Research for Development

Adalberto Del Bo
Daniele Fabrizio Bignami *Editors*

Sustainable Social, Economic and Environmental Revitalization in Multan City

A Multidisciplinary Italian–Pakistani Project

Fondazione Politecnico di Milano

Springer

Research for Development

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Editors
Adalberto Del Bo
Department of Architecture, Built Environment and Construction Engineering
Politecnico di Milano
Milan, Italy

Daniele Fabrizio Bignami
Project Development Department
Fondazione Politecnico di Milano
Milan, Italy

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Foreword

This publication concerns studies, programmes and designs for the project *Sustainable Social Economic and Environmental Revitalization in the historic core of Multan City* in Pakistani Punjab developed by Fondazione Politecnico di Milano, an institution that cooperates with Politecnico di Milano in the research fields of architecture, engineering and industrial design. The activities are part of the Debt Swap Agreement signed in 2006 between the governments of Italy and Pakistan for development in the social sectors.

The need for urgent interventions is clearly evidenced by the condition of the Walled City of Multan. Besides its extraordinarily valuable architecture and its dense and hard-working population, there is a physical and environmental condition that is extremely problematic and that may threaten the continuity of life in the historic part of a city well known for being among the world's most ancient settlements.

The social and cultural interest and the academic challenge of a new opportunity to deal once again with great traditions pushed Fondazione Politecnico di Milano and the University's researchers to face the urgency, complexity and delicacy of an activity that will continue to be undertaken with the same determination and passion that have so far characterised the involvement till now.

In the very short period of 6 months of the first phase, the project produced analysis, surveys, proposals and designs in city planning, architecture and restoration related to the priorities of infrastructures, tourism and energy.

The Multan Project considers a second phase of 30 months to finalise and implement its activities and works.

In these fields worked more than 70 researchers (teachers at different degrees, doctoral students and collaborators from five Politecnico di Milano departments, from Fondazione Politecnico and from other external organisms), divided into 14 working groups, authors of the reports here collected.

The needs to improve livelihood and living conditions and to revitalise the physical assets of value of the Walled City concern competences related to: economy (micro-credit and business relationships), tourism, capacity building, communication (Web site, publications and exhibitions), industrial design (textiles, fashion and ceramics), satellite analysis and mapping (remote sensing), direct relief and techniques of three-dimensional survey (laser-scanner), monitoring and air quality studies, energy (relatively to the cities and buildings), urban infrastructure system (collection, distribution, water quality, sewer and electric), studies and proposals on traffic, restoration, conservation and architectural and urban design.

From the atmospheres of Multan (photo by Marco Introini)

Adalberto Del Bo
Department of Architecture
Built Environment and Construction Engineering
Politecnico di Milano
Milan, Italy

Daniele F. Bignami
Project Development Department
Fondazione Politecnico di Milano
Milan, Italy

Overture

There is no doubt that Pakistan is a land of heritage and strong tradition; a place of fascination and interest; and a crossroad between culture and politics, history and renewal, past and future. This book is the result of an extraordinary, unique, and extended project encompassing a great variety of subjects, such as urban planning, architectural conservation and infrastructure, economic development and capacity building. "Sustainable Social Economic and Environmental Revitalization in the Historic Core of Multan City" is an ongoing dialogue and a new perspective to forge stronger relationships between Italy and Pakistan.

Fondazione Politecnico di Milano is proud to have been responsible for a cooperation agreement between the Italian Government and the Republic of Pakistan, something that is first and foremost inseparable from the passionate and unanimous commitment of approximately 70 researchers and professors from our university. One hundred and fifty years after its birth, the Politecnico di Milano is now an international organisation that speaks the languages of universal challenges that understand and interpret the demands of regions having different traditions, culture and needs.

We would like to express our special thanks to the Bahauddin Zakariya University, a vitally important academic partner, the local institutions and the Italian Embassy for their valuable cooperation and support.

Milan, Italy

Giampio Bracchi
President of Fondazione Politecnico di Milano

Preface

This book illustrates the complex work carried out by Politecnico di Milano, highlighting Italian excellence around the world and the important role played by our country and its leading experts in places that are geographically far but very close in terms of their historical and cultural connections. For thousands of years Multan has been an important caravan and trading city situated on a major trade route. On the basis of an ancient tradition, this is also the place where Alexander the Great died and where some of the main Sufi saints came from. Such figures highlight how Multan was once and continues to be a bridge between the Western world and the Islamic world and between Asia and Europe.

The Italian cooperation project to restore part of the old town centre of this ancient city was first launched in 2012 as part of the Pakistani–Italian bilateral debt-for-development conversion scheme and takes major action to protect the artistic and historical heritage of one of the most fascinating urban fabrics in Pakistan and, perhaps of, all Central Asia. Presented as a platform for the economic relaunch of the area, the project's main goal is the social and environmental redevelopment of spaces and buildings that have been left abandoned for many years, plus an improvement in the health conditions and quality of life for the many thousands of people living and working in the "walled city". The project is also important for the process of identity building of those living in Multan as, with over 70 % of the local population under the age of 30, it enables new generations to rediscover their past and build their future using these origins as a starting point.

Italy therefore paves the way with a large-scale project that encompasses technical and scientific analysis, architectural restoration, capacity building and fight against poverty, by safeguarding ancient trades and protecting the environment and human health. It is hoped that in the future this innovative idea may act as a model for other similar projects carried out by other stakeholders to ensure propitious restoration of the entire old city of Multan and to protect a rapidly declining legacy that could otherwise disappear completely over the course of a few years, victim of an advanced state of neglect and of new construction procedures that pay little attention to the original fragile urban fabric.

This book illustrates how in the first stage, with ongoing support from the Embassy in Islamabad, Politecnico of Milano played a key role not only in carrying out vital activities such as mapping, surveying and planning, but also in acting as a "steering committee" to help drive the project on and facilitate the often difficult interaction between the many figures and various administrative levels involved.

I would like to pay my compliments to Fondazione Politecnico di Milano and the team of researchers, technicians and experts of Politecnico di Milano, led by Professor Adalberto del Bo, who have done a commendable job in the key sector of artistic and historical heritage protection. The work performed by Politecnico di Milano honours Italian tradition in this sector and links its name to a project that will be of very significant importance to Pakistan and the region.

Islamabad, Pakistan
30 July 2013

Adriano Chiodi Cianfarani
Italian Ambassador to Pakistan

Messages to the Multan Walled City Project

Vincenzo Prati
Italian Ambassador to Pakistan (2008–2012)
I believe the partnership between the Politecnico di Milano and the Bahauddin Zakariya University in Multan to be one of the most important initiatives undertaken during my time as Italian Ambassador to Pakistan, and I am delighted that Ambassador Chiodi has continued to support it with similar interest. The projects on display in this book bear witness to the contribution that such a partnership can have in transforming the appearance of a part of the historic centre of the City of Saints. But if this were the only impact, it would not be worthy of our enthusiasm; our enthusiasm is the result of the idea that two major university institutions were able to decide to commit to an important project for the future and to provide a developmental framework for other increasingly important initiatives. It is with this in mind that we must try to look beyond and formalise the idea of regular internationally significant seminars focusing on important global issues. I have been given the opportunity to bring hope for an economic and cultural recovery to my friends in Pakistan, for a conquering of that inspirational leadership role that a great country such as Pakistan deserves.

Kamran Lashari
Secretary, Ministry of Housing and Works, Islamabad, Pakistan
I feel privileged to be associated with the Project of Sustainable Social, Economic and Environmental Revitalization for the historic core of Multan City. Though I was all along based in Islamabad, I was interacting with the Italian team and the local administration on various occasions. The project has yet to take a practical shape, i.e. rehabilitation work hasn't begun; the work that has gone into planning and preparation is quite admirable. The detail surveys and documentations for Multan old city carried out by the Italian team is an asset.

Under the leadership of Professor Dr. Adalberto Del Bo, the Italian team has made a number of visits to the Walled City in the scorching heat of Multan. There has been a great commitment and dedication by the polytechnical school of Milano.

I am very glad to note that the entire experience and effort, studies and surveys are documented in the shape of book. This book covers a wide range of subjects and shall be a very useful document to read and also use for the sake of reference for the living cultural and heritage of Multan. My compliments to the Italian team for this wonderful production.

06 August 2013

Gulzar Shah
Multan District Coordinator Officer—Multan Walled City Project Director, Multan, Pakistan
Bearing in mind the poor living conditions of the old city of Multan, Fondazione Politecnico di Milano's initiative, in the framework of Pakistan Italian Debt Swap Agreement and of Pakistani-Italian Development co-operation, has been important in addressing issues faced by local people towards living and social improvement.

Among the different issues that were covered, Fondazione Politecnico di Milano's concerns for microcredit, handicraft, air quality, water and sanitation system are of primary importance for the Walled City inhabitants.

We are highly thankful to the Italian Embassy and to Fondazione Politecnico di Milano for considering the significance and value of the old historic core of Multan Walled City.

We have also appreciated the commitment and expertise of Mr. Juan Xabier Monjas Kanpandegi, the Multan Walled City Project Director Resident Representative of Fondazione Politecnico di Milano, in managing the project.

30 July 2013

I Should Have Known Better: Anecdotal Remarks on the Sustainability of the *Multan's Core City Project*

> *Merveilleuse dernière scène de* Jurassic Park, *ou les néo-dinosaures clonés dévastent le musée et font un carnage de leurs ancêtres fossiles – une assez bonne anticipation de notre espèce, coincée entre ses fossiles et ses clones. Le problème de l'espèce humaine, c'est que ça commence à être du déjà vu, même a ses propres yeux. Etant donne sa maitrise virtuelle du monde et son succès total (?) en tant qu'espèce, ce n'est plus son évolution, c'est sa disparition qui devient intéressante.*
>
> Jean Baudrillard – *Fragments – Cool Memories III 1991–1995*

Introduction and Background

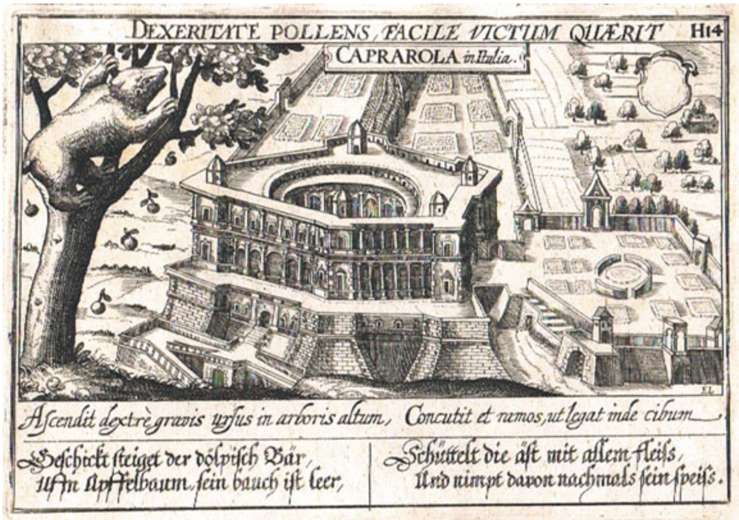
The last memory of an institutional mission carried out in the ancient *Multan Walled City (Punjab, Pakistan)* is about a conversation, walking through the narrow way leading to the City core.[1] The subject was the activity being carried out in the heritage and local development project, sponsored by the Pakistan–Italy Debt-Swap Agreement (PIDSA) program, a multi-sector, nationwide debt-for development undertaking for heritage conservation, training and community-building activities in the Multan ancient city.

The matter of that conversation shifted from technical issues to the language that was spoken amongst the group, that sunny and dusty early morning, in the narrow streets of that impressive bricked ancient town. This was raised by a young project officer of the local project management unit (PMU) who was underlying that it was inappropriate having to listen to a dialogue in Italian, as not everybody could understand. The topic was actually well taken and inspired us to wonder about how many times stakeholders and professionals working people in this ambitious undertaking could not understand each other or more precisely otherwise what was the matter being discussed.

[1] Overseas Technical Unit & Pakistan-Italy Debt Swap Agreement (TSU) field trip in *Multan*, 11/2012.

The Project Area

Multan is believed to be amongst the oldest Asian towns and actually one of the most ancient inhabited places in the world. Through history, the area was ruled and visited by many, including Alexander the Great, the Arabs, the Turks, the Sikhs and eventually by the British, the last starting from the first-half of the seventeenth century. The walled city, whose origins appear confused in a distant past and are hardly known, is somewhat mysterious. Multan has been an important centre in the ancient past and during the middle age, and it was certainly one of the early and most important Punjabi cities of commercial interactions with Europe, and a flourishing site of crossing cultures from Central Asia, India, Europe and other major influences. It is remarkable that it is illustrated and indicated as a main city of ancient Asia in the renowned geographical frescos and *Mappa Mundi* of the *Farnese Palace* in *Caprarola (Italy),*[2] a remarkable example of Italian Mannerism and Renaissance architecture, where the city of Multan emerges, in the fourteenth century (1574) in the Room of the World Map, as an outstanding centre enlightened with power, beauty and economic importance reflected over the whole sub-region.



The Farnese Mansion (Caprarola, Italy) [Engraving of the Palazzo Farnese a Caprarola, possibly of the second-half of seventeenth century (© Domenico Bruzzone)]

Multan passed through several times of wealth, power and decay, and its former importance seems to have been just perceived by some of the British Officers when attempting its seizing. *John Jones Cole* opens his account on the siege of the city

[2] Adalberto Del Bo, Politecnico di Milano (see Chap. 1).

telling us: ...*(Mooltan)*. . .*'It is a very important, and strongly fortified place, and second only to Lahore in extent of trade, and number of its inhabitants. It is said to contain ten thousand houses, which are for the most part built of brick, and many of them two or three stories high; some of them contain good and airy rooms, and are capable of being made habitable for Europeans. As in native cities generally, there are many squalid hovels, close ill-ventilated holes, wherein the very poorest classes live. The streets are indirect, narrow, badly paved and dirty. The inhabitants (Hindoos, Sikhs and Mussulmans) are estimated at 50,000. They carry on a brisk trade amongst themselves, and have large and well-furnished bazaars. They also barter extensively in silks and cotton goods with the inhabitants of the adjacent countries. The town is surrounded on three sides by a high and well-built brick-wall, strengthened at short distances by semicircular bastions, and it has five covered and well-defended gateways. On the fourth, or north-western side it is bounded by the fort itself, at the foot of the glacis of which it terminates*. . .(. . .). . .[3]

Scene in the Multan City centre in 2012

The research work, carried out by the *Fondazione Politecnico di Milano,* as Consultant to the Pakistani *Ministry of Housing & Works* (the Executing Agency) in *Multan* (2011–2013) produced a commendable project planning exercise, in the form of a First Phase report. This is encompassing a number of urban planning studies, advanced field surveys—carried out in the Multan walled city, and in the surrounding areas—a training-on-the job program that involved the Project Management Unit (PMU) on site, and a series of specific applied research trials. All

[3] A sketch of the siege of Mooltan (1849) first print by P.S. D'Rozario and Co. Tank-Square, Sang-e-Meel Publications, Lahore, 1999, John Jones Cole.

these technical activities were conducive to the design of a subsequent phase, in the form of an action *'Project second phase',* whose blueprint is currently being considered by both local and federal authorities for possible financing.

The viability of carrying out the second phase of this project is being thoroughly appraised by the *Pakistan–Italy Debt-Swap Management Committee*[4] (09/13). The scrutiny does not concern the quality of the first phase output results, but the risks inherent with some of the project assumptions. Indeed, it is an ambitious and complex multi-tasking framework of activities, aiming at gathering investments to support Multan's Core City in a threefold dimension, heritage, economic and societal, by applying the aforementioned research findings and planning tools to the City Core as a unitary framework. The aim of this note is to show how easily prime operational research, institutional efforts and sound policy dialogue can be frustrated by factors that were possibly not intercepted while appraising the project during the identification phase, nor were they subsequently redeemed, most likely because of the complexity of technical activities that drained all energies and attention devoted to the project, leaving little room to focusing to the big picture of this undertaking. Other troubles may have been raised by limits in day by day technical communication and some bewilderment regarding roles and functions at the project management level, possibly born out of semantics factors obscuring technical dialogue.

Sustainability: A Science, and the Ability of Managing Process-Complexity

There are many uses of the term sustainability. When associated to the concept of development in what *Herman Daly* defined an oxymoron,[5] it is the result of thinking about the global carrying capacity of the planets' natural resources base in its contemporary utilization and transformation into goods and services by human societies. This vision was first stirred by works of *Vitousek*[6] and their ensuing elaboration by development economists.

In aid practice, the day by day meaning of the term sustainability is perhaps less sophisticated and refers more to the project logic underpinning technical activities and to the complications that invariably arise from a number of factors.[7] These encompass from limits of the project appraisal phase to scientific, technical,

[4] The project is part of the Pakistan-Italy Debt-Swap Agreement (PIDSA), a nation-wide, comprehensive, multi-sector program whose execution started in 2006.

[5] Sustainable Growth: An Impossibility Theorem, In: Valuing the earth: Economics, Ecology, Ethics—Herman E. Daly and Kenneth N. Townsend (1993).

[6] Human Appropriation of the Products of Photosynthesis—Peter M. Vitousek; Paul R. Ehrlich; Anne H. Ehrlich; Pamela A. Matson—Bioscience, Vol. 36, No. 6. (Jun., 1986), pp. 368–373.

[7] *These assumptions should be thoroughly appraised and controlled during the process of project identification and formulation, although experience demonstrates that in a number of cases this is the most vulnerable element managed throughout the process of project cycle management.*

process-related or institutional elements that may remain hidden in the context, to disclose unexpectedly. Hampering factors are fairly common, and a number of specific toolkits were developed at both the technical and institutional level,[8] to assist their identification and control.

At the time this note is written, the institutional dialogue about its future is about the risks that are inherent to the second phase, under the current circumstances. Most likely, these risks derive from an insufficient analysis of the initial assumptions that are causing the stalling of project cycle and a number of problems to disclose; amongst others are the following:

- *At the technical level*. These are mostly management-related, being difficulties that raised from interactions with the PMU in Multan. These were apparently instigated by different judgements of specific technical matters but revealed later to be caused rather by different interpretations of roles and (therefore) of policy priorities. Indeed, at a time, it was most evident that there were tangible differences and discrepancies in interpreting the institutional role of each Party, with the PMU supervising technical activities rather than embracing and facilitating them proactively, or otherwise with the PMU debating the scope of the Consultant's work, instead of its final output product. To a certain extent this can be explained with the fact that simplifying tasks and adopting a command-and-control approach appears easier than scrutinizing complex set-ups of technical information. Eventually, we collected enough indications that supported the existence of a genuine misplaced objective in PMU's daily assessments.[9]
- *At the institutional level*. Local authorities, often pressed by daily quandaries, appeared to be reasonably puzzled with these ambiguities and were themselves somehow trapped between a supportive or a command-and-control approach to this complex scheme. This reflected the confusion of the situation. It cannot be ignored that institutional communication ambiguities tend to play a role in articulated programmes. Moreover, the executing agency did not appear to be in the position to perform at the required level, possibly because of the limitations of its institutional mandate.
- *At the community and professional associations level*. The situation was not easier while elaborating with local communities, during a series of interviews, on projects strengths and weaknesses. Multan City Core dwellers tended to overemphasize roles and responsibilities at the institutional level and showed an inclination to adopt some of the project functions as an opportunity to express frustration and scepticism on local public policies. This is another fact that is not uncommon in these cases. Most important, while they were constantly consulted by the *Fondazione Politecnico* at the survey level, they appeared weakly incorporated within the framework of project activities. This is because they had basically no active role. This fact was adding to the challenges, especially

[8] The Integrated approach to project cycle management—Hellmut Eggers, In: Project Appraisal, Volume 7, Number 1, March 1992, pages 3–10, Beech Tree Publishing.

[9] See January 2013 Technical Report, 12/2012 Consultancy to Ministry of Foreign Affairs, Rome (internal note).

considering the societal project ambition. It is worth to mention here the partnership established between the *Fondazione Politecnico* and the *Zakaria University* in Multan, that lead to involve the institution as well as students and teachers to support activities like survey and communication, facilitating the acquaintance and dialogue with the local community.

In this burdensome situation, one of the most striking observation (and contribution) was made by the interim *Economic Affairs Division Secretary*[10]at the time of presenting the results of Phase I. It was related to the project's institutional architecture, and it was expressed with the simplest possible statement on its very concept: '*this institutional set-up may well make this project unsustainable*'. This consideration was referred to the role of the executing agency, in authority for public works and housing issues, rather than for heritage matters. These, in turn, do have still a reduced track record in Pakistan, the fact which is perhaps also in coherence with a tourist sector that still is by far the least developed in the sub-region.[11] Something, everybody should have known better, most likely. This is certainly not all, but we believe it is informative. It must, however, be stressed that the project was not appraised as a heritage thematic undertaking, but rather as a socio-economic development investment, run with a major heritage focus. This implies skills, expertise and a regulatory mechanism that is barely yet functionally developed in the country. The only similar pilot project, the so-called *Walled City of Lahore,* sponsored by the World Bank and the Punjab Government, has identified a mechanism of a specific authority[12] to it, after several years of implementation, and a similar scheme could be applied as well in Multan, in the framework of the possible execution phase.

Lessons for Project Logic

These issues confirm that development projects—that could be defined as a blend of maximum intellectual creativity with maximum technical strictness—are by far more intricate than what usually perceived from their logframes or blueprints. Often, they tend to be assumed following different interpretation paths and by diverging observatories by the same stakeholders. More important, the inherent complexity and the content of knowledge and technology they convey as value-added of their own to the Beneficiary can often be hindered by very meek or marginal causes, even hidden in elementary management feebleness.[13]

[10] Economic Affairs Division, Paris Club Section, Islamabad, 05/2013.

[11] Development challenges confronting Pakistan, Anita M. Weiss and Saba Gul Khattak (Ed.), Boulder & London, 2013.

[12] Internet source: Walled City of Lahore Authority Walled City Lahore GOP; http://www.walledcitylahore.gop.pk/2013

[13] As an example for this recurrent issue: 'Process-control: an untapped resources for managers of SIT programs' H. Lorraine & D. Bruzzone—Technological forecast and Social Change, 1991.

If approved, the project second phase should thus continue addressing a number of delicate and multifaceted matters such as *inter alia:*

- The importance and scoping of heritage financing[14] in social contexts that face primary and urgent needs
- The technical and institutional specificities of financing heritage project, their project cycle and social participation needs
- The participatory dimension to be associated at early stages of project planning and implementation
- The legal and institutional toolkit necessary for their implementation and administration

At the time this note is written, the opportunity for investing further resources in support of the *Multan* Project Second Phase is still under consideration, together with the need of preserving the beauty of the City work of genius.

As far as financing is considered, both interested parties confirmed the importance and urgency to preserve the much threatened Multan's heritage, its inherent values and their societal significance. However, the role of all involved institutional subjects will need serious reconsideration and further scrutiny. The project blueprint will necessitate upgrade and amendments accordingly.

To a certain extent, this is also to say agreeing upon how much Italian or Urdu will be spoken.

> . . .(. . .). . .Thus, Oriental languages are part of some policy objective—as to a certain extent they have always been - or part of a sustained propaganda effort. In both these aims the study of Oriental languages becomes the instrument carrying out Harold Lasswell's theses about propaganda, in which what counts is not what people are or think, but what they can be made to be or think.
>
> . . .(. . .). . . The acquired foreign language is therefore made part of a subtle assault upon populations, just as the study of a foreign region like the Orient is turned into a program for control by divination.
>
> Edward W. Said – *Orientalism*

Islamabad, Pakistan

Domenico Bruzzone
Director, Overseas Technical Unit, Pakistan Operations.
Embassy of Italy to Pakistan

Marco Marchetti
Consultant – Former Co-Director,
Pakistan-Italy Debt-SwapAgreement (PIDSA)

Ali Raza Bhutta
Joint Secretary (Paris Club) – Economic Affairs Division – Ministry of Finance (Islamabad)

[14] For a comprehensive review of these matters from an epistemological and political viewpoint, see: Salvatore Settis 'Paesaggio, Costituzione Cemento' pp. VIII—328, 2012, Einaudi, Torino, ISBN 9788858406755.

Acknowledgements

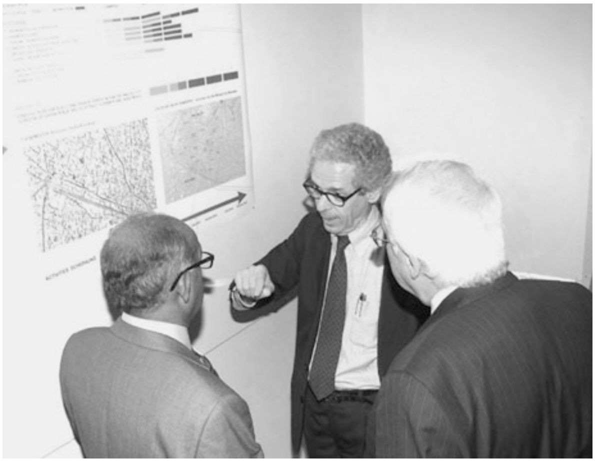
The work on Multan Walled City (MWC) project involves the skills and competencies of numerous individuals, institutions and organisations.

Initially we desire to underline that the MWC project would not have been possible without the strength and determination of Ion Xabier Monjas Kanpandegi, the Project Director Resident Representative. "Xabi" has proved all his ability on the ground; the editors take this opportunity to gratefully thank the support and the solutions offered by him to all the rest of the MWC team. With him Daniele Beacco, spending 6 months in Pakistan, has contributed in giving certainty to our operations on the Walled City.

Fondazione Politecnico di Milano is grateful to the persons, the institutions and the organisations listed below for their contributions and supports to the activities:

- The Ministry of Housing and Works of the Islamic Republic of Pakistan
- The Ministry of Economic Affairs—Economic Affairs Division (EAD)—of the Islamic Republic of Pakistan
- Planning Commission—Government of Pakistan
- The Management Committee and the Technical Support Unit (TSU) of the Pakistani–Italian Debt Swap Counterpart Fund
- Bahauddin Zakariya University (BZU) of Multan
- The Consulate of the Islamic Republic of Pakistan in Milan
- Multan Police, Elite, Special Branch
- Punjab Small Industries Corporation
- The Italian Ministry of Foreign Affairs of Italy (MAE)—Directorate General for Development Cooperation (DGCS)
- The Embassy of Italy in Pakistan
- Mr. Adriano Chiodi Cianfarani Ambassador of Italy in Pakistan
- Mr. Vincenzo Prati, Ambassador of Italy in Pakistan (2008–2012)
- Mrs. Sara Rezoagli, Embassy of Italy
- Mr. Federico Bianchi, Embassy of Italy
- Mr. Domenico Bruzzone, Director, Overseas Technical Unit (UTL) in Pakistan Italian Embassy
- Mr. Kamran Lashari, Secretary Ministry of Housing and Works

- Mr. Ali Zahid, General Consul of Islamic Republic of Pakistan in Italy
- Mr. Muhammad Khurram Agha, Commissioner Multan Division
- The Vice Chancellor Syed Khawaja Alqama of BZU Multan
- Prof. Muhammad Ali, Registrar, Prof. Zafar Haider Gilani and Prof. Tahir Said Bappi of BZU
- Mrs. Ammarah Manzoor Khan, Punjab Small Industries Corporation
- Prof. Arch. Masood Khan and Aga Khan Trust for Culture
- Mr. Luigi Damiani, Italian Codirector Technical Support Unit (TSU) Pakistani–Italian Debt Swap Agreement (PIDSA)
- Mr. Marco Marchetti, Ex-Italian Codirector Technical Support Unit (TSU) Pakistani–Italian Debt Swap Agreement (PIDSA)
- Mr. Ruggiero Ludovici—MAE Consultant
- The Italian companies Mountain Equipe and MMI
- Engineers Without Borders, Milan
- GECO - Laboratorio di Geomatica per la Conservazione e la Comunicazione dei Beni Culturali, Università degli Studi di Firenze



Prof. Adalberto Del Bo exposing to the Ambassador Vincenzo Prati and the Vice Chancellor Prof. Dr. Syed Khawaja Alqama the strategies of the MWC project during the exhibition “Heritage and Beauty” at the temporary Pakistani–Italian Resource Centre at the BZU Campus

We wish also to express appreciation to the MWC Project Management Unit for discussion and communications on the intermediate reports on the works:

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- Mr. Zahid Zaman, Ex-MWC Project Director and DCO Multan
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- Mr. Javed Iqbal (EDO) F & P

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- Multan Electric Power Company (MEPCO)
- Pakistan Tourism Development Corporation (PTDC)
- Government of Punjab (Directorate of Archaeology)
- TEVTA (Institute of Blue Pottery Development, Ministry of Production (SPEI))
- NFC Institute of Engineering and Technological Training
- Multan Chamber of Commerce
- Multan Crafts Bazar
- Italian Pakistan Business Association
- All the people in Multan

Ion Xabier Monjas Kanpandegi, Multan Walled City Project Director Resident Representative (*the third from the left*); Eugenio Gatti, General Director of the Fondazione Politecnico di Milano (*kneeling on the left*); and people of the MWC team, at the end of the preparation of the exhibition Heritage and Beauty at the temporary Pakistani–Italian Resource Centre at the BZU Campus in Multan with our friends of Elite Punjab Police and of BZU

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Contents

Part I
Overview on the Activities and on the Roots of the Multan Walled City Project

Chapter 1
Introduction and Approach: Sharing Culture and Knowledge of the Core of Multan

Adalberto Del Bo

Abstract The city is the synthetic element of a culture because the evocative quality of the urban space recreates a world that, when expresses formal completeness, regards architecture as a research of perfection: research and completeness that the city, particularly the ancient one, reflects in its monuments and even more in its vast, various, and representative totality, also identifiable as monument.

The features of the Indo-Islamic city within urban history are the topic of this essay. Multan, a Pakistani historic city in the Punjab Province, has played, and may still play, a remarkable role as an example of perspectives of development in urban culture. Understanding the reasons for the ancient city's form provides the motivation for conservation and transformation choices. This gives sense and reason in view of the future city, where the ancient parts are destined to play an increasingly decisive role.

The work here presented deals with different fields of activities linked by the polytechnic culture that sees in the city as a great sea toward which flow the rivers of architectural, engineering, and industrial design research. Particularly, as can be seen better in the parts that follow, singular research activities, each directed toward its own distinct disciplinary specificity, proved to be capable of adapting the methods and procedures of knowledge and intervention to the problems and objectives set by the particular social status and economic and cultural conditions of Multan.

Many cities around the world face processes that, on one hand, see the decomposition of their ancient city structure and, on the other hand, lead to a strong homologation of the transformation intervention. Therefore the presence of history increasingly manifests itself as an indispensable resource for knowledge and affirmation of a culture, for understanding its roots, heritage, and perspectives.

A. Del Bo (✉)
Department of Architecture, Built Environment and Construction Engineering, Politecnico di Milano, Milan, Italy

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It has become increasingly clear—even in cultures that haven't yet considered the issue of the ancient city as a resource or that of the monument as a symbol—that the city, including its construction, is the synthetic element of a culture. Its richness and complexity allows its inhabitants to know, even if only through the immediacy of spatial perception, the time that preceded its realization.

The evocative quality of space recreates a world that, when it is intended to express formal completeness, regards architecture as a research of perfection. Research and completeness that the city, particularly the ancient one, reflects in its monuments and even more in its vast, various and representative totality, which is also identifiable as monument.

In the urban transformation of large part of the world, from Eurasia to the Eastern countries, the historic city is increasingly a central issue. The economic development that is taking place in many of these regions raises questions and necessary choices regarding organization and city architecture that are, in many cases, similar to those faced in the last century by the Western European cities, affected by similar transformation processes now seen on larger dimensions.

Even culture that are significantly different in their history, traditions, and languages sometimes find in their architectural culture levels of affinities and analogies because of the unitary and problematic matrix of the discipline and also the strong exchanges of experiences that have always characterized the remarkable task of building cities.

The features of the Indo-Islamic city within urban history are the main interest of the studies of this publication. Multan, an historic city in the Punjab Province of eastern Pakistan, has played, and may still play, a remarkable role as an example of perspectives of development in urban culture, even apart from the huge and complex problems posed today by the ancient parts of the city.

Understanding the reasons for the ancient city's form provides the motivation for conservation and transformation choices. This gives sense and reason in view of the future city, where the ancient parts are destined to play an increasingly decisive role.

In this context, the issues of conservation are intertwined with general urban transformation, recognizing the unity of the city and its form. It is a sensitive topic and is not easy to achieve as it is necessary to develop a critical approach that crosses all levels of the design scales, from urban planning to choices of intervention on individual buildings, in order to obtain a general coherence in the transformations that can guarantee, at all levels, the identity and the continuity in dialectic exchange with history.

On this basis we can support the paradox that in the architecture and city studies, true modernity entails dealing with the past. Indeed the issue of urban identity, which today is correctly seen as a complex set of culture and techniques, is entirely concentrated in the assignment of physical representation of a culture and is the focus of much comparative architectural literature. Urban design is a complex issue in its high elasticity of scale and cognitive analysis that must also involve different technical, organizational, economic and programmatic aspects.

1.1 The Punjabi City of Multan

Multan holds a position of great relevance among world cities for its fabulous historical life, its outstanding monuments, and the fulfilled style of its architecture. The magnificence of Multan is sculpted in its complex and compact urban form, in the majesty and wealth of the many sacred buildings that make it a famous pilgrimage destination, in the elegant houses of the Walled City and the Bazaar, and in the refined textiles, embroidery, ceramics, and jewellery that have been produced over the centuries through skills of its artisans, experts in the continuity of forms and repositories of extraordinary art and taste.

Multan's greatness, celebrated in historic sources found across the Indian subcontinent, is also depicted in an eloquent fresco in the Palazzo Farnese in Caprarola, near Rome. The continents discovered at that time are accurately represented in the famous *Sala del Mappamondo*. On the enormous wall on which Asia was depicted in 1574, the words REGNO DE MOOLTAN (Kingdom of Mooltan) stand out among the few cartographic signs in the Indus plain area, indicating a huge part of the Punjab on the fresco.

Many travellers have noted the relevance of Multan as a center of production and exchange, including Sebastian Manrique, a seventeenth-century friar whose observations[1] are described in *The Civilisation of India* (Fig. 1.1), (Dutt 2004).[2]

Given Multan's prominence during the time period of the sixteenth century, there is a surprising lack of documentation about its material and constructive history. The destruction that has affected a city of such great prestige and heritage, over the course of time, has also, unfortunately, resulted in the loss of documentary evidence, material essential to understanding urban forms and their process of construction. In 1574, the Archives of Royal Acts Department were founded by the Mughal Emperor Akbar in order to collect news from the whole kingdom, together with the more detailed reports of court events, particularly the emperor's daily activities (Abu l'Fazl 1596).

Study of iconographic material on the Walled City conducted in the archives of the British Library in London has yielded scarce results for our research. The work conducted by Professor Fauzia Husain Qureshi on "Conservation of the Living Monuments of Multan, Pakistan"[3] has been useful, however, and we relate some of her observations below.

