelf building materials. Framing and skin systems highlighted stability, lightness, and simplicity.

While there is no 'one model fits all' for design/build programs, every architecture school must develop its own program based on its resources, students and faculty interests and, most importantly, according to its curriculum, which is the biggest obstacle when it comes to introducing time-consuming, labor intensive, and beyond classroom activities to an existing oversaturated program of study and overworked students of architecture. In our post-project opinion solicitation, our students were split over preferring the design/build lab as a required versus elective course. Students reported in the post-project survey that the main challenges and obstacles to the success of the lab included time, arriving to decisions, labor, and fundraising. Almost a quarter of the students emphasized that arriving to decisions as a group was the biggest challenge, while others confirmed that "less devoted members to the project," "lack of interest," and "doubts from university administrators and other faculty members on students' abilities" were also major obstacles.



Figure 1. Typical traditional Turkish Kilim.

1.3 *Historical, traditional and cultural precedents*

Cultural and historical precedents from Turkish traditional arts influenced the first built project of the lab. Two traditional works of art were studied and greatly informed the design of the project. The first inspiration was the art of weaving, which has a history that spans as far back as the earliest human settlements (Barber, 1995). Turkish textile arts have won the admiration of the world with their motifs, colors and materials. The traditional Turkish "Kilim" (Fig. 1) is well known to the world for its distinctive motives and colors. The first built project of the lab incorporated principles similar to those employed in weaving, especially in aspects of form, structure, joinery and furnishings.

The second source of inspiration was the vernacular architecture of the Eastern Black Sea region. A visit by the authors to the *Pervane Köyü Araklı* (Pervane Village in Trabzon, Turkey) resulted in the discovery of the wooden structure of the Black Sea area called "Serander", also known as "*Paska Karadeniz,*" which is used for drying and storing grain. The 3.90 × 3.30 m structure stands on six or eight wooden pillars and is made of chestnut wood joined without using nails to allow for future disassembly and relocation to other villages (Eruzun, 1977), as seen in Figure 2. On top of the pillars, just before they meet the main body of the structure, are round discs to prevent rats from reaching the stored grains; these discs may be wood or stone (Karpuz, 2003). The decorations on three sides of the entrance door replicate other examples of its kind. These decorations commonly consist of plain geometric carvings (Batur and Öymen Gür, 2005).

2 THE 'KILIM' PROJECT

Our first design/build lab project was conceived as two-8-meter tall towers built from wood. The Kilim project used motifs and forms that symbolize the sacredness of the male/female figures. The design



Figure 2. Details of the Black Sea Serander in Trabzon, Turkey.



Figure 3. Bench Seats constructed from short lumber $2'' \times 4''$.

utilized principles of weaving by using wood dismantled from shipping pallets in order to foster an awareness of materials reuse and concern for sustainability. The design allowed for a high flexibility of disassembly and reconfiguration of different structures and utilized a zero-materials waste strategy. The design of the two wooden towers was based on developing a 2×4 meter wall module of a light wood-framing that could be assembled from horizontal and vertical members enveloped with a layer of wooden boards disassembled from shipping pallets that works as exterior "skin". The wall module would then be reproduced 16 times to create all components of the project. This optimized method allowed for shorter construction time, less materials waste and greater efficiency.

2.1 *Dissecting the shipping pallet*

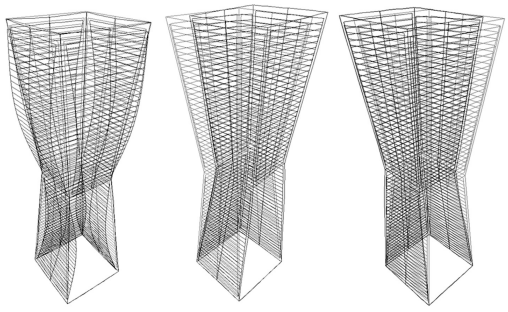
Shipping pallets are typically recycled and reused all over the world. It is very common to see huge stacks of pallets in the backyards of most big box stores and supermarkets. According to a recent report produced as part of the Value to Wood Program, 95% of all shipping pallets are made of wood. In the European Union, 60% of fiber-based packing is required to be recycled, and in the United States, 70% of pallets are repaired and reused (Baumeister, 2009). There are mainly two types of wooden pallets, called block and stringer, that differ in structural integrity and size. The "block" type is mostly used in Europe and is made of soft wood. In our project, and since we requested in-kind donation of pallets from vendors, we received approximately 120 pallets with a mix of types and sizes, but the majority were of the European type. The size of the acquired European pallets was 1200×1000 mm, which is similar to the USA size of $48'' \times 40,''$ which are made from solid Spruce wood. When dismantling one pallet, it yielded approximately the following inventory: 12–15 "boards" sized ($15 \times 90 \times 1200$ mm), 9 "blocks" sized ($90 \times 90 \times 90$ mm), and short dimensional lumber sized ($50 \times 100 \times 750$ mm). Through several design iterations, students developed a strategy of incorporating the exact sizes and dimensions of the inventory into the Kilim towers in order to minimize waste and the need to refurbish and recut materials. Boards were used as the "skin"; blocks were used as the "floor," and short dimensional lumber were used in furnishing as "bench seats" see Figure 3.

2.2 *Multidisciplinary collaboration with engineers*

Collaboration between architects and engineers resulting in iconic masterpieces of architecture in the 20th century dates back at least to the 1950s, according to Don Watson, who noted that Louis Kahn would often refer to his colleague, the structural engineer August Komendant, as an "equal partner" (Watson, 1997). Theirs was an exemplary relationship that began in 1956 and lasted for almost 18 years, at that time, Komendant was known for his outstanding pre-stressed concrete work, which Kahn found a good fit for his architectural forms and ideas. In his book, Komendant reproduced a letter that Kahn had written to the American Institute of Architects (AIA) in 1973, recommending that Komendant be honored with the AIA's Allied Professions Medal for "*inspiring or influencing the architectural profession*" (letter from Louis Kahn to Eero Saarinen, March 23, 1959 (Komendant, 1975). That relationship is one example of how closely architects and engineers work, and how the design process can be inspired by both disciplines.

Catherine Wetzel also has recently argued that when architecture schools integrate design and structures, they increase the working vocabulary and expertise of students, as well as the potential for innovative collaborations in the academy and the profession (Wetzel, 2012). Similarly, in our project, concerns were raised by university officials regarding the structural integrity of the towers and required that we test the proposed design before the actual construction began. Computer simulated structural analyses were performed at the design development phase of the project in order to determine the stability of the proposed structure and to understand its performance under its own weight and wind loads.

While the proposed framing and skin systems were initially found to be acceptable, the connections between the upper and lower modules, and the whole



Self-weight deformation Δz-max=0.023 mm | Wind load deformation (X axis) Δxmax=142.38mm | Wind load deformation (Y axis) Δzmax=089.79mm

Figure 4. Displacement Analysis for the Kilim Tower.

structure to the ground, were critical. A permanent foundation was not suitable since the installation needed to be dismantled and relocated to different locations. A temporary foundation base larger than the tower's footprint was required to overcome the overturning effect of the structure. The exterior wooden skin attached to the structural frame could only carry its own weight. The wooden frame was subject to deformation, and steel connectors were needed to ensure stability. In addition, a cross bracing steel wire measuring 2 mm in diameter was determined to be sufficient for establishing rigidity, and only the sides of the structure subject to torsion needed additional bracing. Knee bracing for the modules would also help in providing rigid connections. Continuous frame members were required but the use of spliced short members salvaged from the shipping pallets were not suitable.

The structural analysis of the "Kilim Tower" was performed using SAP2000 software that considered the closest real dimensions and material characteristics. There was two load conditions: the self-weight of the frame and wind forces (considered according Turkish Structural Analysis Codes). According to the initial results, no critical conditions were found in relation to the preliminary decided dimensions. Two overlapping timber members (50 × 100 mm) were suitable for the main frame, but they had to be held firmly by steel connectors). The simulation models showed deformation of the shape of the frame due to gravity and wind forces respectively as seen in Figure 4.

3 METHODOLOGY

The first design/build lab project was conceived as an experimental case study, utilizing careful observation and recording, followed by a qualitative opinion solicitation of the project participants to document their lived experiences and reactions. Finally, the results were compared to both historical and modern precedents. The project followed a traditional design process, starting with programing, schematic design, refinement and modification, and finally construction. Emphases on collaborating with engineers were implemented throughout the process.



Figure 5. Group decision making and presentation sessions.

3.1 *Group decision-making process*

Following the presentations of design proposals from individual students, a design was consensually agreed on for further development and students were asked to break into six teams of 3–4 individuals. Each team assumed responsibility of one important aspect of realizing the project and these responsibilities ranged from design development to materials sourcing and construction means and methods. Teams were asked to appoint a team leader who was responsible for managing the tasks of the individuals, coordinating with other team leaders, and providing a weekly progress report to the course instructor and other team members. As the project progressed to its construction phase, the design team, in collaboration with the lab instructor, developed the final design and was asked to present their weekly progress to the entire class. Afterwards, informal discussions addressed concerns and suggestions from all the students, during which decisions were made and action agendas were developed. In addition, the other five teams were asked to present their findings and share the progress of their work with others. A group decision-making process was implemented to ensure efficiency and healthy progress of the project (Fig. 5).

3.2 *Four elements of architecture*

There were four elements of architecture that constituted the Kilim Tower project: wall framing, skin, flooring, and furnishings. All were the result of the integration of the available resources, the design concept, and the construction methods within a framework of sustainability measures (Fig. 6).

The decision to purchase new dimensional lumber sized 50 × 100 × 4000 mm for the wall framing was based on the structural analysis that required "continuous" members versus spliced short members. The 15 × 90 × 1200 mm boards salvaged from shipping pallets were surfaced and applied to the exterior of the frame as a perforated skin to allow for shading,

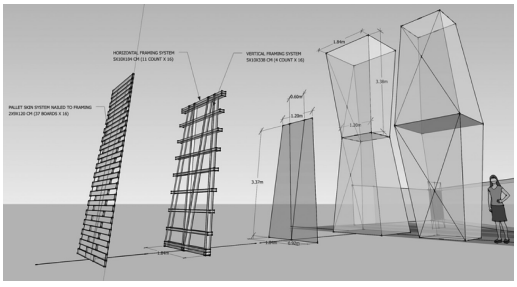


Figure 6. Framing and skin components of the Kilim tower.



Figure 7. View upward inside the Kilim tower.

breathing, visual connection with outside. They also reduced the total weight and wind load effect. The $90 \times 90 \times 90$ mm-salvaged blocks were used for flooring. The $50 \times 100 \times 750$ mm salvaged short dimensional lumbers were assembled to construct four bench seats, which were held together using galvanized steel bolts. All connections of the wall modules and furniture were designed for future disassembly and reconfigurations. Similar to the vernacular precedent of the Black Sea Serander, the corners of the wall modules were overlapped and connected from the outside, leaving a clean joint from the inside and allowing the temporary assembly of modules during construction to be secured (Fig. 7).

Construction Phase: The setting of the lab was a hybrid of a design studio environment, an indoor fabricating facility (wood-shop), and an outdoor assembly/testing yard. Although the workload was generally divided between teams, team leaders and project managers, everyone was involved in every aspect of the project at some point. The project started with zero funding. Students were therefore asked to seek sponsorships and to raise funds and in-kind donations of discarded materials from vendors. Wooden shipping pallets were the only donated materials and a strategy for disassembling and sourcing structural members were developed. After consulting with the structural engineer, however, it became apparent that continuous framing members were essential to the structural stability and integrity of the project. At this point, the university provided a fixed amount of funding (TL 1000) to purchase the structural framing members. After the completion of the project, a reflection phase consisted of two stages. First the students participated in a study abroad program in Italy where they visited the Venice Biennale in 2014. Second a post-project survey/questionnaire was administered to collect their lived experience.

3.3 *Finnish pavilion at the 2014 Venice Biennale*

The Finish pavilion at the 2014 Venice Biennale consisted of a two-part installation based on a concept by Anssi Lassila. With two "primitive huts" that the visitor could enjoy from within, the installation provided two examples of space and shelter at their purest. The pavilion embraced an appreciation for tradition as a source of identity combined with an openness and curiosity toward international influences. Finnish modernism have been inspired by local tradition and by exposure to the world beyond one's immediate sphere of experience (MFA, 2014).

It was a surprise to both students and instructors to observe the similarities of ideas and assembly in both the Finnish pavilion and our Kilim project. The fundamental difference between the two is related to their construction methods: stacking versus assembling. Since earliest times, human beings have constructed their dwellings and shelters by stacking materials, such as stone, to form elements of architecture (e.g., walls), but recently, modern architecture is mostly conceived as planar elements. Eladio Dieste argued that the construction tradition had lost the vitality of its great creative movements due to the enormous effect of the planar framework on today's structures (Anderson and Dieste, 2004). This distinction was clearly evident in both the Kilim project and the Finish pavilion, where one is conceived as planar framework and the other as traditional construction method. Our students were confronted with the two methods of construction and were able to reflect on their own work in light of the Finish pavilion installation.

4 RESULTS AND DISCUSSIONS

Following the completion of the Kilim project, an online survey was conducted to solicit students' opinions. The survey was sent to two groups of students; those who participated in the project from inception to completion, and those who would take part in future design/build labs. The total population sample was 37 students, which consisted of 23 third year students (project participants) and 14 second year students (future participants). The response rate was close to 60% (22 total responses), consisting of 29% second year students (4 responses) and 78% third year students (18 responses).

77% of the respondents had also completed the required two semesters course-sequence of Building Assembly/Building Materials and Construction. 85% of the respondents reported that the design/build lab

was critically integrated into the curriculum of building technology courses, while 15% reported that the lab was not integrated in the curriculum.

According to the university schedule, only two hours were allocated for the lab per week. However, 68% of the respondents reported that they actually spent more than 6 hours working on the lab per week, and 32% reported that they spent between 2–6 hours per week. As a result, 30% reported that they couldn't achieve a balance between their other course workload and the lab, another 30% achieved "some" balance, while 40% achieved "quite a bit" balanced workload. In regard to the size of the lab project in relation to the semester-long activity, half of the respondents reported that the size and scale of the project was 'appropriate', 25% reported 'neutral', and 25% reported that the project scale was 'inappropriate' for one-semester schedule. More than half of the students saw that the distribution of workload was respectively "rarely" and "never" balanced among teams and individuals, the other 35% saw the workload was "sometimes" and "often" balanced, and carefully distributed. The majority of respondents (89%) reported that safety measures were implemented during construction, and that safety information and training were offered during class prior to the beginning of construction. Surprisingly 44% reported that coordination and collaboration with the engineer were 'effective' in understanding the structural issues of the project, while 39% reported that is was 'neither effective nor ineffective' and 17% reported it was 'ineffective'. We assume this is due to the limited interaction and lack of interest of all students during the collaboration sessions and only few interested students, mostly from the design team, attended these sessions. The majority of students (65%) reported that 'major learning outcomes' from the lab included the following:

– Applying knowledge learned from the building technology courses.
– Exploring light wood construction framing techniques.
– Assembly of tilt up wall construction systems.
– Design for disassembly and reconfiguration.
– Resources reuse, optimization and sustainability.

The majority of students (90%) stated that the lab was a necessary part of their education. One summarized his experience as follows (edited for clarity):

> *"Applications should be a large part of our architectural education; it is not common to build a full-scale model during my education years. We improved our skills on working collaboratively and the design/build project played a crucial role in understanding real construction and design problems. Otherwise, we couldn't understand the problems with computers or hand drawings only."*

In addition, some added that their "real-life experience" included collaboration/communication with

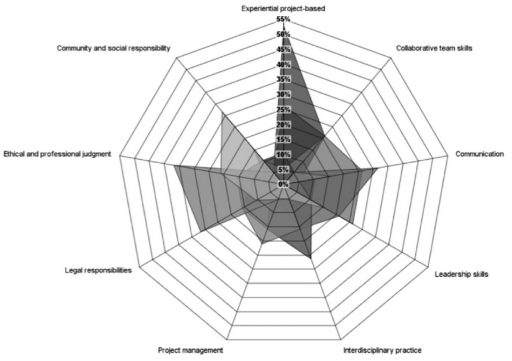


Figure 8. Distribution of personal & professional skills gained.

classmates and instructors, fundraising and sourcing/procurement of materials. 68% agreed that some personal development opportunities that emerged from the lab experience included understanding the relationship between design and construction, having built work on one's portfolio before graduation, solving real construction and onsite problems and learning how to work and collaborate in teams. Students ranked personal and professional skills gained from the lab as follows (Fig. 8):

– Experiential project-based
– Collaborative team skills
– Communication
– Leadership skills
– Interdisciplinary practice
– Project management
– Legal responsibilities
– Ethical and professional judgment
– Community and social responsibility

4.1 *Findings and lessons learned*

Our observation of the Turkish culture indicates that Turkish people generally prefer working and socializing in groups. Our hypothesis was based on the assumption that this attitude would ease the group decision-making process. However, in our post-project survey, only a little over half (53%) thought that "collaborative work culture" distinguishes Turkish students from others, while 47% don't think so. This split could work against a healthy progress of a design/build project, however the end result changed the preconceived mindset of the majority of participants. In general the majority of students reported that the lab garnered very positive attention for the university (79%) while 21% thought a little to none attention was gained. 65% reported that they definitely were willing to participate in any future elective or extracurricular labs. 74% reported that the lab experience succeeded in eliminating the preconceived fear of working directly with real materials and machinery. A little under half of the students (45%) viewed the lab instructor as a "collaborator" and 25% viewed the instructor role as an



Figure 9. Students during construction of the Kilim project.

"advisor". Other roles included "designer", "architect of record" and "leader". As for the project decision-making process, the majority of respondents (75%) viewed that design and construction decisions were made equally by students and instructor. Almost a quarter of the students viewed that collaborative work, realizing design ideas, and the lab instructor were the main factors in motivating them to build their first project. Another quarter viewed the instructor as the main motivator while a third quarter viewed learning onsite, building a project with monumental value and grades, as among their motivations to participate on the project (Fig. 9).

Although respondents were split in half regarding the question of including the lab as a required course versus an elective one, they continued to surprise us. When asked if they were given the opportunity to choose between spending the 2 hours/week of the lab time in front of a computer drafting construction documents, or working on a design/build project, the majority of them (86%) selected working on a design/build project, while only 14% preferred a computer lab. This is very much confirmed our hypothesis that the majority of students favor a real-life experience over a computer drafting one. Justifications for favoring the lab was explained by one students as follows (edited for clarity):

> *"We have many theoretical courses in the curriculum, yet we don't find an opportunity to apply the things we learn in theory to practice. With the design/build lab we had the opportunity to apply what we learned. It's always difficult to visualize joints and details in drawing. I didn't understand them until I actually constructed them by my hands. Now, I have self-confidence about my architecture."*

Students who favored the lab as an elective course stated that their lack of interest halted a smooth progress of the project and created negative arguments among students. In addition, the nature of "labor work" is not suitable for some students, especially females due to cultural constraints. Also the extra time required for the lab beyond the two hours created a burden on some students who couldn't manage a balance for other course workload. The majority of students (84%) agreed that the construction experience gained from the lab could potentially distinguish them from their peers in other Turkish institutions at the time of graduation. Some students stated that they now know more about construction, management and processes than their peers. Others suggested that most of their peers have not experienced this kind of material applications, teamwork and group decision-making and that the experience would most likely be an advantage in their professional life. One student reflected on her design/build experience as the following:

> *"We have done something we couldn't imagine doing before, like what we see in books and magazines. One who didn't experience something like that would never know how it feels like; that proudness and self-confidence. We really built it with manpower, collaboration and belief; we gained courage that certainly will distinguish us from our peers who are unaware of this kind of architectural education."*

5 CONCLUSION

Our design/build project brought a pedagogical evolution to the Turkish architectural education, which was favored by 63% of our participated students. According to some, Turkish higher educational system generally does not pay much attention to applicatory teaching, and we suggest that Turkish architectural education, in particular, could certainly benefit from design/build initiatives. Our design/build lab was developed from the ground up with zero funding, no facility, and a pessimistic view from some faculty members, yet it proved that vision, dedication and hard work pays off and that changing students' perception is applicable through collaborative work. 95% of our survey population agreed that the experience formed an important ingredient in their architectural education for several reasons, and that it provided them with essential skills such as a better understanding of architectural tectonics, assembly and joining of materials, solving construction problems onsite and efficient management, realizing the difference between theory and practice through application, incorporating lesson learned from real life problem back into the regular design studio projects, and finally developing collaborative skills and iterative design process. The three guiding principles for this inaugural project – pre-fabrication, optimization and sustainability – were thoroughly investigated in the context of the available resources and time constraints. Collaboration with a structural engineer at the early stages of the project was essential to the realization of the project within the framework of these principals. Exercising a group decision-making process was challenging, but ultimately yielded a successful experience. We strongly believe that architectural education in Turkey could benefit from integrating design/build initiatives to its existing curriculum and distinguish itself from that

of other countries in the region. Turkish culture, in general, holds quality education in high regards and design/build initiatives such as the one we presented will critically help reposition the role of the architect to the ever-constant societal challenges and changes in the region.

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The author wishes to thank Bilkent University architecture students' class of ARCH 252 Spring 2014 for their dedication and persistence to design and build their first project. Also, sincere gratitude extended to Dr. Meltem Gurel, Dr. Ali Ihsan Unay, Dr. Giorgio Gasco and the woodshop technicians, Erol Bey, Lutfi Koç. The project was dedicated to the victims of Soma mine disaster in 2014.

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The EAAE and the Lisbon School of Architecture—A common history between 1976 and 1986

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ABSTRACT: On April 25, 1974, Portugal underwent a political revolution that put an end to a 40-year-old dictatorship. Since 1976, and in the ten years following, when the country entered the European Economic Community (1986), only two institutions were providing architecture education: the Superior School of Fine-Arts of Oporto and its namesake in Lisbon. The revolution transformed the whole country, including both schools and their architecture courses.

This article analyses the post-revolutionary period within the Lisbon School, taking into account the history it shares with EAAE. Thus, the use of the expression "common history" will firstly here have a sense of sharing; secondly, it will underscore the importance of the recollection of architecture schools' histories for deepening the debate and thus facing present and future societal challenges in architectural education.

The major theme for this conference—Architectural Research Addressing Societal Challenges—is a basic pursuit and a pedagogical quest for two of its hosts: the Faculty of Architecture of the University of Lisbon (FAUL) and the European Association for Architectural Education (EAAE). This article addresses the common history of the Faculty of Architecture of the Technical University of Lisbon (FAUTL, previously to FAUL) and the EAAE in the years 1976 to 1986, a period in which the first was called upon to respond to striking societal challenges and the latter had just been created to "enable teachers and students of Architecture throughout Europe to collaborate towards a fuller communication of ideas, methods and philosophies" (EAAE, 1978).

This article will overview and question architectural education having for basis an historical analysis of architectural education itself, i.e., it will describe institutions and mechanisms that promote teaching, discussion and dissemination of architecture. Thus, it will strive to address a complex and potentially diffuse issue by a narrowing its field of analysis.

The importance of the development of historiography on the most recent decades of the twentieth century—the 1970s, 1980s and 1990s—is widely debated. We find that many of the case studies of this period, even the most complex, are missing pieces of the current history of architecture and culture and have not yet been studied due to the multifaceted and contradictory features that they present. Architectural culture within the Lisbon school of architecture is one of these unexplored and yet revealing themes; it specifically justifies an in-depth study for a Ph.D. that describes Lisbon's architectural culture in the 1970s and 1980s through analytical observation of its architecture course.

To overrun the difficulty of being an unexplored object of study, overall research relies heavily on primary sources. This specific essay is documented by the FAUL's own registries—administrative (paper) and videographic. In addition, personal collections were consulted and re-assessed, and numerous taped interviews and written testimonies were reviewed.

A significant number of secondary sources support the major research; for this paper, the EAAE historical archive should be pointed out, namely its News Sheets, available online (Archive EAAE).

1 THE LISBON SCHOOL OF ARCHITECTURE—HISTORICAL FRAMEWORK

The history of the Portuguese democratic revolution is widely acknowledged, studied and celebrated. Images of the historical streets of Lisbon filled with people show both the physical and social grounds of revolutionary ambience. Lisbon's institutional architectural education participates in this engagement because teaching takes place in Saint Francis Convent, a preserved XIII century building in historical Chiado area (Calado, M. & Ferrão, H. 1996), and because politics, in 1974, were a general concern.