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[1] Manrique, Sebastian, Charles Eckford Luard, and H. Hosten. 1927. Travels of Fray Sebastian Manrique (1629–1643), a translation of the "Itinerario de las misiones orientales", with introduction and notes by Lt-Col.C. Eckford Luard,. . .assisted by Father H. Hosten, S.J. Oxford: the Hakluyt Society.

[2] Sebastian Manrique describes the Punjab from Lahore to Multan as a country abounding in wheat, rice, vegetables, and cotton, with numerous villages and excellent inns. Multan was a considerable city carrying on an extensive trade, and was the rendezvous point of the caravans from Persia, Khorasan, and other western countries.

[3] The work can be seen online at the following: http://multan.uniconsulting.com/

Fig. 1.1 The Mausoleum of Sh. Bahawal Haq in Multan (photo by M. Introini)

The urban typology to which Multan belongs is defined by many researchers as analogous to the Mughal cities of Agra, Delhi, Lahore, and Peshawar. In dealing with these cities, Ahmad Hasan Dani in *History of Pakistan* (Dani 2008) affirms, “All these cities, which originally stood on the bank of a river, had a separate citadel, reserved for buildings of the royalty, and a walled city where the nobility had their own *havelis*, including those of men of letters, arts and crafts and of commerce and business class and common people.”

The typology indicated, echoed in other texts that identify Multan as an example of Mughal architecture and urban culture (Rehman 1997), suggests a strong formal analogy with Lahore. According to a point that we consider important in understanding Multan, the described structure of the Mughal city is in its entirety with the exception of the city walls (as traceable in the perimeter that still clearly defines the outer part of the old city). In Multan, instead, to the widespread presence of the city walls doesn’t correspond the fort, decisive element for the understanding of the whole urban configuration.

The structure of Lahore, indeed, shows evidence of the arrangement and relations between different parts of the city, where the Lahore Fort and the Badshahi Masjid Mosque developed an autonomous representative and monumental role in comparison to the rest of the city. This was also the case with Le Corbusier’s Chandigarh, the planned city which foundation stone was laid in 1952 as the capital of Indian Punjab in place of Lahore, which had been the capital of Punjab for many years.

In Multan, the absence of the representative and monumental part of the fort, which was destroyed by British bombing in 1848, has resulted in a grave lack of completeness for the general shape of the city, of its internal relationships, and its life. This is beyond the strong sense that the urban defense system continues to produce in terms of understanding the unity of the urban organism. In metaphoric terms, it is as if one thought of Chandigarh without this representative sector, a site built on geometric relationships among vast spaces, just as in Lahore, where the intermediate space between fort and mosque plays a crucial role of relationship.

It is interesting to note how the urban form of Chandigarh (Le Corbusier 1953), a celebrated example of the idea of the city as a system of relationships between the two city parts, formally and functionally identified, constitutes a clear expression of an idea that goes beyond the geographical and cultural subcontinent context. It is an example of a general idea of urban development and a real process able to condense the contributions of the of East and West urban experiences.

In the definition of urban life, the central role of the relationship between cities and their monuments has characterized much Italian research on the architecture of the city, particularly in the last half century (Rossi 1966). This research has established the theoretical basis for knowledge and for work on the physical shape of the city as well as on cultural and social aspects of an organism that is an extraordinary economic resource, with ample flows of tourists interested in learning about the monuments and the city. Usually the Italian experience concerns historic cities in which it was possible to combine the evocative power of the past with the actual needs of the present. In the best examples, the city is considered as a master that is able to provide, through the culture that it itself contains and expresses, the ways of its own transformations.

According to these indications, the theme of construction/reconstruction of the Qasim Bagh hill and the Fort constitutes a meaningful idea of intervention, able to drive a notion of deep transformation of the Multan. This idea proposes a vast and central area in which to place, along with public facilities, residential developments to meet the housing needs of the Walled City. For this reason, the Qasim Bagh area, although not included directly in our project area, could be an interesting subject for investigation in order to detect traces of the ancient settlement so as to have a useful guide in proposing transformations.

1.2 Architecture of Multan

In general, Multan is an example of the model of the Islamic and Indo-Islamic city, specifically designed to protect the privacy of the house and defend against difficult climatic conditions for many months of the year. It is attached to the ground and to its morphology according to a system of growing intimacy, leading from the busy street bazaar to the private cul-de-sac location, as shown below in the analysis realized of the Walled City, particularly of its road system. The seven road typologies emerged from the analysis (similar in type and number to those of Le Corbusier's Chandigarh), creating the system of relationship among the main directions of urban crossing, the blocks, and their system of internal distribution.

Fig. 1.2 View from the roofs in Multan (photo by M. Introini)

The logic by which the Walled City system is formed has to do with the region relations and the city assignment of a form organized, on a bazaar system, on the north/south and east/west crossings structure, similar to the cardo-decumanic structure of the Roman cities. The structure system of the compact city blocks considers the housing typo-morphological relationships, the size of the blocks, and the necessity of black-water drainage, which are now in open air at the sides of the roads. Soil morphology and urban typo-morphological layout take on, even on the shaping level, direct relationships that have allowed, in the absence of reliable maps, determination in many cases of the soil shape from the layout of tracks. The studies on the pilot area developed by the geographic information system (GIS), created on direct surveys and topographic measurements, have confirmed this thesis (Fig. 1.2).

The house appears to be the general element. Leon Battista Alberti's definition of the city as a great home finds here a characteristic of its definition strengthened by the structure of whole parts, occupied by large families that give the name to the part.

In Multan, the adherence to the typical condition of the Indo-Islamic city combines with its architectural character, which concerns the existence of a specific style recognized by much of the historical and artistic literature for its expressive and technical–architectural properties. For example, the book Hoag's *Islamic Architecture* (Hoagh 1978) attributes to the beginning of the fourteenth century the definition of a Multan-specific architectural technique of using a brick masonry of heavy walls with a rather pronounced slope, reinforced by wooden anchors also used as main beams for the arches.

In *Indian Islamic Architecture: Forms and Typologies, Sites and Monuments,*[4] Page (2008) emphasizes the importance of Multan grave monuments beginning with Shah Yusuf Gardizi of 547/1152. In Marshall's *The Monuments of Muslim India* (Marshall 1937), the Rukn-i-Alam mausoleum is defined as "one of the most splendid memorials ever erected in honour of the dead." It is possible to recognize in these descriptions the prevailing characteristics of Multan architecture. In its monuments and also the entire Walled City, in whose buildings are present the elegance attributed to tombs and mausoleums, one finds the architectural character, the proportions, and the attention to materials and colors. This elegance relates in general to all forms of city life (so affected by the great Sufi spiritual and artistic tradition) and to the figures of its inhabitants, with their beauty and variety of garments and colours, their personal care, and their posture and gait. This constant attention, as expressed by Burckhardt, reflects the Prophet's understanding: "God requires perfection in everything" (where the term *ihsan*, here translated as perfection, also includes the meanings of beauty and virtue) (Fig. 1.3) (Burckhardt 1985).[5]

1.3 Knowledge of Reality

In the case of Multan, given the difficulties in finding documentation materials, knowledge of physical reality and acquisition of reliable data are crucial and constitute a problem that must be solved as soon as possible. In addition, promoting more connections and relationships between the various institutions and agencies in the city is necessary. These steps are essential for understanding the existing physical situation and the identity of the area, enable the collective awareness of local values, contribute to the preservation of memory, and provide information and useful insights for the future organization of territories. Data related to the social and economic situation and trends are also essential.

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[4] "This resembles the previous examples in being built of baked brick with some structural bonding courses of wood in addiction, with a lofty second storey which forms an octagonal drum, with an hemispherical dome, and with pinnacles at each external angle, but differs from them in its lowest store y which is also an octagon, with battering faces and engaged tapering buttresses terminating in pinnacles at each outer angle. The external decoration is worked out in stringcourses of tile-faced bricks and bands of raised diaper pattern, bands of calligraphy in carved brick, and the typical Multan tile work (known also at Ucch but nowhere else) wherein the main geometrical patterns are raised as much as 2 cm. above the tile background; this adds greatly to the richness of the tile work by adding depth and a constant effect of light and shade where the sheen of a plane surface would have become dulled by the dust which pervade Multan in the summer. The interior decoration includes fine woodcarving in shisham wood, with the six-pointed star (a common Ghaznavid motif, but otherwise rare in India until early Mughal times) in the spandrels of the wooden mihrab and scrolls of arabesque ornament similar to that of the maqsura of the Quwwat al-Islam mosque at Delhi."

[5] About the term *ishan*, Burckhardt continues, "This word represents, in the Islamic world, the moral and spiritual base not only of the arts in strict sense, but of every work, no matter how modest is: the fact that every job can be executed with more or less perfection, it involves a value in itself, independently from its economic utility."

Fig. 1.3 Haveli's interior hall (photo by M. Introini)

The development of georadar equipment has for allowed investigation of the subsoil and laser-scanners are used for aerial and land surveys. These are high-precision tools that, combined with the GIS, allow us to obtain the highest level of knowledge and precision, which is required to make decisions more reliably and faster than ever before.

In absence of an urban cadastre or reliable plans, and because of the ineffectiveness of satellite-reliefs due to the widespread presence of buildings' protrusions along the roads, the use of a laser-scanner system has allowed the detection of large parts with absolute precision, particularly monuments, public areas, and some sections of pilot area bazaars.

Within this context, the study of objectivity seen in the photographic work of Marco Introini has been useful. These photographs[6] are flawless and valuable working tools in which, through a description that is detached, calm, and devoid of interpretative intention, there is a desire to depict urban life as it is, to realistically depict the concrete physicality of the city, its reality, and its beauty. The scenes of the deserted city during the night and at dawn, loaded with the intensity of the day that has just passed or is yet to come, effectively depict the sites of old Multan, while the daytime images of the terraces reveal the magic of the special relationship between the houses and the sky, the scenes of the kabootar games, the extraordinary competitions between flocks of trained pigeons. These black-and-white photographs, as well as the skilful composition of the framing, highlight the

[6] These photographs can be seen online at the following: http://www.marcointroini.net.

architectural forms, the sharp shadows, the depth, the material, and the relationships between the buildings and their immobile mirroring that make up the appeal and the essence of the city.

1.4 Urgency and Interweaving

The scarcity of materials in Multan (as in other cities in a similar situation, not only in the Indian subcontinent) requires the culture to adjust their skills and tools to interventions that can quickly diagnose the condition in order to propose concrete solutions in a short time. The most urgent problems are thus solved, thereby forcing the traditional timetable of studies on the cities that, for the natural complexity and dimensions of the objects of application, require appropriate work time, far more extensive than those necessarily activated for Multan.

Investigations obtained through the GIS, activated with the help of students of Bahauddin Zakariya University, have been extraordinarily useful. The GIS, overcomes the problems of geographic reference, allowing cognitive frameworks that, starting from the functional and quantitative data of the pilot area, have made it possible to obtain qualitative analysis results.

The decision to take into account from the beginning the interweaving of knowledge of the physical reality and its problems (conservation and restoration, infrastructure, traffic, etc.) with the present circumstances and resources in Multan (economic, productive, handicraft, trade, tourism, etc.), along with the opening of the local university structure to ensure the necessary continuity through training, has allowed us to build a rich and extensive knowledge framework capable of addressing the employment choices of resources and initiatives that are defined in guidelines and priorities described below (Fig. 1.4).

The work deals with different fields of activities linked by the polytechnic culture that sees in the city as a great sea toward which flow the rivers of architectural, engineering, and industrial design research. Particularly, as can be seen better in the parts that follow, singular research activities, each directed toward its own distinct disciplinary specificity, proved to be capable of adapting the methods and procedures of knowledge and intervention to the problems and objectives set by the particular social status, economic, and cultural conditions of Multan.

Decisive for the researchers was the direct relationship with this reality that has allowed us to become aware of the characteristic complexity of the questions raised in that particular situation. Scientific notation involves the entirety of a condition, allowing us to fully place the characters directly in their own culture and a tradition in which history plays a decisive role both as a strong presence in people's lives and as a fixed scene in which take place the succession of generations. A deep relationship emerges that still exists between antiquity and ancient life traditions (business, customs, etc.) in a characteristic correspondence that no longer belongs to the

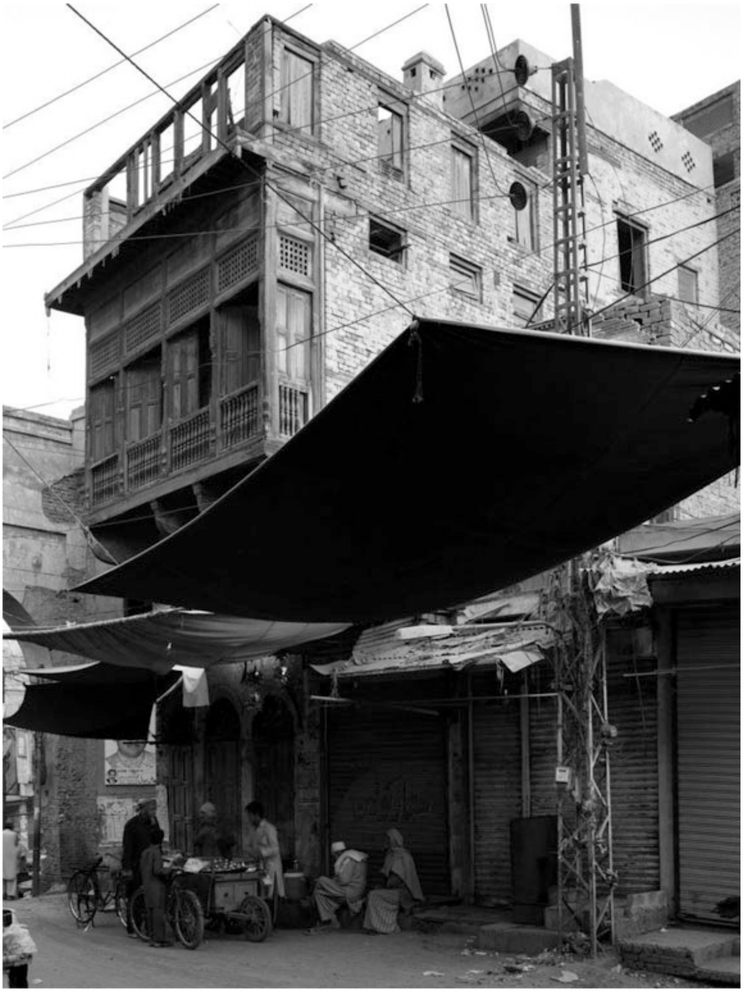

Fig. 1.4 Wood architecture elements and canvasses at Bohar Gate (photo by M. Introini)

Western world, now accustomed only to a coexistence with the physical traces of the past.

The strong interest of the working group in Multan, and in general of Western culture in the East, is, beyond the charm of the exotic and the far-away, a recognition of the deep connection between life and scene found in the Walled City. Over 6 months of work we directly witnessed Multan's precarious condition, seeing the disappearance of buildings and places that we had just studied and measured, fascinated by their beauty and interest. We found on starting our work that the central parts of the pilot area had already seen vast unexpected demolition in the Musa Pak area.

Fig. 1.5 Canvasses at Haram Bazaar

1.5 Pilot Area

The original choice for the pilot area in 2011 was motivated by several factors related to the particular richness of elements that characterize the are: the location of the area on the walls, the presence of two significant gates, the level of accessibility from the outside and from the airport, the presence of two bazaars (structural elements of the Walled City), the presence of a strong handicraft production (especially in jewellery), and, finally, the existence of a high number of monuments, partly disseminated in the pilot area and partly concentrated in the area of Musa Pak (Fig. 1.5).

In this traditionally compact city framework, the unexpected demolitions that have occurred in the area of the Musa Pak and enlargement as a paved path of the connection with the walls to the south constitute a working theme to which we have applied the objective of solving open problems on the functional level, the formal level, and the energetic level.

1.6 Architectural and Urban Strategies and Proposals

These studies, on the whole, present a positive view of the Walled City's potentialities, as it is strong asset in itself from several points of views:

- As a place of residence of a traditionally concentrated population
- As a place of productive activities in the craftsmanship sector
- As a place of commercial activities extended to the wide and fertile Multan rural area for which it has been the reference center for centuries
- As a place of relevance for worship, being known as the City of Saints and Shrines
- As a place of tourist attraction, given the high value of the urban ensemble and the outstanding monuments

The intervention plan covers the three main issues: infrastructure, tourism, and energy, together with a complex of several other activities that support and accompany the project (micro, craftsmanship, and capacity building). The Walled City's condition has great infrastructural problems, from which the plan must move in order to create interventions that may trigger a positive city transformation process and attract additional contributions and investments by local and international institutions. For this reason, the intervention plan provided has a flexible structure that is divided in phases and can relate—in its extension—to greater resources than those available to the Pakistan Italian Dept Swap Agreement (PIDSA).

The plan provides for, along with the interventions in the pilot area, the redevelopment of the Walled City crossing the north/south axis that connects Haram Gate and Pak Gate with the large area north of Qasim Bagh. The plan mainly concerns the public structure of Multan, the streets, bazaars, squares, and public buildings, and public used that go alongside this part of the city. The solution of the serious infrastructure problems (water and sanitation, electricity, public lighting) is combined with more general upgrades to public spaces. The plan also provides for the restoration of buildings of historical and architectural interest and the creation of important guidelines for the maintenance, conservation, and reuse. Such guidelines are included in an important handbook that allows intervention on ancient structures through the use of examples of best practices and case studies.

There is a new shading system for Sarafa and Haram Bazar, and trees have been planted within the internal areas of the pilot area and at the walls to provide a new urban décor and to reduce temperature. This project is intended to help to address the country's serious energy difficulties, to which the city's transformation strategy must contribute in a meaningful way. Also to this purpose, new buildings roofs are equipped with photovoltaic panels for the production of energy that is also used for public lighting. Existing public buildings such as schools and police stations also receive these panels.

Infrastructure renovation and enhancement of public spaces includes interventions in the empty areas resulting from collapsed houses, with the reconstruction of residential buildings and the creation of new spaces.

Tourist itineraries crossing through the area were studied and new places have been designed to welcome tourists.

The buildings are planned following an Italian realistic way to design (careful of architectural roots, the city, and necessary technical innovations), with an understanding of the elegance and rationality of the architecture of the past of

Multan and an intention to propose, through a process of transference, forms and materials recognizable as unitary.

Surveying activities will be necessary for the implementation of the projects and to improve training and capacity-building initiatives provided with Bahauddin Zachariya University. The capacity-building activities, following the main directives of the PIDSA (Pakistan Italian Dept Swap Agreement), are one of the most important aspects of the Multan project in the view to enhance the skills of local professionals and technicians.

Acknowledgments The collaboration with the Aga Khan Trust for Culture has been useful both in terms of knowledge of its experience in the Walled City of Lahore and for the direct collaboration through which it was possible to obtain the topographic survey of the pilot area. For this contribution, we are grateful to the AKTC architects and technicians. Particularly, we are grateful to professor of architecture Masood Khan, an expert in conservation of historic living contexts. The experience of AKTC in the Walled City of Lahore under the responsibility of Professor Masood Khan is an exceptional example of urban intervention for scientific quality, methodological accuracy, and adherence to reality.

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Chapter 2
An International Multidisciplinary Cross-Cultural Cooperation Project of Urban Regeneration

Daniele F. Bignami

Abstract The challenges of conducting a project such as the "Sustainable Social Economic and Environmental Revitalization in the Historic Core of Multan City" were unprecedented in the framework of Italian academic institutions. As a matter of fact, such an undertaking meant to perform a multidisciplinary cross-cultural project in a framework characterised by a region such as Punjab in Pakistan, with an important history, strong traditions, many tangible environmental and urban difficulties, low incomes and a rapid demographic growth. To combine so many technical and social objectives, to be achieved working in different continents, needed innovative ways and approaches in order to coordinate research activities, technical approaches and project groups; it was at the same time necessary to find the best way to transfer the obtained results and to have the related applications quickly employed and implemented on the ground.

The activities demanded first of all to design the right mix of actions, to specify the principal options to the preparation of strategies and projects, to offer a way of obtaining a better knowledge of a region and a city with its populations, to understand the ways to operate in a country of particular administrative structure and to cooperate with local stakeholders and representatives.

A special team, operating both in Milan and in Pakistan, has been created with different competencies: urbanism, architecture, buildings, cultural heritage conservation, energy, environmental engineering, economics, industrial design and project and innovation management. The activities of the team have been developed considering the whole context of action outlined by the Pakistani–Italian Development cooperation, balancing the aims of poverty alleviation with the environmentally sustainable resource use. Our efforts aspired to obtain and harmonise actions of socio-economic development, environmental protection (in our case in the priority sectors of health and education) and basic infrastructure renewal, trying to verify the possibility of synergies and triggering further collaborations to

D.F. Bignami (✉)
Project Development Department, Fondazione Politecnico di Milano, Milan, Italy
e-mail: daniele.bignami@polimi.it

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guarantee the prosecution of interventions beyond the duration of the specific approved project and the extinction of the corresponding funds up to now allocated.

The results obtained in the first 6-month phase of the project, and the preparation of the plan for the second phase of 30 months, encourage the strategy of the Fondazione Politecnico di Milano (FPM) of exploiting the technical and cultural competencies and skills of the Politecnico di Milano in international cooperation projects. Such cooperation projects are very likely to prove themselves excellent opportunities of methodological and educational growth and of sharing fruitful knowledges to support progress and to generate interesting research outcomes and fallouts.

2.1 The Choices and the Planning

Continuing to neglect the maintenance of the Walled City of Multan, or try to modernise it by imposing external models, could end in the irreparable loss of the significant cultural characteristic of one of the most important and ancient city of Central Asia. This is the reason why the joint committees[1] managing the Pakistan-Italian Debt Swap Agreement (PIDSA—signed at Islamabad on November 4, 2006) and the Ministry of Housing and Work of the Islamic Republic of Pakistan have approved the project suggestions and plans of the FPM on the Walled City of Multan. Consequently in the Autumn of 2011, the signature of the contract concerning the works related to the phase 1 (a 6-month term) was authorised; the project, therefore, started on the 6th of January 2012 and reached its conclusion on the 6th of July 2012.

The Multan Walled City (MWC) Project, short for the entire name of the project "Sustainable Social Economic and Environmental Revitalization in the Historic Core of Multan City", suitably matches the aims of Pakistani–Italian Development cooperation to promote socio-economic development and/or environmental protection in the priority sectors of agriculture, health, education and basic infrastructure. Indeed the project provides actions to work on poverty alleviation, health and education (through several differentiated initiatives in the field of social services and facilities, sustainable economy and the training and technical assistance related to them), in a context of a verifiable social participation and with an environmentally sustainable resource use and management.

On the basis of the project scheme proposed to the FPM, the MWC project has been accurately built, in agreement with the guidelines above mentioned, by means of an approach aiming at taking into consideration culture, history and the protection of the environment as keys apt to trigger social and economic development

[1] The Management Committee and the Technical Support Unit (TSU) of the Pakistan–Italian Debt Swap Counterpart Fund established by the Italian Ministry of Foreign Affairs of Italy (MAE)—Directorate General for Development Cooperation (DGCS)—and the Pakistani Ministry of Economic Affairs of Pakistan-Economic Affairs Division (EAD).

Fig. 2.1 Different "layers" of the historic core of Multan city (photo by Marco Introini)

Fig. 2.2 Haram Gate, the "entrance" to the MWC project pilot area (photo by Marco Introini)

(Figs. 2.1 and 2.2). That means, as far as the Walled City of Multan is concerned, to start by preserving the traditional settlements, thus improving the quality of life in the areas located near monuments and memorial sites.

The project scheme proposed for consultation to the FPM is organised to pursue five specific objectives, described in their many components as shown below:

- A **livelihood improvement programme** concerning economic revitalisation, standards of business services, income earning, capacity of women, reinforced marginalised trade and craftspersons and religious-cultural tourism
- **Living conditions improvements** through the development of preliminary studies and analysis based on surveys and feasibility studies in order to develop a programme, within a pilot area, of the upgrading of the physical environment inside the Walled City: improving the air quality, water and sanitation services, utilities for the neighbourhood, the household level and housing living conditions
- **Revitalisation of physical assets** through studies and researches of existing monuments and residential building having historical, cultural and religious value, also in view of further operations within the project
- The **establishment of the Pakistan-Italian Resource Centre** at Multan, developing technical drawings (from preliminary designs to executive ones) of the Pakistani–Italian Resources Centre (PIRC) building and starting to conduct preliminary studies on urban planning, strategies to enhance local economical networks, meanwhile having initial meetings and encounters to establish and strengthen Italian–Pakistani relationship regarding cultural and business fields
- An **Italian collaboration programme for training and capacity building** through the creation of general framework of collaboration in order to find out topics and subject matters useful for the implementation and organisation of scholarships and university student exchanges

On the basis of the elements contained in these brief sort of "guidelines" we received, we have deployed our long-term vision, to achieve the requested objectives preserving the historic identity of the local society, and proposed our mix of specific actions. Thanks to its many historical layers, the Walled City of Multan represents an international instance of urban roots almost ideal to symbolise and at the same time act as a new option to build bridges among the cultures of the world, in particular as far as the so-called Middle East, the Maghreb and the Euro-Mediterranean regions are concerned. As a matter of fact, in all these regions, we can find similar configurations and overlapping designs of the characteristics of the city centres of most of their ancient cities. To preserve these historical aspects and issues can also be a good way to find new elements of shared knowledge and culture[2] for regions of the world apparently so different, especially as regards their religions. But in the Walled City of Multan, we also saw immediately the presence

[2] Coherently, we decided the two "mottos" of the project: "History, conservation, heritage—working together for development" and "Sharing culture and knowledge", as it is possible to see on the project website http://www.italyformultan.org; moreover, in other circumstances, as in the case of the exhibition at Bahauddin Zakariya University (BZU) in April 2012 at the temporary Pakistan–Italian Resource Centre of Multan, we used the slogan "Heritage and beauty" to describe the MWC project.

of a number of problems, in particular regarding environmental conditions (overflowing sewerage, bad water supply and lack of electricity systems, critical conditions of buildings, etc.) and the dramatic income differences between profitable activities and the situation of poor residential people, as well as the material state of both private and public buildings and properties.

To guarantee the sustainability of everyday living and producing in the Walled City, we designed our programmes trying to maintain the or to give new independence to the beneficiaries of our studies and works, paying particular attention to human resources, the improvement of which is an essential condition for the success of the project, along with the environmental and financial sustainability. In our opinion the MWC project must be compatible with the long-term welfare of the community of the inhabitants, retailers, workers and entrepreneurs of the town, because the well-being of the citizens and of the users of the Walled City is a crucial key point to safeguard their cultural wealth, assets and identity (Jodidio 2011). Simultaneously our programmes operate considering the Walled City of Multan as a feasible test case by which to pursue the desirable results of the development of one form of urban improvement. Our idea of a city avoids many of the social problems seen in typical western societies of the twentieth century as well as in many modern societies all over the world. In our opinion Multan and in particular its Walled City can preserve a real interrelation between people and their living spaces, an interrelation as harmonious as possible, these spaces having the power of spiritual values of a particular and recognisable human community, built by the contributions of scores of generations. Reasonably, the Walled City of Multan represents a case of urban pattern to which it would be advisable to apply a concept of place legibility; as a result of a millenary history of use of a city, in Multan it is possible to identify the presence of an already existing urban landscape, which can give to the inner city of Multan its own clear recognisability. The distinct features of the Walled City of Multan are specifically what makes it so full of pulsating life and still attractive, albeit in danger of more decadence. In the Walled City of Multan, a layout is present where a network is created by roles (Fusaro 1984): Sarafa and Chowk bazaars are attractive paths representing channels by which people move along; the old wall remains and traces are a typical and emblematic case of edge as perceived boundary; the local character of settlements is apt to identify clearly a distinguishable district as a section of the whole the city of Multan; the gates (Lohari Gate, Bohar Gate, Haram Gate, Pak Gate, to name a few) and the intersections of bazaars and of the external roads with the ring road of the Walled City are noticeable nodes or focal points; and the Qasim Bagh Fort with its monuments is the most prominent landmark that sometimes helps users in the orientation inside the Walled City (especially looking from the top of the roof of the buildings of the Walled City).

Too many times, when working at the heart of historic cities like Multan, projects of urban renewal did not respect the needs of too many city dwellers and users. Our intent is to work to protect the local characteristics of the neighbourhoods, well knowing the importance of embracing the delicate positive balance created by a right mix of human presences at all hours of the day in the streets inhabited by a community. The Multan Walled City is in fact like an ecosystem that had its own logic and dynamism. The roads and alleys preserving their liveliness, the variety and the high pedestrian permeability, the buildings of various ages and short blocks and their high density mean the existence of a stable street life. Something comparable, to be considered a valuable input in order to guarantee a well-balanced outcome of our strategy of urban regeneration, is already present also in the Walled City of Multan, despite the city's need of many improvements. On this basis, during our works of analysis and design, with the support of local stakeholders and representatives, to separate the weaknesses of the Walled City from its strengths to be preserved has proved crucial to the success of our project. Planning on sustainability in the Walled City of Multan has consequently meant not only to choose appropriate technologies and solutions aiming at advancing forms of productivity and ways of living but also to imagine actions effective in maintaining the richness of the pluralism of presences, in giving opportunities and choices, in disseminating the knowledges developed in living and working day by day and in preserving traditions of the architecture and beauty of the urban landscape of the Walled City. In synthesis, our effort has been to work in order to make the historical city stand in such situation as to coexist with the modernity imposed by an urban planning and an economic development with the target of a stable regeneration. By so doing, the MWC project wants to respect the context of the city and its architecture and desires to make the basic features of the city keys and foundations to start and actuate the processes of urban regeneration. In Italy, outstanding examples of preservation-oriented approaches to entire urban centres date already back to the 1950s and the 1960s[3] of the nineteenth century. The reinterpretation of the urban history of the town must recognise incompatibilities between certain modern architectures and the traditional context; rather, an effective reinterpretation must select the needs and accept the suggestions of both the past and the present, starting from an in-depth rereading of the existing territorial landscape and urban reality. In our opinion a city must be approached as something constructed over the course of history, maintaining a particular concern, as far as, for the monuments and the collective memory are concerned, going beyond alien styles and new trends. Logically, this approach is also to be carefully considered outside Europe, in places rich in history and culture (as, obviously, Multan is).

To manage such complexity needed a choice among disciplines and competencies coming from many research departments of Politecnico di Milano University as well as from some other selected partners.[4]

Before the signature of the contract, during several missions to Multan with the scientific coordinator of the project, we have defined the "pilot area" of the project itself, with the additional support of the research team of the Politecnico di Milano

[3] For instance Astengo (1958) and De Carlo (1966).

[4] For further details, see the different affiliations of the authors of following chapters.

Fig. 2.3 One sample of the contrasting characters of the MWC pilot project area (photo by Marco Introini)

who already had experience of working in Pakistan, as well as the support of local stakeholders and of the MWC Project Management Unit (PMU).

This pilot area represents the site on which the first phase of the project has focused the activities of developing field analysis, studies, methodologies, guidelines and tests to be extended to the whole of the Walled City.

To answer the requests of the component one (see above), concerning the livelihood improvement programme, six tasks have been fixed, having as a goal the survival of the Multan Walled City (Fig. 2.3), as we know it today, giving to its inhabitants tangible chances to improve their standard of living and going beyond the needed action for the conservation of architecture and landscape. The tasks can be briefly described as follows: two framework studies of the interested areas have been developed from both the urban planning and the traffic point of view (see Chaps. 12 and 15); another task has been dedicated to conduct studies and documentation on tourism and on mapping of historical hotspots and to produce a strategy dossier and identification and promotion of cultural heritage routes (see Chap. 4); another one was to produce an operational plan to start up a microcredit system for building rehabilitation and the strengthening of arts and crafts (see Chap. 5); in addition an analysis on the Multan handicrafts to enhance the cooperation with Italian and European fashion market was provided (see Chap. 6); and finally a study on economic fundamentals to create Italian–Pakistani entrepreneurial relationships and enhancing local economical network has been produced (see Chap. 7).

To answer the requests of the component two, that is, the living conditions improvement activities, we had first of all to fill the gap of the lack of data and inputs about the Walled City (Fig. 2.3), as far as many cartographical aspects were concerned. Remote sensing and ground survey research units have been chosen in order to allow a multi-scale cartographical framework to be given to the other components of the "Italy for Multan" Team (see Chaps. 8 and 9). Three further tasks have been dedicated to the most important environmental difficulties in the Walled City: the water and sanitation aspects (see Chap. 12), the energy problems (see Chap. 10) and the air pollution conditions (see Chap. 11). These choices have been made after a couple of appropriate verifications from the point of view of the occurrence of natural hazards in the district of Multan: the first one is on seismic risk, concerning which we found that Multan is located in a "minor to no damage" zone of the related "Pakistan earthquake zone map" and consequently in the seismic zone "2A" of the "seismic zoning map of Pakistan" of 2006 (the seismic zone "1" is the least hazardous of the 4), as a consequence of the fact that the expected Peak Ground Acceleration (PGA) of Multan results substantially low in the Seismic Hazard Map of Pakistan (Cfr. Bilham et al. 2007; PMD and NORSAR 2007; Rafi et al. 2012); the second verification has been on flood risk, by which we found Multan to be among the districts moderately affected by the 2010 flood (probably the worst flooding in the history of Pakistan) and to have a territory that is considered in part situated at a "high" level and in part at a "very high" level, on the basis of the Flood Hazard Index of the World Health Organization (UN-OCHA 2010; WHO 2010). Linked to the flood problem, the suspicion that since the early 1970s the weather pattern has been irregular due to the uncertain global circulation trends (Cfr. Wang et al. 2011) suggested for us to include in our team special research units dedicated not only to investigate local air pollutants or to design proper sewer systems but also experts in climate change, atmosphere and hydrology.

Finally, to fulfil our sub-plan and to adequately complete the living conditions improvement activities, two more tasks have been dedicated to the most relevant and crucial activities of Multan Walled City's urban design and of production of the master plan on housing and living conditions, with the objective to obtain urban rehabilitation, infrastructure renovation and enhancement of public spaces with the additional aim of making local culture and tourism realistically exploitable with better results (see Chaps. 14 and 15).

The revitalisation of physical assets has been thought to give both immediate effects and provide tools for the continuity of subsequent actions. Three tasks have been dedicated in particular to the conservation of historic settlements: the first meant to provide the guidelines for the preservation of historical buildings within the Walled City (see Chap. 17), the second aimed at the wooden element building conservation (see Chap. 18) and the third dedicated to the conservation project of the Haram Gate, chosen as the symbolic local landmark of the pilot area of our project, being a perfect starting point of our work on the Walled City (see Chap. 19).

The design of the Pakistan-Italian Resource Centre (PIRC) at Multan has been entrusted to one of the architectural research group of Politecnico di Milano, who already has experience on working in Pakistan. The realisation of the building has a special role in the long-term objectives of cooperation between Italy and Pakistan (see Chap. 20). The activity in Multan is coupled with the presence of a “twin” Pakistan-Italian Resource Centres, in Milan, active from January 2012 at the Politecnico di Milano in both the university campuses of “Leonardo” and “Bovisa”.