Before 1974, architecture was officially taught in Lisbon as post-secondary education at the Superior School of Fine-Arts. During the 1974 revolution, inner turmoil led to the course of architecture's suspension until 1976, when it was re-established for, among other goals, the purpose of distinguishing the department as an autonomous university faculty from the other fine arts (George, 1987).

The decade that followed the reopening of architecture classes within the school—which was, in 1979,

formalized as Faculty of Architecture of the Technical University of Lisbon (FAUTL)—was characterized by social instability, political struggle and prolific extra-curricular activity.

1.1 *Architecture and revolution*

The years from 1976 to 1986 are critical for understanding contemporary architectural education in Lisbon. They will testify to an extreme transition between two systems: a collegiate *beaux arts* structure to a university system linked to a wider and substantively more complex academic field (Silva, 2012). Although this process was not immediate, Portuguese schools were instantly 'democratized' under military governance that lasted about two years. Lisbon's Architecture Department embarked on a virtual internal revolution just a few days after April 25, 1974 (FAUL, 1975a).

At first glance, the suspension of architecture classes and the closing of the working spaces were the practical result of the expulsion of many docents for political arguments, supported by groups of students (Silva, 2011); a second examination adds that this closing is naturally caused by a sense of opportunity given what Lisbon architects and students had regarded as a social and cultural depreciation of their discipline and careers in the previous decades. Therefore, an immediate proposal for the separation of architecture from plastic arts to integrate the university system was made. The option of disciplinary autonomy and specialization and the urgent need for architecture's ethical and technical refinement were generally agreed upon among those who ended up intervening in the school's reform. The Lisbon Superior School of Fine-Arts' previous division into two sections—architecture and painting and sculpture—was thus reinforced by the conception of two new post-revolutionary departments: architecture and arts and design (FAUTL, 1981a).

It was clear at this point that the school's population believed in its own self-awareness and in acting on behalf of architectural practice rather than for strict academic values. However, this implicit assertion in times of such turmoil does not mean a disregard for teaching methods or a lesser concern for architectural education; on the contrary, the political crisis intensified the disciplinary discussion. The debate within the school revisited theoretical inquiries that utterly questioned pedagogical methods, specifically the reasonableness of the *beaux arts* system. The Lisbon School's students wanted to be prepared for the 'real world'. The academy stood face to face with a territorial reform expressed in actions like self-construction and in many cases supported by the state. Architecture discourse revolved around primary questions like the *utility* of architecture, taking into account a country with deplorable housing conditions (RTP, 1975). The idealism of the conjecture 'Architecture or Revolution', put by Le Corbusier years before, is illustrative of how architectural education would have profoundly marked a societal transformation if only the extreme and programmed makeover that was being planned had taken place—in other words, if the shift had been portrayed as an heroic, modernist-like act. However, some architecture students of the Lisbon School as well as some teachers who gathered in successive general assemblies after April 1974, expressed not only their views on the political and social circumstances but, most incisively, on their academic and personal expectations, uncertainties and frustrations (ESBAL-Arquitectura, 1974). In sum, despite having prompted an educational blackout for political and ideological motives, these students and teachers were admitting during the revolutionary years that the conjecture *'Architecture or Revolution'* should, in fact, be more of a conjunction of words— like in Architecture *and* Revolution—anticipating that architectural education would in fact at the Lisbon School, overcome instability and engage in societal transformation within a mild everyday transitory manner, as we will see.

1.2 *The post-revolutionary first study plan proposals*

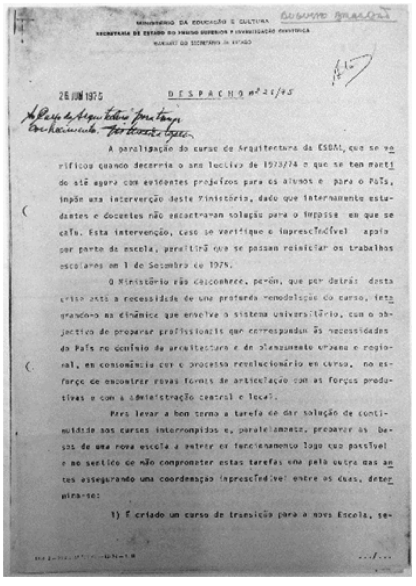
1.2.1 *Architecture, regional and urban planning school, by N. Portas*

In June 1975, more than a year after the April 25, 1974 revolution, the dead end in which architecture students and teachers found themselves motivated A. Avelãs Nunes, the Secretary of State for Superior Education and Scientific Research, to write a legal resolution (Fig. 1) (FAUTL, 1975b) that created a three-headed installation committee for the conception of a new school to be called *Architecture, Regional and Urban Planning School*. To do this, Nunes appointed architect N. Portas, a former professor at the Lisbon School and a dedicated researcher at National Civil Engineering Laboratory (LNEC).

As a member of the installation committee for the creation of a new school of architecture, Portas wrote out its program in detail (FAUL, 1975c), conceiving a fresh start supported by his convictions on the matter.

He carefully planned the integration of the students from the current suspended architecture course—which should be eliminated, according to his proposal—and the complete change of the faculty composition. As to its substance, the new structure Portas planned summarized most of what he had been advocating in his classes at the school, in the years prior to the revolution, and, moreover, on his experience at LNEC: In this proposal, Portas intended to join urban planning and architecture, giving urbanism a prominent place, in a straight relationship to social sciences.

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MINISTÉRIO DA EDUCAÇÃO E CULTURA
SECRETARIA DE ESTADO DO ENSINO SUPERIOR E INVESTIGAÇÃO CIENTÍFICA
GABINETE DO SECRETÁRIO DE ESTADO

26 JUN 1975 DESPACHO nº 25/75

A paralisação do curso de Arquitectura da ESBAL, que se verificou quando decorria o ano lectivo de 1973/74 e que se tem mantido até agora com evidentes prejuízos para os alunos e para o País, impõe uma intervenção deste Ministério, dado que internamente estudantes e docentes não encontraram solução para o impasse em que se caiu. Esta intervenção, cedo se verifique e imprescindível apoio por parte da escola, permitirá que se possam reiniciar os trabalhos escolares em 1 de Setembro de 1975.

O Ministério não ignora, porém, que por detrás desta crise está a necessidade de uma profunda remodelação do curso, tendo em conta a dinâmica que envolve o sistema universitário, com o objectivo de preparar profissionais que correspondam às necessidades do País no âmbito da arquitectura e de planeamento urbano e regional, em consonância com o processo revolucionário em curso, no esforço de encontrar novas formas de articulação com as forças produtivas e com a administração central e local.

Para levar a bom termo a tarefa de dar solução de continuidade aos cursos interrompidos e, paralelamente, preparar as bases de uma nova escola a reter o funcionamento logo que possível e no sentido de não comprometer estas tarefas uma pela outra das antes assegurando uma coordenação imprescindível entre os dois, determina-se:

1) É criado um curso de transição para a nova Escola, se-

.../...

Figure 1. Dispatch 25/75, 24 June, by A. Avelãs Nunes. Creation of an installation committee for a post-revolutionary school of architecture (Faul, 1975b).

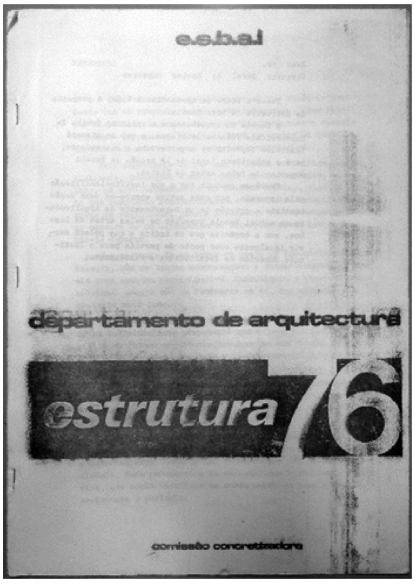


Figure 2. *Estrutura 76*. Draft presented to A. Brotas for the first post-revolutionary architecture course study plan. Cover (Estrutura 76, 1976),

to his proposal—and the complete change of the faculty composition. As to its substance, the new structure Portas planned summarized most of what he had been advocating in his classes at the school, in the years prior to the revolution, and, moreover, on his experience at LNEC: In this proposal, Portas intended to join urban planning and architecture, giving urbanism a prominent place, in a straight relationship to social sciences.

This process was elaborated upon and roughly debated (at a distance) between Portas himself and the school's population from October to December 1975 (ESBAL, 1976a). Students and teachers would then present a myriad counteract proposals to the same level decision-makers therefore Portas did not succeed in providing Lisbon with a new architecture school.

1.2.2 *Architecture and planning superior institute – estrutura 76*

The Lisbon School's architecture course reopened in April 1976, two years past the political shift, under a new resolution (Dispatch 7/76 and 7A/76), signed by A. Brotas, the Secretary of State after Nunes. This legal statement was based on a work document titled *ESBAL-Arquitectura*, presented by six professors, that had made its way through earlier disputes (FAUTL, 1976b). This document included a study plan called *Estrutura 76* [Structure 76], supposedly named after the year 1976 (Fig. 2) (Estrutura 76, 1976), that had no single authorship, being the result of an agreement among students and teachers under the guardianship of F. George, a dedicated professor and a renowned cultural figure who enabled a smooth transitory process thereafter. In fact, the myriad of ideas contained in *Estrutura 76* confirms a harmonious relationship

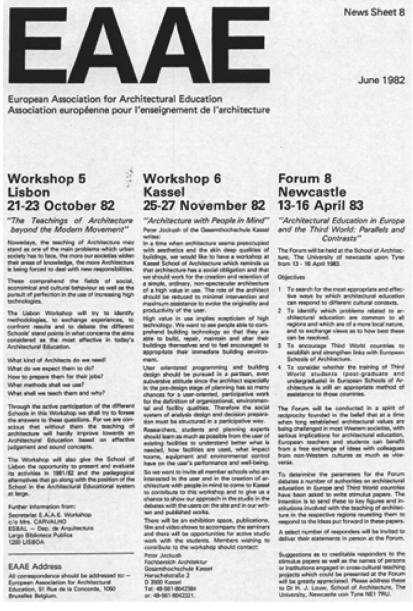


Figure 3. EAAE News Sheet n. 8, June 1982. Announcement of the Fifth Workshop in Lisbon (EAAE, 1982).

between multiple worldviews; on the one hand, the text alludes to George's pedagogical artistic charisma:

> "It is difficult to establish the borders for an architect's intervention; the range of materials include the positive sciences, and the humanistic and social sciences, ever combined with

a spirit of permanent creativity" (Estrutura 76, 1976).

On the other hand, the written words of *Estrutura 76* are clear political sound bites:

> "The architect will have to question some of his concepts, using, for that matter, idealistic and materialistic philosophies, and should give prominence to an analysis of society, from the perspective of historical and dialectical materialism (. . .)" (Estrutura 76, 1976).

This drafted study plan diverges from Portas' proposal in other aspects, all reflecting the multiple contributions from the school's population. Overall, it is a less demanding and more flexible proposal for both students and teachers engaged in the former system, reinforcing the counteraction thesis.

Specifically, it suggests a four-year curriculum for a diploma in architecture that is sufficient for registration in a professional association. In addition, students could then engage in a specialization of 18 months in architecture or planning, but also in theory and architectural history, a specialization disregarded by Portas, and aimed for developing skills for specific "public agencies devoted to the Portuguese architecture heritage conservation and protection" (Estrutura 76, 1976).

Estrutura 76 narratively reflected the students' idealism, whereas, in practice, it proposed a simplistic and pragmatic learning process. In this aspect, the collective study plan was extremely different from Portas' line of intentions, since the latter believed that a highly demanding course was the only way to "avoid social disqualification in a certain "batch" [meaning a group of students who would graduate in the same year] of architects" (ESBAL, 1976a).

Besides cutting the course from six to four years, this study plan included for evaluation methodology a "continuous assessment" and the passing of the year dependent on a "general consensus between students and teachers" (Estrutura 76, 1976). This plan included the abolition of classes with precedency—which meant, if necessary, the passing over of students with a "poor knowledge on the subjects". All this was in favour of "collective work", "group spirit", and elimination of exams, an "evaluation act" that promoted "individualism, creating undesirable competitive situations, moreover the infallibility and injustice thereafter raised" (Estrutura 76, 1976).

As for the students from the fourth to the sixth year from the former curricula who had to line up in a transitory scheme, it was planned that they would not have to meet the requirements of the new study plan to graduate. The same benevolence was here applied—that is to say, these students were implied victims of the previous system (idealist view), or a 'complicated business' for the new one (practical view).

As for teachers, this study plan most of all acknowledged the interests of the interim school's population; specifically, the professor's 'acquired rights' should be acknowledged in a clear statement against the extinction of the course and their contracts, as proposed a year before by Portas through the former Secretary of State.

This study plan enforced the creation of a new school, to be called Architecture and Planning Superior Institute. However, this school was not mentioned by Brotas when the document *ESBAL-Arquitectura* was submitted for legal support. Brotas would only support *Estrutura 76* as the basis for an experimental period for the reopening of the architecture course, thus recognizing the architecture department within the fine arts school, from April 1976 to December 1976.

Estrutura 76 was then accepted with some ecpections like the evaluation methods, which would have to be exclusively individual, and of the full docent responsibility. In addition, Brotas required the course to have a four year curricula for a bachelor's degree, starting at year one to four, and two more years for a master's.

Brotas' appreciation and subsequent legal resolution and reopening of the architecture course in the spring of 1976 did not mean that classes in the years followed achieved *Estrutura 76* or any other stable and rigorous plan. In fact, until the mid-1980s, study plans were altered yearly (FAUL, 1977) to contend with multiple deficiencies—an increase in the number of students and scarce resources of financial, administrative and spatial natures. Pedagogically, absence was severe among both students and teachers. As to educational contents, exploratory architecture contents like drawing and experimenting with models were scarce. It was difficult, especially for students who wanted to be engaged at school, not to devote most of their energy in bringing to classes their concerns about everyday post-revolutionary outdoor life. Classes were, therefore, the natural ground for debating architecture education (Planeamento, 1976).

2 THE EAAE AND THE LISBON SCHOOL OF ARCHITECTURE

In that same year of 1976, when the architecture department reopened in Lisbon, the EAAE was founded for the promotion of "a wider understanding of the theory and process of Architectural Education" (EAAE, 1978).

The EAAE is an important entity in this essay since the relationship between the EAAE and FAUTL is symbolic of the interest that FAUTL revealed about both architectural education and external worldwide affairs in the decade in question. On this matter, Professor A. Brandão stands out in his role as president of the architecture department's governing board from 1978 on. Working alongside the installation committee designated by the 1979 law to conduct the entry of architecture course in university, and eventually as its member, Brandão enforced a stable internal structure and promoted a connection of the department to the rest of the world.

The promotion of a qualified pedagogical offer, internationally referred, as an agency for a personalized



Figure 4. Fifth EAAE Workshop. FAUTL, Lisbon, 1982. Lecture by T. Dejksdtra. (Faul, 1982d).



Figure 5. Third EASA Workshop, The *Lisbon Ateliers*. FAUTL, Lisbon, 1983. (Faul, 1983h).

and credible renewed school, was particularly important for Brandão. His endeavour meant, in practical terms, a particular insistence on requesting financial aid from various entities and for particular needs like travelling (Silva, 2011). In his tenure, Brandão also encouraged more disciplined conduct among the school's population, enforcing, for instance, new pedagogic and docent structures with pre-determined objectives (FAUL, 1977). Although he was not always successful in his quests, the interaction with outer academic realities, in which the EAAE played a special part, are significant outcomes.

From as early as 1980, Brandão established a relationship with EAAE, sending Professor S. Sanches to the First EAAE Workshop titled *The Teaching of Architectural Technology* (Fig. 6) (FAUL, 1980). The First EAAE Workshop took place at ETH Zürich, academic home for H. Kramel, who had become EAAE's president in 1979 (EAAE, 1980). In the firs visit to Libon, Kramel delivered a seminar on *The Teaching of Architectural Technology* (FAUTL, 1982a). His lecture focused on the environment, energy conservation and how a university education should be able to articulate research related to both rudimentary and contemporary technologies (FAUL, 1982b).

In his visit, Kramel encouraged the Lisbon School of Architecture to innovate in technological research, stating his conviction about the importance of pedagogical evaluation. These two aspects—experimentalism and self-evaluation, within technological research—might seem reasonable at a distance; however, in the early years, they meant unsettling the pedagogical ground on which the architecture course had been raised, thus potentially triggering political distress. This episode hence illustrates the risks that Brandão had to face when trying to develop a school based on a set of external references, instead of promoting internal debate and participation. In this context, a series of post-graduate courses, namely on building energy conservation, were made, rather than bringing the know-how and spirit of initiative into everyday architecture classes (Silva, 2014). On a specific point of Kramel's statement, he affirms it is "advisable to consider as academic work all the school activity". Brandão handwrites on the subsequent report report the word "fundamental" (Faul, 1982b), valuing the globalized path the university system was undertaking and the potential of the institution within this line of inquiry.

This is the context in which the Fifth EAAE Workshop took place in Lisbon between 21 and 23 October 1982, having for theme *The Teaching of Architecture* (Fig. 4) (Faul, 1982c). A few months later, Kramel reported his impressions, noting what he believed were the two most identifying characteristics of the FAUTL in the early 1980s: a desire for affirmation and a particular geographical status—peripheral in relationship to Europe, central to the rest of the world:

> "The same feeling of being on the edge of Europe was recreated in Lisbon [in comparison to Ankara]. (. . .) South America and Africa seemed closer than at any other place of the continent.
>
> (. . .) While Portugal, in the past, has been very strongly orientated toward colonies, today it seeks stronger alliances with Europe. The Workshop was one of the many attempts made to re-establish ties through relationships with other schools of architecture.
>
> Brazil, Mozambique and Macao are reference points even today. The role of Portugal in these countries has been considerably different from the one England played *vis à vis* with its colonies. (. . .) The Portuguese, more than any other former colonial power, have the potential to mediate between Europe and the other continents.
>
> (. . .) The motivation, energy and vision of Professor A. Brandão, (. . .), together with the support of an enthusiastic staff, made this EAAE event possible." (EAAE, 1983)

The Fifth EAAE Workshop stood out for its quality: The participants were all suggested by Kramel

and debated teaching methods in a genuinely scholarly environment, which is directly observable from the videographic records, one of the features that adds to the school's efforts to enrol in a technological dynamic (Figs. 4 and 5). As for the contents of the debate, it is in line with 'turning the page' from the idea of a *utilitarian* school— an issue that had been strongly articulated in the revolutionary years. In his Fifth EAAE Workshop's lecture, T. Dejksdtra, on the contrary, defended the development of academicism, foreseeing the coming times:

> "A massive class, as opposed to the studio method, is based on the assumption that architecture can be taught. This approach is based on the idea that architectural problems are teachable, i.e. accessible to a rational treatment and to a rational argument. Any didactic strategy in class, at school, is then not basically different from the process of office practice. (. . .) The virtue of a school is not to be practical, like the office practices. The virtue of the academy is to be academic" (Faul, 1982d)

Having once been very close to extinction, the Lisbon School of Architecture was then welcoming numerous foreigner academics who had persisted in the architectural education debate in their own contexts. Along with Kramel and Dejksdtra came A. V. Randen, from the Delft University of Technology; N. Segvic, from the Architektonsky Fakultet in Zagreb; B. Hoelsi, from ETH Zürich; R. Schweitzer, from Paris; P. Jockusch, from Kassel; P. Rich, from London; and N. O. Lund, from Aarhus, Denmark.

3 A BRIEF HISTORY OF OTHER EDUCATIONAL DEBATE AT THE LISBON SCHOOL

Since the late 1970s, the teaching of architecture had been the subject of numerous conferences that the Lisbon School of Architecture had promoted and in which it had participated. For instance, its representatives had been present at the First Congress of the newly founded Association of Portuguese Architects (AAP) in 1979, which had for theme the *Education of the Architect* (Fig. 6) (FAUL, 1979). At this gathering, the architects had debated the "creation of the architecture Faculties of Lisbon and Oporto", which were to be formalized that year (Decree-Law 498-E/79). The two primary topics for debate were the "educational programme for architecture and urban planning in the European context" given the "impact of the EEC", but also "educational degrees and postgraduate courses" (FAUL, 1979).

In 1982, FAUTL had planned the creation of an association of schools between developing countries (FAUL, 1982f), a theme that was undertaken by the 1983 EAAE Forum, planned for Newcastle upon Tyne, titled *Architectural Education in Europe and The Third World: Parallels and Contrasts*.

The FAUTL again made its presence known, this time with professors J. Real and J. Calado, who had asked for travel funds from the Gulbenkian Foundation, having for fundament the presentation of a "thesis" with the title *Teaching of Architecture in the 3rd World. The Basin of the Mediterranean and Africa* (FAUL, 1983b). The interest some teachers had about developing countries, together with the FAUTL's self-proven capacity of promoting its own events, had motivated the idea of uniting some architecture schools from the Mediterranean to debate architecture, society and teaching methods, in particular, at an event titled *Réunion D'Écoles D'Architecture Méditerranéennes: Architectures, Societés et Enseignements* (Fig. 6) (FAUL, 1983e). This reunion also had the contribution of Mello, who presented *Knowledge in Architecture and Its Transmission* (FAUL, 2006).

At this time, Brandão had already invested in designing abundant extra-curricular pedagogical training for FAUTL (Fig. 6). In 1982, a post-graduate course was begun, titled *Monument and Building Rehabilitation and Conservation* (PG1). Its study plan consisted of an eight-month period of late afternoon classes two times a week.

In 1983, a new edition of PG1 was administered, along with two new post-graduate courses that won especially positive feedback from the participants, titled *Environmental Architecture. Energy Conservation in Building* (PG2) and *Architecture for Tropical Areas* (PG3).

In 1984, a new seminar focused on the *City Outskirts Housing*, and in 1985, PG1 was at its third iteration (FAUL, s.d.).

As for undergraduates' school work, the conviction of a "qualitative jump" (N/A 1982) within a school path for internationalization had led Brandão to ask the Royal Institute of British Architects for recognition of the course of architecture (RIBA, 1983d). The schoolwork was then formally presented at an exhibition that was visited by Kramel during his 1982 visit and by members of the AAP—an attempt to gain formal recognition of the pedagogical progress.

The year 1983 was the most culturally active year in the school's life. Debate on architectural education gave way to an overall post-modern tendency for 'seizing the moment'; many events then assumed other themes rather than architectural education, but most either had for basis the invitation of foreigner personalities or imported artistic expressions. Many of these occurrences were recorded on home-video technology (VHS and others), a symbol of the abandonment of any bias against consumerism that signalized a rapid mentality turnaround or new political detachment (Silva, 2016; Silva, 2017).

The Faculty of Architecture Students Association (AEFA) itself played a fundamental role in the school's engagement with architectural education debate and external liaisons by participating in events organized by the European Architecture Students Assembly (EASA). First, AEFA promoted the presence of FAUTL by sending students and teachers to the first

DATE	LOCATION	EVENT	THEME	PARTICIPANTS (referred on text)
79.11.23-26	FEUP, Oporto	AAP First Congress	*The Education of the Architect*	
80.-	ETH, Zurich	EAAE First Workshop	*The Teaching of Architectural Technology*	From FAUTL: S. Sanches
81.04.23-25	[Various Schools] Vienna	EAAE Second Workshop	*The Teaching of Architecture and Urban Design*	From FAUTL: A. Brandão; C. Spies; C. Duarte
82.01.26-29	FAUTL, Lisbon	Scientific Seminar	*The Teaching of Architectural Technology*	Invited speaker: H. Kramel
82.01-06 (Plan)	FAUTL, Lisbon	Post-graduate course (PG1)	*Monument and Building Rehabilitation and Conservation*	
82.10.21-23	FAUTL, Lisbon	EAAE Fifth Workshop	*The Teaching of Architecture*	Invited speakers: H. Kramel; T. Dejksdtra; A.V. Randen; N. Segvic; B. Hoelsi; R. Schweitzer; P. Jockusch; P. Rich; N. O. Lund
83.05.18 (Inaugural Day)	FAUTL, Lisbon	Post-graduate course (PG2)	*Environmental Architecture. Energy Conservation in Building*	
83.08.1-12	FAUTL, Lisbon	Third EASA Workshop, The *Lisbon Ateliers*	*Social Spaces*	Undergraduates from 26 countries, mostly European
83.09.19-23	FAUTL, Lisbon	Réunion d´Écoles d´Architecture Méditerranéennes	*Architectures, Sociétés et Enseignements*	Assistant professor D. Mello presents his research.
83.10.19 (Inaugural Day)	FAUTL, Lisbon	Post-graduate course (PG3)	*Architecture for Tropical Areas*	
84.03-12 (Plan)	FAUTL, Lisbon	Post-graduate course	*City Outskirts Housing*	

Figure 6. The EAAE and the Lisbon School of Architecture. Significant Educational Debate and Didactic Offer, 1979–1983.

two EASA workshops in Liverpool (1981) (FAUL, 1983a) and the Delft (1982) (AEFA, 1982e); secondly, and most importantly, AEFA organized, in an almost freelance manner, the Third EASA Workshop in the FAUTL's ground, with the title *Lisbon Ateliers* (see Fig. 6) (EASA, 1984). This workshop gathered students of three nationalities outside the European continent, a total of 520 participants from 26 countries—an impressive demonstration of an effective internationalization of a Saint Francis Convent's improvised campus (FAUL, 1983h).