The Italian collaboration programme for training and capacity building has been initially focused on the building sector, while remaining open to other selected topics and disciplines to be shared in particular with the Bahauddin Zakariya University (BZU) of Multan (see Chaps. 21 and 22). Within this framework and with this aim in mind, the two universities have already signed, in March 2011, a first framework agreement to promote activities and projects of mutual interest and, in April 2012, with the presence of the General Director of the FPM Mr. Eugenio Gatti, a second agreement for academic exchanges and teaching cooperation.

A first significant step of the cooperation between the two universities has been the allocation of a building within the campus of BZU to be used by the Politecnico di Milano as its temporary PIRC in Multan; one of the first event organised in the PIRC was an exhibition, that we called “Heritage and Beauty”, opened to the public, showing a collection of pictures and posters of the works of the MWC project activities; that was done in occasion of the “Global Forum Pakistan” dedicated to “The International Financial Crises and European Union”, organised by the BZU (Institute of Management Sciences—IMS), with the participation of the Ambassador of Italy in Pakistan Mr. Vincenzo Prati. The exhibition has been an important event involving BZU students and professors in the work of Politecnico di Milano and an opportunity for a tuning up of the activities together with an assessing of new suggestions and ideas for MWC project.

Previously, in January, in the occasion of the beginning of the ground survey activities of the MWC project, a 2-day seminar was organised at the BZU about the numerous experiences of each department of the Politecnico di Milano, experiences that have been collected during the years, to illustrate how Pakistani students might be involved in the field work and research, having as speakers Professors A. Del Bo, M. Boriani, G. Tucci, B. Calvi, M. Invernizzi, and A. Soncini and witnessing the attendance of 89 students and 10 teachers of Department of Building and Architectural Engineering of BZU.

On the whole, 20 tasks[5] (on research, planning and design, but also on the final delivery of work dossier and on communication and dissemination activities) divided into 26 subtasks have been adequately managed, abroad and in another continent, by the Fondazione Politecnico di Milano, as a kind of general contractor of five research departments of the same European state university (as the Politecnico di Milano is). A complexity of different activities, field actions and deliverables were to be consigned to the Project Management Unit established in Multan as prescript by the PIDSA every 2 months. An amount of field work, that, perhaps, other European state universities (as the Politecnico di Milano is), if asked to take care of the project, would have carried out seeking the collaboration with a private partner, and therefore perhaps with more preoccupations regarding the impartiality of actions (both of the researchers and on the ground) and the possibility of keeping the costs low, than as a non-profit institutions like the FPM can do, in accordance with the provisions of its statute, which encourages and supports the development and extends excellent competences. From the operational point of view, FPM, in order to monitor more satisfactorily the progress of the project activities, established also a special Coordination Committee, composed of one representative from each involved department of the Politecnico di Milano, having the objective to guarantee managerial transparency and inclusion to all technical and research groups concerned with the MWC project.

Among these various tasks, a special one has been the one dedicated to the communication and dissemination of the activities related to the project. A special effort has been simultaneously dedicated also to the promotion of Multan, by means of the choice to dedicate particular energy to the documentation of the uniqueness and richness of shapes and styles of the Walled City; that was obtained by a specific campaign of taking pictures and put them, to their advantage, in the very rich, interesting and documented Web site Italyformultan.org and in a wonderful recent photographic book (Del Bo and Introini 2012), edited by Fondazione Politecnico di Milano. That work is part of our global approach to the sustainability of the amelioration of historic Walled City of Multan.

A choice consistent with our approach to the sustainability, also by means of the communication activities, has been the identification of the logo, chosen to represent synthetically the whole project. As it is shown in Fig. 2.4, the preferred, and fine, solution is based on the juxtaposition, in different green tones recalling Pakistani flag, of the profiles of the more important monuments and buildings of the city, all of them combined in a symbolic skyline of Multan. The resulting skyline is composed by the profiles of the Bab-ul-Qasim, on the left; of the mausoleum of Shah Rukn-e-Alam, at the centre and of the Ghanta Ghar or Clock Tower of Multan, on the right. This profile has been positioned on top of a line presenting the colours of the Italian flag and has as its foundations the synthetic name of our initiative “Italy for Multan”.

[5] For a complete description of the activities of the phase 1, see the following chapters.

Within this framework, a special kind of interaction has been developed between the Italian and the Pakistani counterparts, even in Milan, not only in Pakistan, such as the wonderful and fruitful collaboration that has been established with the Consulate of the Islamic Republic of Pakistan in Milan and especially with the General Consul of Pakistan Mr. Ali Zahid. Furthermore, a number of seminars and meetings have been arranged to show and illustrate, in Pakistan as well as in Milan (in particular in July 2012), to the PMU, to the Ministry of Housing and Works and to other local stakeholders the specific works developed by all the research and design units of the Politecnico di Milano. Among the participants in these meetings we had the pleasure to welcome in Milan, as distinguished visitors, Mr. Kamran Lashary, Secretary Ministry of Housing and Works; Mr. Muhammad Khurram Agha, Commissioner Multan Division; Mr. Rashid Shoaib and Mr. Jamshaid Alam of the MWC Project Management Unit; Prof. Muhammad Ali, Registrar and Prof. Tahir Said Bappi of BZU and Mrs. Ammarah Manzoor Khan of the Punjab Small Industries Corporation. During these meetings it was possible to have the very special possibility of a direct debate of refining and reaching joined assessments of the hypotheses proposed for the regeneration of the Walled City. On the basis of the results synthetically shown in the present book, FPM is now completing the evaluation and the detailed decisions to be carried out in the second phase of the project, during which to implement the actual works.

The local support group of the project activities in Pakistan, directed by our Project Director Resident Representative Mr. Ion Xabier Monjas Kanpandegi, had to deal with several different aspects in order to take care of 70 technicians, researchers and professors, who have been devoted practically full time to the project (simultaneously in Milan and in Multan and other cities of Pakistan); 32 of them spent periods of time in Multan, for a total of 49 missions, amounting to the equivalent of 808 days actually spent in Pakistan in numerous field and documentation activities,[6] and that only during the year 2012 (especially in the first semester).

Safety and security aspects have been our first concern. A special solution of international insurance has been identified to cover possible risks connected with the activities, equally considered from the logistic, the economical and the health assistance points of view. Regarding the needs of security, our institutional counterpart was the local police that protected us every hour of our stay in Multan, employing the personnel of the Punjab Police and of the Elite Punjab Police, both coordinated by the Senior Superintendent of Police Operations. To them our special thanks for having permitted us to work more quickly and more effectively. In parallel, diplomatic and collaboration aspects with local and national Pakistani institutions have been organised with the help and partnership of the Embassy of Italy in Islamabad and of the local Italian Development Cooperation of the Italian

[6] These numbers excluding the heavy and out of ordinary administrative and legal work (needed to the execution of the project) which was mainly done by the administration of Fondazione Politecnico di Milano.

Fig. 2.4 The logo of the MWC project

Foreign Affairs; they were fundamental, for instance, as far as the visas of our stakeholders coming in Italy were concerned and during the first phases of the creation of effective relationships with the Technical Support Unit of PIDSA as well as with other local and national stakeholders. The financial side of the management activities was also essential to guarantee the feasibility of the project. The official currency of the monetary aspects connected with the MWC project contract is the Pakistani Rupee, which is subjected to the granting of general permission of the State Bank of Pakistan to be taken out of Pakistan in a given amount of foreign currencies.

2.2 Conclusions

The successful challenge of conducting such a complex project shows that FPM is a new actor with an important potential role in engaging multidisciplinary cross-cultural projects all over the world, especially in the field of urban regeneration, of protection of the environment, of cultural heritage conservation, of building and of local economic improvement. The FPM has the capability to guarantee efficiently the combination and balance of the needs of sustainable development and urbanism, combining the desired high level of competencies and the implementation of the accomplishments. The FPM proves to have reached such a good level to operate giving assurance of pursuing rewarding research activities with full understanding of problems, freedom, intellectual honesty and deontological ethics. In particular the FPM Project Development Department through this experience has strengthened its capabilities and assets which enable it to play an important part as an instrument of, and for, the elaboration and exchange of culture and technology.

On the basis of the results obtained by the activities of the first phase of the MWC project, as it will be shown in details in the following pages, the choices and the planning of the tasks appear consistent and fruitful not only to comply with the signed contract but also to answer to the most important needs for the future of the city of Multan. The research and design units, due to the right mix in term of the complementarities of their skills and thanks to the deployment of the support activities, collaborated in such a way as to ensure the positive achievement of the assignments. Indeed all the tasks had been carried out with satisfactory results, proper solutions and exhaustive designs, all of which will prove instrumental to bring into being the desired revitalisation of the historic Walled City of Multan. So much so that it seems reasonable to suggest the future possibility to export this working model in other contexts, thus trying to give a positive contribution to the sustainable development and the growth of the experience of the Politecnico di Milano in its working on the history of the cities, on the conservation of monuments, on the protection of the environment and of the human cultural heritage.

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Part II
The Multan Walled City Project

Chapter 3
Territorial and Historical Framework of Multan: A Prosperous Land and an Inspiring Past Leading to a New Progress

Daniele F. Bignami

Abstract To work with the goal of triggering and achieving a sustainable, social, economic and environmental revitalization of the historical core of an ancient city such as Multan is, in fact one of the oldest cities of the central southerly Asia, asks for a deep and full comprehension, as far as it is possible to attain it, of the territorial and historical conditions of a human community growth. The richness of the multilayered site of Multan, offered us the inspiration towards technical and creative actions, based first of all on profound respect and admiration for such a strong cultural identity. In the following pages are selected and presented basic geographical and socio-economic data as well as fundamental and distinctive facts, all of them considered essential key inputs to a better comprehension of the background and starting points of our interpretations, suggestions and plans for the future of the Walled City of Multan.

3.1 Local Conditions of Multan's Area

Multan, situated in the province of Punjab, in Pakistan, is an important historical city and a famous site of multicultural pilgrimage (Bianchi 2004). The geographic site of Multan is well known as one of the oldest urban settlement of the central southerly region of Asia, dating back at least more than 2,000 years, but probably even 5,000–7,000 (Qureshi 2011). Its historical core is a walled city[1] that retained for centuries its unique characteristic urban form. Due to its rich history, the ancient city of Multan has been given in the past numerous highly evocative names, such as

[1] Unfortunately the wall that had belted the city in the past today is almost vanished, even if its mark on the urban configuration is still clearly and easily recognizable along the "ring" road of the Walled City.

D.F. Bignami (✉)
Project Development Department, Fondazione Politecnico di Milano, Milan, Italy
e-mail: daniele.bignami@polimi.it

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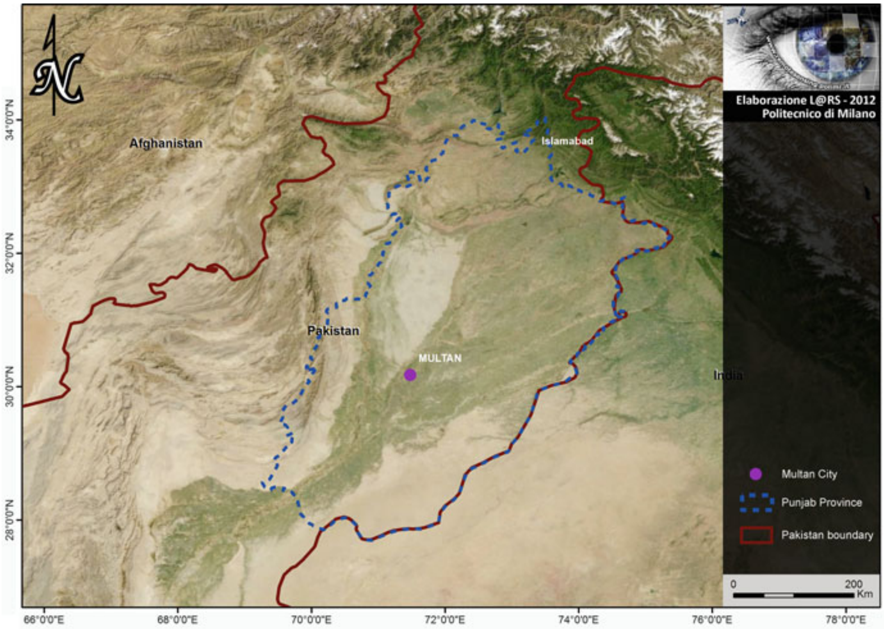

Fig. 3.1 Location of the city of Multan in the Pakistani province of Punjab

City of Gold, City of Peace, City of Sufis and recently as City of Saints and Mausoleums (or Shrines), due to the presence of many important and appreciable mosques, holy places and tombs.

Nowadays Multan, which fortunately still maintains its historical and cultural identity, is the fifth largest city and metropolitan area of Islamic Republic of Pakistan (http://www.census.gov.pk), due to last centuries' urban growth outside the old walled town. It is located on the eastern side of the river Chenab, a major river of the Indus basin that forms in the upper Himalayas and runs through Punjab, Jammu and Kashmir. Multan is the only big city of southern Punjab, being therefore the heart and the financial hub of its district. It is located at 400 km from Lahore and 1,000 km from Karachi, occupying a position at the very centre of Pakistan (see Fig. 3.1). Due to its position in the country, Multan has a good road and rail network (especially connecting Multan to Lahore and Karachi) and an adequate air connection with all the major cities in Pakistan (Punjab Portal 2013).

From a strictly geographical point of view, Multan has an elevation of 216 m AMSL[2] and extends over an area of 3,721 km^2. In summer the weather is almost extreme, reaching even up to 48–49 °C, while in winter the temperature can drop down to 1°/−3 °C, but in general, from October until March the district has an ideal

[2] But the Muhammad Bin Qasim International Airport of Multan (10 km away from the city centre) has an elevation of 122 m AMSL.

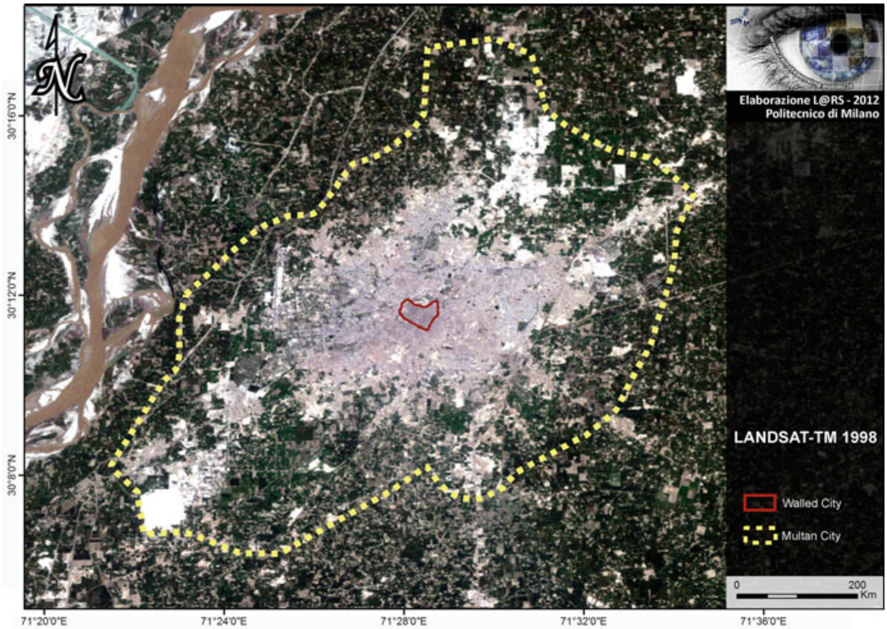

Fig. 3.2 The city of Multan (*yellow dashed line*), the river Chenab and the Walled City (satellite scene) (Colour figure online)

low temperature (NOAA 1961–1990; WMO 2013). The average rainfall is approximately of 180–190 mm (http://www.world-climates.com; http://www.weather-and-climate.com). Thanks to the canals deriving from river Chenab and the river Sutlej (on the east of the city, the second nearest river after the Chenab), the district derives benefit from a fertile land for agriculture, providing ideal conditions for mango, cotton, citrus and other crop productions. It is noticeable how, as shown in Figs. 3.1 and 3.2, the principal direction of development of the urban area of Multan and of its road networks is almost parallel to the main direction of the overland hydrological flow and network.

According to the 1998 Pakistani official estimations,[3] the population of Multan district counts 3,117,000 of inhabitants (only 42.2 % in urban areas; 38.4 % in Multan that counts 1,197,384 of inhabitants[4]), with a population density of 838 persons/km^2 (one of the highest of the country, in which the same indicator is 166 persons/km^2); the Average Annual Growth Rate between 1981 and 1998 has

[3] http://www.census.gov.pk/PUNJAB/MULTAN.htm. Census data of 2011 not still available (last access April 4, 2013).

[4] But, on the basis of a 2012 estimate, the population of Multan has already reached 1,550,000 of inhabitants (http://world-gazetteer.com/—Pakistan: largest cities and towns and statistics of their population). Professor Fauzia Qureshi in 2011 gives to Multan City a population of even 1.6 million (Qureshi 2011).

been 2.64 % (2.69 in the whole of Pakistan, 2.93 in Multan). Altogether Punjab is the most populous province of Pakistan with approximately 55.06 % of the country's total population.

The total of housing units of the Multan district is 433,362. Housing units having electricity are 301,527 (69.58 %), housing units having piped water are 93,825 (21.65 %) and the housing units using gas for cooking are 125,548 (28.97 %).

As far as the adults' health is concerned, on the basis of the Multiple Indicator Cluster Survey of Punjab (MICS 2007–2008), reported tuberculosis and hepatitis in Multan district are, respectively, 0.1 and 0.4 %, less than in the rest of Punjab, which are respectively 0.3 and 0.7 %. As far as the children's health is concerned, the data show that under-five mortality rate (per 1,000 births) is 73 (111 in Punjab), less than in 2003–2004 (when the data were 130 in Multan district and 112 in Punjab) (MICS 2007–2008).

The literacy rate of the district of Multan (10+ years) is 53 %, a significant increase compared to 1998, which was about 43 %, with variation from 32.28 % (female) to 53.25 % (male); in the Punjab province, it is 59 %.[5] Inhabitants of district speak a great variety of Punjabi dialects (on the basis of the data related to the population by mother tongue in the Province, Punjabi is 75.23 %, Saraiki is 17.36 % and Urdu is 4.51 %), but also English is understood and spoken. Sex ratio (male per 100 females) is 110.4 (when in all the country it is 108.5).

The historical core of Multan City is a walled city, heart shaped, having narrow and snaking streets with houses piled up very close together (see Fig. 3.3), the outcome of subsequent not planned or programmed interventions over the centuries. As a result its intricate urbanization, full of history and local traditions, is characterized by high population density and many different commercial activities, such as shops, mainly in the bazaars, and several business initiatives, such as art and crafts, especially in courtyards of different shapes and dimensions. At the north side of the Walled City, on a mound, there is the most prominent landmark of Multan, the site of the towering historical Qasim Bagh Fort,[6] today unfortunately in ruin, once separated from the city by the old bed of river Ravi.

The "Pilot Area" of the project, on which the first phase of our work has focused its activities, is defined by the "ring" road, connecting Haram Gate and Pak Gate, and by the first 200/300 m of Sarafa and Chowk bazaars, in the Walled City, as shown in Fig. 3.3. That area has been chosen as representative of the complexity and of the richness of all the rest of the Walled City and consequently ideal to test the specific solutions investigated and designed during our work devoted to its urban regeneration.

[5] http://www.literacy.gop.pk/ and MICS Punjab (2007–2008).

[6] Its date or period of construction cannot be fixed with any accuracy; it was considered as one of the best forts of the Indian sub-continent from the defensive point of view as well as from the architectural one.

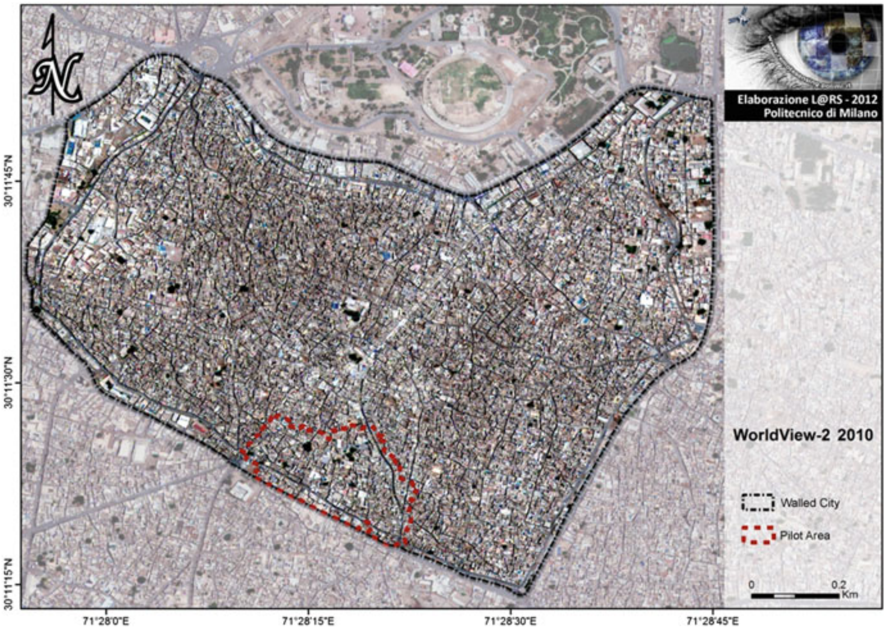

Fig. 3.3 The Multan Walled City and, evidentiated in *red*, the pilot area of the first phase of the Multan Walled City project (satellite scene) (Colour figure online)

3.2 Multan Through the Centuries

The ancient origins of Multan go back to the Indus Valley Civilization (Harappan[7] Culture, about 2500–1800 BC) or to the Vedic Era (about 1500–1000 BC), so that we can find the city as the capital of a kingdom in the Hindu mythology and in a number of legends. Probably there is also evidence that the foundation of the city is linked with the non-Aryan civilization, prosperous in the Sindh Valley in 5000 BC. Nevertheless Multan in view of that is accordingly considered a pre-historical city, perhaps the oldest living city in Pakistan (Raza 1988; Kinder-Hilgemann 1985; Qureshi 2011).

As far as the early history is regarded, we find in Greek sources that Punjab was the eastern edge of the Achaemenid Empire, and consequently, after the Achaemenid invasion (about 550 BC), Punjab was forced to pay tributes to Persia.

Indeed throughout its history the Multan's area has been not only a fertile land for agriculture but also the site of a most important trading and caravan city along significant commercial routes. As a result the Multan's area has been also an ideal and desirable land for conquerors (just as the north-western part of the Indian

[7] Harappa is an ancient city, today an archaeological site, in Punjab. In 1857 the site was damaged during the construction of the Lahore–Multan railroad (the bricks were used for track ballast).

subcontinent, including Punjab, has been). In fact, in the course of centuries, not only the Persian, but also the Greek and many Central Asian empires, among them the best known being those of Alexander the Great, Gengis Khan and Tamerlane, contended among themselves for the richness of the region.

In particular, in 326 BC the people of Multan and other cities, being well trained in the arts of war, formed a coalition against Alexander the Great, but they suffered a defeat notwithstanding a strong resistance during the battle of Sagala (which occurred just after the most famous downfall at the Hydaspes river of King Porus and his elephants) against the heavy cavalry and phalanx of the Macedonians. However, due to the cost of those battles for Alexander and to the valour of the Punjabi spirit, Punjab maintained its culture, so that the official language of Punjab remained Persian (Mir 2010) until the arrival of the British in the mid-nineteenth century, testifying the major influence of the Persians from a cultural point of view (Pollok 2003).

After the Greek invasion and the splitting of Alexander's empire, the modern day territory of Pakistan was conquered by Chandragupta Maurya (under whose dynasty Indian subcontinent was united) and later (about 180 BC) by the Greco-Bactrian Kingdom (under which domination Punjab embraced Buddhism). Afterwards Parthians annexed much of the Indus region, but after their clashes with the Roman Empire, under the rule of the Emperor Trajan (114–117 AD), an independent Indo-Parthian Kingdom was established, until the White Huns invasion of 454 AD (Kinder-Hilgemann 1985). Despite that invasion, Hindu rule continued for about 200 years, under the Gupta Empire of Magadha, one of the largest cultural, political and military empires of ancient India.

The definitive arrival of Islam (after the first Arab invasion of the Indus Valley in 631 AD) dates back to 712 AD, when the army led by Muhammad bin Qasim subjugated Southern Punjab by defeating Raja Dahir and thus established the Umayyad Caliphate[8] (from Baghdad), despite the fierce resistance of the city of Multan. In that period began the gradual conversion to Islam amongst the native Hindu and Buddhist majority, but apparently that did not happen in the northern territory of Multan, so that the rest of Punjab continued under Hindu rule (Qureshi 2011). At that time Multan was known as the House of Gold and place of pilgrimage and rich offerings.

However Multan, being part of the Muslim Empires from 965, when the city was conquered by Halam bin Shayban and became an Ismaili state (after several attacks by the Arabs during the eighteenth century), to the annexation to the Mughal Empire in 1520–1560, passed through a period of violence and destructions, including also the demolitions of many Hindu temples. In the first part of this long period, Multan remained almost independent[9] under Arab rulers; later, after

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[8] In the same years the Muslims took control of nearly the whole of the Iberian Peninsula, this way reaching the maximum extension of their empire.

[9] For the first time under the Abbasid Caliphs, who failed to consolidate the Muslim power; the second time under the Saffarid kingdom, when Multan was an independent state, "guarded" by the Sun God, whose temple, and "presence", the Muslims preserved, even after the Hindu retreat.

the occupation of Ghazni by the Turkish ruler Muhammad Ghori, in 1160, Multan (captured in 1175), although formally subjugated to the Empire of Ghori, who had established a capital in Dehli, initially was only nominally subjected to his power. Soon afterwards Multan became the western frontier of the Dehli Empire, being practically a separate and independent kingdom. As a matter of fact, from about 1200 to the end of 1400, Multan continuously suffered from Mongol and Turco-Mongolian invasions (from Genghis Khan in 1221 (Juvaini 1958) to Tamerlane—or Timur—in 1397), but it also became a city with a distinctive place in the history of the Indo-Muslim architecture (Cfr. Cuneo 1986); due to the presence of the tombs and mausoleums of the Sufi Saints, such as those of Baha-Ud-Din Zakariya, Rukn-e-Alam (Fig. 3.4), Musa Pak Shaheed and Yousaf Shah Gardezi (or of the Ismaili Saints Sha Shams Sabzwari), the city gained its absolute religious prestige, strengthening its position as a place of worship from all over the subcontinent (Qureshi 2011), mainly thanks to the message of tolerance of the above-cited saints.

After almost 200 years of peace under the Mughal Empire (during which Multan was known as the City of Peace), Nader Shah (Shah of Iran) in 1739 came from Persia and controlled the region until 1747, when Ahmad Shah Durrani, born in Multan, made the Punjab a part of Afghan Kingdom. In the later eighteenth century, after years of fighting, and the demolition of many mosques, the Sikhs took control of Punjab and established the Sikh Empire from 1799 to 1849, putting an end to the Muslim rule in Multan (captured in 1818 after an artillery bombardment against its surrounded fort). Nevertheless, due to the political chaos emerging among the factions, the weakened empire in that year became a territory which merged into British India, even if as the result of two Sikh defeats (1846–1847 and 1848–1849), after the second of which the British attacks were terrible, not only for the Sikh army but also for the city of Multan, due to the effects of the bombardment of heavy cannons, which also caused the explosion of the mosque. This battle was the cause of the destruction of most of the city and of its fort (Qureshi 2011).

During the period of the British rule, in which some rail routes to the city were built (the most important to Karachi and Lahore[10]) and a new administrative system was established, Multan was made the headquarter of a division and of a district, a fact that increased the population and importance of the town. Also District Boards were constituted, for the administration of local and municipal government, which included elected members; they principally exercised some forms of control on education, health, finance and public works. In this period a certain development was encouraged, commerce and trade, but above all agriculture, thanks to the new canals excavated (Qureshi 2011).

Despite this favourable circumstances, Multan in 1947 (the year of the partition of India, of the independence of Pakistan and of the First Kashmir War) was a district without a university, without a high level hospital and without industries, while the city was characterized also by the absence of parks, by the low level of the

[10] Also on the basis of the India 1909 General Map of Railways of the Imperial Gazetter Atlas of India.

Fig. 3.4 The mausoleum of Shah Rukn-e-Alam in Multan (photo by Marco Introini)

roads and by a serious lack of sewerage (Raza 1988), mainly in the Walled City. Also the fort was completely abandoned. Nevertheless, due to the predominantly Muslim population of Western Punjab supporting the Muslim League (the leading representative body of Indian Muslims), a religious line became a real boundary, dividing into two the previously united province of British India, so a part of it became a province of the new country of Pakistan, causing inter-religious dark violence and consequently the migration of the minority Hindus and Sikhs over the border, while many Muslim refugees from India settled in Multan (in particular in the Walled City).[11]

After the period of the two wars, the one of 1965 and that of 1971 (with the independence of East Pakistan as Bangladesh) against the armies of India, in the 1980s many people from Punjab migrated in the Middle East, Europe and North America, despite some industrial local growth, because meanwhile the population of Multan had been continually growing.[12] Unfortunately it is proved that the

[11] "*By the summer of 1947[. . .] ten million people -Muslims and Hindus and Sikhs – were in flight. By the time the monsoon broke, almost a million of them were dead, and all of northern India was in arms, in terror, or in hiding*" (Singh 1956). "*Pakistan was carved out in a desperate urgency. It came into existence with horrible loss of life and property, and the migration of millions of dazed and destitute men, women, and children. The cost was heavy in terms of human suffering*" (Iqbal 2013).

[12] Of this recent period, it is also today known that a "Multan meeting" took place in January 1972: a secret meeting called by Zulfikar Ali Bhutto, aimed to rally academic senior scientists (physicists and engineers) to build the atomic bomb for the country (http://www.defence.pk; http://www.pakdef.info).

above-mentioned military confrontation significantly reduced bilateral trade with India (Baroncelli 2012). However new opportunities of advancement and progress can probably be obtained (signs being already visible in Pakistan's today economic growth[13]) through a more cooperative environment, for instance, also by the implementation of the SAFTA (South Asia Free Trade Agreement) (signed in 2006 and to be fully implemented by December 2015).

Such a troubled and difficult modern history explains partly why the old city of Multan and its monuments continue to be in an undeserved state of problematic disrepair.

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[13] The average real growth rate (on an annual basis and adjusted for inflation) of the gross domestic production (GDP) since 1999–2011 is 4.6 % [our elaboration on Index Mundi data (http://www.indexmundi.com)].

Chapter 4
Studies and Documentation on Tourism, Mapping of Historical Hot Spot in Multan Walled City

Vincenzo Donato, Alessandra Terenzi, and Samuele Camolese

Abstract Tourism represents a major economic generator and a labor-intensifying industry for the development and for the economic growth of a country. In accordance with this principle, the Government of Pakistan has officially declared tourism as an industry, formulating new tourism policies. Due to the unique richness of its composite landscape, consolidated over the centuries by the passage of innumerable civilizations and cultures, Pakistan is a country with a very high potential for tourist attraction from all over the world. The first part of the study is focused on the analysis of some significant data and aspects related to the tourism evolution during the last years and up to the present. One of them consists in the existence, in Pakistan, of a unique network of specialized visitors, wanting to visit the country for niche reasons: every city and every place then deserves a particular vocation and identity, becoming the main reference for different kinds of tourists. The investigation of the very unique role that Multan merits within the national touristic framework led to identifying, as its main vocations, the religious and sacred dimension of the place, as well as the significant presence and specialized workforce of local handicrafts. Regarding these particular kinds of tourism vocations, the case of Multan has been compared with other examples of tourism development, also in relationship to international examples: even in their differences, these comparisons have been used as strategic tools for the case of Multan, highlighting the weaknesses, as obstacles to any kind of development of tourism in the country, as well as its points of force, to be increased and reinforced. The second part of this work is focused on the identification of urban development strategies and new scenarios, aimed at revitalizing the historic core of Multan and strengthening the main tourist vocation of the place, highlighting the unique structural characteristics of this city and of its landscape.

V. Donato (✉) • A. Terenzi • S. Camolese
Department of Architecture, Built Environment, Construction Engineering, Politecnico di Milano, Milan, Italy
e-mail: vincenzo.donato@polimi.it

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4.1 Tourism Development in Pakistan: Today's Trends of Evolution

Pakistan, with its diverse cultures, people, and landscapes, is a country richly endowed with tourist potential and attractions; it is a well-suited destination that could become the choice for all types of tourists, offering far greater diversity than is generally assumed, especially historically and culturally: today an Islamic country, the local culture is enriched with the influences and resources of over half a dozen ancient civilizations, which flourished here since the fourth millennium BC (Multan: history and architecture 1983). As it will be demonstrated, the trend of tourism evolution during the past years reveals the existence of some critical aspects that still hamper tourist development in Pakistan. In particular, while it is possible to read a growth in the tourist evolution during the last decades up to 2005, the following years until the present date have not actually undergone changes of extreme relevance (World Economic Forum 2007). Pakistan's tourism industry was very active during the 1970s, when the country received important numbers of foreign tourists; even later, the following trends show a constant increase, from 368,700 tourists in 1996 to 798,300 in 2005 (T&T, World Economic Forum 2007). Nevertheless, a comparison with other South Asian countries[1] showed a touristic dimension far lower than its potential and far exceeded by that of India[2] and Iran. The investigation made by the World Economic Forum[3] highlighted a deficit in policy rules and regulations (with a very low position for the presence of foreign ownership and for foreign ownership restrictions) and in safety and security as well as the lack of any prioritization of travel and tourism and of marketing and branding. Among the main reasons for traveling in Pakistan in this period, social tourism (visiting friends and relatives) accounted for more than half of all foreign arrivals (56 %), followed by business visits (21 %); holiday and vacation visits were only 14.7 %. Trekking and mountaineering represent high-profile activities, followed by religious tourism, especially related to Sikh and Buddhism; nevertheless only 8,800 tourists arrived in Pakistan for religion purposes in 2005 (*Managing Tourism in Pakistan. A Case Study of Chitral Valley* 2007). The data of 2009 does not show significant changes in the trend of tourist arrivals.[4] The Government of Pakistan launched a series of public and private initiatives in order to encourage and revitalize the tourist attraction, improving the state of affairs in tourism sectors. 2007 was declared the "Year of Tourism" considering it as an effective industry. Despite this innovative campaign, the numbers continued to decrease during 2008 (World Economic Forum 2011), ranking Pakistan 103 out of 124 countries to visit: the main reasons were related to the low level of security,

[1] Ministry of Tourism Pakistan, 2006.

[2] In 2005 the international tourist arrivals in Pakistan are 798,000 while India shows an amount of almost 4,000,000.

[3] (WEF) Report "Analysis Tourism Management in Pakistan."

[4] United Nations World Tourism Organization.

low priority for travel and tourism industry (including travel infrastructure), as well as the low level of tourism infrastructures and facilities (such as hotel accommodation) compared with other international standards. After 2009[5] the situation worsened, leading in 2011 to a downfall of the Pakistan ranking to 125 over 139 countries (World Economic Forum 2011). In addition to external reasons, related to the world economic crisis, there were also dramatic local events: the floods in July 2010 made millions of people homeless in Pakistan and took serious toll on hotels, motels, bridges, roads, and houses, further contributing to the collapse of the tourism industry in the country. Apart from these exceptional events, the main disadvantages are more or less the same over the years.[6] Despite the difficult scenario, this country deserves unique forceful methods to help strengthen its tourist industry. For example, one should mention the competitiveness of the price with regard to the travel and tourism industry (ranking Pakistan 35 over 139 countries), as well as in cultural resources, World Heritage, and cultural sites, where Pakistan ranks 29 out of 139. Also creative industries' exports rank a respectable position (33/139): as will be discussed below, this aspect could represent one of the main keys for future touristic development in Multan.

4.2 Improving Tourism in Pakistan: An Open Challenge

Historically, Pakistan is one of the most ancient lands, with strong cultural and historical roots, that have to be preserved from the rapid transformations taking place (*The early history of Multan* 1963). When compared with other South Asian countries such as India, Nepal, and Sri Lanka, Pakistan shows a lower position in tourism arrivals. Actually India boosts its incomes from tourism, having ranked 68 out of 139 (unlike Pakistan, 125/139) and 12 out of 26 countries in the Asia Pacific region (whereas Pakistan remains 24/26). From a comparison on different parameters between India and Pakistan, India shows a better attitude on behalf of the population towards foreign visitors, as well as a stronger government prioritization towards travel and tourism. Along with China, India is also well assessed for its natural and cultural resources (ranking 8/139 and 24/139), with many World Heritage sites, strong creative industries, and many international fairs and exhibitions. India also has reasonable air and ground transport infrastructure; however some aspects remain underdeveloped, with fewer hotel rooms per capita compared

[5] 2009 is also a particular year due to the beginning of the world crisis that affected many different contexts and countries, not only from the economical point of view.

[6] Policy rules and regulations (such as prevalence of foreign ownership, foreign ownership restrictions, Visa requirements) have been ranked in an average of 119/139; for safety and security (business cost of terrorism) Pakistan is 138 over 139. For the affinity for travel and tourism, it ranks 135/139, and for facilities as the quality of general hotel rooms, Pakistan deserves the position 131/139. Prioritization of travel and tourism and effectiveness of marketing and branding is also in a very law position.

to international standards. Pakistan should also increase such aspects: a widespread network of fairs and exhibitions, for example, could actually represent further valid reasons for international arrivals in the country; furthermore in 2009, the WEF ranked Pakistan as one of the top tourist destinations for its World Heritage sites. In 2010, to promote Pakistan's unique and various cultural heritage, the PTDC launched a large campaign, including events such as fairs and religious festivals, regional sporting events, various arts and craft shows, folk festivals, and the opening of several historical museums (Tourism Events in Pakistan in 2010, PTDC website). Nevertheless, unfortunately Pakistan is not well advertised regarding the level of safety (World Economic Forum 2012), and such data damages the country's image with major impact on tourism, obscuring its qualities related to its very good position in South Asia for tourists' attractions, deep culture, and heritage sites. All these data are signs of the necessity to highlight and improve the significance in these areas, by making available supportive business opportunities, as well as involving public and private stakeholders in planning, organizing, and implementation of tourism plans.

4.3 A Role for Multan, the City of Saints

Among the different initiatives undertaken for the revitalization of the arrival of tourists in the country, in 2006, The Guardian released a report titled *The Top Five Tourist Sites in Pakistan:* the five sites were Taxila, Lahore, the Karakoram Highway, Karimabad, and Lake Saiful Muluk (*The Top Five Tourist Sites in Pakistan; The Guardian* 2006). In 2007 the Prime Minister launched the *Visit Pakistan* marketing campaign, in order to promote Pakistan's unique and varied cultural heritage. In the general absence of numerous tourists in the country, the travel retail providers looked to package their tours in a way that increasingly attracted specialized visitors wanting to visit for niche reasons. Specialist packaged tours included adventure tourism in the Himalayas, ecotourism, cultural tourism, horse safari tours, and bird-watching tours. Art workshops, hiking and trekking tours, hunting packages, and rock climbing tours were also featured strongly among the proposals. A potential reevaluation of the different touristic itineraries, based on the strengthening of specialized tourism for each individual place to visit, could actually represent a focal strategy for the touristic development of Pakistan, identifying the unique culture, history, and leisure amenities of each province and encouraging provincial exchanges. A series of initiatives should be strengthened, such as publicizing local festivals and sporting events through the media and the tourist information centers; improving access, signs, and facilities at tourist sites; and developing budget-priced accommodation and camping sites. This strategy could satisfy every kind of tourist, both for cultural or natural reasons, having religious or adventure-related aims and interest in archeology or business. Among the *Top Five* of The Guardian, Taxila could be the center for archeology; the Karakoram Highway is a great landscape attraction, being the only way to the tourist attractions of the Northern Areas, connecting with China, and being the highest road in the world (5,000 m); Karimabad is the tourist oasis for excellence; Lake Saiful Muluk defines an important natural destination; while Lahore is the cultural capital of the country. In this framework of niche travelers, Multan, one of the most ancient living cities of Southwest Asia and today the sixth largest city in Pakistan, could certainly play a strategic role in this national network. The original city comprised of the Citadel, or Fort (now known as Qila Qasim Bagh), and a Walled City is like an open book of history for all the subcontinents where every invader, from Alexander, through to the Mughals, right up to the British, has fought for its control. Throughout history Multan has maintained its position of a sociopolitical and religious hub, spread over a period of almost 5,000 years. Multan has always been a place of worship, with people coming for pilgrimages from all over the subcontinent: also known as the city of saints and shrines, it gathers in one place more tombs of saints and Sufis (highly regarded here) than anywhere else on earth.[7] Indeed, this city was an important center of learning and pilgrimage for many cultures: the base of the Hindus was the Temple of the Sun, in Qila Qasim Bagh. The rise of Islam strongly influenced the city of Multan, becoming the first center of Muslim culture in the subcontinent and the hub of the Sufis, even when the rest of the Punjab continued under Hindu rule; several tombs and shrines are outstanding examples of pre-Mughal Muslim architecture (from the sixteenth century). Despite the similarities of Muslim and Hindu heritage, indeed, a fierce dichotomy in religion, languages, social customs, education, and ideology is still readable in the existing cultural heritage of this site. The province of Multan has always played an important role in the area, also due to the fertility of its rivers and agricultural produce, as well as the prosperity of trade and commerce. Multan lies in South Punjab, near the River Chenab: this strategic position, in the geographical center of Pakistan and along the major nodes of interest, makes this city a potential destination for tourism and cultural heritage, not only of great interest, but even easily accessible and potentially well linked from all over Pakistan by road, rail, and air. In consideration, the main touristic route identified by The Guardian list of top places to visit could be improved and completed by adding Multan and Karachi. While Karachi could be the capital of leisure, shopping, dining, and recreational activities, the religious heritage of Multan, with Buddhist, Sikh, and Muslim shrines, identifies it as the potential religious capital of the country. Its rich culture, influenced by different civilizations that flourished here leaving their imprints, provides an appeal for Multan that is hard to match in other parts of the world. Such a role as an important religious capital should be improved by developing a wide range of religion-based programs and even exploiting existing events, such as the annual Multan Sufi festival.

[7] TDCP (Tourism Development Corporation of Punjab).

4.4 Critical Aspects: A Framework of Different Cases

All around the world, religious tourism represents a potential powerful tool, capable of attracting huge flows of tourists and new opportunities for socioeconomic development. Despite their nature of little villages, with nothing of the rich cultural heritage of Multan, famous European religious places, such as Fatima, or Lourdes, have become pillars in the principal religious itineraries, basing their entire economy on tourism-related activities, while Multan is not yet taking advantage of its great touristic potential as a main religious destination of the country. Nevertheless, this situation could totally change by introducing and improving appropriate policies of intervention related to restoration projects, urban planning, and high-quality facilities. A look at some of the maps available on the Web sites, presenting some services (such as high-quality international hotels), shows how even the appearance, concerning the international advertising for tourism in Multan, should be significantly improved. A comparison with other touristic cities in the national framework has revealed the low level of services offered by Multan with respect to these places. Islamabad, for example, despite counting far fewer places of interest, presents a much higher quantity of tourists than Multan, offering many more tourist facilities. Another interesting case concerns the comparison with Karachi: despite a population ten times lower than Karachi (i.e., 13 million people) and a clearly smaller urban surface, Multan shows a level and number of historical and cultural places to visit that have nothing to envy to the great Karachi. Despite this, Karachi registers a much higher number of tourists compared to Multan. These cases bring us back to the main point, the very high potential of Multan for a significant touristic development, as well as its present impossibility to fully exploit such great potential.

4.5 The Touristic Development in the Multan Walled City

The numerous monuments inside the old city primarily comprise tombs, shrines, mosques, temples, gateways, city walls, and fort walls. Many of them are located within the Walled City of Multan and Qila Qasim Bagh, whereas others, also of great interest, are outside the Walled City. The proposed interventions aim to develop tourism through an optimum use of Multan's natural, cultural, and historical resources, which would also impact positively on the environment, as well as on the economy, increasing employment opportunities and stimulating the entrance of foreign capitals into the country. In order to grow into a major economic generator and labor-intensifying industry, the tourist sector in Multan should be developed for domestic as well as for foreign tourism: both kinds, with their expenditure in local communities, play an important role in the growth of tourism in Pakistan, contributing to the economic development of the area. The first intervention is related to the creation of three touristic itineraries in the Walled

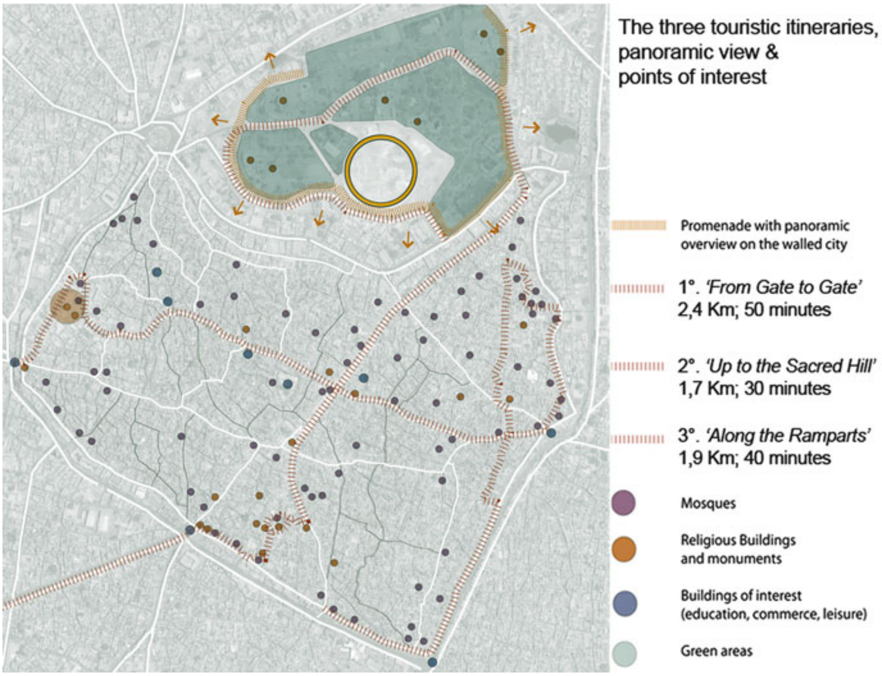

Fig. 4.1 The three touristic itineraries; panoramic view and points of interest

Fig. 4.2 Proposal for the reorganization of Akbar Street

City (Fig. 4.1 shows paths, length, and duration of each one). The first one, from Haram Gate to the Fort, passes through the *cardo*, with a rich concentration of bazaars. A proposal for the reorganization of the square in front of Haram Gate has been developed, together with a reassessment of Akbar Street (Fig. 4.2) which, connecting the station with the Haram Gate, could become a boulevard model through a significant reduction of private motorized traffic with the introduction of public transport by the new shuttle (see Chap. 16) and improvement of the

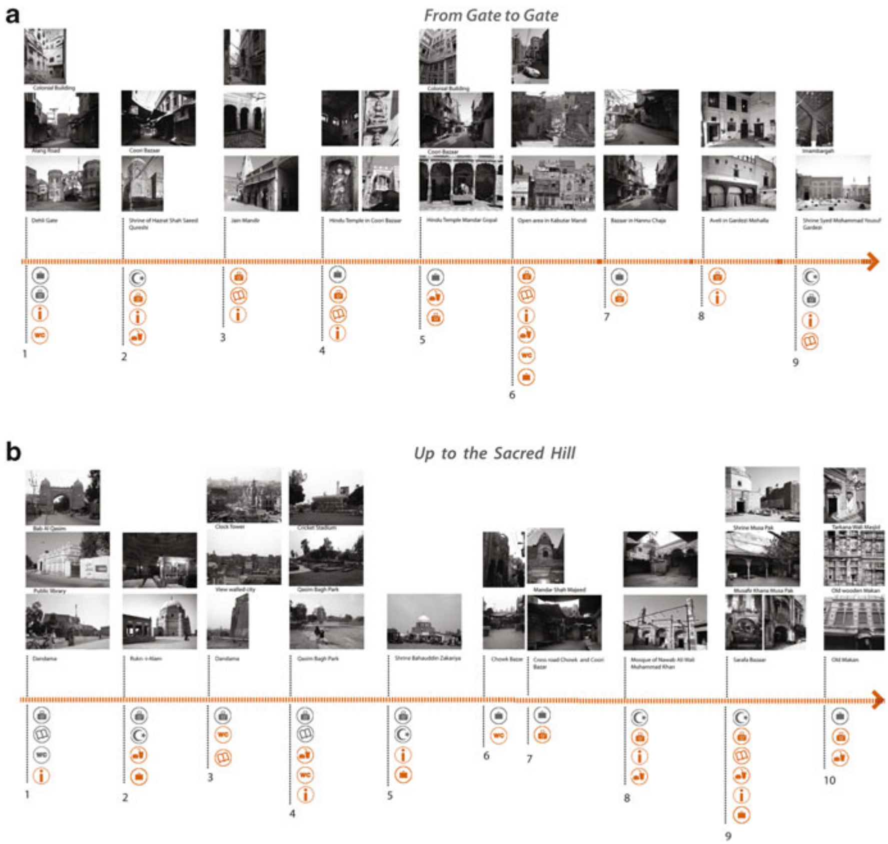

Fig. 4.3 (**a**, **b**) Monuments, architectures, and points of interest along the first and second itinerary. Different services available for each stop along the way

pedestrian accessibility. Arriving by train or by bus in the central station, one could take the shuttle to Haram Gate or walk along the new boulevard, making it an integral part of the first itinerary. The second itinerary starts from the Delhi Gate and passes along the *decumanus*, with a significant presence of tombs, shrines, mosques (including that at the intersection with the *cardo*), and temples, as well as a very well-preserved sacred complex of precious shrines and religious buildings, sited in the Shah Gardez Mohalla, near Bohar Gate the last stop of this path. Both gates are served by the shuttle system. The third itinerary is characterized by a pleasant walking promenade above the wall's ramparts, offering different perspectives of view, and it is part of a project for the improvement of this high walk over the ramparts; it ends at Delhi Gate. At the end of this path, one could continue inside the Walled City, visiting the interesting monuments of the eastern sector. For each itinerary a series of significant points have been identified, such as monuments and touristic and leisure facilities (Fig. 4.3a,b). A more detailed project has been developed along the first itinerary, using four different typologies of signposting

Fig. 4.4 Different typologies of signage along the first itinerary and possible positions

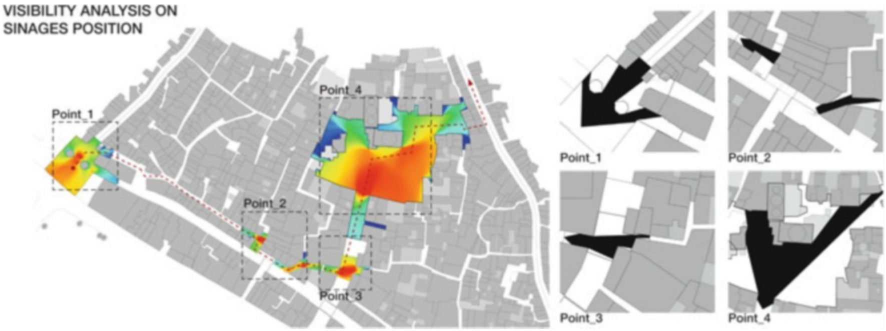

Fig. 4.5 Analysis of the different optical cones for each node of the path, aimed at the identification of the points with best visibility (*warmer colors*)

to guide the tourist: the first type would be placed at the beginning of each itinerary, offering information about the whole path; the second is the information board, in front of each significant religious or cultural building, that would give information of each building; the third typology, placed in correspondence of possible deviations, represents the directing system for each itinerary; and finally, the fourth kind would provide information about the location of tourist facilities (not only hotels, restaurants, bars, and info points but also museums, festivals, and location of craft activities), and this would be integrated in all the itineraries (Fig. 4.4). For a correct choice of the sites for each signpost, a specific analysis, made with specific software, has been developed on different optical cones in order to locate the points along the way with optimum visibility. This study has analyzed each node of the path characterized by a change of direction, identifying the areas that provide the best visibility for the signposts (Fig. 4.5). A series of architectural suggestions and references have been considered for the most significant religious, historic, and architectural hot spots, as well as for empty urban spaces inside the Walled City, reusable as new public areas for leisure and rest and provided with info points (Fig. 4.6). Many courtyards and terraces existing in the Walled City, identified as

Fig. 4.6 Suggestions for the touristic use of empty urban spaces, for leisure, rest, and information centers

Fig. 4.7 (**a**, **b**) References of tourism facilities in courtyards and terraces of ancient buildings developed in the Islamic culture

Fig. 4.8 Casa Nova, Franciscan house for pilgrims

Fig. 4.9 (**a**, **b**) Christ Church Guest House

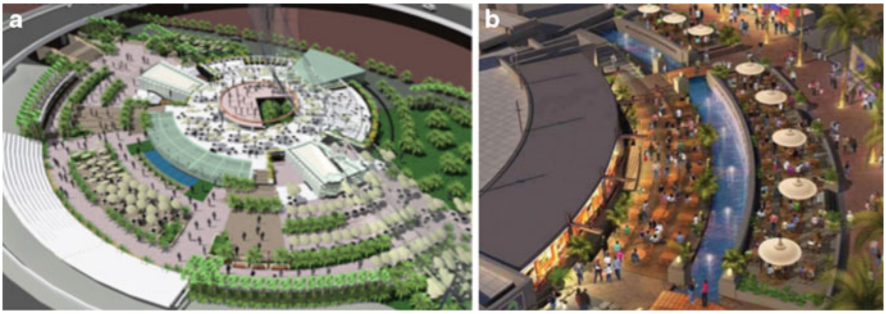

Fig. 4.10 (**a**, **b**) Project for the Port Grand Food and Entertainment Complex, Karachi, 2011

spaces of great architectural potential, could be renovated taking a cue from the rich and wide Islamic architectural tradition, interesting cases where ancient buildings of high value have been renovated and used for tourism facilities (Fig. 4.7a,b). With regard to eventual accommodation, a series of references have been specifically identified for the possible development of particular typologies of hostels, specifically thought for religious devotees and often organized in structures already existing in close proximity to significant sacred monuments (Figs. 4.8 and 4.9a,b). Finally, despite the great importance of religion in Multan, this city is not only the "city of saints" but also an industrial city, producing fertilizer and processing textiles (as for cotton products). The industrial vocation of Multan is related to the potential improvement of the touristic sector, characterized by the production of local handicrafts, ranging from ceramics to carpets, among others. This important characteristic could represent the basis for the introduction in Multan of creative workshops, fairs, and exhibitions aimed at the discovery, learning, and promotion of local handicrafts, products, and traditions. An interesting case is the city of Karachi that, in 2011, was invested by a huge project, the *Port Grand Food and Entertainment Complex* (Figs. 4.10a,b, 4.11, and 4.12a,b,c,d): a recreational area built in the center along the waterfront of the nineteenth-century Native Jetty

Fig. 4.11 Qasim Bagh area, Multan

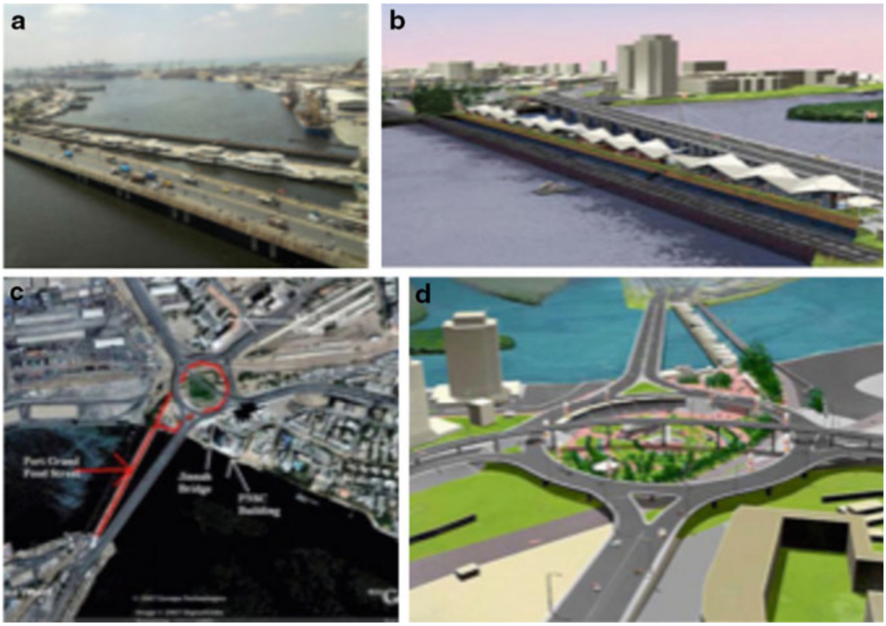

Fig. 4.12 (**a–d**) The Port Grand Food and Entertainment Complex, Karachi, 2011. Different views of the project

Bridge; the complex was expected to attract up to 5,000 visitors a day, reflecting the shared image of Karachi as a capital of leisure and major hub of shopping, dining, and recreational activities. This project could represent an architectural and functional point of reference for Multan, as also investigated in the chapter *Microcredit System for Building Rehabilitation and Strengthening Arts and Crafts*, in particular for the area of Qasim Bagh (Fig. 4.11): since its destruction, in the nineteenth century, this place lost the main part of its historic treasures; its actual importance is due to the presence of the British obelisk and two shrines that represent the epitome of the local culture of Muslim South Asia, where Islam spread through the Sufi teachers (the Sheikhs). Over time, a stadium has been built in the Fort area and the green spaces nowadays offer a pleasant promenade with a panoramic view on the Walled City below. Following the virtuous case of Karachi, even Qasim Bagh, a point of great potential for the city, virgola could be reconsidered as a strategic place to host periodical fairs at different times of the year, virgola reflecting the local culture and customs, as well as attracting a specialized kind of tourism. It could also be used as a daily local market where farmers exhibit and sell their products and local crafts. These events could be held in cooperation with the hotels and the new tourism facilities in the Walled City.

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Chapter 5
Microcredit System for Building Rehabilitation and Strengthening Arts and Crafts

Claudio Di Benedetto and Irene Bengo

Abstract Poverty is widely considered as the major problem in the socioeconomic development of Pakistan. The main objective is the alleviation of poverty through the start-up of a microcredit system in the Walled City of Multan for the promotion of income-generating activities and the rehabilitation and strengthening of local arts and crafts. A theoretical and practical research methodology is applied to investigate the most suitable microcredit model for the local context. The study briefly analyzes economics of microcredit affecting the efficiency of the market as well as its improvement mechanisms and their applications. Subsequently the conventional microcredit lending methodologies (interest based) and their potentials in Multan were examined. Authors have conducted two levels of analysis to explore the strategic environment and the peculiar aspects of local context. The former is a field research to observe the unsatisfied local needs and the cultural and religious norms influencing the success of the initiative, and the latter is a desk analysis to assess the macroeconomic factors affecting program achievement and its sustainability. The study deepens the Islamic financial principles and related lending methodologies for tailoring the proposal on the cultural, social, and economic characteristics of the potential demand. The study suggests two different models to guarantee not limited access to loans. The first model is the "Poverty Reduction Project" aiming at poverty eradication and social inclusion promotion. This model is oriented at satisfying the needs of the lower market segment including "ultra poor," poor, and vulnerable people (almost 55 % of Pakistani population) through the adoption of Akhuwat's model. The "Poverty Reduction Project" has the double aim of preventing vulnerable people to fall into poverty and helping poor people to rise from poverty by providing interest-free loans for the promotion and support of income-generating activities. Proposal products are of two sorts: infrastructure loans and business loans. The second model is the "Handicraft Model," developed by an interdisciplinary team of work, that has the purpose of financial inclusion of

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C. Di Benedetto (✉) • I. Bengo
Engineering Without Borders Milan, Milan, Italy
e-mail: claudio.dibenedetto@isf.polimi.it

A. Del Bo and D.F. Bignami (eds.), *Sustainable Social, Economic and Environmental Revitalization in Multan City*, Research for Development,
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craftsmen. It is oriented at the higher market segment composed by "quasi nonpoor" and provides loans through the adoption of Murabaha model. The clients served by the Handicraft Model are small entrepreneurs. Main objective is supporting, aggregating, and promoting best practices of handicraft production for exporting opportunity. In this case the full cost of loan provision is charged to the borrower. Akhuwat is chosen as local partner for its social innovative business model, based on the vision of interest-free loans to economically poor. Both models are based on individual lending methodologies. By means of family loans, Akhuwat demonstrates that it is possible to reach very poor people through individual loans. Furthermore, individual lending seems to better fit the needs of people working in a productive urban context as the Walled City and allows to reduce inefficiencies nested in group loans historically applied in Pakistan.

5.1 Introduction

Pakistan is the sixth most populated country of the world with 184 millions of persons (2010). The gross domestic product (GDP) has increased around 7 % yearly from 2004 to 2007, with a robust growth of sectors as agriculture, manufacturing, and services (Ahmad 2008). This considerable size and the estimated GDP long-term growth, of 6.5 % per annum, makes Pakistan one of the major emerging economies of the Asian region (Pakistan Economic Survey 2012). The growth of economic activities and government policies have generated good expectations on poverty reduction. Indeed, in 2007, medium-term prospects for creation of employment and poverty reduction were the best in the last decade (SBP Annual Report 2007). Besides these favorable conditions for economic growth and increase in GDP, still a lot of problems persist in law and order situation and political instability (Mustafa and Ismailov 2008). According to the State Bank of Pakistan (SBP), some unfavorable macroeconomic factors (global economic recession, the following low economic growth rate, the high inflation rate, especially from food price) could compromise poverty reduction and human development gains achieved by the Government of Pakistan over the last decade. Microcredit, providing financial services to targeted poor people and micro-small enterprises (historically not bankable), is recognized as an effective tool to reduce poverty (Ahmad 2008; Muhammad 2010; Khan 2008; Ruiz 2007). Microcredit contributes to enhance productivity, to increase income, to improve living standards, and to promote people empowerment (Ali and Alam 2010; Asim 2008). Considering that 90 % of business in Pakistan is created by small and medium enterprises, microcredit seems to be moreover an effective tool of employment promotion and social inclusion (Ahmad 2008). The Government of Pakistan and other development agencies have promoted the expansion of microfinance market and, simultaneously, the establishment of a regulatory framework. The aim was to enhance "scale, quality, diversity and sustainability of microfinance providers in Pakistan" (Pakistan Microfinance Network 2006). The outreach in terms of active borrowers increased from 240,000 in 2003 to 2.39 million in 2012. From the point of view of the demand, the market presents very low penetration rate. Penetration rate in Multan district amounts at 13 % with 90.561 clients served against the almost 700.000 potential customers. The target market in Pakistan is estimated to be from 25 to 30 million borrowers. The outreach goal set by the government of Pakistan amounts at three million borrowers by 2010 and ten million by 2015. In this context, to encourage microcredit expansion and enhance well-being of people, authors propose to implement two microcredit models. The "Poverty Reduction Project," by the provision of Akhuwat family loan (interest-free), serves the economically poor in order to promote income-generating activity and poverty alleviation. Instead, the "Handicraft Model" aiming to support and promote Multan handicraft's best practice provides loans to small entrepreneurs by the adoption of Murabaha model.

5.2 Relevant Factors

The purpose of this section is to analyze the different factors influencing the start-up of a microcredit system in the Walled City of Multan. First, some arguments have been focused to set the development of the plan: the economics of microcredit, the conventional microcredit models, the Pakistani strategic context, and the Islamic microcredit models.

Microcredit can be analyzed by the use of Information Asymmetry theory in credit market, according to which the borrower has more or better information than the lender. In developed countries this sort of problems is solved by the use of material collaterals, but in developing countries, this contract form is inapplicable. In this context, microcredit is a "contract mode" that aims at reducing the risk of adverse selection and moral hazard in an innovative way (Armendáriz and Morduch 2005). Therefore different mechanisms are used to build successful microcredit lending methodologies: *joint liability, rotating access to credit, threat of nonrenewal, progressive lending, weekly repayment, forced savings, meeting participation, women borrowers, others dynamic incentives, guarantees or guarantors, public repayments, flexible approach to collateral, and disincentives.* By using these instruments, microfinance providers are able to distinguish high-risk debtors from low-risk debtors and offer the right incentives for the action (Ruiz 2007). The lending methodology adopted in specific context from Bangladesh to South America blends some of these mechanisms, depending on local context, especially on social, cultural, economic, and legal characteristics.

Modern microcredit started in 1970s, when tiny loans to groups of poor women were provided through experimental programs in Bangladesh (Pelgreffi 2009; CGAP 2006). The most widely known microcredit program was developed by Muhammad Yunus in 1976, which brought to the establishment of Grameen Bank in 1983. Grameen-style lending methodology is based on solidarity groups. Over 94 % of clients are women, and loans are mainly used for income-generating activities. Groups are small, self-selected, and self-organized and assume the responsibility for the management of financial services (empowerment dimension) (Microenterprises Training Guide 2003). Another group lending methodology is Latin America Solidarity Group. Such lending model includes joint liability, self-selection of members, rotating access to credit, and progressive lending. Most of the clients are female. It is demonstrated indeed that female loan repayment rate is higher, and they use almost all of their profits for the welfare of their children. Other models historically applied in microcredit are village banks, credit unions, and individual loans (Microenterprises Training Guide 2003).

The study of the Pakistani context has been structured in two levels of analysis: the first focuses on the general strategic context, and the second is a field research study to understand the local context of Multan Walled City.

The field research has been conducted during a mission in Pakistan. Many information were collected through direct interviews with privileged stakeholders. To deepen the analysis of the local context, a research methodology was built and five stakeholder categories (university, MFI or other organizations, civil society, institutions, and craftsmen) were interviewed on different issues.

Pakistan shows an average GDP growth rate, during the last 5 years, of 5.3 % compared to an average growth of population of 2 %. This means an increase in nominal per capita income (Ahmad 2008). The official unemployment rate amounts at 5.8 %. In urban areas, the unemployment rate is 15 %, a higher balue than in rural areas, especially for women. Although many employment opportunities were created by the increase of labor force, a big gap between unemployment and employment ratio persists (SBP Annual Report 2007). Following SBP, for consistent progress in economy, there is the need to provide opportunities and facilities both in agriculture and industry sector. Despite that the head count ratio (HCR) had decreased from 36.5 % in 2000 to 22.3 % in 2006 (Pakistan Economic Survey 2011), the global economic recession, the following low economic growth rate, the high inflation rate, and the inadequate employment opportunities reincreased HCR at 36.1 % in 2009 (Pakistan Economic Survey 2011). The rise in food inflation (around 18 % from 2007 to 2011) (Pakistan Economic Survey 2011) has transformed poverty from transitional to chronic (Mustafa and Ismailov 2008). Indeed, having Pakistan's large number of people close to the poverty edge, it is highly vulnerable to food price shocks (Pakistan Economic Survey 2012). Poverty in Pakistan has many dimensions and implies not only low income but also limited access or total exclusion to basic services such as education, secure food, health, clean drinking water, and sanitation (Ali and Alam 2010). This condition generates a vicious circle toward social exclusion, especially for women. They usually live in a marginalized condition with respect to males. They show lower level of literacy rate, labor market participation, educational attainment, and involvement in decision-making processes. Following Pakistan Poverty Alleviation Fund (PPAF 2010), major educational attainment and literacy rate of mothers has been observed to positively affect the "health and well-being of children." In Pakistan, "73 percent of all working women and 61 percent of urban working women are involved in informal sector" (Khan and Khan 2009). Workers engaged in informal sector are deprived of "secure work, workers benefits, social protection, and representation or voice" (Khan and Khan 2009). Contributing to bridge this divide would create a great impact for the community as a whole (PPAF 2010). Microcredit providing financial services to targeted poor people and micro-small enterprises (historically not bankable) is recognized as an effective tool to remove poverty (Ahmad 2008; Muhammad 2010; Khan 2008; Ruiz 2007). In the last years a strong evolution of the microfinance sector in Pakistan was observed, with "new entrants, products, practices, and a growing clientele" (Ahmad 2008). Following Siddiqi (2008), numerous funds were used to improve the outreach of microfinance within Pakistan, and, besides funding, other facilitators of microfinance were established. Outreach in terms of number of active borrowers increased from 1.13 million in 2007 to 2.39 million in 2012. Gross loan portfolio increased from Rs. 11.83 billion in 2007 to Rs. 37.97 billion in 2012. The number of savers rose from 3.5 million in 2011 to 4.5 million in 2012 (Pakistan Microfinance Network 2007, 2011, 2012). Currently in Pakistan two main categories of organizations are operating. Eleven microfinance banks, registered under Microfinance Institutions Ordinance 2001, are active in formal regulated market (Pakistan Microfinance Network 2012). The second category is composed of microfinance institutions, nongovernmental organization, rural support programs, and some other small organizations, not registered with State Bank of Pakistan (Muhammad 2010).

One of the most widely known features of the Islamic financial system is the prohibition of charge to receive or pay any form of interest (Riba) (Karim et al. 2008; Allen and Overy 2009; Segrado 2005). Indeed Islamic finance does not conceive money as an asset by itself, but permits to earn a reasonable return only if capital is invested in real economic activities and the financier or investor share part of the business risk. According to Segrado (2005) debt arrangements are not allowed and fund providers are considered investors (with profit and risk sharing) rather than creditors (with fixed return guaranteed). Following Khan (2008) the ban of interest is a way to establish an economic system where "all forms of exploitation are eliminated." Another important principle is the prohibition to earn profit from speculation (Allen and Overy 2009) or from any business activity where "monetary gains are derived from mere chance, speculation and conjecture" (Segrado 2005). Under Islamic Law, certainty of terms and conditions is a key requirement in any transaction, though a degree of commercial uncertainty is allowed (Allen and Overy 2009). Islamic lenders have developed different lending methodologies; the main ones are Mudaraba, a methodology similar to the Western style limited partnership; Musharaka, close to a joint venture, an equity participation in a business venture; and Ijarah, akin to the Western idea of leasing (Khan 2008; Segrado 2005). Other two methodologies are Murabaha and Qard Hasan that will be explained more in detail in the next paragraph due to their adoption in the models proposed.