In 1985, the Architectural Association School of Architecture in London promoted an early visiting school programme to the FAUTL, enrolling 15 of its students (FAUL, 1985).

In 1986, the FAUTL and its concerns on architectural education reached a turning point, prompted by Portugal's entrance into the European Economic Community. From then on, Portuguese architectural education became liberalized, and the three major concerns of the very First Congress of the AAP back in 1979—architectural education, university and Europe—adapted to a different prospective future. In 1989, one of FAUTL's assistant professors was sent to the 20th EAAE Workshop in Helsinki, reporting that "FAUTL continues to be in debt as to its participation towards the AEEA, since 1986" (FAUL, 1989). The same year, AEFA promoted an introspective debate titled *What Architecture Is Taught Here?* (Mello, 2006).

4 CONCLUSION

This paper's primary objective was to trace a common history between the EAAE and the FAUTL in the 1980s. Secondly, it proposed to demonstrate the importance of developing historical research on the common histories of contemporary institutions.

Bearing the conference's theme in mind, what we can observe from this joint analysis is an overall educational crisis and deep societal challenges from the 1960s on. Particularly in Lisbon, a 1974 political revolution induced student takeover within the architecture school. Great political narratives are still present in the Lisbon School of Architecture in the first post-revolutionary years; however, a proposal for the old architecture course's elimination, meaning a school's actual radical reform, was rejected. The succeeding experimental years, within a convened transitional manner, much less connected to 'the real world', as proposed by the students' initial idealisms, will then reveal the first true identity for the new democratized FAUTL.

Even so, the first sequence of events that link FAUTL and EAAE unfold a general concern over qualifying and invigorating the school by connecting to other revered institutions as well as other accountable aspects like didactic offers or extracurricular events.

The agency of promoting the school and referring to external and visible actions implies a reflection over didactic problems like the precarious pedagogical structures, the lack of human and material resources, and the growth of the student population.

It is true that the school's agency, in the years 1976 to 1986, was to turn outwards to a globalized system, i.e., to invite foreigners, to record and publicize a specific self-image, to invest in specialized collaborative research rather than in this interim observation. If the new university-levelled Faculty of Architecture was to abandon its collegiate nature, with the disadvantage of being disqualified from its former familiar scale,

this was accorded to this premature susceptibility and for the sake of some advantages, namely the ability to seek out a wider field of educational options and realities. Whether this opportunity was embraced and hat kind of work and teaching resulted from this option are subjects for another study.

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This essay is dedicated to today's FAUL's students.

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A changing academic community: The faculty of architecture of the University of Lisbon

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ABSTRACT: Throughout the period of two academic years, the Faculty of Architecture of the University of Lisbon (FAUL) underwent a revision of its five-year study plan for Architecture. In 2013, the final version of the syllabus was approved and it has already been implemented. The previous syllabus had already been conceived to respond to Article 46 of European Directive 2005/36/EC, set to guarantee the basic knowledge and skills required for training architects within the European Union. The challenge addressed in the revision of FAUL's study plan was to find a better balance between research and practice. This paper aims to identify the current challenges faced by the Faculty of Architecture of the University of Lisbon in the midst of a changing academic community, which is evermore international and research-based. Framing the debate within the historical evolution of the Faculty from its sixteenth-century origin to today aims to contextualise the nature of the present day challenges.

1 INTRODUCTION

This paper aims to present the current challenges faced by architectural education at the present day Faculty of Architecture of the University of Lisbon (FAUL), by framing the current debate within a five-century old tradition. The early beginnings of the present day FAUL can be traced back to the sixteenth-century. Despite its long history, the detailed evolution of FAUL has not yet been fully addressed. The literature reviewed for this paper mainly includes research produced within FAUL, namely by Frederico George (1964), who presents a broad historical framework with some statistical information; Maria Calado (2003), who refers briefly in her PhD research to the early beginnings of architectural education in Portugal. Furthermore, the review included legal decrees and regulations, which legally record the rules and ideas defining architectural education in Portugal throughout changing times.

2 HISTORICAL OVERVIEW

2.1 *Education through practice*

Architectural training in Portugal had its early origins in the 'Aula do Risco', which roughly translates as 'classroom of tracing'. Aula do Risco was created by the Italian Filipe Terzi, at the end of the sixteenth-century, under the rule of Filipe II. At the time, there were three students per tutor, and education was mostly based on classical treatises. As described in George (1964, p. 21) 'There were four hours per day of classes and the Professor of Architecture had to, in the first two hours, teach the fundamentals of arithmetic and geometry, and in the next two hours, show his disciples the main proportions of the five orders of architecture – Tuscan, Doric, Ionic Corinthian. Then move onto the layout of a simple house, and, from then on to a palace. He had to provide the exact notions of the solidity of construction, and then introduce ornament and the use of perspective'. Aula do Risco was a small studio, with its principal location at Paços da Ribeira, in the centre of the city; however, it can be nowadays be characterised as a mobile classroom, as it was created to operate mainly on construction sites of royal commissions, as was the case with Mafra (Calado, 2003, pp. 93–95).

In 1755, Lisbon had its central core destroyed by a devastating earthquake. The reconstruction of the city, that succeeded the earthquake, became the means for the Casa do Risco to improve both its techniques and theoretical support. At this time, there was a merger between the studio and the engineers dedicated to building fortifications. Manuel da Maia, an engineer responsible for overseeing the reconstruction of the Baixa Pombalina after the earthquake, himself became the architect of Casa do Risco, overseeing, onsite, the reconstruction works of the city (Calado, 2003, p. 95).

This early tradition traces the roots of architectural education in Portugal to practical training, as architects were instructed through the practice of architecture directed towards ongoing construction works. This tradition would change with the influence of Liberal ideals and French culture in the nineteenth century.

2.2 *Academy of the arts*

In Lisbon, architectural education framed within an Academy emerged in 1835, with a national-decree

that provided a general revision of education. At this time, all courses in Sala do Risco were discontinued, transferring existing human and physical resources to Lisbon's Academy of the Arts (Calado, 2003, pp. 96–99).

Lisbon's Academy of the Arts was created on the 25th of October of 1836, stating its purpose as being 'uniting all arts within one institution' (Calado, 2003, p. 99). While the education provided at Sala do Risco was mostly practical and onsite, at the Academy, the education of the Fine Arts was considered more important. The main tutor was no longer the supervisor of construction works, but the Drawing tutor. Architectural education was then guided by the academic education of the Beaux-Arts, inspired by the French tradition of classical treatises. The minimum age to enrol in the Academy was 10. Students had to be able to read, write and know basic mathematics (Calado, pp. 99–101).

It was only in 1881 that architectural education in Portugal, received a more specific syllabus, different from the general education of the arts; however, architecture only earned its place in higher education, along with the arts of Painting and Sculpture, in 1957.

2.3 *Escola de Belas Artes, the Beaux-Arts school*

In the early twentieth-century, architectural education was taught as a course, alongside Painting and Sculpture, to selected groups of around 10 students per year (Tainha, 2005).

In 1957, there was a decree (Decreto-Lei,1957) changing the status of the Beaux-Arts education from a general course to a higher education level. Universities did not offer this course. It was today's equivalent of an undergraduate course; thus, in the 1950s, it did not include scientific training. The decree of 1957 included the possibility of creating "centres of study", which were to cooperate with museums and workshops.

The Architectural diploma was obtained after six years of study and a mandatory six-month internship onsite. The Faculty included a mix of lecturers and professors from the Instituto Superior Técnico, an engineering university (Decreto-Lei, 1957).

At this time, Portugal was under a dictatorship, which lasted until 1974; hence, the decree did not fail to include, in the preamble, that schools of Architecture must take into account the 'the natural and ethnical diversity of conditions (…) the popular and erudite references of the metropolis and the overseas empire (…) without losing sight of the fundamental unity of the nation and its traditional mission' (Regulamento das Escolas Superiores de Belas-Artes). The school was framed by the decree of 1957 until 1974, the year of the democratic revolution, which overthrew the dictatorship. The school was then closed for one academic year (1974–1975) and, when it reopened, it started on its path towards technical training, moving away from the arts.

2.4 *Faculdade de Arquitectura da Universidade Técnica de Lisboa, from Beaux-Arts to Technical University*

It was only in 1979, five years after the revolution, that the present-day Faculty of Architecture of the University of Lisbon evolved from being a course taught by Lisbon's Faculty of Beaux-Arts (Escola de Belas Artes de Lisboa) to becoming an autonomous Faculty of Architecture (Decreto-Lei nª498-E/79 de 21 de Dezembro).

The new institution moved away from its beaux-arts tradition to become part of the Technical University of Lisbon. The preamble of the decree, in 1979, underlined the need for an architectural education of a scientific nature given the 'evolution and development of society and the pressure arising from both demographic growth and the concentration of the population in urban areas'. According to the preamble these societal changes demanded constant research seeking 'new solutions' which required 'high scientific training'. This training should 'cooperate with other scientific and technical areas (…) safeguarding the artistic elements' of architectural training.

In 1979, the Faculty offered two five-year graduate degrees, Architecture and Urban Planning, and, for the first time, PhD courses in these areas; however, the clear specification of the curriculum, the system of credits and the abolition of the architecture course from the Beaux-Arts were only stated definitively in 1984. (Portaria n°448 de 9 de Julho). In this Administrative Order, architectural education emerged with a syllabus of 5 years. The first four years were dedicated to generalist training in architecture, and the final year included three specializations: Architecture, Urbanistic Planning, and Renovation and Conservation of Architecture and Urban Areas.

In 1995 (Despacho Reitoral, 1996), there was a Senate decision within the university, introducing new areas within the Faculty of Architecture, namely Design, Fashion Design and Interior Design. The existing specialization in Planning was divided into two areas, Urban Planning and Urban Management.

2.5 *The European Union: the master degree and the rise of scientific training*

In 1999, ministers of education from 29 European countries signed a treaty, the Bologna Declaration, which held as its main goal the establishment of common rules for higher education in the European Union. The aim was to implement these rules by 2010. One of the fundamental tools established was a common European Credit Transfer System (ECTS), promoting the interchangeability of students between member states. (Decreto-Lei n°42/2005).

One of the most important decisions for architecture, in the Bologna process, was the decision to keep training with 4 to 6 years of study; thus, placing mandatory education of architecture at the second cycle level, with an integrated master's curriculum. As defined by Decreto-Lei n°42/2005, first cycle education, today,

refers to undergraduate courses consisting of three years of mandatory enrolment, second cycle to master degrees and third cycle to PhD degrees.

The European Directive of 2005, related to the recognition of professional qualifications in member states, further declared the fundamental contents of architectural training, which must, in all European Universities, be upheld to the present day: 'That training, which must be of university level, and of which architecture is the principal component, must maintain a balance between theoretical and practical aspects of architectural training and guarantee the acquisition of the following knowledge and skills: (a) the ability to create architectural designs that satisfy both aesthetic and technical requirements; (b) adequate knowledge of the history and theories of architecture and the related arts, technologies and human sciences; (c) knowledge of the fine arts as an influence on the quality of architectural design; (d) adequate knowledge of urban design, planning and the skills involved in the planning process; (e) an understanding of the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale; (f) an understanding of the profession of architecture and the role of the architect in society, in particular in preparing briefs that take into account social factors; (g) an understanding of the methods of investigation and preparation of the brief for a design project; (h) an understanding of the structural design and of constructional and engineering problems associated with building design; (i) adequate knowledge of physical problems and technologies and of the function of buildings, so as to provide them with internal conditions of comfort and protection against the climate; (j) the necessary design skills to meet building users' requirements within the constraints imposed by cost factors and building regulations; (k) adequate knowledge of the industries, organizations, regulations and procedures involved in translating design concepts into buildings and integrating plans into overall planning.'

At FAUL, the first syllabus framed by the Bologna Declaration, with a five-year curriculum leading to a master degree, was approved in 2008 (Despacho n°22848/2008) and, since then until the current curriculum of 2013, changes have been made in 2009, 2011, and 2012. These changes focused on fulfilling the requirements laid out by the European Directive, specifically for the specializations in Urban Planning and Urban Management, which were initially not recognized as architectural training by the Directive, due to too many ECTS being dedicated to planning and not enough to architecture. The changes implemented in 2013 focused on providing a common first cycle of study to all courses, followed by two years of three possible specializations: architecture, urbanism and interior design and rehabilitation.

In 2013, the Technical University of Lisbon merged with the University of Lisbon becoming not only the oldest, but also the largest university in Portugal. The Faculty of Architecture is one of the eighteen faculties included in the University of Lisbon. Today, the Faculty of Architecture is no longer framed by the Technical institution created in the 1970s; thus, is free to find its place in between the sciences and the arts.

2.6 *Today's heritage: practice, arts or science?*

This historical development of Lisbon's architectural education, at present day FAUL, gave rise to an ingrained heritage, which can be divided into three components: practice, arts and science. The practice-based education is the heir of the sixteenth-century origin of architectural education in Lisbon. Training through knowledge of the Arts dominated in the nineteenth century with the rise of Liberalism and the influence of French culture. Scientific training emerged at the end of the twentieth century.

The challenges of the present mirror these three poles (practice, arts and science) proving that institutions have a memory which can be forgotten but never erased.

3 CHALLENGES OF THE PRESENT

3.1 *The final project*

One of the main questions, which remains as a source of conflict and debate, is the content of the Final Project. In 1957 (Decreto-Lei 1957, Art. 28), to get the architectural diploma students were required to present a report of the mandatory six-months internship taken within a construction site to a jury of three architects. Today, the internship is no longer a possibility, due to the school's current second cycle regulation.

Those who uphold the practice-based tradition defend that students should end their diploma with a project-based architectural design, or even an internship, as was the case in 1957. The Drawing Department, which makes up a large part of the ECTS credits in the first two years of the syllabus, claims it should be more involved in this final process, reclaiming the school's Beaux-Arts tradition. Professors who are focused on scientific output and research-based work argue that a dissertation abiding by scientific methods and tools is the only possible conclusion to a Master degree.

The most debated change in the current syllabus was the introduction of the possibility of choice for the student. Today, the student can chose to end the diploma with either a dissertation, or an architectural design project. Research-based professors believe progress has been made. Practice-based defenders are currently preparing a proposal, which aims to end this possibility of choice, imposing the mandatory presentation of both an architectural project and a dissertation.

3.2 *A changing academic community*

Long gone are the sixteenth-century days, when one architect was made responsible for the architectural training of groups of three students. Table 1, presenting an evolution in the numbers of students and teachers throughout the past four decades, best shows how

Table 1. Teachers and Students at FAUL.

	***1975	***1990	**2016
TEACHERS_total	9	108	163
PhD	2	9	130
Masters	7	1	5
Graduate degree (5 years of study)	_	98	28
Full Professors	1	6	6 (+1*)
Associate Professors	_	2	13
Auxiliary Professors	_	12	93 (+29*)
Assistants	8	84	1 (+20*)
Intern Assistants	_	4	_
	***1973	***1990	****2016
STUDENTS_total	880	1153	2657
Architecture (Integrated Masters)	880	1153	1759
Design	_	_	475
Mobility	_	no info	242
PhD	_	_	156
Post-graduate	_	_	25
Ratio Teacher/Students	1/90	1/11	1/16

* Invited teachers who do not belong to the Faculty's permanent teaching staff.
** Data provided by FAUL Human Resources, as of January 2016.
*** Data from Silva (2010)… no existing data of students in 1975 or of teachers in 1973.
**** Data provided by the Repartição Académica (Registry) FAUL, as of March 2016.

the architectural community involved in architectural education has changed.

3.2.1 *The teacher: practitioner or researcher?*
The total number of teachers hired by the institution has increased 18 times from the 1970s to today. Two clarifications need to be made regarding the data from the 1970s. The first is that, in the 1970s, the students took some courses in the Faculty of Engineering; hence, the ratio of 1/90 cannot be compared to today's, when students study only at the FAUL faculty. The second is that, in the 1970s, both school and country were in turmoil after the revolution of 1974. The school was closed for one academic year (1974–1975); hence, it is not safe to determine any valid ratio for the 1970s.

In 1979, the Faculty included 38 people: one full professor, 36 assistants, and one intern assistant. Of the 38 members of Faculty, only 5 held a PhD. Given the very few people with a degree, regulations allowed the Dean to choose personalities who might be 'qualified for any of the positions in the Academic structure' (Decretolei, 1979).

One verifiable conclusion is that the academic community hired by the institution, from the 1970s to today, increased and changed its profile from mostly practitioners (7 out of 9) to mostly Doctors of Philosophy (130 out of 163). Most of the Doctors of Philosophy who are architects either practice architecture or have practiced in the past; however, a considerable portion of their time has been devoted to research. The Faculty further includes painters, historians, economists, social scientists, engineers and geographers, providing a diverse faculty that meets the European Directive's 11-point requirement.

The reality of today is that architects, with a thriving practice, are a minority within the permanent members of the Faculty, as most of the practicing architects invited to be professors make a valuable contribution, but have little say on the scientific council's decisions; hence, little influence on the future of training and research in architecture.

This has been a fundamental change that has had both positive and negative aspects. On the one hand, losing experienced practitioners carries the risk of having an academic body out-of-touch with the reality of architectural practice; on the other hand, having a strong research component in diverse fields, such as computing or sustainable design, can open new fields of specialization, which might lead to emerging possibilities within the practice of architecture. These emerging fields within research are particularly important in the current times of economic recession that potentially shrink an architects' career possibility.

FAUL's current policy has been to keep hiring, as invited professors, architects with a thriving practice, recognized both nationally and internationally; thus including, within its community, the best of both worlds, practice and research.

3.2.2 *A changing community of students*
The number of students, from the 1970s to the present, has increased by threefold, and the tendency of the past couple of years has been an increase, despite the shrinking demand for architects due to the economic crisis of the past years.

One of the main reasons is an increase in the community of international students, as can be seen in Figure 1, showing the countries of origin of incoming students, from the 1980s to the present. The present-day community of students has little to do with the 10 students enrolled in the early 1930s in architectural training and it raises many challenges, the most important of which is the ability to provide a common ground to train a community of students with not only different languages, but also diverse cultural and technical backgrounds.

The PhD student body has also increased, from 0 students in the 1990s to 156 students enrolled today. The growing research community, along with the growing internationalization of the institution, are the most important changes in this academic community, creating challenges, forcing the institution to adapt, and at the same time providing opportunities, through widening the scope of the research and of cultural diversity.

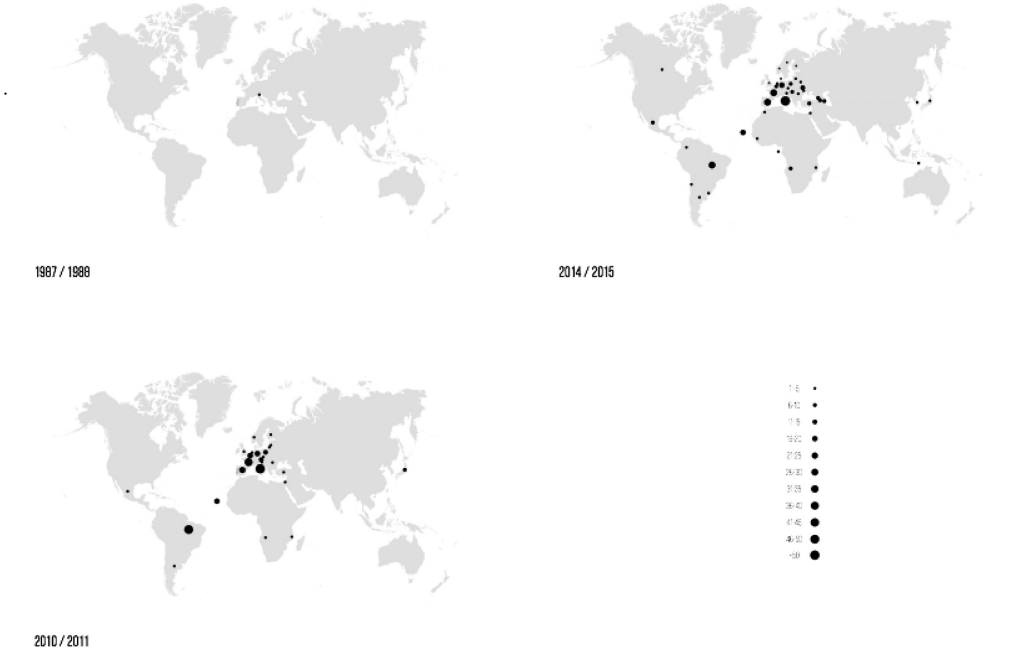


Figure 1. Countries of origin of incoming students at FAUL and numbers of students. Map by Emanuela Mendes/Filipa Roseta and Source of data: Gabinete de Mobilidades in Intercâmbios.

Table 2. PhD graduates. Data collected from the Postgraduate Office (Secretaria de Pós-Graduação – 2016).

	PhD graduates		PhD graduates
2005	1	2011	9
2006	1	2012	35
2007	6	2013	22
2008	6	2014	19
2009	9	2015	27
2010	4	2016	5

4 CONCLUSIONS

This paper aimed to identify the challenges today's Faculty of Architecture of the University of Lisbon faces in the midst of a changing academic community, which is evermore international and research-based. Answers to these challenges are not simple, as they have not been met before.

The historical development of Lisbon's architectural education gave rise to an ingrained heritage, which, we believe, can be divided into three components: practice, arts and science. The practice-based education is the heir of the sixteenth-century origin of architectural education in Lisbon. Training through knowledge of the Arts dominated in the nineteenth century with the rise of Liberalism and the influence of French culture. Scientific training emerged at the end of the twentieth century. Today, most of the conflicting debates still revolve around these three different perspectives.

The one conclusion, which can be drawn, is that architectural education will not move forward if the academic community ignores the changes of the present, but it will certainly fail if it chooses to forget the changes of the past.

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Renaturalizing urban campus case study: integrated-design, placemaking, and ecology

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ABSTRACT: Pollutants from nonpoint sources increase with urbanization and urban sprawl due to the intensification of the amount of land covered with impervious surfaces (e.g. roofs, roads, and parking lots). Research confirms that when chemical pollutants accumulate on these surfaces and transmit to the groundwater during rain events, they could cause different types of chronic and acute illnesses to people through drinking water. With funding from two agencies, this paper introduces Low Impact Development (LID), an intertwined ecological landscape and site design technique, for stormwater management practices developed as a crucial tool to mitigate these impacts of urbanization. Utilizing the principles of contemporary urbanism, placemaking, and multilayered landscaping, multidisciplinary teams of Architecture and Civil and Environmental Engineering students applied an integrated-design framework to renaturalize an urban campus's open spaces through a series of LID techniques, and to provide a prototype system for adoption by local and state regulatory agencies.

1 DESIGN FOR ECOLOGICAL URBANISM

1.1 *Green infrastructure*

Contamination of surface water and groundwater is caused by two sources of pollution known as point and nonpoint. The United States Environmental Protection Agency (USEPA) defines point source as those from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack. On the other hand, nonpoint sources of water contamination are the most significant, particularly as pollution from these sources increases with urbanization and urban sprawl (USEPA, 2015a). This increase is due to impervious surfaces such as roofs, roads, and parking lots. With the expansion of the amount of land covers, the likelihood of accumulation of chemical pollutants on these surfaces and the transmission of pollutants to groundwater during rain events enhance (Gaffield et al., 2003). As a result, symptoms of different types of chronic and acute illnesses are developed among the people who drink from the water. In order to reduce the negative impacts of nonpoint sources on water contamination, Green infrastructure (GI) site configuration that mimics pre-developed land characteristics has successfully been implemented in emerging urbanized areas. GI is a set of an intertwined ecological landscape and site design practices for stormwater management. Within urban and city territories, this approach utilizes tools known as Low Impact Development (LID) practices.