5.3 Poverty Reduction Model

The main objective of the "Poverty Reduction Project" is the alleviation of poverty through the provision of microcredit services to assist in the development of income- and employment-generating activity. These loans are addressed to micro- and small enterprises located in the Walled City of Multan. The second aim is to enhance the livelihood and housing condition of the people by the promotion of healthy lifestyles, housing betterment, and enabling citizens in getting private connections of basic utilities (as water supply system or sewerage system). It is hoped that this will contribute to improve the economic and social welfare of participants, their families, and the local community. Being Pakistan a Muslim country, it has been proposed to develop schemes of microloans that do not limit the access due to cultural and religious norms.

The target market of the "Poverty Reduction Project" includes ultra poor, poor, and vulnerable people. The latter category is included inasmuch as small changes of income may influence their poverty situation drastically. The purpose is to prevent vulnerable people to fall into poverty and help poor people rise from poverty by providing microloans and training programs in order to foster citizen empowerment. The research has identified the need of widened credit access to run income-generating activity of any scale and sector in the Walled City of Multan. The need of credit is particularly high in such area (Walled City) inasmuch as this is a very productive zone, with a wide variety of business activity from the jewelers to the street vendors. Furthermore applied research in urban planning (Davis et al. 2008) has revealed that the poorest households, in many countries, pay more for water and sanitation services. Due to the lack of service coverage, poor households must rely on labor-intensive alternative, such as tankers and cart vendors, paying prices until 20 times higher as compared to households with network connections (Davis et al. 2008). The lending methodology proposed to serve such clients is the *family loan* developed by Akhuwat and based on interest-free loans (Qard Hasan).

In order to meet the financial needs of people living and working in the Walled City of Multan, three types of loans are proposed to start the "Poverty Reduction Project."

Business loans are thought for establishing a business or expanding an existing one. It is the most common type of loan offered for managing a business and purchasing new assets, working capital, and machinery.

Infrastructure loans are offered in order to promote private connections to water and sewerage systems but also, if needed, to gas supply system or electricity network. Such loans can have a great impact in terms of environmental betterment and social inclusion, thanks to the positive externalities they produce.

Housing loans are for necessary renovation of houses in the Walled City including construction of rooms, roofs, and walls. The house renovation can have positive influence on borrowers' income capacity for many reasons.

The selection of local partner is a key factor for the success of microcredit system. Akhuwat's mission is dedicated to improve the life of the people who is economically disadvantaged, neglected, and often marginalized by society. According to Akhuwat, microcredit is a means to an end for a "vibrant economically strong society based on sharing resources" (Akhuwat 2008). Akhuwat was chosen due to the principles underlying its methodology. The provision of *interest-free loans* to the economically poor derives from the practice of Qard Hasan (helping someone in need with interest-free loans is preferred over charity). Such loans are nonprofit and borrowers should only repay the principal or at most the costs of disbursement incurred by the lender. In practice, Akhuwat charges only a membership fee of 5 % of the loan amount, extremely low compared to the average interest rate of 30 % usually charged on microloans in Pakistan (Munir 2012). "Akhuwat strives to mobilize all members of the society to play their part in poverty alleviation" by fostering a *spirit of volunteerism* to create a system based on mutual support. The contribution can be in the form of "resources, knowledge, skills, energy, or time." Once ex-borrowers have gained enough economic stability, they are encouraged to make a donation to Akhuwat in order to widen the program outreach. This willingness and capacity of Akhuwat to sensitize borrowers on the importance of helping (fund) people in a solidarity manner (interest-free loans) sparks a positive circle of mutual self-help among citizens, generating benefits for the community as a whole. Akhuwat's financial sustainability does not depend on international funding; it raises funds from civil society. Last but not least, Akhuwat's model "institutionalizes the use of local religious places as centers for loan disbursements and avenues for community participation" (Akhuwat 2008). Use of religious places allows Akhuwat to minimize operational costs and increase transparency, accountability, and people awareness (Akhuwat 2008).

By the development of family loans, Akhuwat demonstrates that it is possible reaching very poor people also through individual lending methodology. The key steps of the lending process are program introduction, individual selection, preparation of business plan, credit appraisal, guarantors of loan, disbursement, and recovery. The use of guarantors and public repayments is a simple way of maintaining peer pressure, in the absence of joint liability (Armendáriz and Morduch 2005). Each borrower who joins the program has to pay a membership fee of 5 % of the total amount and subscribe an insurance of 1 %. Family loans given by Akhuwat are cosigned by the male and female head of the family. Income from this business is jointly shared by the whole family. Akhuwat believes in strengthening family unit as some studies show that separate loans to male and female may result in tensions in the family and hence may cause disintegration of this important institution (Akhuwat 2008). The proposal is to replicate and diffuse Akhuwat's model because it has shown to be socially oriented and particularly successful in Pakistan context. Akhuwat's emphasis in replicating the model, by providing training to the local staff, helps in setting up a new branch, acting as monitoring organization. Akhuwat deems that success depends mainly on "how widely the model is replicated and how effectively and efficiently poor are served" (Akhuwat 2008).

5.4 Handicraft Model

The mission of the "Handicraft Model" is supporting, aggregating, and promoting best practices of Multan handicraft production for exporting opportunity.

The target market is comprised of craftsmen operating in three sectors: jewelry, blue pottery, and textile, identified as the most promising ones in terms of either product quality or production techniques. Craftsmen must have 5-year experience in their sector and be located in the Walled City of Multan to be eligible. Selection criteria are based on technical skills and quality production, not on socioeconomic conditions.

The "Handicraft Model" is a multidisciplinary model developed by three research groups of the Multan Walled City Project: fashion design, entrepreneurial relationship, and microcredit (see Chaps. 6 and 7). In order to ensure high-quality production, the fashion design group provides technical support and training, microcredit disburses loans to craftsmen for enabling the expansion and improvements of their production means, and the entrepreneurial relationship group contributes in the development of export opportunity through the research and the establishment of marketing channels between Western market and Pakistan. In this context, the model valorizes the existing production and through the training and technical support strengthens it in order to create a complete product portfolio of high quality. Such model is a multidisciplinary framework to support and promote entrepreneurial activities with specific focus on arts and crafts. If located in the Pakistan Italy Resource Center (PIRC) (see Chap. 20), the model could turn into a multiple service center for supporting craftsmen needs in developing their business activities. The services offered might vary from loan provision and technical support to ICT technology support and marketing promotion.

Craftsmen would be supported and advised by experts in seeking out the most suitable solution in terms of appropriate technology.

The lending methodologies proposed to run "Handicraft Model" is Akhuwat family loans coupled with Murabaha model instead of Qard Hasan. Murabaha is the most widely offered Sharia-compliant financial product (Khan 2008). Murabaha consists in the resale of a good after adding a specific profit margin ("markup") by the lender to the borrower who agrees to buy that commodity for the new offered price (Khan 2008). The markup is for the services that the lender provides: searching, purchasing, and delivering the required goods. Clients served by the handicrafts model are not poor people but rather small entrepreneurs and will be charged to the borrower the full cost of loan provision, through markup application. In this context the use of Murabaha delivery model creates some benefits; small entrepreneurs are supported and advised by experts in choosing the most appropriate solutions to satisfy their specific production needs. This consultancy is very valuable in order to ensure, among entrepreneurs, either homogeneity or high-quality level. From this point of view, the high initial costs of searching, purchasing, and delivery of the required goods are considered as part of consultancy service. In the presence of higher transactions, it is possible to standardize potential purchases creating a catalogue of the most suitable production means to fulfill the quality standard established. Standardization allows to exert bargaining power with supplier to get lower prices compared to those achievable by the craftsman in case of single purchase.

5.5 Project Synergies

The microcredit system is part of the wider project called "Sustainable Social Economic and Environmental Revitalization in the Historic Core of Multan City." Such project is composed of twenty research modules, among which microcredit is one. To enhance the impact of the project, different synergies and collaborations were developed among the research modules. The decision to provide *infrastructure loan* was developed to harness synergies between microcredit and the module that operates on the construction/rehabilitation of public parts of several infrastructures. To maximize the impact of the project, it was argued to fund household private connections by providing microloans to poor families living in the Walled City. The second synergy consists in the provision of *house loan*. House renovation may have positive influence on borrower's income capacity. House loan creates continuity with the urban revitalization module by improving life's conditions in Multan Walled City. The module working on *capacity building* could contribute to run training programs needed to support and empower borrower's capacities. Another module has the task of building the "Pakistan Italy Research Center" (PIRC), where the office dedicated to microcredit will be located in order to reduce operational cost and maximize accessibility, especially to women. Last but not least the *Handicraft Model* was developed, a multidisciplinary model where three research groups are involved: fashion design, entrepreneurial relationship, and microcredit. The main objective is supporting, aggregating, and promoting best practices of handicraft production. The skills combination among these three modules could create a powerful synergy toward a real and competitive development of the handicraft production in the Walled City.

5.6 Conclusion

In Pakistan more than 80 % of microfinance loans are lent through group lending methodology. Despite its diffusion, many authors argue about several inefficiencies nested in such methodology undermining its effectiveness. Following Hussan-Bano (2009), across the province of Punjab, 70 % of microfinance borrowers have parallel loans; among them the typical borrower has taken more than three loans simultaneously. Despite that many factors influence such phenomenon, the mismanagement of group leader role seems fundamental (Hussan-Bano 2009). Moreover, group loans are characterized by low flexibility of the loan timing, fixed amount, rotating access to credit, etc., potential hurdles for business development. Akhuwat has phased out group loans (since 2006) because group leaders were found to manipulate position and extort money. Most group members were selected on the basis of their popularity in the locality and not on their genuine need for credit (Akhuwat 2008). In urban context as the Walled City, social ties are not necessarily high, hampering group loan adoption. Family loans present innovative features to better fit people's needs and strengthen family units. In this context the implementation of interest-free (family) loans is an ambitious solution toward poverty alleviation. Akhuwat has developed an innovative and successful approach to microfinance. It is characterized by a very high operational efficiency (costs/loan amount; 7.13 %) and reaches financial sustainability in an innovative manner: transforming ex-borrowers into donors. Donations rely totally on trust and are made by citizens sharing Akhuwat's principles and methodology. From a technical point of view, ex-borrower donations can be considered as voluntary loan repayments not in terms of principal costs, already repaid, but of additional delivering costs to membership fees. Only if the ex-borrower gains enough financial stability the donations can be made. This mechanism is results oriented toward poverty alleviation and it is simultaneously effective and efficient. Akhuwat's business model, based on the provision of interest-free loans, is an undeniable social innovation. Akhuwat strives to mobilize all members of the society to play their part in poverty alleviation in order to create a "vibrant economically strong society based on sharing resources" (Akhuwat 2008). The valorization of Akhuwat's model and its expansion will enhance social and economic welfare of participants.

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Chapter 6
Strategic Analysis on the Multan Handicrafts

Giovanni Maria Conti and Anna Sara Zanolla Mancini

Abstract The research programme proposed focuses on the territorial dimension as an asset able to act for the preservation, the valorisation and the development of the local culture, supporting and improving them. In the last few years, the importance of the territorial values of a specific region, restricted or intended like a macro-continent, becomes the strategic level for the creation of international and multilateral projects which the university confront itself with.

Pakistan, and in this specific case Multan City, is undoubtedly one of the Middle East countries that better represents the new challenges about the social, cultural and economic hybridisation, for all those Italian companies that want to approach to these markets and vice versa. This great interest originates from the fact that the historical textile tradition, as other handmade works as accessories and ornaments, and in general the handicraft products today become an added value and a potential factor of diversification in the complex *fashion design* landscape.

During the research, the aim was to understand more thoroughly the characteristics of Pakistani crafts, especially inside the Multan area: in this case, through a field research, the staff did a survey to understand which are the typical products sold there; the raw materials used to make them; the shapes, the colours, and the functions that they have; the resources that Pakistani territory has; and where they are sold (markets, handicraft shop, malls, etc.). The results of these activities define a common development strategy for the handicraft field as textile, jewellery, blue pottery, shoes and so on.

Pakistan is a country considered wrongly, in handicraft field, a delocalisation border, since it is possible to find affordable workforce. It is, instead, more interesting to consider the potentialities based on the great tradition and know-how for the creation and production of high-level handicraft products. For example, Multani textile tradition has very ancient roots and its quality enhanced by fancy materials, bright cotton and patterns that show unique visual suggestions. From this

G.M. Conti (✉) • A.S.Z. Mancini
INDACO Department (Industrial Design Arts and Communication), Milan, Italy
e-mail: giovanni.conti@pdimi.it

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analysis, it emerged that from the design point of view, the actions on the handicraft sector together with Pakistani institutions would have involved two paths: the first pertains to the product innovation for its valorisation; the second aim was about the product communication for its promotion with the final goal of connecting the local craftsmen/artisans with the global market through digital and real platforms to build strong relationships with the Western partners.

In some way, research activities should be focused on the development of handicraft products that can preserve the tradition quality, working on performances, on functionality and on process efficiency, with the aim not to propose affordable but high-quality products, following sustainable development models even on the social field.

At the end of the research period, together with microcredit and entrepreneurial relationship teams (see Chap. 6.6), a handicraft system model was elaborated to be activated in the PIRC.

6.1 Textile Traditions and Fashion Design

Human reactions to an object are complex and determined by different factors. Some of them come from within the individual, from his or her personal experiences.

Every design object is destined to prompt in its user a certain behaviour, therefore an experience.

There are three levels of design: visceral design, behavioural design and reflexive design, each of them with a distinct role in the shaping of individual experience: visceral design concerns immediate reactions linked to human nature. It is fully based on the immediate emotional impact. Behavioural design is based on use. Appearance is not very important; what counts is performance. Tactile and sensorial perceptions are crucial elements for a behavioural judgment of products. Men are biological beings provided with body, arms and legs. A great part of their brain is occupied by sensorial systems that are constantly engaged in exploring and interacting with the surrounding environment. Finally, differently from the other two kinds of design, reflexive design is linked to the message, culture and meaning of the objects and to the personal memories they evoke. Reflexive value goes beyond behavioural factors, because products can be more than the sum of their functions. Their true value consists in answering people's emotional needs.

Attraction is a visceral phenomenon; beauty comes from a reflexive dimension and from conscious experience. Therefore, it can be claimed that every object has a soul, no matter if it is real or not. Every object has a value attributed to it by those who use it and by those who created it. The latter, in particular, leave on the object a permeating, unique expertise. This is the soul that makes the object “live”.

6.2 Design for Innovating Tradition

By introducing objects into the world, design participates in the planning of culture. Therefore, the history of designed objects becomes the history of culture. A functional object is, by its own nature, multifaceted, elusive and full of meanings. Throughout time, every object has had different meanings connected to its origin.

Today, innovation is a transformation in the way problems are thought of. If in the past innovation could have been a change in colour or in shape, nowadays innovation means researching and experimenting on new materials. This can be done through new technologies or by recovering sartorial techniques specific of a given sector. Above all, the contents of a project are not limited to material products.

A project is a primary activity with capillary ramifications in all human activities. As a consequence, it does not belong to any specific profession. Regarding the world of objects, the most urgent question concerns objects' future or the future of design and its social role.

In this context, design becomes a necessary interface between tradition and modernity. The role of design is important in order to make craft production more contemporary.

The capability to build connections and to coordinate different multidisciplinary actors throughout the development of new products has always been a winning characteristic of the design profession. In history, designers have always demonstrated to be able to be "mediators" between producers and consumers, "catalysts" of multidisciplinary experts and "facilitators" of relationships between companies.

The capability of a designer is that of interpreting needs and transforming them into answers that must inevitably merge with the capability to interpret cultures; capture values, signs and traditions; and transform them into innovative consumption solutions.

The globalised contexts, where once the lack of design and production competences spontaneously gave birth to new supply chains, today need new tools for codifying and planning the correct connection strategies. The number of opportunities of connections and the velocity of creation and destruction of networks ask for strategic capabilities capable to build sustainable networks which can guarantee the mutual respect of values, stiles of life and social and cultural specificities of all actors involved.

This phenomenon leads us to reflect on the role of a designer in the construction of international relationships (networks), on the possibility to develop connection strategies guided by design actors and on the importance of determining a geopolicy of products.

6.3 Cross-Fertilisation for Design-Driven Innovation

This is why we talk of cross-fertilisation, that is, transfers of knowledge between complex know-how, operative methods and planning approaches. Cross-fertilisation is used to indicate interdisciplinary phenomena, relations/matching between different areas of human knowledge. Cross-fertilisation is a phenomenon that does not involve a defined discipline but rather the border that is generated between one discipline and another.

Cross-fertilisation has had its greatest implementation in scientific literature, within a social phenomenon in which the subdivision of knowledge into disciplines, thematic fields and areas of research is a fundamental principle. Here it has been noted that the opportunities for innovation increase as you move from the centre towards the edges of the same discipline and towards the "border zones". Scientific progress in the broad sense increasingly occurs within the overlaps of adjacent disciplines. This implies that the necessary fragmentation of a discipline into many subdisciplines can lead to intellectual stagnation in the centre, while on the edges the innovators are induced to exceed the limits of the discipline, thus encouraging the exchange of methods, concepts and theories (Conti and Dell'Acqua Bellavitis 2006).

What are "design-driven innovation transfer" projects? Who are the main actors of these projects and what are their aims? Design-driven innovation transfer projects are a "kit of actions" mainly offered by design institutions (universities, design centres, design associations, etc.) who have achieved a privileged knowledge in the field of design innovation and in particular have defined effective tools and methods for transferring this knowledge to communities of designers or of productive entities (enterprises or artisans). Over more design-driven innovation transfer projects (which we will call DDIT projects for simplicity) are generally led in territories in which a gap has been detected either in the field of design-driven innovation knowledge or in methods of transferring design knowledge from research centres to local productive entities or in both areas.

Even though there is a lack of literature in the field of the design discipline which defines these projects as part of the range of actions that can be led by design entities (single designers, firms or design institutions), the activity in this field has been ongoing ever since the birth of the discipline itself.[1]

[1] For further information on the pioneers of design innovation transfer projects: Bonsiepe Gui, Paesi in via di sviluppo: *La coscienza del design e la condizione periferica in Storia del Disegno industriale 1919–1990*, *Il dominio del design, Electa*, Milano, 1991, pp. 252–269; Bonsiepe Gui, Teoria e pratica del disegno industriale, Feltrinelli, Milano, 1975, p.70; Papanek Victor, *Design for the real world*, Thames and Hudson, London, 1972; S. Balaram, *The idea of Design. A design issues reader*, edited by Victor Margolin and Richard Buchanan, The MIT Press, London, 1995, p.200; *Industrial Design: Basic Guidelines for a policy of UNIDO*; Ahmedabad Declaration, 1979. Other materials developed in this field can also be found in works done by single design firms such as Chapman and Yamasaki, Joe Careiro and the Campana brothers (in South America) and by single designers such as T. Maldonado (in South America), W. Morris (in India), C. Eames

In the field of what is defined by the European community as transnational technology transfer[2] projects (TTT projects), there are new forms of actions which do not strictly concern the transfer of machinery or production processes but which aim to enable local productive communities to reach new markets through the start-up of innovative new product development processes. These actions aim to transfer know-how to communities of enterprises or single enterprises which give them the capacity and the tools to research strategic partners in other territories, develop new products and achieve a higher competitive value on the global market. Today, in the age of globalisation, these actions may have a more important role in creating new product development processes which no longer act on a local scale but involve the entire production chain distributed over a large range of territories all over the world. Within this new framework of global disseminated actors, one can agree that there is a common need for a reconfiguration of DDIT projects and the definition of new transfer methodologies which are able to combine different productive territories in the development of innovative solutions (Simonelli et al. 2007).

6.4 The Aims of the Design-Driven Innovation Transfer

The general aim of DDIT projects is to identify and plan research themes in collaboration with associations, institutions and entities in order to promote design as a competitive factor of the national economic system and to spread out design-driven innovation culture even in national and international manufacturing contexts focusing on the existing relationship between design and local manufacturing systems.

Briefly, the general activities developed up to today through DDIT projects can be summarised as follows:

- The promotion and planning of didactic and education activities in the design field
- The promotion of international events and confrontation/debate occasions on multidisciplinary fields linked to the design field
- The development of education and research projects with institutions and associations and, together, the promotion of design as a competitive factor for local economic systems
- The exchange of competences of university research units, through partnership or consultancy, for the development of specific projects of design innovation transfer for single companies or systems of companies, local manufacturing systems and industrial districts (Simonelli et al. 2007)

(in India), M. Bellini, E. Sottsass, F. Otto, J.L. Larsen, B. Rudofsky, M McFadden and C. Moore (in India).

[2] For further information about what is defined as TTT projects, read Identification of New Methods of Promoting and Encouraging Transnational Technology Transfer, SSA, FP6-2005-innov-7, INNOVATION-2005-1.2.3.3, http://fp6.cordis.lu/fp6/call_details.cfmCALL_ID=200

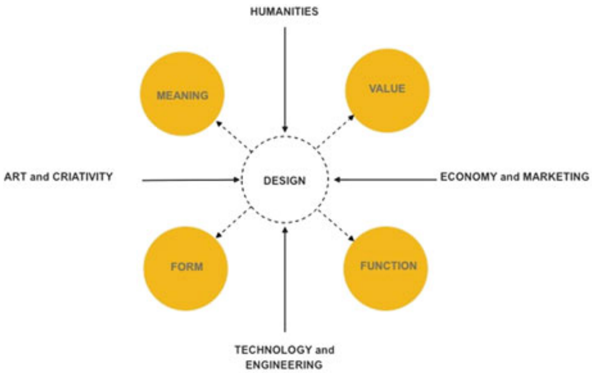

Fig. 6.1 Design as a hub: inputs and outputs of the discipline

In particular, the challenge of innovation design driven with design as hub (please see Fig. 6.1) are:

- Design is a natural carrier to discontinuity: it "breaks with the past".
- Design is the carrier of dynamic of innovations and contemporary vision.
- Design and its culture are a set of knowledge that make easier development of innovation.
- Design is a set of knowledge that promotes the integration of disciplines.
- Design is a mediator of interest among the consumer, business, environment, government, etc.

6.5 First Step of the Project: Searching for Reality

To help the productive Multani handicraft system in real terms, the research has been led through both a desk research and an on-field research.

From the desk research, the results of the survey suggested to us that Multani handicrafts are composed by:

- Multani Khussa (shoes)
- Embroidery work (by hand and by sewing machine), i.e. thread and Aar work
- Textile work (by hand loom and by weaving loom), i.e. carpets and home textiles
- Camel skin products
- Lacquered wooden products
- Blue pottery
- Gold jewellery

The aim of the first document has been to understand how it is possible to intervene with a design-oriented approach on existing products.

The goal was to understand and which actions to propose together with the INDACO (Industrial Design, Arts, Communication and Fashion) Department of Politecnico di Milano and artisans, accompanied by the relevant Pakistani institutions, might develop activities to redesign and promote Pakistani products in a way of "narration of the product". Furthermore, it is understood that the industry, which employs 13.2 % of the active population and represents the 25.8 % of GDP, has suffered a lot from damage caused by the flood and the frequent interruptions of electricity that have a significant influence on the slowdown of production (+3 %), compared to an average in the years 2001–2008 of 7 % annual growth.

In the face of sectors that have contributed positively to this modest result: automotive (18.2 %), leather (14.9 %), paper and paperboard (4.5 %), pharmaceuticals (3.9 %), chemical (3 %), industrial machinery and equipment (2.5 %), electronics (2.2 %) and textiles (1 %), other have had negative trends: non-metal minerals (−10.7 %), metallurgical industries (−8.7 %), fertilisers (−6.8 %), petroleum products (−4.8 %), rubber processing (−4.8 %), food, soft drinks and tobacco (−2.3 %).

In the textile industry, it still represents the predominant sector of the domestic industry with a contribution to 46 % of manufacturing output, almost exclusively cotton industry, which uses the local availability of abundant raw material. The sector is also work to 38 % of the workforce in industry and generates about 60 % of revenue derived from exports in Pakistani currency.

To revitalise the textile industry, threatened by competition from neighbouring China, Bangladesh and India over all, as early as August 2009, the Pakistani government has approved a package of measures (Textiles Policy 2009–2014) providing a budget of 42 billion rupees (about 360 million euros) to encourage investment. The elimination of customs duty on imports of textile mechanical stands out among the measures taken (Information based on AA VV 2011).

During the research on field, conducted by Anna Sara Zanolla Mancini, the aim was to understand more thoroughly the characteristics of Pakistani crafts, more specifically in the city of Multan. In this case, she came in contact with some institutions (PSIC, BZU and other ones); she did a survey to understand which are the typical products sold there, the raw materials used to make them, the shapes, the colours, the functions that they have and the resources that Pakistani territory has and where they are sold (markets, handicraft shops, malls, etc.). The results were transferred into the first deliverable, together with the final considerations, that summarise the importance to go in depth with the textile sector (both handmade, where it included the handloom, and the machine-made ways of producing textiles), the blue pottery one and the gold one. In particular, this last sector was followed by the researcher in mostly every step of the supply chain going from a laboratory to another, gathering information about extraordinary Pakistani potential in the gold market.

6.6 Second Step: General Aims, Specific Needs and Action Planning

From these two kinds of analysis above, it emerged that from the design point of view, our future actions on the handicraft sector together with Pakistani institutions would have involved two paths:

- The first pertains to the product innovation for its valorisation with the final aim of making the local craftsmen/artisans conscious of their skills, capabilities, peculiarities and unicities but also likenesses to improve, to valorise and to put in practice; in fact, it's important to make the Multani handicraft product saleable in the Western saturate fashion market. *To reach this first aim, the responsible for the research individuated three lines that are* **three levels of specific actions** in which INDACO (Industrial Design, Arts, Communication and Fashion) Department and the School of Design of Politecnico di Milano together with the Multani handicraft sector and BZU can work and collaborate:
  - *Training*: Firstly, it's important **to work with the private sector** (entrepreneurs, artisans, future professionists, future experts, future designers, associations, consortia, organisations, institutions as PSIC) and **from the other side, with the public sector**, that is, BZU (professors, researchers, PhDs, collaborators, technicians) and **train them through technical courses ad hoc**.
  - *Accompaniment*: For the private sector that is more conscious about its needs and lacks, the Italian technical and scientific staff will work with it giving technical support to specific projects.
  - *Consultancy*: For the private sector that is expert and wants to enlarge its capabilities and skills with another point of view.
- The second aim is about the **product communication** for its **promotion** with the final aim of **making in contact the local craftsmen/artisans with the global market through digital and real platforms**; in this case, it's important to work immediately to create a net of places, actors and tool here in Italy, linked with Multani handicraft sector, that can be a strong support to make the Multani handicraft product visible, sealable and available in the Western fashion market. This means that it's necessary:
  - **To innovate the communication** of the product (catalogues, websites, retail shops, etc.)
  - **To plan a series of exhibitions** in Italy/Europe to start to make Multani handicrafts and its specificities visible and tangible to Western people
  - **To build strong relationships with the Western press** that is a strategic filter
  - **To work together** with Pakistani handicraft sector, where part of it will **visit some planned Western fashion fairs, events,** etc. (Fig. 6.2)

This interdisciplinary model has been developed by three different areas of research and work, microcredit, handicrafts and design and entrepreneurial relationships, because, with different but integrated actions, actors, specific aims and methods, the three teams have got the same final aim: to build an innovated and international Multani handicraft sector.

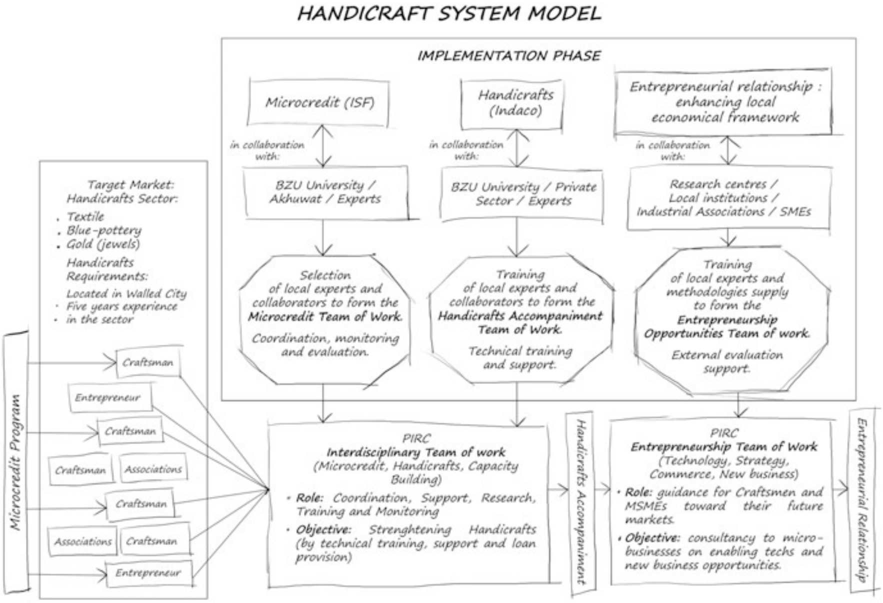

Fig. 6.2 Handicraft system model

6.7 A Common Mission: The PIRC

To realise this, the synergy among the three teams working together would build the PIRC as:

- The centre supporting and helping the actors of the sector in the future
- A multiple-service hub in which the trained (during the pilot project) local professional figures have the skills (economical, social, technical, technological, design, management, communicational, etc.) to support and accompany craftsmen, entrepreneurs and groups of them during:
  - The creative processes
  - The productive processes
  - The distribution processes
  - The communication/marketing processes
- An interaction point with spaces and technology at the service of the entrepreneurs where they can meet each others; share information, ideas and competencies; and hopefully mix and cross-fertilise them

6.8 The Model: 2 Time/Lines

The model is divided into two parts:

– The first part concerns the 30-month pilot project that sees the collaboration between the handicraft sector (from now, HS) and Politecnico di Milano.
– The second part is related to how the results of the pilot project (in terms of skills, trained actors, financial resources, entrepreneurship solutions and innovation) will work together in the next future after the 30 months.

6.9 The Implementation Phase: Specific Mission

The pilot project has a main objective to train actors from the private and the public sectors, with different actions explained below.

To realise this goal, the collaboration between the Multani community and Politecnico di Milano is the virtuous point: without one of the actors, the project does not find the right direction because of lack of the respective and peculiar resources, which are:

1. School of Design and INDACO (Industrial Design, Arts, Communication and Fashion) Department of Politecnico di Milano with:
   - Design strategy
   - Design vision
   - Design competences and skills (research, creative process, management skills)
2. Multani handicraft sector with:
   - Know-how—raw materials, local resources
   - People that want and/or need to be supported in specific projects or in the methodology to apply to the creative process

6.10 Target Market

The target market for the pilot project is strictly connected to the type of handicraft product due to its central and primary role as bearer of the material and nonmaterial values of the system that it has behind it (artisans, techniques, territory, culture).

The three categories of product that would be the object of the pilot project have been selected through these criteria:

- Products with strong Multani identity to be reinforced
- Products with characteristics that can go towards the Western taste
- Products that can be easily modified, adapted and cross-fertilised to meet defined parts of the international market. These are blue pottery, gold and textile sectors

Besides, entrepreneurs and craftsmen whom production falls within these three categories have also:

- To have their units as nearest as possible to Multan City (for the gold chain, it is easier, thanks to the already existing small workshops besides the shops in the gold market; for the textile chain, it is also possible; for the blue pottery sector, it would be more difficult due to the larger spaces requested to the production phases)
- To have an experience of at least 5 (five) years

6.11 Local Actors Involved in the Implementation Phase

The local actors involved in the implementation phase have to be divided into three different groups, with different tasks, roles and contents to learn:

1. Public sector or better said the education system, that is, the Institution of BZU:

   - Full professors, assistant professors, visiting professors (which often are also researchers and/or designers): Their purpose is to give specific design education to the students (future designers, researchers, professors, etc.). They will be trained about the design methodology and the whole creative process with specific courses in training and education design methodology through:

     – Theoretical courses (about design theory, design methodologies, design research, design processes, design-driven innovation, design culture, design practice).
     – Practical workshops with real projects where the private sector will be the experimental ground for the methodology to be put in practice. For example, after the acceptance of a specific request from an entrepreneur with a small unit that makes blue pottery objects, a team from Politecnico di Milano with some selected actors from BZU will work together on the projects, in some cases also with students. In this way in the same time, an accompaniment/consultancy action will be done, while the local actors involved will try to act with the methodology learnt under the guidance of the experts of Politecnico di Milano.
     – Seminars, open lectures and visits to specific fairs, events, the Salone del Mobile (in April in Milan), the Triennale (in Milan) and the Biennale (in Venice) would be planned in Italy as parallel sessions to experience the Western design context.

   - Researchers (that often are also professors): Their aim is to research about possible scenarios and future scenes of the consumers, the global market, new emerging productive processes, etc. They will be trained together with the professor category but with specific courses in research design methodology.

- PhD students: They are a very important resource for research (applied or not). The PhD degree is the highest academic degree awarded. To plan a specific PhD path for the project programme could be a unique occasion for all the parties. For example, the doctoral programmes of Politecnico di Milano aim to develop the professional competence to carry out high-level research in manufacturing and service companies, public bodies and universities. The doctoral programmes provide a selected number of highly qualified graduates, endowed with a solid preparation and keen intellectual curiosity, with the opportunity of acquiring a high degree of professional expertise in specific scientific, technological, social and economic fields. PhD graduates not only are capable of carrying out research projects but also develop, during their period of study, new knowledge on scientific frontiers that can be immediately applied in professional activities. For these reasons, PhD students could be involved as junior researchers with specific surveys to conduct (i.e. about a particular technical process or about innovative solutions for a product) and consequent innovative visions, connections and small projects.
- Students: During the pilot projects, some students would participate to some specific projects with the team of Politecnico di Milano and the professors/researchers involved; proceeding in this way, while professors learn how to teach, the entrepreneurs and craftsmen will have their specific consultancy. Students can be part of the pilot project also through contests formalised by BZU and Politecnico di Milano, in which they can propose solutions for a specific issue.

2. Private sector as "subjects":

   BZU alumni, general actors that already studied design and professionals that work in associations, consortia and institutions related to the handicraft sector: They will be trained through general courses and workshops (as seen above) to make them become new professional figures as consultants and technical design experts.
3. Private sector as "objects":

   The pilot project will give technical and strategic support to entrepreneurs, craftsmen or groups of them (consortia, associations, institutions, etc.) as occasions for training the other actors above.

   In fact, the 30 months in collaboration with Politecnico would bring competences to the selected people through practical projects. Once this complex set of actions is completed, the new professional figures are ready to support and accompany in the future the actors of the handicraft sector that will apply for help or consultancy requests.

   About the numbers of subjects and "objects" involved, the selection criteria are to be decided in the first step of the implementation phase and cannot be foresee right now.

6.12 Actors Involved from Politecnico di Milano

From Politecnico di Milano, some experts will be invited to take lessons, courses and open lectures. They would come from INDACO (Industrial Design, Arts, Communication and Fashion) Department and would be full professors, assistant professors and researchers.

The precise number and the specific areas of interests would be decided during the first phase of the pilot project, in the service of the needs requested.

6.13 Result 1: New Professional Local Figures

The main result of the pilot project is the human trained resources: people are the difference if they have the capabilities and the competences and if they developed their skills.

Through different ways of transferring the design-driven vision and strategy, the new professional local figures will have got different tools and methods to apply to real cases and practices.

The design workshops will give practical results that will be immediately usable by the entrepreneurs and the craftsmen in their everyday work, and in the same time they will train people.

6.14 Result 2: Figures Getting Together

When local figures will be ready to operate on the territory, it is necessary to create a conceptual hub of them: accentered always in contact, they can go on in collaborating.

For this reason, PIRC is a very important part of the pilot project.

Built or not, real or virtual and temporary or permanent, it does not matter: as we discussed during our presentation at the meeting of July 5, 2012, at our School of Design, the force of PIRC is in the human resources that are connected and linked to each other.

Obviously, if PIRC will be a real space, it has to be in the Multan City, near the units.

6.15 Result 3: The Model as a Method

The accompaniment and consultancy actions, tools for training the local actors, will make a methodology emerge that would be a mix between that thought by Politecnico di Milano and that of the local system: this set of tools and methods, after the 30 months, can be applied to other typologies of products and production chains, as important as the three we selected (e.g. the camel skin objects, the typical shoes, etc.).

6.16 The Future After the Pilot Project: The Handicraft System Model Regime

PIRC as the practical result of the pilot project will have inside a specific design area. This part, integrated with the microcredit experts and the entrepreneurial relationship professional, will have as primary objective the diffusion of the research in the field of design with constant application to specific projects of accompaniment and consultancy. The design actors inside will present themselves as authorities aimed at the promotion, communication and experimental design for the protection of the activities of design and manufacturing process. The design area of PIRC will serve as the promotion of domestic products by taking advantage of institutional funding: it will dispense basic services offered to design both activities (training courses, forums, seminars, competitions) and some areas of corporate action (planning, research, analysis, databases). The typical form of incubators as PIRC is nonprofit cooperatives or associations. Inside the design hub and incubator (from now, DHI) can rise to the incubator design: a place dedicated to the design with the aim of fostering interdisciplinary innovation (technology, art, economics) and involving young designers in entrepreneurial projects.

As may be seen clearly in the figure, the main actors for the realisation of a DHI are basically two:

- The design community of a group of design professionals (professionals, researchers, teachers)
- Public institutions that act as lenders of the initiative

Once set up, the operational structure is added to the project of other secondary actors, such as companies that fund individual initiatives or some sponsors to carry out the projects.

The DHI of PIRC proposed for Multan will operate as a nonprofit association or consortium and in close collaboration with the institutions. In particular, the DHI of PIRC, advanced and international, will be organised as a complex structure, an integrated system which manages a network of academic and professional institutions and businesses and spaces to accommodate different activities and services tailored to the needs of businesses and professionals.

In particular, the agency should include:

- Activities related to training courses to be channelled through master and advanced courses with topics in design area, economics and microcredit, marketing, etc. with the aim to know and understand:
  - The socio-economic projects for innovative design
  - The potential of technological innovation in order to improve the quality of the performance requirements of products
  - Plans for specific products in different fields of application design.
- In this case, the strategic connection with the BZU and its faculty with a permanent relation with the Italian design faculty will be important.
- Activities related to research and development of new products to improve the living conditions in respect of traditions and cultural contexts and environmental sustainability or to build the Multani identity and to experiment new "brand strategies".
- Activities for experimentation aimed at innovation and production. The centre can be imagined as a laboratory, a real incubator, where professors and students, young designers and established designers with artisans experiment with and develop new ideas and new services for enterprises, institutions and professional and research centres.
- Activities related to the organisation of events, international competitions as well as the publication of monographs, magazines and catalogues.
- Activities related to promoting individual artisans or associations to promote excellence and creative ability, developed through various actions, such as the presentation of new products, business meeting and thematic workshops.

6.17 Objectives and Services Provided by DHI at PIRC

In particular, the DHI PIRC will pursue the following objectives:

- Diffusion of design culture within the local–global production systems
- The promotion of knowledge on innovation and local production
- The protection of handicraft
- Research and experimental design for process and product innovation
- Awareness to environmental and sociocultural contexts of design choices in reference
- The promotion of national products to the outside
- Creation of new brand strategies
- The establishment of a national recognisable styling (Multani identity) and high value added

The key service areas offered by the DHI at PIRC are the training, valorisation, experimentation, production, information, promotion and consultation.

In particular:

6.17.1 Training

The DHI of PIRC will carry out training services. An important area is that relating to technical design preparatory culture. The goal is to operate on different levels of expertise; training is given to artisans, designers, technicians and contents range over all matters relating to the design, planning and corporate culture.

6.17.2 The Experimentation for the Production

The DHI of PIRC will also play the role of incubator for innovation in process and product, configured as an "experimental environment protected". The centre will be a place to create research partnerships and plan for the artisans, associations and local institutions aimed at developing "virtuous" innovations.

6.17.3 The Consultancy

The DHI is responsible for creating networks among designers and artisans to develop new products. In this case, it is possible to argue with short-term actions and long term.

The DHI at PIRC will promote and host temporary, permanent and itinerant exhibitions and become a place of Pakistani culture but also an area of multicultural exchange, promoting training activities with an outstanding institution as BZU of Multan.

It will be an opportunity and a "window" for Pakistani artisans and especially an opportunity for designers around the world to deepen their knowledge of a national reality—complex and growing exponentially—working jointly on the development of Italian and Pakistani.

6.18 Human Local Trained Resources in the DHI at PIRC

The link between the pilot project and the future of the handicraft sector after the next 30 months is the human local trained resources that craftsmen and entrepreneurs can find at design hub and incubator at PIRC.

The numbers of permanent people can only be hypothesised: two technical professionals could be an optimal number; obviously, thanks to an informatisation of the sector, the net made by the other figure will be available to meet, discuss, train, teach, support and help. As can be seen in Fig. 6.1, ideas, meetings, exchanges of visions, competences, etc. can be transmitted from person to person but also through a digital way as Internet offers.

Every need is a case apart and will have its specific solution through the most adapt tools for the transfer of the contents and the methodology.

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Chapter 7
Entrepreneurship Collaboration, New Business Models and Firm Creation: Enhancing Local Economical Network

Paolo Vercesi, Ion X. Monjas Kanpandegi, Riccardo Vecchiato, and Renato Pugno

Abstract Collaboration is a reference point for both Milan and Multan business environments, as far as they want to achieve a stable growth and competitiveness. A credibly proactive collaboration model means that all local stakeholders have to share a vision of the real possibility to transfer experiences and to implement a growth path, made by innovative steps. Transferring experiences needs a partner who wants to share all the practices that can be adapted to another framework. On the other side, there should be the commitment to provide resources, to involve partners and to motivate people; innovation does not come in a blink of eye and is an inspiration that becomes a transpiration.

Business model is not the business itself but is a way to design and simulate the interaction between main parts of the business. When it comes to transfer our experience into a foreign environment, we must align which are the likenesses, which things are deeply different and which elements must remain unmodified with their specific and brilliant tonality.

The starting point of the reflection proposed in this chapter rests on the idea that Italy and Pakistan and Milan and Multan share a vision: the aim to be the referring centre of the area for old and new businesses, an economic system that needs to change and grow to survive a challenging worldwide arena and, at the same time, keep safe and continue to exploit the traditional ability and creativity of businessmen, entrepreneurs and artisans. How do entrepreneurs imagine their organizations and the corresponding business models, 5 or 10 years from now? Reasonably, Milan

P. Vercesi (✉)
Fondazione Politecnico di Milano, Milan, Italy
e-mail: paolo.vercesi@polimi.it

I.X. Monjas Kanpandegi • R. Vecchiato
Department of Management, Economics and Industrial Engineering, Politecnico di Milano, Milan, Italy

R. Pugno
ABC Department – Architecture, Built Environment, Construction Engineering, Politecnico di Milano, Milan, Italy

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and the whole Lombardy region have passed through the necessity of repositioning the entrepreneurship system into an intensely competitive landscape and had to cope with the redesign of firm and institution collaborative model; should this effort fit Multan requests of improvement?

On field experiences, methodologies and technologies can force a resilient traditional economy to move further on this evolutionary pattern; whichever will be the destination point, local institutions should help and orient enterprises, the smaller they are, to undertake the necessary efforts to remain in a continuously changing market.

7.1 Introduction

To assure the economic sustainability of everyday living and producing in the Walled City, we designed our projects of its urban regeneration trying also to stimulate and encourage new independence to the beneficiaries of our project, giving particular attention to innovative human resources and creating a new Italian–Pakistani entrepreneurial relationship to enhance local economical network; these planned progresses are crucial point for the success of the project, as they aim to guarantee the availability of the resources required to the maintenance of the used historical assets of the Walled City.

The topics and disciplines promising effective results are many, but we decide to focus our attention on four industries, agrifood, gold and jewels design and manufacturing and pottery, as they have been a field where Lombardy has experienced the importance and power of maintaining traditions whilst innovating processes and made an evolutionary step from an artisanal concept of business to a more powerful presence on the international market via a firm-institution network connections, brand creation and digital economy.

7.2 General Economic Overview

Pakistan is the biggest multilateral development partner of Asian Development Bank. ADB has assisted the Government of Pakistan in undertaking critical economic and governance reforms in the last decade, which contributed to steady economic growth and boosted spending on poverty reduction programmes. Similarly, the World Bank is currently working with the Government of Pakistan to prepare a new Country Assistance Strategy (CAS) for the period 2010–2013. During the past 4 years from 2006 to 2009, the World Bank has approved 30 projects of total US$3.7 billion for Pakistan. Also Pakistan is ADB's largest recipient in both number of loans and volume of assistance received—over $19.8 billion in loans to fund development from hydroelectric projects to banking for the poor, with about $14 billion disbursed as of the end of 2008. A record-lending programme in 2008 included $1.9 billion in disbursements and $1 billion in newly approved assistance.

Major Pakistani industries, with a considerable growth and investments, are the following sectors: automotive, telecommunications, information technology, oil and gas, food and beverage, financial services, infrastructure development and engineering consultancy, education and training and power generation. Following the liberalization of markets and the implementation of economic reforms, the following developments in the economic and social sector have been identified: high GDP growth resulting from output and sales growth, monetary stability, developments of money and securities markets, improvements in the standard of living and poverty reduction, development and reinforcement of the banking sector and enhancement of its role in the social and economic development of the country. However, the economic development has been slowed down since 2008, as the macroeconomic situation deteriorated significantly owing to adverse security developments, large price increase of some commodities such as oil and food, global financial turmoil and national political issues. Other challenges being faced by Pakistan's economy include energy deficiency and growing population.

Pakistan's major exports consist of five items (cotton textiles, leather, rice, synthetic textile and sports goods). These five items account for about 70 % share in the total exports. Intensity of concentration further deepens when analysed within these five export items, as above 52 % contribution in the total exports comes from cotton textiles. The composition of export markets remains fairly concentrated, as about 40 % of Pakistan's exports are destined to seven major markets (USA, Germany, Japan, UK, Hong Kong, Dubai and Saudi Arabia) and the remaining exports' share of 60 % consists of all other countries.

Pakistan's major import groups include food, machinery, petroleum, consumer durables (electric machines and apparatus, road motor vehicles, etc.) and raw materials (chemical products, iron and steel and scrap, plastic material, fertilizer manufactured, insecticides, silk yarn, synthetic fibre and raw cotton). Most of imports in the country are concentrated in few numbers of markets in the world, namely, Saudi Arabia, Kuwait, Malaysia, USA, Japan, Germany and UK.

An important role in the export value is also represented by the food and beverage industry, where rice has the main role, but fruits are considerably an interesting value added industry. But so far, particularly even for the mango, an example of excellent local product, not the whole value that is captured.

7.3 Evolution in Agriculture: Innovating the Mango Chain

In Pakistan, processing of vegetable and fruit products is a viable and profitable business opportunity that is yet to be fully exploited. Currently, growers are not familiar with latest processing techniques that can add value to the products and bring lots of foreign exchange through exports. Introduction of such facility can increase the income of the growers and exports from the country. Based on consultation/feedback of stakeholders in general and Mango Growers Association (MGA) in particular, SMEDA took initiative and planned to develop a common facility centre in collaboration with Punjab Small Industries Corporation (PSIC), MGA and Multan Chamber of Commerce and Industry (MCCI) so that stakeholders may get benefit of value addition and contribute to national economy by earning better returns on indigenous agro produce. The project Agro Food Processing Facilities (AFP) is a non-profit organization aimed at providing processing facilities for domestic fruits/vegetables and guidance in latest processing techniques being used in developed countries. AFP would provide the processing facility for pulp extraction of various fruits like mango, guava, apple, etc. and vegetables like tomato paste/puree on state-of-the-art imported plant on nominal charges.

Multan old town revitalization project also includes several interventions in terms of urban planning, also comprising the proposal of developing an intermodal logistic centre in the Multan airport area. This is because the Multan area features a considerable production of perishable fruits and vegetables, above all mango, that require a dramatic improvement of the logistic system in general and of the "cold chain" in particular. Mango world production in 2010 accounted for about 31 million tons; production in Pakistan was, in 2008, equivalent to 1.75 million tons. Average yearly increase in mango production in Pakistan accounted for 8.1 %, thus an average yearly growth rate that is more than double than the average world one. About 95 % of production is for domestic consumption. Thus, exports just represent a 5 % of production; in 2008 they accounted for 90,000 tons. Mango fruit accounts for a 15 % of the horticulture's 5 % share to Pakistan's agriculture GDP. Mango farmer just takes a 12 % of the product's end value on the foreign market. A 27 % of the value chain certainly remains in Pakistan. Due to the highly perishable nature of the fruit and improper picking and handling, 20 % of the loss occurs at a farm level. The mango is then put into plastic baskets and transported to the processing plants in open trucks. Throughout this operation, at least 4–5 % of the mango is lost. At the processing plant during the processing, a 5 % more is lost. During transportation to the export destination, 6–8 % of the fruit is lost. So the total loss accounts for 40 %. According to the prices and costs we have considered, the value of mango production in Multan to be reached on the market is estimated at about 88.8 million euros (year 2008), considering that about 40 % of production is lost during the manufacturing process.

Mango produced in Pakistan is considered among the best ones. The possibility of meaningfully improving the present logistic system does not require any special investment and can be carried out in the short-medium run. Thanks to such improvements, product losses will be considerably reduced, as well as production costs, thus increasing profits. This way price competitiveness of Pakistan mango will be growing considerably. Changes occurring in world economy are favouring Pakistan mango manufacturers. In fact one of the reasons of the lack of export expansion was also the higher distance of rich markets (USA and EU) for Pakistan as against other big manufacturers (Mexico, Africa and Brazil). Over the last few years, there has been China's economic growth. China alone accounts for 12 % of mango import/export international market. Such a market, as well as the Japanese one and Arabian Emirates one, reaches 20 % of world import/export total. An increase of GDP in the Multan area of about 1 % can be forecasted, depending only on the mango export rise in this area.

The processors and exporters declare that there is no competitor of Pakistani mango all over the world. The condition to develop this potential is to make mango production and its marketing logistic system efficient, in particular by guaranteeing the "cold chain". This means to invest on refrigerated warehouses, refrigerated containers/trailers and handling equipment. The potential meaningful export rise in Pakistan and in the Multan district in particular has been highlighted several times by various recent studies. Starting from these studies, the responsible government authorities have decided to develop a refrigerated plant for goods storage in Multan airport, in particular for mango storage (but not only) for the export, since this product mainly travels by airplane to be exported.

7.4 Fostering a More Technology-Based Collaboration

A great sustain to the empowerment of the capacity generated by an entrepreneurial community, when it comes close to a more mature system, originates from the creation of a business momentum, more than from direct product exchange itself. For instance, a municipality area enclosing the craftsman ability to produce creative artefacts should work in a systematic stimulation of this creativity, offering new technologies and aggregate services to creative entrepreneurs. If an area encloses a lot of family-run microenterprises, the technology innovation process encounters difficulties to be encompassed in such economic framework. All the propositions are based on some assumptions that give us a picture of proximity between Lombardy and Multan entrepreneurial situations; we assume that, in general, enterprise systems are formed by entities with the following common features: they are micro; many are one-man band; the boss decides everything; many are family run; they often work out of the labour and fiscal rules; strong labour-personal life intersection; they are based on traditional distinctions; the chief knows in deep any singular phase of the process and of the local business; the chief knows a little of noncore technologies; none of them knows in deep potential effects and features of emerging technologies; leaders fear the leakage of position if they decide to move; many business are based on single-man creativity, but values come from manufacturing expertise; somehow, some of the leaders feel that there won't be a local market only, no more; they look at facts, but they take business decision on trust and personal feeling; and the system is populated by an aging society. Fostering the collaborative model means preparing a path, and it can be made by two phases:

- A medium-term RTDI (Research, Technological Development and Innovation) study, to define a growth strategy for MSMEs, based on a holistic approach and an enlarged collaboration analysis
- Focus on recognizable enabling technologies and existing industries, adopting well-known and already applied short-term plans

7.5 How to: Medium-Term RTDI

The number of enterprises connected to innovative products and new technologies has grown to number in the thousands, and here they find support in the prestigious research centres of Milan, known for their excellence throughout the world. These centres can be an interesting innovation, methodology and technology source also for Multan entrepreneurial system. From medicine to food farming, from transport to energy, from chemistry to microelectronics and from biotechnology to pharmaceuticals, the complexity of the Milanese research system manages to encompass every aspect of life. It does so by making the research sector cross-sectional. This collaboration scheme can be part of the transfer between Italy and Multan, in the way the Milanese research system responds to the needs of the enterprises in its territory. In the large scope of the Multan Walled City Project, Fondazione Politecnico di Milano aims at supporting the Regional (District) Government of Multan in enhancing the local entrepreneurship's framework, formulating and describing a study for its Research, Technological Development and Innovation—RTDI—strategy. The main goal is to support the local scientific and industrial systems to improve its competitive position at international scale in the main industrial sectors of the region, i.e. food, textile, goldsmith and pottery, through the development or the transfer/acquisition from external (Italian) partners of a few selected technologies. The rationale of this study is the need for a systemic and selective research and innovation strategy, which is targeted to the medium-term and long-term economic and industrial deployment of the region and involves all the relevant actors (local policymakers, universities and public research institutions, firms). The main objective is to evaluate the regional interest and the scientific and industrial feasibility of developing or transferring and adopting new emerging technologies in selected areas in order to allow public decision-makers and larger firms to set priorities, in a rational way, thus optimizing the impact of RTDI policies on the economic development of the region of Multan. The time horizon is 5 years, coherently with the usual strategic planning process of most firms and industrial partners. Initiators and supporters of the project should be the Multan Government (city district administrations); the chamber of Commerce of Multan; academic and public research institutions in Pakistan and Multan region (e.g. Punjab Small Industries Corporation, BZU, Textile Institute of Pakistan, National Textile University, APTMA, PYMA, Multan College of Arts, the Swedish Institute of Technology in Multan, Nishtar Medical College and University of the Punjab); banks and financial institutions of the Multan region; large, medium, small and microenterprises of the Multan region; Multan Walled City PMU; Politecnico di Milano; Milan research centres; Milan design schools and Milan technological firms. A steering committee, in which the above institutions will be represented, should guarantee the support from all the main local firms and academic and research centres of Multan. A task force, made up by experts within PIRC or a selected Pakistan team or if necessary by experts of Fondazione Politecnico di Milano and the Regional Government of Multan, will design the RTDI process, make the operational programming, coordinate all the activities, provide background materials and edit the intermediate and final reports. Local support is mandatory. The RTDI project for the region of Multan will be based on the following macro-organizational steps:

- Phase 1—selecting experts and emerging technologies
- Phase 2—evaluation of emerging technologies: collecting data
- Phase 3—evaluation of emerging technologies: elaborating results

The main methodological steps to be carried out in the RTDI project for the Multan region are as follows: selection of emerging technologies, potentially interesting for the agriculture and manufacturing sectors of Multan; definition of the evaluation criteria indicators of attractiveness and feasibility (positioning); synthesis of these indicators; cross-correlation of attractiveness and position indicators; evaluation of the indicators for each technology and design of the most appropriate R&D and innovation policies for the most promising technologies. The most relevant output of the project will be an action plan, detailing the ways to develop and use the technologies selected as the most promising for fostering the international competitiveness of the industrial system of Multan. Cooperation of all local stakeholders is needed and has to be based on a common vision of how the regional industrial system of Multan should evolve in the future.

7.6 Short-Term Plans: MSME ICT-Based Evolution

An interesting project carried out in Milan that can be replicated in Multan is the "Dinameeting ICT 1 year programme",[1] offered by Regione Lombardia. The idea was to extend the use of ICT to microenterprise and artisan system. Most of the entrepreneurs were not used to ICT, due to the aging of most of them and to the small dimension of their businesses. The main problem rarely relies on a lack of money to invest in their processes. The resilience was based on the difficulty to:

- Understand what can be done for their business with available ICT tools
- Select few (one?) main goal
- Which tools (usually hw and sw) fit the expectations
- A list of features not too big/not too small
- Who provides the right tools
- How much money and how much time will require the acquisition process
- Which competences are necessary within the enterprise
- Which infrastructure is necessary to make the tool working
- Go alone or aggregate
- Due diligence

[1] Information and a brochure about the project can be found (in Italian) at http://www.finlombarda.it/finanziamentieservizi/dinameeting

Regione Lombardia, via a tender process, provided a list and several experts that assisted the entrepreneur in solving above-listed questions. In Multan, the programme can be under the PIRC biz team guidance, based on Multan ICT student expertise, linking them to Italian students.

7.7 Short-Term Plans: MSME Growth Funding Support

Another practical idea to foster SME competitiveness can be to fund firms via two different streams, one supported by public economical resources:

- Public bodies, in partnership with universities, choose few sectors or enabling/advanced technologies to focus on and the amount of support (cash or service equivalence).
- MSMEs (in compliance with that focus) present a "request for support" declaring which technology, the supplying research centre or enterprise, acquisition costs, time planning and market expected result.
- Public bodies, in partnership with universities, perform an evaluation phase.
- MSMEs start the acquisition project and the body the economic provision and the other by private ones.
- MSME proposes to a credit institution a developing project that encompasses a new technology or methodology.
- The credit institution submits the technical part of the project to a community of experts.
- Experts feedback with an innovation ranking and some advisory suggestions.
- Based on expert ranking, the credit institution can lower the loan rate (maybe in agreement with a higher-level credit entity).
- The credit institution releases the credit.

7.8 Business Model: Supporting the Creative Industry

New approaches can especially dedicate to Multan younger entrepreneurial people, offering opportunities to creative-oriented and to third sector-oriented businesses. Giving a practical example, in Multan textile, pottery and jewel industries, creativity represents a good portion of the inner value. To steer and support creative industries, some steps can be implemented:

- Set in of a "creative contest" between young people (e.g. university or art school students) to present their innovative ideas on a traditional sector (e.g. textile, jewels).
- A committee (PIRC[2]) chooses the most interesting ideas.

[2] PIRC Pakistan Italy Research Centre; see later in this chapter.

- Winners are rewarded publicly.
- They can be hosted in a "creative" incubator or facilitate by other services (e.g. firm foundation, VC contacting, etc.).
- They can be linked to a "traditional" firm able to catch the market value.

Often the birth and growth of these microenterprises based on innovative business models do not require cash support only. They can be launched via services, like the ones described for the PIRC business team, also offering them:

- Spaces and visibility for product showcases
- Common access to technologies, production tools and machines
- Commerce and networking platform
- Simplification of start-up bureaucracy
- Coaching by champion entrepreneurs

7.9 Tools: Creative Industry Incubator

Multan creative entrepreneurs will probably express different needs, when they come from textile or pottery and if compared to Italian artisans. Despite the differentiation between and countries and among subsectors, some conclusions about needs expressed by interviewees in Italian survey seem to be clear, applicable across sectors and stimulating for the design of an incubator for CI (creative industries) in Multan. As regards funding which could be useful to all businesses, creative people do not think that this is essential for their profession, for the creation and growth of a creative business; the project deliverable about microcredit can be a reference to satisfy seed money requirements. Some considerations should be encompassed during the future design of an incubator for creative new enterprises in Multan, to re-evaluate the type and mode in which the support services are supplied, which does not need to be focused on the supply of permanent space (standard incubation) for production sites but rather of:

- Spaces like showrooms for design and fashion, in Multan's most prestigious areas, flanked by suitable advertising campaigns, in order to continuously attract buyers, web and journalists. These spaces can be allocated in different places such as hotel, airports, stations, Multan trendy city areas (or projected to be) or other popular city spots.
- Production studios set up for "video, advertising and games" subsectors; post-production is carried out with specific instruments, but which have a reasonable cost, whilst products require centres which need to be set up and used over a relatively brief period of time.
- Networking platform for exchange and acquisition of noncore competencies.
- Hub which distributes digital contents, based on captive market models. Often single creative people or small firms deliver intangible products, which can be distributed digitally (see applications for iPhone, Android Market or other possibilities like the network of platforms for web games). A young Multan

Fig. 7.1 The creative hub, a model to connect resources

creative entrepreneur must start thinking about interactive models for the creative user without the use of physical support in the individual steps in the value chain.

- The grouping between individuals and small businesses is necessary in order to grow and is possible only if supported by public or private intervention.
- Mentoring, in particular in the phase from start-up to stable business, is essential but impossible and difficult to receive from experts in the field; as far as this expertise is difficult to find in Multan district, a strong link to PIRC biz team is advantageous.
- Marketing, branding and the sales network are weak points in the chain of value for the SMEs in the sector.
- Even free or low-cost spaces can be attractive, but best effects will be obtained if this "service incubator" offers Multan resources as a hub of services and facilitations for new entrepreneurs. Follow a scheme for this Multan creative hub (Fig. 7.1):

7.10 Italy–Multan Cooperation: PIRC, a Joint Business Centre

As observed by the PMU during the delegation visit in Milan (2012, July), a holistic approach should encompass all elements, institutions and relationships that influence the trade exchange between Multan and Italian markets. The conditions that are critical are the quality of products, payment way and credit infrastructures in order to guarantee the buyer.

As far as we believe that most of these elements fit also Multan enterprises, Fondazione Politecnico di Milano team suggests to insert a team within the PIRC Pakistan Italy Research Centre composed by people encompassing these competences:

- Horizontal technological expertise—ability to understand technical side of artisan/MSME processes and to address needs/demands to technical experts and to explain possible impact to non-technical entrepreneurs
- The ability to gather together entrepreneurs to access a technology/services
- Have knowledge about IPR and customs rules in the world and agreement between the two countries
- Ability to translate an idea in a business plan and to support pretending entrepreneur to present their businesses to institutions or VCs
- Knowledge of new (digital) promotional and commerce tools
- Knowledge on start-up creation bureaucracy in Pakistan
- Knowledge on start-up services and incubation in Punjab
- Contacts with Italian incubation experts
- Ability to implement support programmes within the industrial system
- Linking to Pakistan and Italian industrial associations

In Fig. 7.2, the PIRC operating scheme, on its right column, designs a component of the centre dedicated to economic collaboration.

7.11 The MWC Business Matching Programme

One of the goals of our activity to enhance local economical networks, fostering entrepreneurship collaboration, new business models and firm creation, has been to develop the solutions to be applied to a Business Matching Programme (BMP) customized upon the needs of Multan district, in general, and, in specific, of the Walled City. The service developed has been tested to help export-ready companies in identifying and screening potential Italian business partners. Business matching appointments in Italy have been arranged, during which selected counterparts of Multan have been chosen as companies to start business negotiations with immediately.

On the basis of the conducted analysis, as shown in the previous paragraphs, our programme has been structured on four steps: understand the local economic needs, aiming at a correct selection of the readiness of the ideal businesses to be involved in the matching activity; identify and select the potential Italian partners; check the mutual linkage interest, the complementarity of the competences and the Middle East export aptitude; and connect the Pakistani company to the chosen Italian partners (usually the proposed meetings take place several times during the same mission in Italy).

The two most promising sectors elected to test the BMP have been agriculture and jewellery. Three entrepreneurs from Pakistan, in July 2012, and two in April

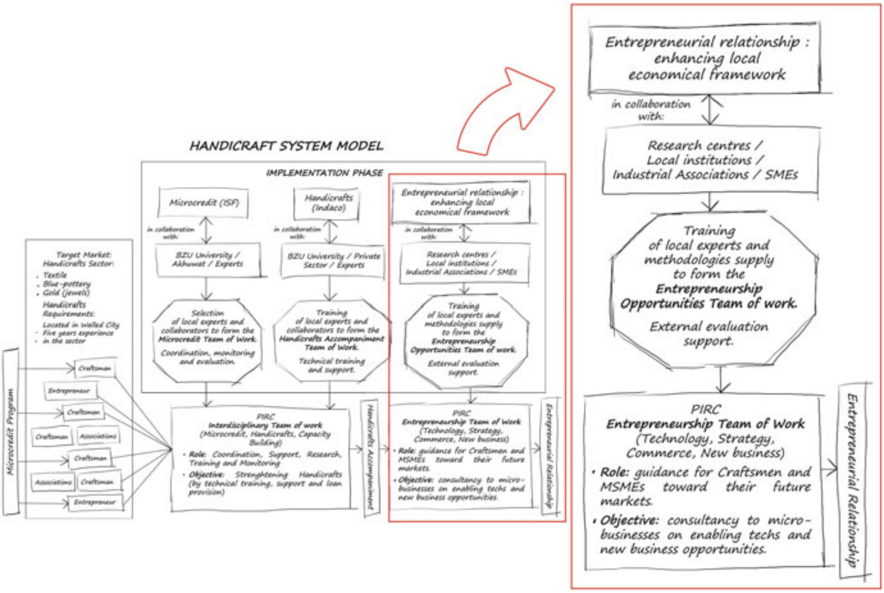

Fig. 7.2 Implementation phase of the entrepreneurial relationships

2013 were in Italy, having the possibility to know directly some of the best Italian companies, especially selected among those in condition to bring the needed and rapidly exploitable technological upgrading and start business relationships.

New business opportunities created by the BMP test have been useful to verify the propensity and the vast possibilities of collaboration and integration among entrepreneurs from Italy and from Pakistan but also to identify some weaknesses to be underlined: the visa process and the customs procedures for European Union and the fluctuation of exchange rates. The identified solution to partially solve the first of these problems is to ask for a quick or simplified procedure to be offered to entrepreneurs from Multan to obtain visa if presented by the PIRC in the framework of the BMP of the MWC project.

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Chapter 8
Remote Sensing Urban Analysis

Marco Gianinetto, Gabriele Candiani, Andrea Marchesi, Marco Rusmini, Francesco Rota Nodari, Pieralberto Maianti, Federico Frassy, and Giorgio Dalla Via

Abstract Satellite remote sensing is the process of collecting information about the Earth surface from the space through the measure of electromagnetic radiation. Nowadays, remote sensing is a mature technology used to extract, analyze, and detect changes of geographic and thematic information over large areas, inaccessible sites, or where only limited knowledge is available. In this chapter, we describe how satellite's data collected over Multan (Pakistan) have been used for mapping and monitoring the dynamics of the urban area. A multi-scale approach allowed to evaluate the urban growth of the municipality area occurred in the last 2 decades with medium-resolution Landsat-5/TM time series. Urban green plots and infrastructures (buildings and roads) have been mapped at the local scale of the historic Walled City with the state-of-the-art GeoEye-1 and WorldView-2 very high-resolution multispectral imagery.

8.1 Introduction

Remote sensing, often referred to as Earth observation, is the science of gathering information about an object or an area through the analysis of data collected from distance. Typically, remote sensing techniques are divided into two main groups: (1) *passive remote sensing systems* where the sensor detects the radiation coming from an external energy source (normally the Sun) and (2) *active remote sensing*

M. Gianinetto (✉) • A. Marchesi • F. Rota Nodari • P. Maianti • F. Frassy • G. Dalla Via
Department of Architecture, Built Environment and Construction Engineering, Politecnico di Milano, Milan, Italy
e-mail: marco.gianinetto@polimi.it

G. Candiani
Optical Remote Sensing Group, IREA-CNR, Milan, Italy

M. Rusmini
ERM Italia S.p.A, Milan, Italy

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systems where the sensor acts both as a source of energy and as a detector. Both active and passive sensors could be *spaceborne systems* if hosted on satellites or *airborne systems* if mounted on aircrafts.

The pattern of reflected radiation at varying wavelengths of the electromagnetic spectrum is called *spectral signature*. In particular, different materials feature different spectral signatures: this property allows to discriminate between different surfaces. Thus, the better the *spectral resolution* of a sensor (i.e., the number of spectral intervals recorded), the more surfaces can be discriminated. Along with the spectral resolution, another key feature is the *spatial resolution*. According to their spatial resolution, satellite's sensors can be divided into (1) *very high resolution* (VHR; less than 1 m), (2) *high resolution* (HR; from 1 to 10 m), (3) *medium resolution* (MR; dozens of meters), and (4) *low resolution* (LR; from hundreds of meters to few kilometers). Spatial and spectral resolutions are generally inversely proportional: sensors with high spatial resolution usually have few spectral bands, while sensors with a medium spatial resolution usually feature more spectral bands. Consequently, the selection of a sensor is always a trade-off between these two features and depends on the study to undertake.

Nowadays, remote sensing techniques represent a useful tool in several geographic applications. In particular, in recent years, satellite remote sensing has been successfully used in numerous urban studies, ranging from multi-temporal analysis with MR sensors up to 3D city modeling performed with VHR systems. For instance, time series of MR satellite data have been used to monitor the spatiotemporal dynamics of urbanization in several world megacities (Taubenbock et al. 2012), in Washington D.C. (Gianinetto 2012), in four cities around the Poyang Lake area (Michishita et al. 2012), in Hurghada (Kamh et al. 2012), and in the Islamabad metropolitan area (Butt et al. 2012). Examples of VHR satellites used to detect buildings can be found in Gianinetto (2009) and Dey et al. (2011), whereas Alobeid et al. (2010) presented three different methods to estimate their height. Moreover, the new generation of VHR satellites can represent a promising tool for vehicle movement detection due to a peculiar acquisition process: examples can be found in Kääb (2011), Tao and Yu (2011), and Marchesi et al. (2012). Finally, since urban green spaces are important to improve the quality of urban environment, several examples of urban vegetation classification based on VHR sensors can be found in literature, such as in Hofmann et al. (2011), Ardila et al. (2012), and Cavayas et al. (2012).

8.2 Study Area and Dataset

Multan is one of the largest cities of Pakistan and an influential political center of the country, presenting a fast-growing economy and rapid urbanization rate. Its historic core—the old Walled City of Multan—is a peculiar and extremely dense urban area featuring old-style small and low houses built up very close to each other, with narrow roads and bazaar streets full of historical importance. The road network is full of stands and pedestrian, animal-drawn carts, little van, motorcycles, slow cattle trucks, and other things causing traffic jam.