LID eliminates or reduces pollutant loadings through filtering the pollutants and reducing the quantity of storwater runoff in the areas adjacent to contamination sources. LID techniques, see figure 1, include rain gardens, vegetated swales, pervious pavement, and green roofs. Each is restricted by a set of landscaping and site characteristics to efficiently manage rainfall through reiterating the natural process (USEPA, 2015b and USEPA, 2015c). When properly designed, LID practices capture water on site, filter it through vegetation, and penetrate it into the soil layers and recharge groundwater reservoir.

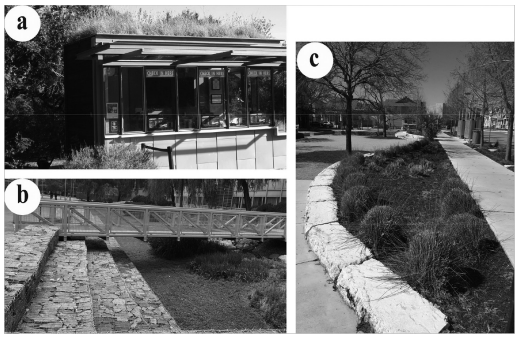


Figure 1. Examples of LID practices: a) green roof of ticket booth at LBJ Wildflower Center, Austin, TX; b) vegetated swale at MIT campus, Cambridge, MA; and c) rain garden at Mueller community, Austin, TX.
Source: photos by the author.

1.2 *Sustainability and water management*

Through multi-complex and diverse layers, our ecologies collectively inform the design of our urban and urbanizing landscapes. According to Waldheim

(2006), landscape design is a synthetic phenomenon that offers more than just the manipulation of a physical surface. It also serves as a medium of construction and interaction. Dealing with sites and their context goes beyond their physical components of the ground plane, and extends to embrace socio-cultural, political, and economic dynamics of landscape, as well as new infrastructure typologies. Multilayered landscape is also evident due to the complexity of physical and non-physical issues it responds to, and therefore it requires a multifocal perspective that entails both culture and nature to intertwine throughout the metropolitan landscape.

The emerging need for sustainable landscape and resilient design not only maintains the performance and condition of infrastructure systems, but allows them to recover from disturbance and to tolerate climate change, all of which are factors contributing to the complexity of landscape and contemporary urbanism. Therefore, resilient, adaptive, and thus sustainable site designs that mix economic, ecological, health, and cultural vitality needs to be further examined. Agencies concerned with sustainable sites and resilient infrastructure have developed various programs to assess sites and/or communities based on sustainability credit systems. This paper focuses on one program, known as STARS.

1.3 *STARS plan*

Throughout North American higher education campuses, administrators are rethinking their resources use to reduce costs and -at the same time- improve the environmental performance and campus resiliency through various policies including water conservation programs (Mascarelli, 2009; and Jackson-Smith et al., 2009). These policies aim to raise awareness about sustainability, as well as promote and advance the institution's role as exemplar in the society (Creighton, 1999; Leal Filho, 2009).

The Higher Education Associations Sustainability Consortium (HEASC) organized the policies into a plan for a campus sustainability rating system in 2006. The program, a Sustainability Tracking, Assessment & Rating System (STARS), encompasses benchmark comparisons provided –via collaborative efforts- by all participating departments. STARS materializes through a track, measure, and self-report framework for both long-term sustainability goals in already high-achieving institutions, and for institutions that are taking first steps toward sustainability, eager to secure entry points of recognition.

STARS covers all facets of campus sustainability including health, social, economic, and ecological issues. It expands to all functions of the campus including curriculum, facilities, operations, and engagement with communities. To increase the credit attained in the STARS academic category, the author developed various metrics for the research and curriculum components.

2 INTELLECTUAL OUTREACH MODEL

2.1 *Research-centered studios*

The format of the research-centered studio combines scholarship with learning outcomes, which is adopted by different schools of architecture in North America (Chodikoff, 2004, Hinson, 2007, and Douvlou, 2006). The studio vividly integrates structured methodology for attaining specific research goals with a foundation of practice. Diamond (2002) explained the distinction between regular studio and research studio as the way the latter is likely to focus on activities for organizing and documenting all studio stages. The studio procedures control over various variables, and maintain a reliable method of inquiry. It also entails a systematic review and an assessment of the work produced by several discipline-based experts (Diamond, 2002). The research-centered studio supplements orthodox components of the studio (i.e. design decisions, reviews of best practices, and regular critiques) with intensive research of publications examining similar design problems, reliable data, and avenues of dissemination of outcomes in research professional venues. In his article in the National Academy for Academic Leadership, Diamond (2002) also argued that rigorous scholarly research can be conducted in the studio setting (i.e. classroom, laboratory, and community).

Research that looked at the results of different models of research-studio teaching (Symes and Seidel, 2001) found that the young architects who graduated with this learning experience continue to benefit from the knowledge they acquired and the skills they developed through this focus on research and pragmatic thinking. The author argued that studio curriculum should be centered on developing the imagination and creativity, unlike in practice where the emphasis is on the application of knowledge to serve the client.

Short's (2008) study, nevertheless, discussed the limitations of research-studio models as a result of lacking the capacity to manage design research and the shortage of academic resources including research-trained professors. The structured and intensively controlled setting for research-studio curriculum encompass working with various organizations and partners within and outside the academic institution. As a case study, this paper is based on a studio that supports state policy and promotes Low Impact Development techniques as a public interest issue. The author taught the studio in fall 2015.

2.2 *Public interest and policy*

State, regional and local regulations in Texas' Edwards Aquifer Region deal primarily with allocating water use. Water quality standards are managed by two agencies: San Antonio Water System (SAWS) and Texas Commission on Environmental Quality (TCEQ). Both agencies offer two separate records of locations of structured engineering systems designed for treating pollution from nonpoint sources. According to SAWS' 2015 records, there are 141 noncompliant structures

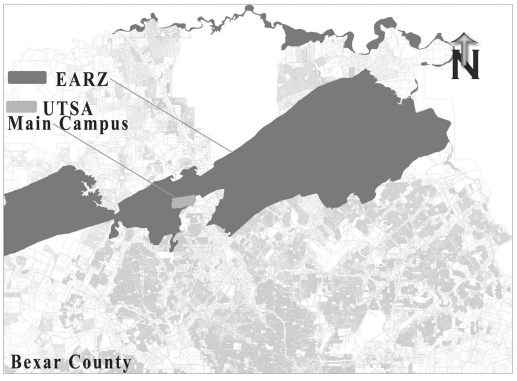


Figure 2. Campus location on the Edwards Aquifer Recharge Zone (EARZ), and Bexar County, Texas.

over the Edwards Aquifer Recharge Zone (EARZ) in Bexar County alone, shown in figure 2. Noncompliance is due to existing problems of clogging, unsustainable maintenance, and accumulated debris and litter. A County-wide public interest in changing the design, maintenance, and operation regulations created pressure on various local and regional agencies. Collaborative efforts resulted in a tendency to adopt LID techniques (GEAA, 2014) and to fund the exploratory designs in the author-led research-intensive studio.

The studio integrated a multidisciplinary framework of research, design, and community outreach and was structured around individual and teamwork expectations discussed in the orthodox models of (Diamond, 2002; Douvlou, 2006; and Hinson, 2007). The studio developed students' skills in dealing with real-world complex design problems, and focused on understanding LID practices, implementing ecological landscape, and manipulating different water management scenarios. Existing engineered-structures for water treatment located on the main campus of the University of Texas at San Antonio on the EARZ were the proposed sites that the agencies have been exploring for a pilot project. The sites were identified for exploring potential implementation of a series of LID practices to replace the dysfunctional, poorly engineered structures, known as San Filters. All developments in that area are sensitive and are potential causes of water contamination due to their location on the EARZ. Rain gardens, swales, pervious pavements, and green roofs are some of the proposed components of LID practices for the campus site.

2.3 *Multidisciplinary framework*

Building on Waldheim's (2006) premise of multilayered landscape and utilizing green infrastructure benefits discussed in the Center for Neighborhood Technology's report (CNT, 2010), three teams of architecture (ARC) seniors and juniors collaborated with three graduate and undergraduate Civil and Environmental Engineering students (CEE) in ARC 4156 studio. The goal of this collaboration was to exchange expertise among the team members to advance the research foundation for this studio. The teams therefore aimed to evaluate site characteristics of five existing, dysfunctional and poorly engineered, systems build a digital simulation model for hydrology and environmental performance, assess the number and location of LID sites, and design these sites according to standardized LID criteria. An overarching goal of the project was to identify locations where outdoor event places would complement LID practices and enhance the STARS sustainability score. The pedagogy was structured to reach these goals. It was designed around a framework that includes benchmarks for different tasks in addition to a set of developed skills through engaging students in various formats of work configurations and expectations. Tasks transitioned between research, creative inquiry, and design. Consequently, the acquired skills and development were intended to build preliminary skills such as basic literature review and best practices analyses. Gradually, students would develop advanced skills at the final studio delivery in a learning curve with incremental levels of increased complexity. Acquired skills were independently measured using different metrics (see Table 2) and based in how the teams responded to the following tasks:

1) Identifying the university campus as a pilot study for future regional replication;
2) Selecting different typologies for incorporation into LID series;
3) Analyzing natural hydrology and terrain;
4) Reviewing possible credits for campus Sustainability Tracking, Assessment & Rating System (STARS), developed by the Higher Education Associations Sustainability Consortium (HEASC, 2006);
5) Developing the program and integrated-design of LID proxies;
6) Quantifying the total ecological, economic and social benefits of a selected proposal; and
7) Proposed enhanced visual representations of the framework to advance campus and community awareness about the practices and benefits of LID in the regions with endangered sources of water supply.

3 INTEGRATED DESIGN APPROACH

3.1 *Pedagogical structure*

This upper level –vertical– studio that focused on examining LID techniques for the University's main campus included 13 senior students. Students enrolled in this studio with them technical skills attained through pre-requisite courses such as structure and building technology. The process of intervention in the existing sites focused on exploring available open spaces within the central campus zone; developing data-driven and measurable section criteria, including site characteristics and pollutants loading. Sites

were shortlisted, and two final sites were advanced for design iterations of a series of LID practices. In each of the two proposed sites, individual students were also responsible for designing a light-structure that would host various events to promote social and cultural sustainability. The following phases, see also figure 3, explains further details about the study:

Phase I (LID Design Research), stimulated students critical thinking through working in small research teams -four to five students each- to explore GI typologies, create a catalog for native plants, conduct intensive site analysis, and develop a preliminary LID proposal. This phase triggered students' curiosity, challenged their understanding of ecological urbanism, and created a work environment for collaboration and exchange of ideas.

Phase II (Sustainable Edifice), focused on measuring individual design skills, independent problem-solving challenge through integrating technology and innovation in tectonic and design concepts of eco-friendly edifice for outdoor activities.

Phase III (Assessment and Performance) entailed environmental, social, community, health, and aesthetic benefits to the campus and users. Students also developed a list of possible STARS credit using HEASC, v2 (2006) metrics that could be attained upon implementation of LID techniques.

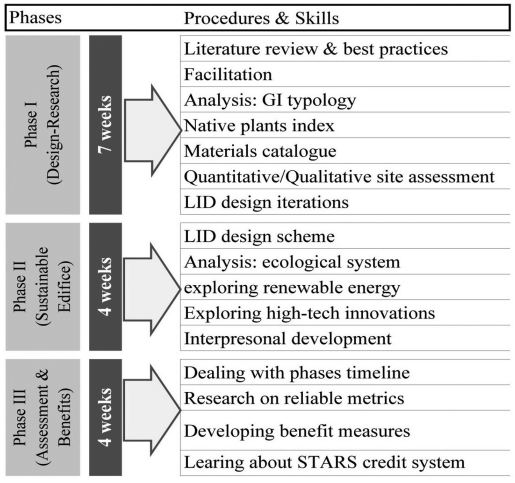


Figure 3. Pedagogical Structure and skills set.

3.2 *Design negotiation & collaboration*

The 13 students chose their teammates, forming three teams. After a thorough review of literature on LID specification, and site requirements, each team conducted a comprehensive site assessment for the UTSA main campus, and identified one of the five existing water treatment basins to be re-designed. Scholarly evidence backed their analysis of hydrology, topography, catchment area, social, environmental, economic, and built environment attributes (LaGro, 2001, and McElvaney, 20112). Two basins -Water Quality Basin B (WQB-B), and Water Quality Basin D (WQB-D) – met the selection criteria, and therefore were selected by the teams (see figure 4).