The analysis of this extremely complex environment using Earth observation systems can take advantage of their multi-temporal, multisensor, and multi-resolution capabilities. According to the best available sensor technology, spatial resolution, and period of acquisition, both MR (i.e., Landsat-5) and VHR (i.e., WorldView-2 and GeoEye-1) satellite data have been used to track changes in time and map the urban environment at different scales.

Regarding MR data, the Landsat program is the world's longest continuously acquired collection of space-based images. A time series of 22 scenes acquired over Multan by the Landsat-5 satellite from 1992 to 2011 was selected. Each scene consisted of seven spectral bands recorded by the Thematic Mapper (TM) sensor with 30 m ground resolution, covering the electromagnetic spectrum from the visible to the thermal infrared. All the Landsat images have been made available by the United States Geological Survey (USGS) through the GloVis archive.

Concerning VHR imagery, WorldView-2 is the state-of-the-art multispectral satellite today operational, while GeoEye-1 has the highest imaging resolution among all the civil satellites for Earth observation. Both sensors feature a panchromatic band plus a multispectral set ranging from visible to near-infrared wavelengths of eight bands for WorldView-2 and four bands for GeoEye-1. The images are distributed with a commercial resolution of 0.5 m for panchromatic and 2 m for multispectral data. The analysis at the local scale was carried out using two WorldView-2 scenes of June 19, 2010, acquired from the DigitalGlobe archive, and a GeoEye-1 stereo pair of April 25, 2009, acquired from the GeoFUSE catalog.

8.3 Municipality Level: Analysis of Urban Textures

In the last decades, the developing countries, especially in Asia, have seen an impressive urban development with significant implications to environmental change. The expansion trend of urban areas is expected to increase in the future with negative consequences on human health, environment, and residential necessary systems. In many cases, the complex process of massive urban sprawl could not be properly studied, since socioeconomic data of developing countries are usually incomplete, not updated, not standardized, or not easily accessible. In this frame, the spatial coverage and the long acquisition period covered by images from MR satellites, such as those of the Landsat mission, can be a useful tool to monitor the dynamic of urban development.

In this study, the time series of 22 Landsat-5/TM images has been used to describe the dynamics of the urban municipality area of Multan occurred during the last 2 decades, from 1992 to 2011 at approximately 10-year steps. Landsat data have been previously converted to top-of-atmosphere radiance and then corrected to surface reflectances removing the influence of the two main atmospheric processes (gas absorption and aerosol scattering). The atmospherically corrected images have been used to compute three indices useful to detect soils, vegetation, and water. For the datasets of 1992, 1998, and 2011, the three indices and the

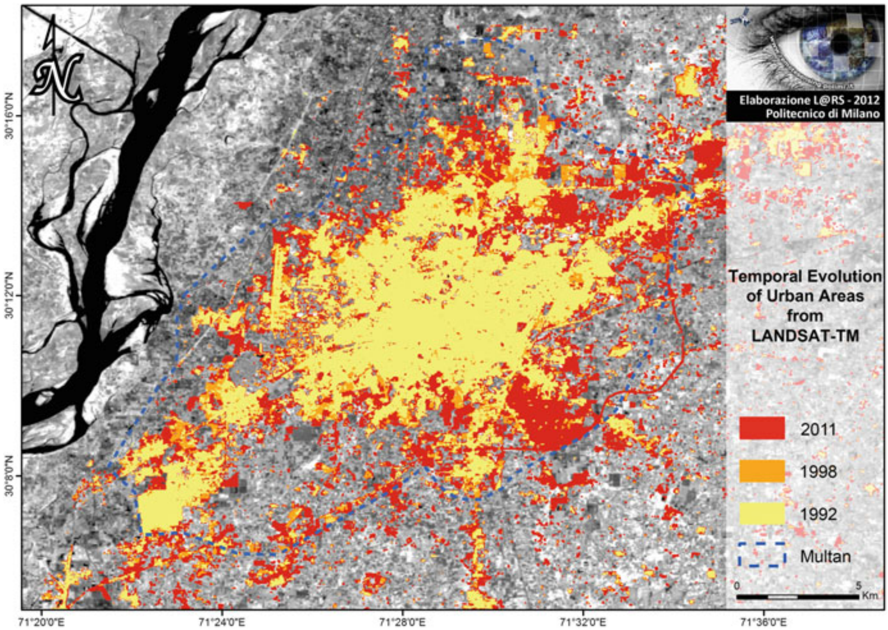

Fig. 8.1 Spatiotemporal dynamics of the urban growth in the municipality area of Multan using medium-resolution Landsat time series

surface reflectances have been used as input in the unsupervised classification procedure performed using the K-means algorithm.

The comparison of the three classifications shows a large expansion of urban areas from 1992 to 2011, with the consequence of a reduction of vegetated surfaces. This result is presented in Fig. 8.1 where the urban footprints for 1992, 1998, and 2011 are overlaid. The quantitative analysis shows that the urbanized area in the municipality has almost doubled from 1992 to 2011, increasing from about 74 km^2 in 1992 (29 % of the municipality area) up to about 138 km^2 (55 % of the municipality area) in 2011. The trend of urbanization development presents a growth ratio of +36 % for the period 1992–1998 and of +52 % for the period 1998–2011. On average, the urban growth of the Multan municipality area has been about 3.4 km^2 per year during the last 20 years with an average urban growth ratio of about 4 %.

8.4 Local Scale: Analysis of Urban Infrastructures and Urban Green Spaces

Infrastructures are the skeleton of a city. They include fundamental systems such as water supply or drainage systems, networks such as roads or telecommunications and grids such as power or natural gas pipelines. Urban green spaces represent fundamental resources which improve the life quality of a city. In recent years, both the urban infrastructures and urban green spaces of Multan have become heavily burdened and the city has been subjected to considerable urban strife (Chaudhry et al. 2006) and, as many other important Asian metropolitan areas, the more and more rapidly growing required new methods for planning and monitoring its sustainable growth.

8.4.1 Simplified 3D City Modeling

Photo-realistic three-dimensional city models are becoming a tool more and more used by urban planners. These models are created from aerial images integrated with terrestrial acquisition and high-resolution LiDAR (Light Detection and Ranging) data which are very cost-demanding activities. The spaceborne technology could represent a low-cost alternative to airplane surveys. In this case, a digital surface model representing the Earth surface, including all the natural and artificial elements laying on it, is calculated by exploiting two different satellite images acquired on the same orbital overpass from different looking angles (stereoscopic imaging). The automatic measurements of common points identified on each image and the knowledge of the satellite position and attitude are used to determine the 3D location of each element, including height.

Using the 0.5 m GeoEye-1 stereoscopic images, a simplified 3D city model of the pilot area inside the Walled City has been generated. The very dense urban texture and the low spectral separability of the buildings in this area represent a very challenging task, at the edge of the actual satellite technology. To overcome this issue, first of all a dense 3D point cloud has been extracted from the GeoEye-1 stereo pair by automatic image matching. Then, a geometric constraint on the building shape has been added using the building footprints vectorized from the GeoEye-1 data and integrated with field surveys (carried out in close collaboration with Prof. Del Bo and his research group of Urban Design, Politecnico di Milano). Consequently, the digital surface model of each building has been derived by calculating the average elevation value of the 3D point cloud included in each building footprint. Since the Walled City of Multan is not a completely flat topographic surface, the terrain elevation has been estimated by interpolating a field survey of spot levels provided by courtesy of the Aga Khan Foundation. Finally, the simplified 3D city model has been calculated as the difference between the satellite-based digital surface model and topography. The building heights estimated by satellite are shown in Fig. 8.2.

Validation of the 3D model was performed comparing the estimated building heights (in terms of number of floors) with in situ description for 275 buildings surveyed. About 90 % of residuals ranged from −1 to +1 floor with near half of the buildings correctly estimated. This means that the elevation accuracy of the satellite-based simplified 3D city model was no more than one floor in 90 % of times.

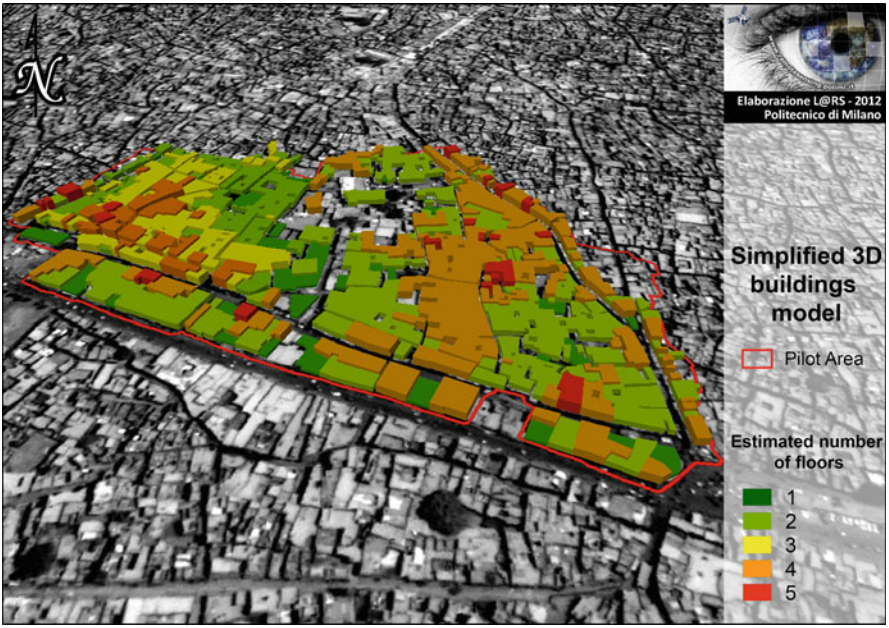

Fig. 8.2 Simplified 3D model of buildings in the pilot area of the Walled City of Multan using high-resolution GeoEye-1 stereoscopic satellite data

8.4.2 Traffic Monitoring

The advent of remote sensing technologies has played an important role in urban management. Novel methods for traffic monitoring systems, exploiting the latest VHR satellite technologies, can be used to create maps of vehicle speed and traffic congestion which can be integrated in the traditional ground-based traffic monitoring systems (e.g., closed circuit television, traffic counters). Typically, VHR optical satellites feature a very small time lag in data acquisition between their different spectral bands: thus, moving objects will be slightly displaced in the images of different spectral bands. In recent years, this characteristic has been used to test the potentialities of satellite data in traffic flow monitoring on expressways (Mishra and Zhang 2012; Salehi et al. 2012), while dense urban areas were still a complex task to address. Exploiting the potential of the unique configuration of the WorldView-2 satellite, Marchesi et al. (2012) presented the first satellite-based traffic monitoring system in a very dense and complex urban area with narrow and low speed roads, like the historic core of Multan.

The method developed exploits the asynchronous recording between the panchromatic and the multispectral bands. Among the eight spectral bands available, the *coastal blue* and the *blue* bands have been selected as the most useful for traffic detection because they both showed high contrast between roads and vehicles and sufficiently long time lag for movement detection (about 300 ms delay between *coastal blue* and *blue*). Theoretically, a car traveling at 50 km/h will move on the ground about 4 m in 0.3 s, corresponding to 8 image pixels in panchromatic. Moreover, a typical car has a length of about 4 m and a width of about 2 m, corresponding respectively to 2 image pixels and 1 image pixel in multispectral. Consequently, moving vehicles can be recognized as bright or dark objects moving along the road network with imperceptible displacements between the three images (only few image pixels).

The information which can be extracted from a single WorldView-2 acquisition are speed and direction of travel of moving objects. For the Walled City nearby, it has been generated a satellite-based vehicle speed map (Fig. 8.3), and the road network has been split into segments with different estimated traffic densities computed as the number of vehicles per unit area (Fig. 8.4). Among the 223 vehicles mapped, 176 had a speed slower than 20 km/h, 38 ranged from 20 to 40 km/h, and only 9 showed an estimated speed faster than 40 km/h. The highest speed recorded was 65 km/h. Validation has been performed on 219 moving objects detected in the Walled City nearby, comparing those automatically extracted from the satellite images with those manually detected by a trained operator. The overall accuracy showed a correct detection of about 70 % of moving vehicles and reasonable speed rates estimated considering the characteristics of the roads and vehicles in Multan.

8.4.3 Urban Green Spaces

According to the Environmental Protection Agency of the United States, the term urban green spaces includes parks, community gardens, and cemeteries. They represent an important resource providing natural, environmental, cultural, and social benefits, thus improving the quality of an urban area. The fast urban growing, especially in the developing countries, is increasing the pressure in these already fragile systems, and their protection should be a priority. However, the monitoring of green spaces in an urban area can be a time-consuming task depending to the number of green spaces, their accessibility, and the extension of the urban area. Remote sensing technologies, with their synoptic capabilities, can be a useful tool to help the management and monitoring of these areas.

The analysis of the urban green spaces at both the Walled City level and the pilot area levels has been carried out using VHR imagery from GeoEye-1 (2009) and WorlView-2 (2010). Panchromatic and multispectral datasets of each sensor have been combined together in order to take advantage of the better spatial resolution of the panchromatic band and the better spectral resolution of the multispectral set. This procedure, called image sharpening, has been performed using the Gram-Schmidt spectral sharpening technique (Laben et al. 2000). The urban green spaces have been classified from the pan-sharpened dataset (GE-SHR and WV-SHR), using an object-based image analysis (OBIA) approach (Lang 2008). In OBIA, the base element is represented by the object, a collection of pixel with similar features. The advantage of this approach over traditional per pixel analysis is its

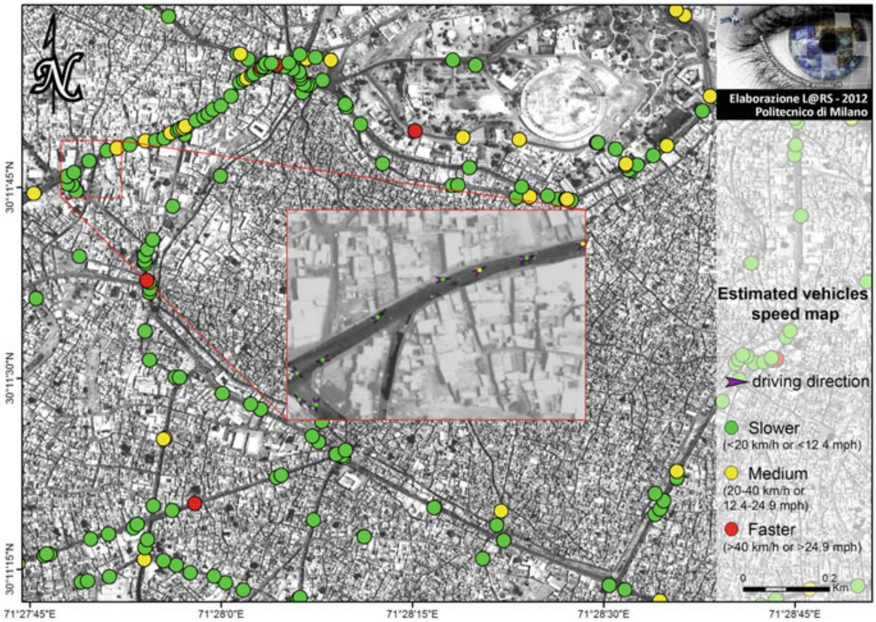

Fig. 8.3 Map of estimated vehicle's speed using high-resolution WorldView-2 satellite data

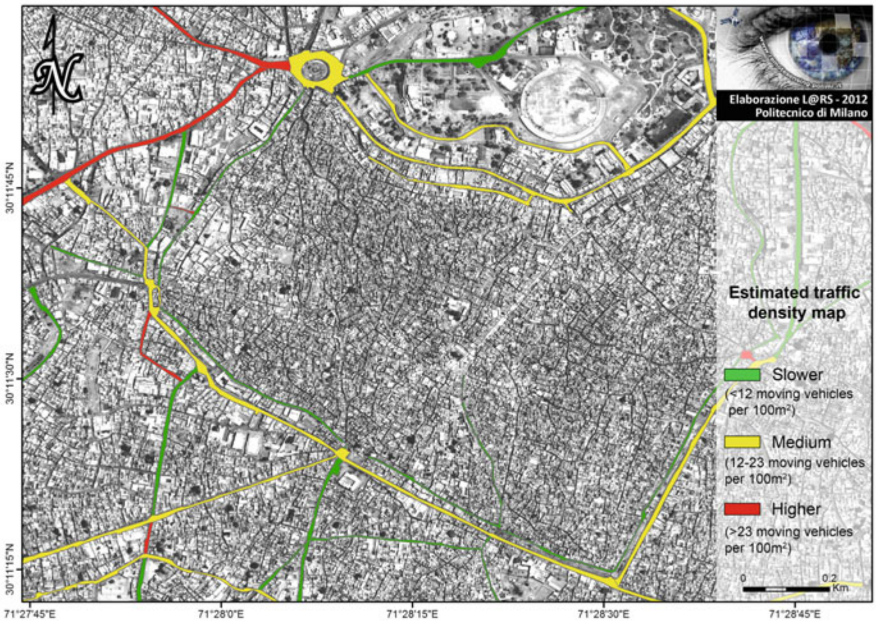

Fig. 8.4 Map of estimated traffic density using high-resolution WorldView-2 satellite data

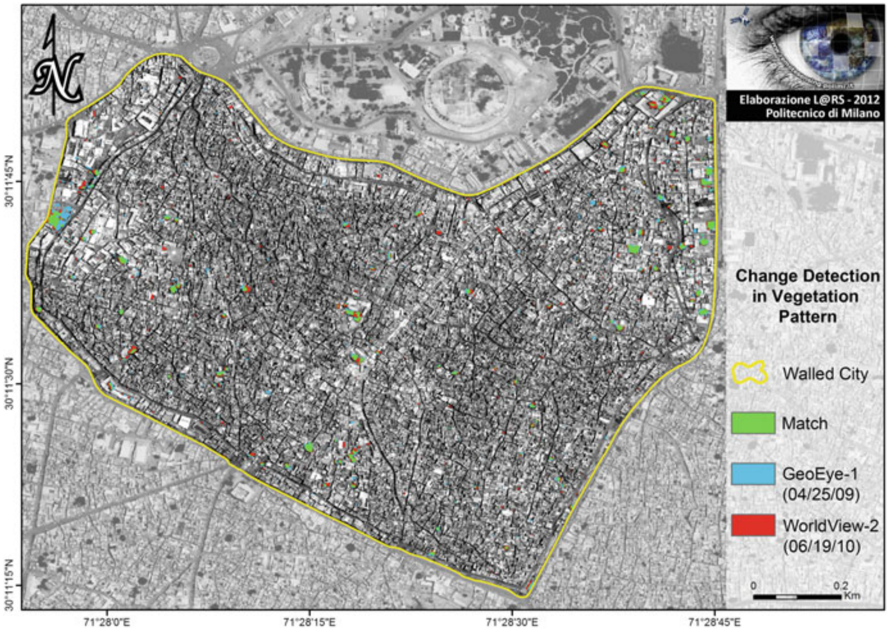

Fig. 8.5 Short-time change detection of urban green spaces of the Walled City of Multan using high-resolution GeoEye-1 and WorldView-2 satellite data

capability to exploit spatial, geometric, and semantic relations among the objects in addition to the classic spectral characteristics.

The classification of green spaces in the Walled City is shown in Fig. 8.5. Results show that green spaces represent about 1 % of the whole surface of the Walled City (about 12,650 m^2), with a vegetation density of about 260 vegetated plots per square kilometer and a mean area of 46 m^2. The short-time multi-temporal analysis (2009 vs. 2010) showed no significant changes in the vegetated plots. The same analysis performed for the pilot area (Fig. 8.6) showed that the number of plots was almost the same in 2009 and 2010 but the overall green surface has been significantly increased (about 14 %). This result may be partially explained by the different acquisition dates (April for GeoEye-1 and June for WorldView-2) where the vegetation increase is more likely related to a different extension of the canopy surface.

8.5 Conclusions

Nowadays, satellite remote sensing is a mature technology for analyzing thematic information, updating geographic data, and monitoring environmental changes. Due to their multi-temporal and multi-scale capabilities, satellites can be

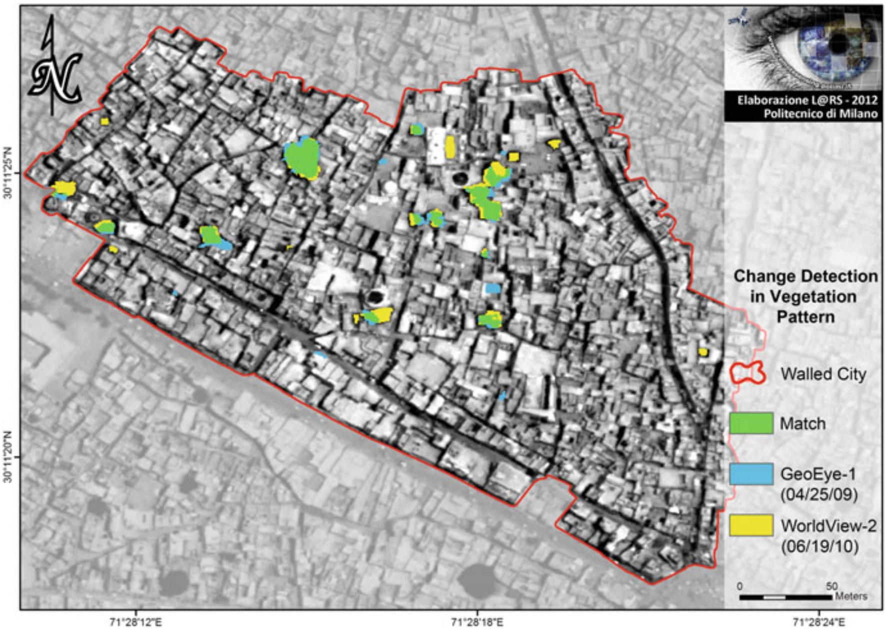

Fig. 8.6 Short-time change detection of urban green spaces in the pilot area of the Walled City of Multan using high-resolution GeoEye-1 and WorldView-2 satellite data

successfully used for mapping changes over space and time of both large-scale and small-scale areas. Moreover, being satellite observations not constrained by air-space restrictions, they can represent an alternative to airborne surveys when the latter are not available.

This study showed how Earth observation could be a valuable tool for supporting policy- and decision-makers, public administrations, local governments, and urban planners. The nature of information gathered from space is typically used in multidisciplinary studies, and the capability to collect data in remote and inaccessible areas makes remote sensing an interesting technology not only for well-developed countries but also for developing countries, where the demand of cost-effective, timely, and updated information is continuously growing.

With respect to urban studies, medium-resolution time series can give a synoptic overview. Their spatial resolution is suitable for studies at the municipality scale, and the availability of historical data, collected during the last 40 years, makes possible a unique description of the urban dynamics, both for built-up and rural areas. On the other hand, very high-resolution satellites can give a detailed geometric description of the urban environment, and their imagery products can be used, among others, for updating existing maps, for 3D city modeling, or for the monitoring of urban green. Furthermore, the possibility of fusion and integration of data characterized by different spatial, spectral, and radiometric properties makes satellite remote sensing a powerful and scalable technology that can be adapted to different contexts and needs.

Regarding the new frontier of Earth observation, the latest generation of very high-resolution satellites has opened the door to new applications, such as novel methods for space-based traffic management. Exploiting the opportunities offered by the state-of-the-art WorldView-2 satellite, it is now possible to create maps of vehicle speed and traffic congestion from space, and these products can be integrated with the traditional ground-based traffic monitoring systems.

With respect to the future activities planned in the city of Multan or in similar projects to be held in Pakistan, remote sensing techniques could be efficaciously used not only in the implementation actions but also for midterm assessment and monitoring after the completion of the works. All these data and information collected from above could also be used for feeding models related to themes such as the urban heat island phenomena, air quality and pollution, or network management for increasing the overall quality of life of citizens.

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Chapter 9
Ground Survey: An Integrated Survey for Urban and Architectural Heritage Conservation and Management

Franco Guzzetti, Nelly Cattaneo, Grazia Tucci, Lidia Fiorini, and Alessandro Conti

Abstract Recording is a key activity in the cultural heritage conservation management. Conservation-related information is usually obtained (certainly in the case of this project) from multidisciplinary research activities. In such teams, geomatics build a framework to connect all members' contributions both in preliminary studies and in project development and applications.

In this project, the documentation approach used the most sophisticated surveying techniques to properly capture the geometries of the "sample area": the pilot area, as well as the whole Multan Walled City, is made of very articulated buildings, with façades rich in decorations, and the urban pattern created by these buildings is very intricate. Metrical data acquisition of such a wide, complex, and crowded urban area with traditional survey techniques would request a lot of work, involving many people for a long time.

The rapid rise in new technologies has revolutionized the practice of recording heritage places. The advantage does not rely only on time saving, but mostly on accuracy and management of digital data. Digital tools and media offer many new opportunities for collecting and disseminating information about heritage sites. From a methodological point of view, an integrated survey has been planned combining topographic and laser scanning technology.

In pilot area, two macro-areas were selected and subdivided in six different sites.

A reference frame connecting all sites was created by a topographic survey carried out with total station. In the meantime, detailed survey was carried out using a laser scanner in all sites.

F. Guzzetti (✉) • N. Cattaneo
Department of Architecture, Built Environment, Construction Engineering
Politecnico di Milano, Milan, Italy
e-mail: franco.guzzetti@polimi.it

G. Tucci • L. Fiorini • A. Conti
Geomatics for Conservation & Communication of Cultural Heritage Laboratory (GeCO Lab), DICEA – Department of Civil and Environmental Engineering, Università degli Studi di Firenze, Florence, Italy

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The fieldwork is only the smallest part in this kind of survey. Subsequent activities were carried out in Florence and Milan during the following months producing a digital model to create 2-D drawings and 3-D models. Graphic outputs were used by other work teams for many different tasks: conservation/restoration, structural analysis, architectural and urban planning, mapping, and so on.

9.1 Premises and Tasks

Surveying is one of the first steps in the comprehension and knowledge of a place (Letellier 2007; Eppich et al. 2007). Nowadays, technologies provide a wide set of possibilities in methodological approach. However, a cultural approach, which has been a permanent guideline in this work, consists on defining the method referring to the object to be surveyed: that means that the object to be investigated suggests the main rules in choosing and using any surveying techniques (Santana Quintero et al. 2011). In order to plan a survey in Multan Walled City, it was necessary first of all to get to know the city: no photo and no aerial map could help in understanding such a lively, mazy, rich-in-detail urban area. In this area, a traditional topographic survey might not be so effective: to proceed from a general survey to a more and more detailed one in this case may not make sense. Everything is a detail in Multan Walled City, that means everything is meaningful as a structure and as a decoration at the same time. That is why, in consideration of all the technologies now available, the use of general criteria in a descending order that is, providing the main geometries to be then enriched in details by celerimetric survey would not be fully appropriate. The use of techniques and technologies which enabled an uninterrupted collection of details connected with each other was considered more correct, providing on the side just a basic topographic reference frame.

Geometric survey is not an end in itself. Besides the acquaintance of the place, it is also important to understand which are the real needs related to the place itself in order to outline a truthful purpose of the survey. This theme is very relevant because, as a team of technicians coming from abroad, it is very easy to define purposes and targets that do not fit the real dynamics, uses, and needs of the place. For example, at a first glance, it would come natural to promote a cadastral map similar to the Napoleonic and Austro-Hungarian ones, which were intended to provide order and data for administration. This could be an interesting purpose, but in Multan Walled City, a cadaster may be more useful and fitting if considered as a fact-finding and cognitive instrument: it should be already oriented in providing information about the modification constantly occurring in this part of the town and in producing guidelines in the process of urban renovation. In this way, this cadaster should include many layers able to describe more and more deeply all the visible and not so visible aspects of Multan Walled City. A “smart” geometric survey able to face Multan’s challenges must have both an overall view (as a map does) and a detailed sight from the inside. Moreover, it is important to remark that in the general project a broad set of experts is involved, each one focusing on a very detailed aspect of the area. In this situation, a ground survey must provide a set of data as wide in contents as the experts involved are, with a high and homogeneous level of accuracy. Moreover, so various geomatic techniques are used to create a reference base that enables all members to meaningfully participate in both investigative procedures and project development (Tucci et al. 2009).

The search for existing maps at urban scale must be and has been indeed the first step, and evaluations on every documents acquired must be pursued. When we first approached Multan Walled City, we had no useful metrical data we could refer to: an aero-photogrammetric map dated 1992 in a local reference system was the most important cartographical base. Although its scale was quite high, at a first visit in the city, it was immediately evident that this level of detail was not sufficient for any of the survey's tasks: in such a dense area, a map at scale 1:2000 could not even be used for rough planning. The pilot area, as well as the whole town inside the walls, is made of very articulated buildings; the urban pattern created by the blocks cannot be reduced to simple geometries: even important covered passages are not represented on the map.

Owing to the existing maps, the most appropriate approach for the survey of Multan Walled City would consist in a set of activities:

LiDAR survey: An airborne laser scanner provides a dense georeferenced point cloud. From this point cloud, an accurate digital terrain model can be derived, useful for a first basic hydraulic planning, and a digital surface model which can help studying, for example, urban microclimatic conditions. The well-defined shape of buildings from the point clouds can be helpful in the correct interpretation of remote sensing imagery.

TLS: Point clouds acquired with terrestrial laser scanner must integrate data acquired with LiDAR technology, thus providing accurate data at the architectonic scale of representation and reducing the "shadow areas" normally resulting from both kinds of survey.

Traditional topographic survey must be carried out with three main purposes and three different instruments (1) differential GPS to provide ground control points for the accurate orientation of the LiDAR dataset and to connect the other surveys to the same reference system, (2) total station to control the alignment of the terrestrial laser scanner point clouds, and (3) geometric leveling to provide accurate data in order to accurately project the sewerage system.

The purpose and the role of each of these activities must be clearly defined, because on the field many problems may prevent from respecting any step previously planned: for example, the permissions for a flight over Multan is not easy to obtain, and the LiDAR flight has not been fulfilled yet, as well as finding information on ground points already measured for the production of local cartography. This means that, on the field, little and partial steps are made and each one must be valid and useful in itself, and at the same time non regardless of the whole surveying plan.

9.2 Urban Setting

Choosing the proper surveying technology had considered also problems which can be defined practical or logistic (Tucci et al. 2011b). Multan is a very lively and busy town, in particular in the bazaar area where the pilot area is located, that means that during the day it is not possible to place a topographic instrument for the time necessary to acquire data and, even in case it is, too many accidental obstacles may affect the result. Therefore, the nighttime is the best moment to carry out the survey on the field. The terrestrial laser scanner proves to be the proper technology in working independently from sunlight, being based on an active device (Bonora 2007).

Moreover, it acquires 3-D coordinates from all the surfaces visible from the scanning position and, depending on the selected scan resolution, allows surveying details as window wooden frames, crevices in the walls, wells, and open drains on the streets, thus providing the wide set of data necessary for the whole project. It would not be possible to reach the same level of detail and accuracy with other surveying technologies.

As mentioned in the premises, the pilot area, as well as the whole town inside the walls, is very articulated; the urban pattern created by buildings is often unexpected: important passages are covered, and sometimes normal doors are the access to courtyards leading to other courts, thus organizing the block as a conventional street would do. As open space is shaped by constructions around, masonry is shaped by decoration: surveying these edifices means surveying their details. Many historical buildings are affected by structural problems, and using laser scanner we can easily estimate out of plumb and deformations of the walls (Tucci et al. 2011a).

Summing up, the 3-D "point clouds" are a real database, an extremely dense and accurate "information depot" that can be explored as a significant referent of the object and from which experts can derive all requested graphic outputs on demand.

9.3 Planning the Survey

A proper survey planning is essential, particularly when fieldwork must be streamlined in a complex urban fabric as Multan Walled City is. Planning consists in preparing and scheduling all survey operations to collect requested data.

As often as not, it is possible to plan accurately survey only on-site. First inspections were done during daytime, together with other teams and consulting local representatives. The most meaningful elements in pilot area were found, selecting the parts that were possible to survey during the mission.

Two areas were selected, the first one focused on a section of Haram Bazaar (Fig. 9.1) (from the Haram Gate and the surrounding square to an interesting old wooden house, Fig. 9.4) and the second one including a part of Sarafa Bazaar, the Darbar of Musa Pak Shaheed, and the square in front of his Mausoleum (Fig. 9.2).

Then topographic network was planned to connect all areas and measure the targets used to align laser scanner range maps.

For a proper laser scanner survey, it was necessary that canvas obstructing the acquisition of building top in bazaars would be removed. Then, depending on available space and visual lines, optimal scanner and target positions were determined. Along bazaars, considering street width/height ratio, scanner stations were located every about 10 m.

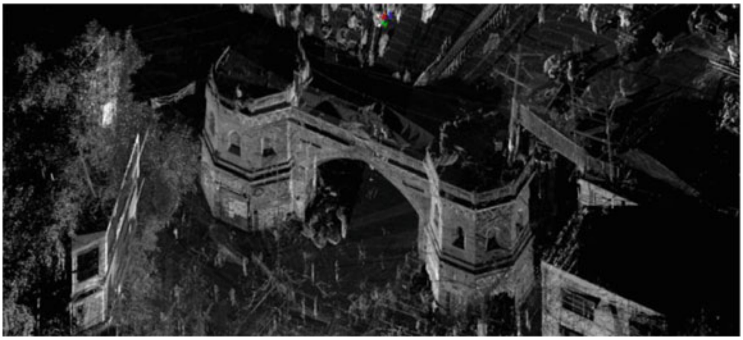

Fig. 9.1 Point cloud of the Haram Gate and its surroundings

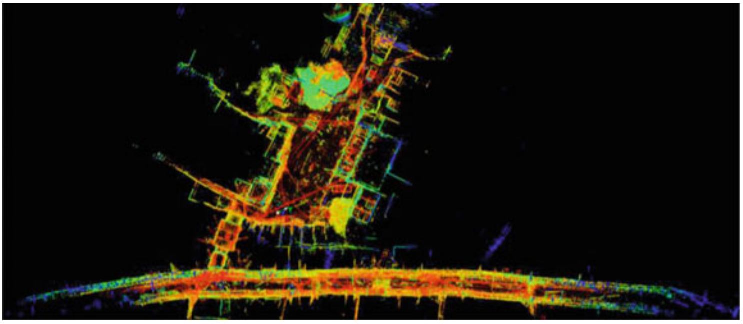

Fig. 9.2 Overall view of the Sarafa Bazaar and Musa Pak Shaheed Mausoleum square

So the whole work was split in six subtasks feasible in a single night session. Total station and a laser scanner teams worked simultaneously to be sure that targets would be not removed.