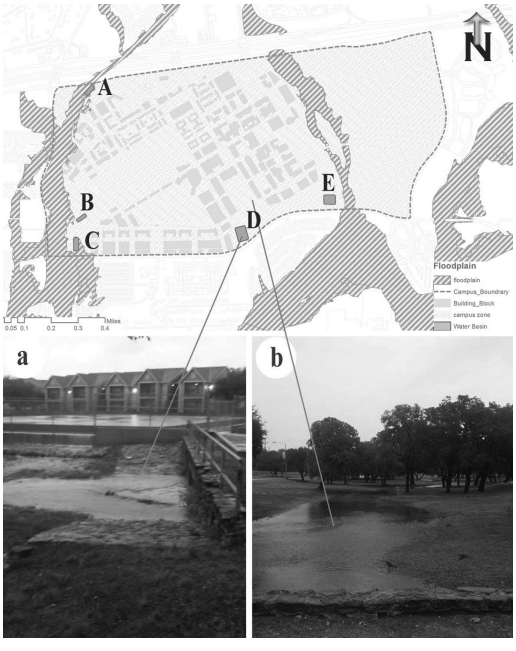


Figure 4. Water quality basins (A, B, C, D, and E) in the UTSA campus, and views of a) WQB-D after intensive rain event, and b) flooded swale near WQB-D.

The teams proposed three design iterations, one for WQB-B and two for WQB-D and their adjacent open spaces. ARC and CEE students negotiated between themselves to develop design concepts, programming, water conservation estimates, and hydrology/ infiltration models for each basin.

Members from each discipline (ARC and CEE) highlighted the following as design goals and worked together to achieve them: site sustainability, project feasibility, and maximized campus benefits, water treatment and conservation, and design aesthetic.

A multidisciplinary approach for design, through organized meetings between ARC and CEE students and faculty advisors from the two departments developed confidence and furnished a trajectory for negotiating design iterations for edifices for events and placemaking, green components, renewable energy, tectonics, water conservation, xeriscaping, plant selection, materials selection, LID series, treatment train (TT) technique, and site terracing (Barret, 2005 and GEAA, 2014). In phase I, the teams developed design concepts according to strict site requirements identified from reviewing best practices. They based their designs on the following criteria: 1) achieving high water quality through infiltrating 80% of stormwater into the EARZ without jeopardizing aesthetics and other design goals; 2) a maximum of five-acres for a catchment area; 3) a proximity to academic core and

high-traffic nodes and routes; 3) a maximum slope of 15% for LID feature, and 1:3 (vertical: horizontal) for riparian land; 4) spatial distribution of multiple cisterns for water harvesting; 5) reuse of 300,000 gallons of air conditioning condensate -reclaimed from existing Engineering and Science building- for irrigation.

As part of the protocol assigned to students, the instructor of this studio imposed professional role play. Each team was required to elect a coordinator who would manage everyday work, facilitate tasks overlapping with the CEE team, and discuss major procedural updates with the instructor. The process helped the teams build interpersonal skills, accountability, and control over time management.

Instruction methods and the nature of student involvement varied throughout the semester. A collaborative work environment furnished a milieu for reflection on students' own perspectives on the facts retrieved from research, and improved innovative skills and creativity when linking facts with real-world best practices analyses as well as site constraints in Phase I (see figure 3). Developing individual accountability was a transformative experience that prepared students for the job market. This was measured by assigning parts of the analysis to each team member, observing each student while discussing research and assessment tools with teammates, and consulting the overall goals and outcomes of the research among team members.

In Phase II, an autonomous design proposal was undertaken by each individual in the three teams. Students utilized data acquired from Phase I to define an event, for which discussions over placemaking were brought about during studio critique. Students focused the design work on exploring different sustainable light-structure for the edifices. Space functions and events programming was at students' discretion, yet an all-inclusive and coordinated program for the entire team was encouraged. Place definition was utilized to redesign outdoor spaces. The phenomenology of defining a place comprised a complex, scientific, and multidisciplinary approach that intersects various viewpoints. It also addresses the interrelationships between multiple disciplines (Castello, 2010). In these disciplines, place varies widely from a physical-territorial approach in which a place by itself is the gathering of separate elements, to a psychological interpretation where events could be encouraged, or discouraged. Place has also been described through architectural and urbanism interpretation, or anthropological interpretation (Castello, 2010; and Malpas, 2006). Events are largely manifested as happening and as gathering/belonging.

Places created by students incorporated interactive and high-tech events that support academic programs and extracurricular activities. Proposed events also expanded instruction activities to the outdoor environment, and enhanced engagement in campus life, student-led activities, and promoted interaction between campus and contiguous communities. Events varied by time of occurrence, duration, location, serenity, and involvement. Examples included: meditation, class instruction, group study, reading, eating, art performance, exhibits, walking, sitting, sports, recruiting, advertising, and selling fresh produce.

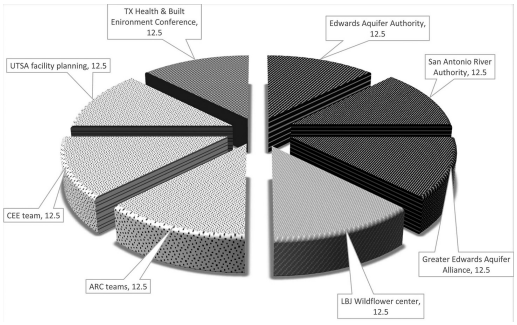


Figure 5. Multidisciplinary team and studio partners.

Table 1. Categories of STARS rating system with possible points that could be attained by implementing LID on campus.

Credit	Categories	Details
Academics (AC)	Curriculum	AC1: Academic courses
		AC8: Campus as a living lab
	Research	AC9: Academic Research
Operations (OP)	Grounds	OP10: Landscape management
	Water	OP27: Water management

Source: Based on HEASC (2006).

Phase III synthesized the knowledge developed in phases I and II through developing assessment tool for the performance and benefits of the design work produced. Scientific metrics from literature were used to assess water management and conservation, LID social and environmental benefits, sustainability credits attained through STARS plan, and plant selection benefits. A strong partnership with the funding agencies, the UTSA office of facility planning, and different organizations and the programs, strengthened the feasibility of the produced design as well as the reliability of the assessment metrics (see Figure 5). Partnering organizations encompassed a multidisciplinary team of experts including LID policy makers, practicing architects, and faculty members as well as landscape architect, environmental planner, water management professional, university administrators, and urban designer.

3.3 *Design quantification & data*

Data used in this studio comprised existing maps and reports on the university's master plan, and Geographic Information System (GIS) digitized features (i.e. trees, entrances, roads, transportation routes, etc.). Students created 3D data visualization models using existing data and maps, integrating 25-year growth projections for the campus.

Developed models were used to examine LID techniques and to eliminate floodplain areas. Building on the research of LID typologies and nationwide best practices, Phase III challenged the team to quantify the performance and benefits using scientific metrics. The students adopted two methods of quantification: first, an assessment of possible STARS credit that could be attained upon the implementation of LID features; second, a quantitative analysis of water management. STARS credits were estimated to increase in two categories: Academic (AC), including curriculum and research; and Operations (OP) including groundwater management (see table 1). Assessment of water management performance yielded 1) the count, location, and area of rain gardens, surfaces, and swales required to achieve an 80% water treatment during intensive rain events; 2) volume and count of water harvesting cisterns that would store stormwater and would enhance design quality and aesthetic; and 3) environmental benefits of the edifices around LID proposals for WQB-B and WQB-D.

Assessment of students' development and learning outcomes throughout the studio were quantified using metrics for review benchmarks throughout the three primary phases of the project. Metrics were developed using reliable rubrics associated with measures of deep-learning (Bain, 2004). Measures focused on evaluating students' progress, creativity, self-motivation, facilitation, accountability, and communication with teammates.

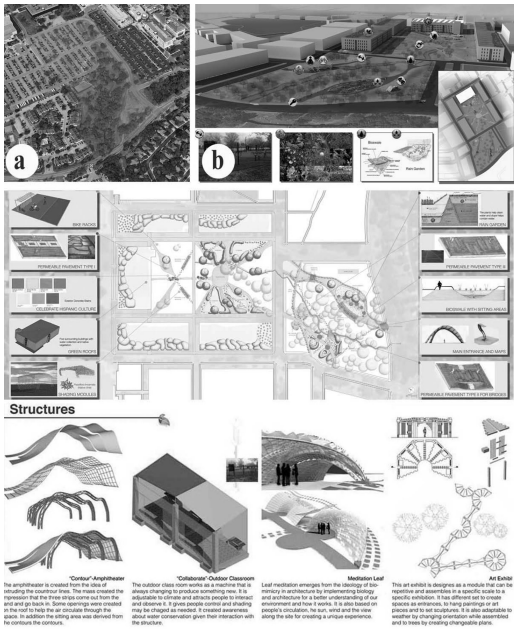


Figure 6. Existing (a) and proposed (b) site of WQB-D in addition to redesigned central quadrant and proposed design scheme and sustainable edifices.
Source: Based on design development by team (Karen Apellaniz, Mauricio Reyes, Jesus Garcia, and Samuel Pena).

4 RESULTS AND CONCLUSION

This paper reviewed the procedures and challenges of a real-world design studio for the upper level undergraduate students taught by the author. The studio challenged students' traditional learning styles with a profession-based format that sought experiential and evidence-based design solutions to a multilayered design problem of dysfunctional water treatment sites. Approaches to tackle design problem were transformative for students through enhancing their technical, creative, quantitative, engagement and team-work skills. Design solutions for LID proposals, see figure 6, emerged by different configurations of team/individual mechanisms that forged facilitation, negotiation, and performance measures. Results of this collaboration produced three projects, each focused on improving water quality through LID techniques, embracing an ecological landscape through xeriscaping and natural plants, and enhancing placemaking for educational, extracurricular, and community event. Improvement of campus life was considered to be the most significant economic and social benefit for the university that would be achieved through a number of multi-purpose edifices designed around LID features for WQB-B and WQB-D. These edifices aimed to enhance instructional spaces and raise student awareness of sustainability and water management.

The two proposed LID designs (WQB-B and WQB-D) were redesigned by three multidisciplinary teams of ARC and CEE students. Design iterations, programming, and hydrology model for each basin were examined through virtual and simulated models. Proposed designs will advance water conservation on the UTSA campus, in addition to incorporate local and affordable materials. A series of rain gardens, bio swales, water harvesting systems; terracing, and pervious surfaces composed the proposed treatment train (TT) of the stormwater management system.

The research studio format channeled student work through a systematic development of the design framework. Through the process, students gained technical skills and learned about the benefits and efficiency of combining LID typologies. The results of this process addressed the challenges and policy barriers for higher education institutions in integrating LID techniques; and discussed the pedagogical and learning outcomes of the multidisciplinary learning. The process also revealed the need for creating metrics for LID benefits because of the lack of such metrics.

Proposed LID designs for existing water treatment sites (WQB-B and WQB-D) located in the UTSA main campus promote ecological and water-conservation landscape, enhance the quality of spaces for various redefined events; and support campus sustainability through increasing STARS scores. They also serve as an open outdoor learning laboratory for future multidisciplinary courses on sustainability and water conservation that the university campuses should implement, which would raise awareness of the benefits of using native and drought-tolerant plants

that conserve water and enhances water infiltration through various LID-design techniques. The proposed designs enhance the visual quality of the campus landscape, promote easy and frequent maintenance of stormwater infiltration structures, facilitate water collections for irrigation, and create a natural environment for social and educational events. The results inform future research and practices regarding necessary metrics as well as multidisciplinary collaboration in the study of urban sustainability, ecological landscape, and applications of LID practices. Funding agencies sponsoring this studio and the broader research aim to utilize the design schemes and metrics developed in this studio for site selection processes by local communities and neighborhoods, and to facilitate LID-design guidelines on the EARZ through state regulations.

The results of this paper raise the awareness of future professionals who will be engaged in projects related to sustainability through pollution prevention from nonpoint sources, and managing stormwater runoff in areas with groundwater and surface water streams. The paper paves the way for future professionals with methodological approaches for LID design tools, a commonly emerging practice in site design and water treatment policy across North America. It also provides educators, curriculum developers, and university administrators with tools to support the curriculum that could, in turn, be counted towards the academic credit for the university's STARS score.

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