9.4 The Topographic Network

The topographic surveying was carried out with a total station (Leica TCR 307) and was used to define the three-dimensional position of specific points, in a local reference system defined on purpose for this step of the survey. The on-site survey in the pilot area has been divided into the following sequential phases:

- The survey traverse
- Measuring targets required for laser scanning
- Detailed surveying

The survey traverse is composed by a set of consecutive observations, whose lengths and directions have been measured with the use of the total station. Closed

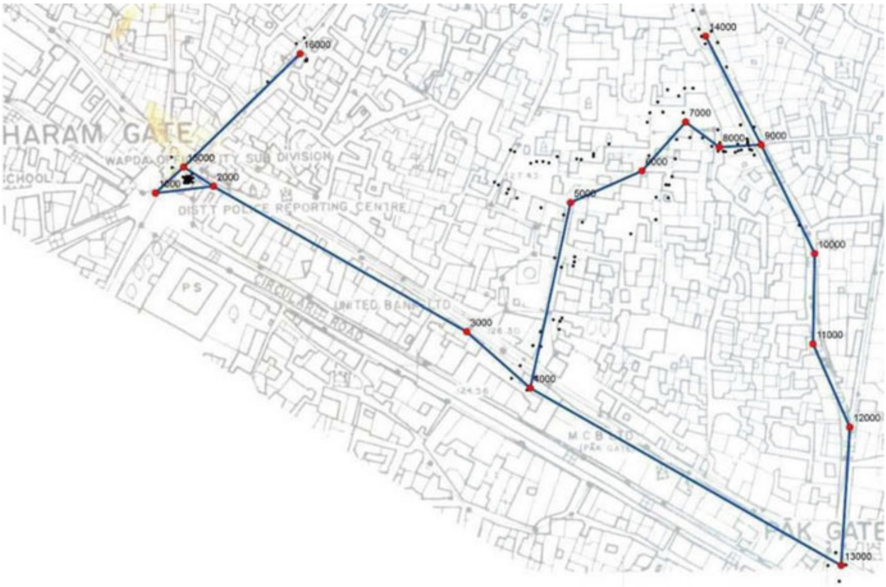

Fig. 9.3 Layout of the whole traverse, including the two traverse legs

traverses, which means that the first stationing point and the last coincide, are generally preferred in order to check the final results of the survey and to enable the application of the most rigorous adjustment procedures. All the stations have been materialized and then carefully sketched and located by measuring their distance from a nearby fixed object in order to ensure their future identification. Station locations have been selected in such a way as to ensure complete coverage of the surveyed area. The reference frame produced during the surveying campaign in Multan is composed by 16 main stations plus 2 additional ones. The position of these 16 points has been selected in the field in order to achieve the following aims:

– Collecting the coordinates of the target markers used for the alignment of the point clouds acquired by laser scanning: 50 targets have been collimated
– Defining a unique local reference system useful to refer all the surveyed spots, which are not contiguous
– Making metrical evaluations about accuracy of existing maps and aerial imagery available at the time of the survey

Although preferable, only ten stations, from 4,000 to 13,000, belong to a closed traverse. As shown in Fig. 9.3, the street system of the pilot area does not facilitate a closed traverse. To reach all the areas interested by this first investigation, two traverse legs have been carried out.

Regarding the detailed surveying, in the pilot area, 170 points have been collimated with two main purposes:

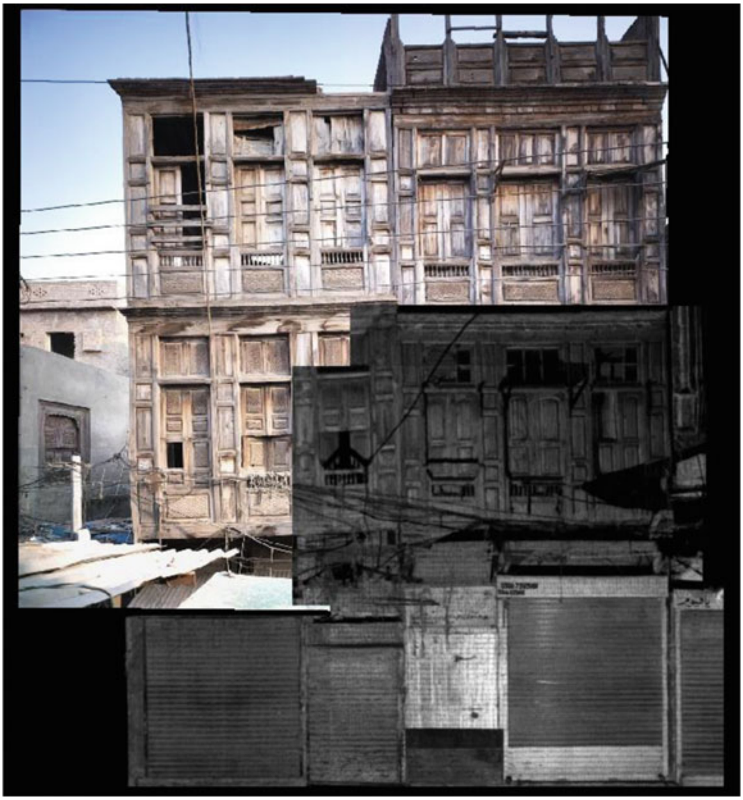

Fig. 9.4 Comparison between “wooden house” rectified image and point cloud (Ph. M. Introini)

– Achieving the layout of the correct profile of the area between the Circular Road and the Musa Pak Mausoleum, where a wide demolition had been carried out which is not represented on the maps available at the time of the survey
– Outlining the irregular geometries of the eastern tower of the Haram Gate, interior ground floor (Aga Khan Trust 2012)

The topographic network has been extended in the following months by local topographers to enable the correct interpretation of remote sensing imagery in those areas where no data could be acquired at the time of our first mission.

9.5 Laser Scanner 3-D Data Acquisition

Laser scanning describes a method where a surface is sampled using laser technology. It analyzes a real-world environment to collect data on its shape and possibly its appearance (e.g., color).

Laser scanners are line-of-sight instruments, so multiple scan positions are required to ensure complete coverage of a structure.

Laser scanners function as a total station: they measure lengths and angles in a 3-D space. The advantage of laser scanning is that it records huge amounts of points with high accuracy in a relatively short period of time and using entirely automatic procedures. It is like taking a photograph with depth information.

Once the instrument is set and positioned, it performs a "scan" of all the surrounding space by sending a laser spot with high frequencies and a very small angular step. All points measured on the surface produce a "cloud" that is a digital three-dimensional model of the object.

It is obvious that the correspondence between the object and its model is proportional to the resolution used and to the density of the points. In Multan Walled City pilot area, the distance between scanner and buildings never exceeded a few tens of meters in order to obtain an average resolution of about a centimeter.

The automatism that characterizes the measurement phase means that it surveys everything visible from the scanning position: in the final model, not only the walls are acquired but also everything around—electric plants and cables, trees, canvas, cars, and, above all, people. It has been just to avoid the usually crowded streets that work was done during nighttime.

The device used is an HDS 6000 (Leica Geosystems) laser scanner, with a rapid rate of acquisition (up to 50.000 points a second): each scan required between 3 and 10 min.

9.6 Data Elaboration

Fieldwork is only one side of this kind of survey. Subsequent work was carried out in Florence and Milan during the following months. On one hand, traverse was calculated; on the other hand, point cloud cleaning and alignment were carried out.

Each scan is initially acquired in an intrinsic reference system, which origin is the scanner itself. The transformation of the data acquired from all the intrinsic systems to adapt it to the topographic reference system takes the name of "scanning alignment"; this process uses the abovementioned targets as control points. As the target coordinates are known both in the intrinsic scanning system and in the topographic one, it is possible to compute the rotation and translation that has to be applied to all points of each scan to align them to the topographic system. Target recognition can take place automatically, thereby speeding up the alignment phase and limiting operator intervention to the verification of the results obtained. If a scan does not have at least three clearly recognizable signals, then natural points can be identified manually.

After the scans have all been aligned, it is possible to carry out global compensation: an ICP algorithm is applied to further reduce any residual distance between corresponding surfaces in adjacent scans.

Fig. 9.5 Darbar of Musa Pak Shaheed façade (Pakistan/Italian Resource Centre in Multan team)

As the whole database was really big and it's difficult (and useless) to manage always all data together, data was divided according to project subareas. In this way, it was possible to make available for other teams selected data to create georeferenced 2-D drawings and 3-D models.

9.7 Use of Data for Specialized Studies

The data acquired in the pilot area provided a multitasking set of information. As said, the team involved in the project includes different professional skills. Some examples of deliverables by other working teams show different uses of survey data.

The architects involved in conservation could dispose of a highly accurate 3-D description of the buildings, including wall cracks and deformations and masonry texture (Fig. 9.5). The direct survey data could be referred to the point cloud set of data.

The structural engineers, starting from point clouds, created models to study dome deformation in Haram Gate (Fig. 9.6).

The urban design group produced the layout of the elevations on the Sarafa and the Haram bazaars, using the ortho-images extracted from the point cloud and a set of high-definition pictures. The result enables to describe the sequence of the buildings and the texture of the street fronts (Fig. 9.7).

The outlines of the ground floors were used to define the polygons describing plots and blocks in the geographic information system of Multan Walled City (Fig. 9.8).

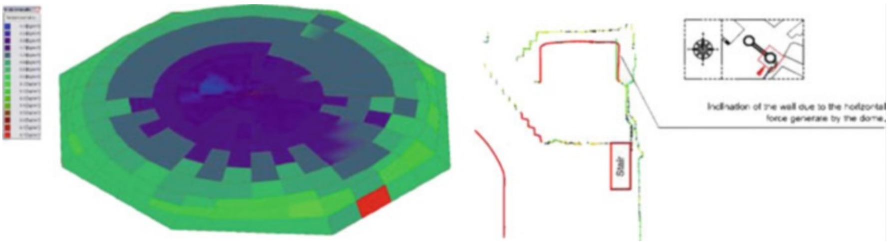

Fig. 9.6 The laser scanner survey used to create a model for structural analysis (Haram Gate conservation project team)

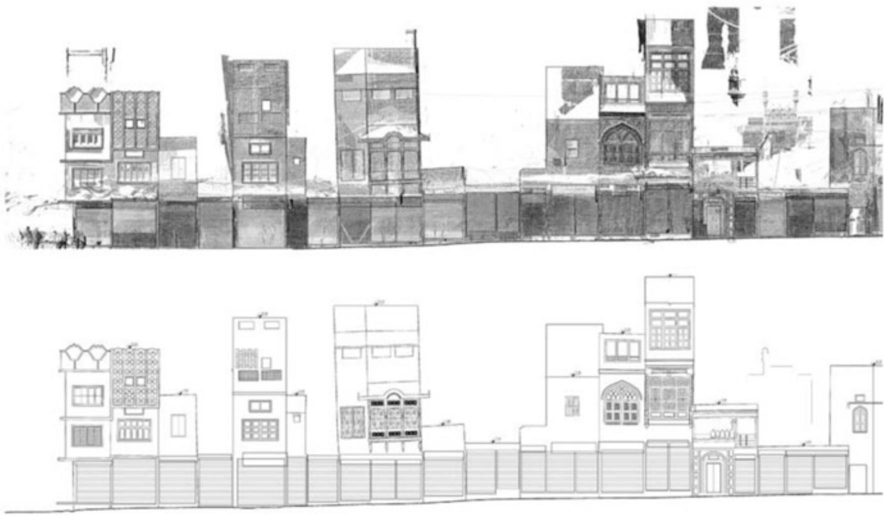

Fig. 9.7 Layout of elevations along Haram Bazaar (urban design team)

9.8 Conclusions

Integrated geomatic techniques allowed to collect in few days a huge amount of data useful for all teams in Multan Walled City Project. Even if work done during this mission covers only a part of the overall mapping project, as explained in premises, the used methodology always allows integrations at every scale, from LiDAR data to direct survey.

The accuracy and resolution of the point cloud model recorded the selected areas as a 3-D photography which will constitute a benchmark to verify every urban transformation in future.

A further remarkable aspect is the interest by Pakistani scholars and officials on scanning technologies, which enriched relationships and collaboration on this project. There again, new and unusual technology attracts itself, people curiosity about instruments helped us to explain our tasks, and we wish to make people more aware about the relevance of their own cultural heritage.

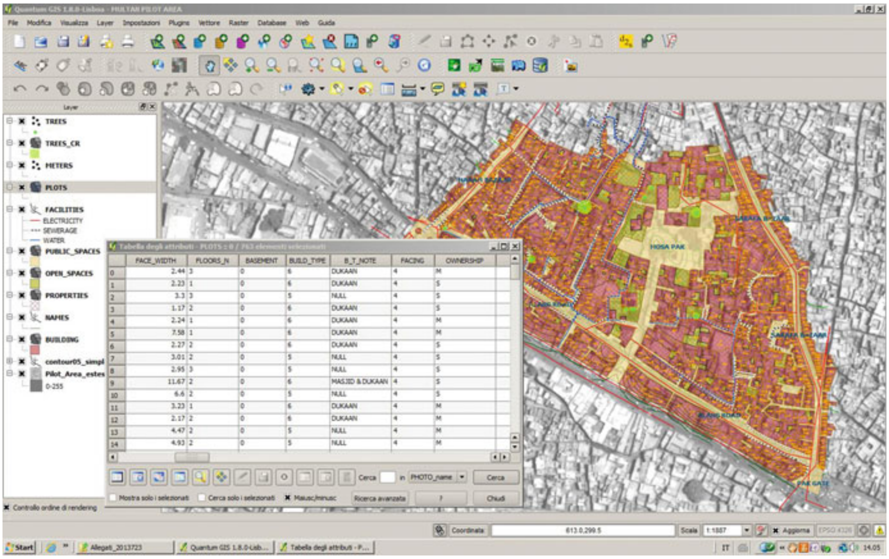

Fig. 9.8 The ground floor outlines used to define pilot area GIS (urban planning team)

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Chapter 10
Energy Problems Analysis

Tiziana Poli, Riccardo Paolini, Andrea Giovanni Mainini, Giorgio Pansa, Enrico De Angelis, and Matteo Fiori

Abstract The reduction of the energy demand of building stocks is a crucial issue for designers and public administrations, considering the huge effect on population in terms of health related to thermal comfort and to pollution, and in terms of energy costs. However, in common design practice just the effect of climate on buildings is considered, while designers, normally, since they are not provided with the suited tools for this, do not care about the influence of the built environment, which is proved in the literature to be huge. Herein we present the analyses of possible actions for refurbishing and reshaping the energy demand of the Walled City of Multan, focusing on three main aspects: urban scale, building scale, and solar energy exploitation. In detail, we analyzed and modeled the existing condition and possible improvements to mitigate thermal stress in urban areas. Then, we analyzed the energy demand of single buildings, modeling possible actions to improve indoor thermal comfort. Finally, we considered the possible ways to exploit the available solar energy to reduce the energy use in buildings. The aim of this study is then to assess the mitigation of outdoor heat stress conditions, within the urban environment; the thermal comfort conditions indoors; the operational energy need of buildings; and the fraction of energy that is possible to cover with renewable sources.

10.1 Introduction

The climate in Multan's area may be classified as subtropical continental (hot and arid), with the yearly average air temperature of 25.18 °C and frequent daily maximum values above 40 °C during the summer period (with more than just a few days with a daily maximum of 47–48 °C), weak air circulation (average wind

T. Poli (✉) • R. Paolini • A.G. Mainini • G. Pansa • E. De Angelis • M. Fiori
Department of Architecture, Built Environment and Construction Engineering, Politecnico di Milano, Milan, Italy
e-mail: tiziana.poli@polimi.it

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velocity of roughly 2 m s^{-1}), and high values of solar irradiance. Albeit a few numbers do not completely describe the physical reality, these simple statistics already provide the general feeling of the possible issues related to thermal comfort and cooling energy demand of buildings. In addition, Multan's Walled City is an irregular and compact pattern of low-rise buildings, with narrow streets, providing a further barrier to wind penetration, and commercial and artisans' activities and traffic releasing heat and pollution at street level and further worsening the thermal comfort conditions and the air quality.

Thus, to identify possible refurbishment interventions at urban and building scale, first of all we analyzed available weather data, to evaluate the boundary conditions affecting the building energy balance, as well as the urban energy balance. In detail, we isolated peak and average values, frequency and distribution, and day–night temperature ranges, identifying the hottest periods of the year, the percentage of time in which air conditioning is needed, and the daily average temperatures for each summer month. Thanks to these analyses, different strategies were selected to mitigate the heat island phenomenon within the city of Multan, such as the introduction of low vegetation, high vegetation, shading, and protection from hot wind. These strategies have been assessed by means of simulations with the software ENVI-met. Considering the Physiological Equivalent Temperature (PET) as the best indicator in order to evaluate the external comfort, results show that the introduction of high vegetation, where this is possible (i.e., squares and other open spaces, namely, the areas having higher solar access), is the best strategy.

We estimated the potential energy production with photovoltaic panels, and we conclude that, for the considered context, the use of integrated coupled solar thermal and PV systems could be a good solution for producing electric and thermal energy with satisfying efficiency. At smaller scale, we assessed the indoor thermal comfort and energy behavior of individual buildings. Among all types of different buildings, a reference building has been analyzed by means of the software model EnergyPlus. Several simulations have been performed with a 24 different boundary condition combinations. The building has been analyzed hourly through all the summer period (from April to November). In order to assess a building energy balance during the summertime, we have been using an hourly dynamic simulation model.

10.2 Urban Scale: Strategies for Mitigation of Thermal Stress

To mitigate the heat island intensity within the city of Multan (Pilot Area), we analyzed different strategies including greenery (i.e., the introduction of low vegetation such as grass and bushes), the use of green spots of high vegetation (i.e., trees), and canopy shading. These strategies have been analyzed with numerical

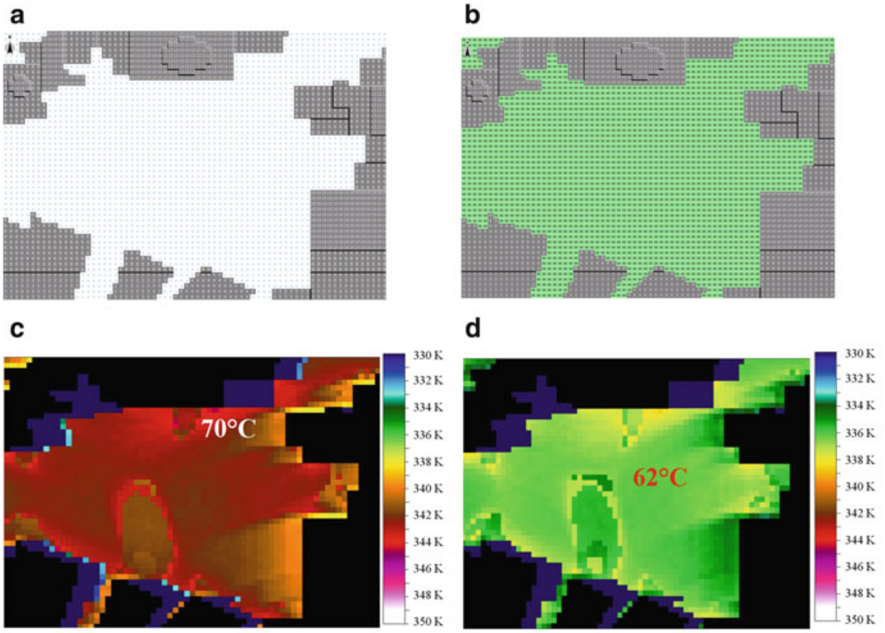

Fig. 10.1 ENVI-met model of zone 1 considering (**a**) the present state and (**b**) after greenery, and mean radiant temperature at 4 p.m. for 21 June of a square within the Walled City (**c**) in the present state and (**d**) considering greenery with low vegetation. Local decreases (*blue areas*) are due to the shadows of surrounding buildings (Colour figure online)

modeling with the software model ENVI-met. Simulations refer to the square surrounded by the Peer Moosa Masjid and the Tomb Hamid Shah Gilani (Zone 1).

10.2.1 Greenery

Greenery concerns the introduction of low vegetation, such as grass and small bushes. Vegetation can mitigate the average mean radiant temperature of the area, thanks to the cooling effect of plant evapotranspiration (Kruger and Pearlmutter, 2008). We estimated reductions in mean radiant temperature up to 10 °C, within the considered area (Fig. 10.1).

10.2.2 Green Spot

Introducing green spots consists of planting trees, almost small urban woods, in this case in a square of 13 m × 13 m in the middle of the analyzed area. The vegetation can reduce the average mean radiant temperature of the area, thanks to the shading

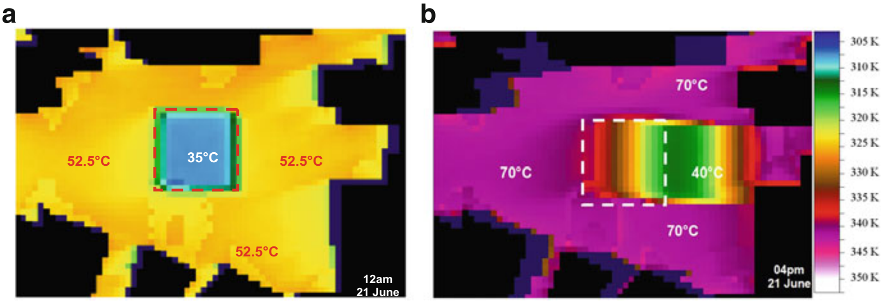

Fig. 10.2 Mean radiant temperature around a green spot at 12 a.m. (**a**) and at 4 p.m. (**b**)

provided by the tress and thanks to the cooling effect given by the evapotranspiration of plants. At 12 a.m. (Fig. 10.2a), the mean radiant temperature is relatively homogeneous outside of (with values of about 52 °C) and within the green spot (equal to 35 °C), since the short shadow projection in the middle of the day. Later, at 4 p.m. (Fig. 10.2b), the benefit provided by shading is still very relevant, but it is shifted following the shadow projected by the trees.

10.2.3 Canopy Shading

Microclimate mitigation strategies often need to be implemented at urban canyon scale, more than at neighborhood scale. To assess different design options, we performed an analysis (through 1 year) of the air temperature within an urban canyon of an East–west oriented street in the Walled City of Multan, representing the features of a typical street in Multan (Fig. 10.3). The considered canyon has a height to width ratio (H/W) equal to 2, considering buildings 10 m high and a street 4 m wide. Masonry walls, 40 cm thick, of handmade bricks delimit the canyon, and as for the street, we simulated a pavement made with the same bricks (considered the intention of the municipality of using this as paving material). For both the walls and the street, we assumed an albedo equal to 0.40 (i.e., a common value for clay materials).

The model used for performing the simulations is a variant of the model by (Kusaka et al. 2001), which is a surface energy balance parametrization, used for weather forecasting at urban scale and resolving the balance above the urban canopy. In the variant of the model by Kusaka et al. (2001), multiple reflections (up to six) of both short-wave and long-wave radiation within the urban canyon are computed, and the heat and moisture transport through walls and street pavement, thanks to a finite difference module.

The weather data collected at Multan's weather station (NOAA reference code 41675; latitude, +30.200; longitude, +71.433; elevation, 123 m) have been used to force the model at the top of the canyon, as describing the first atmospheric level.

Fig. 10.3 An urban canyon in Multan. Buildings have irregular height and average H/W = 2

This is a rough approximation considering that the conditions at the top of the canyon should come from a mesoscale model. However, given that the weather data used for the simulation are collected at an urban (or suburban) station, we regard this first approximation as acceptable for capturing the microclimate mitigation potential of different design opportunities, and currently there is no sufficient information available to accurately model Multan's urban heat island. Further investigations, measurements, and mesoscale climate modeling of the area are required to improve the accuracy and better assess other aspects such as the air mixing at the top of the canyon. In addition, knowledge about the anthropogenic heat emissions is fundamental to model properly the microclimate conditions in Multan, given the relevant use of air conditioners and the commercial and manufacturing activities releasing heat in workshops facing the street.

Initially, we considered that the weather data already include the effect of anthropogenic heat emissions (simulations marked as "nQf," namely, "no anthropogenic heat within the canyon"), as well as for the air layer over the canopy, and not within the canyon. Then, to model the heat release within the canopy derived from human activity, we assumed a flat value of 100 W m^{-2} (simulations 01, 02, 03, and 07, marked as "Qf," namely, with anthropogenic heat) of anthropogenic heat for an urban canyon in Multan. With these two alternatives (Fig. 10.4), we represent the option of placing the external units of air conditioners on rooftops, or on building façades, as it is (thus with anthropogenic heat release within the canopy).

First, we modeled the canyon as it is, without shading provided by tents (case 02, no tent) and with tents without improved optical properties (cases 03 and 04). We assumed that the tents normally placed over the streets in Multan (approximately 30 cm distant from the walls) may offer a solar reflectance equal to 0.50 and

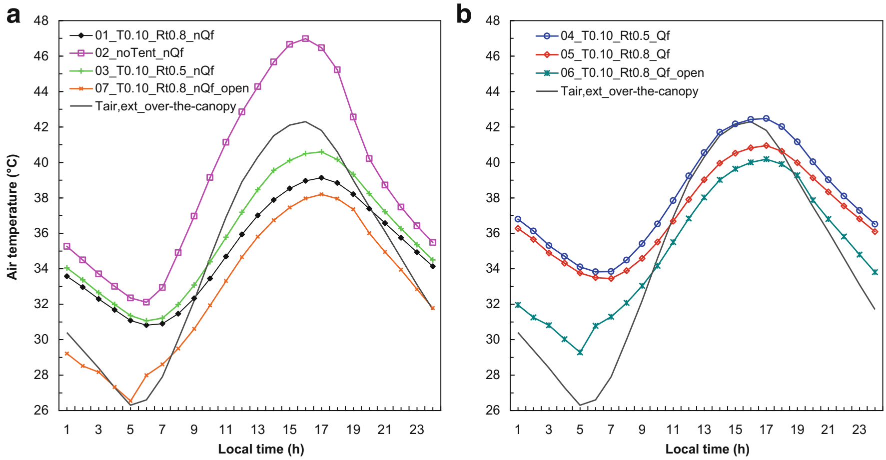

Fig. 10.4 Air temperature within an urban canyon for 28 June (maximum air temperature representing the 90th percentile for the summer period): (**a**) with heat release from human activity over the canopy with a tent having solar transmittance (Tsol) equal to 0.1 and reflectance (Rsol) equal to 0.8 (case 01), or Rsol = 0.5 (case 03), or Rsol = 0.8 and opened during the night (case 07), or with no tent (Case 02); (**b**) with heat release from human activity within the canopy, with a tent having Tsol = 0.5 (case 04), or 0.8 (case 05), or 0.8 and opened nighttime (case 06)

a solar transmittance equal to 0.10. Then, we assessed the possibility of adopting tents with improved optical and radiative properties, namely, with solar reflectance (on the upper side) equal to 0.80, and solar transmittance still equal to 0.10 (cases 01 and 05), fixed at rooftop level, and with minimal distance from the walls (about 10 cm). Finally, we evaluated the effect of opening the tents during the night, for allowing nighttime radiative cooling (cases 06 and 07). In all cases (i.e., different scenarios of anthropogenic heat release) we note that the best-performing design option is proposing tents with high solar reflectance fixed at the top of the canyon, and removed during the night, and with external units of air conditioners—as well as any other relevant heat source—placed at rooftop level rather than inside the canyon. This option allows radiative cooling during the night and provides shading during the day. As a result, the thermal mass is best exploited, reducing the peak load during the day and releasing heat during the night, which would not be possible without removing the tents. In any case, the worst condition modeled is the canyon without any shading.

10.2.4 Evaluation of the Outdoor Comfort

In order to evaluate the outdoor comfort in Zone 1 and cooling contribution given by low vegetation, it was decided to use the Physiological Equivalent Temperature (PET) (Höppe 1999; Mayer and Höppe 1987). As the PMV index (Fanger 1972;

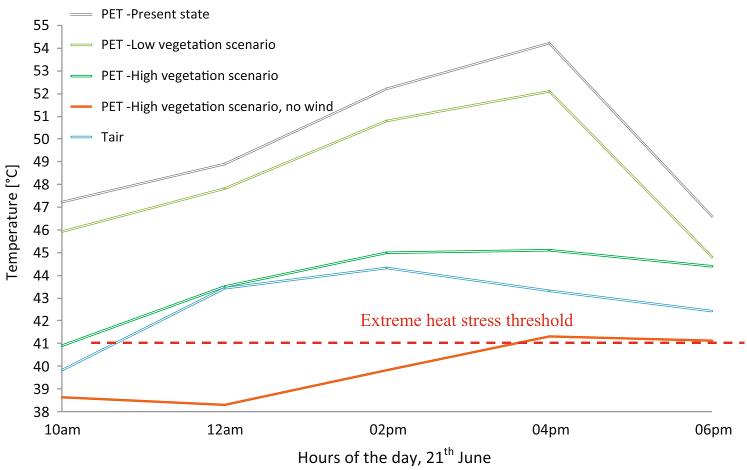

Fig. 10.5 Comparison between the PET in the present state, in the low vegetation scenario, and in the high vegetation scenario, with and without wind

Fanger et al. 1974), PET is a comfort index for characterizing the human thermal sensation useful to assess thermal conditions in a physiologically significant manner. The Physiological Equivalent Temperature was calculated by means of the software RayMan (Matzarakis et al. 1999), which stands for "radiation on the human body." (Fig. 10.5).

10.3 Indoor Comfort and Building Energy Demand for Cooling

With both quasi-dynamic and dynamic simulations (these by means of the software model EnergyPlus), we explored low-cost and easy-to-integrate strategies to reduce the energy demand of buildings within the Pilot Area (in Multan's Walled City) and to improve indoor thermal comfort. For instance, we analyzed in detail building Gali, performing dynamic energy simulations, on hourly basis, for a combination of 24 different boundary conditions all through the summer period, which goes from April to October. Since there were no data about ventilation and building use, the building was modeled with different heat loads (2.5 or 5 W m^{-2}) and infiltration conditions (0.5, 2.5, or 5 Vol h^{-1}) with constant values or with a day–night variation.

The Gali building has been analyzed with the aim of decreasing the mean indoor air temperature. Mean results indicate that:

- Internal heat gains play a significant role in the building energy balance.
- A variable ventilation profile (lower rate during the day and higher during the night) is more effective than a constant one. Improving ventilation is an effective cooling strategy if the intake air has a temperature lower than comfort

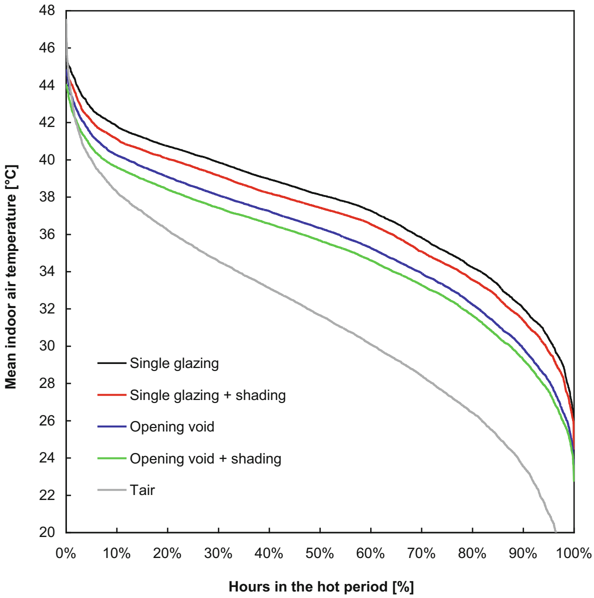

Fig. 10.6 Frequency of mean indoor air temperature with or without shading elements. Heat gains were assumed constant (2.5 W m^{-2}), constant air change rate for voids, and variable ventilation for the glazing case (0.1 Vol h^{-1} from 8 a.m. to 9 p.m., 2.5 Vol h^{-1} from 9 p.m. to 7 a.m.)

temperature or, at least, if it is lower than indoor temperature. A possible solution is to use, as inlet air source, internal shadowed courtyards cooled (as also seen by Tahbaz and Djalilian 2008), thanks to evapotranspiration of vegetation and high trees shadowing.

- The introduction of glazing (single panes or insulating glass units) increases indoor air temperature during summer, if windows are kept closed during the day. The high amount of uncontrolled infiltrations is reduced, resulting in a lower heat transfer coefficient. As a consequence, heat gains have to be compensated through natural (especially nighttime) or mechanical ventilation, in order to provide the same comfort level. External shading elements are necessary to reduce the solar heat gains, but they have to be permeable to air in order to favor ventilation (Fig. 10.6).
- Shading shelters above the roof are useful to decrease the indoor air temperature of the last floor. It is important to remove them during the night.
- If the thermal capacity of the roof is high, it is not very useful to insulate the roof externally. It is important to exploit the thermal mass in existing buildings. Cases shown in Fig. 10.7 are representative of a high thermal capacity roof. If walls are non-insulated (thermal transmittance >2 W m^{-2} K^{-1}), thermal insulation results in benefits in indoor air temperature, also in summer conditions.
- If the building is conditioned, the use of glazing reduces the cooling energy need (Fig. 10.8). It has to be pointed out that the introduction of glazing leads to lower ventilation rates (here assumed as constant, equal to 0.3 h^{-1}). However, no relevant differences between single and double panes are detected; as a result, double glazing windows do not yield significant improvements compared with the single glazing solution (as also seen by Al-Saadi and Budaiwi 2007).

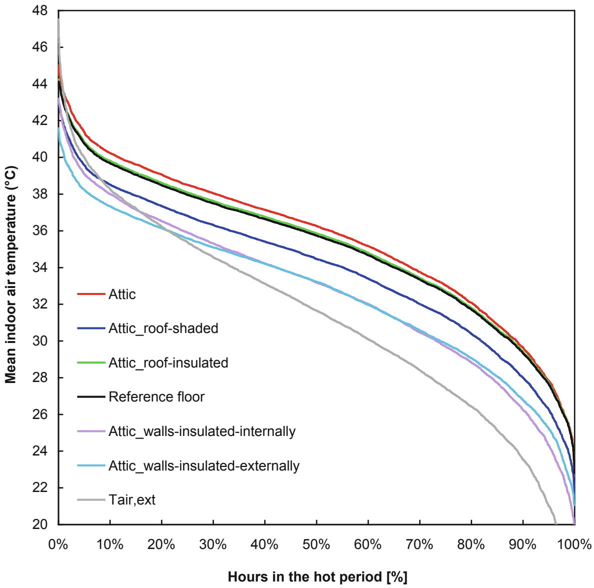

Fig. 10.7 Mean indoor air temperature frequency with roof exposed to solar radiation, considering constant heat gains (2.5 W m^{-2}), and constant air change rate (voids, 2.5 Vol h^{-1})

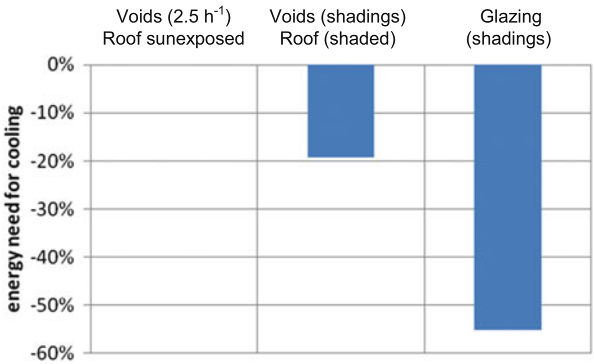

Fig. 10.8 Cooling energy reduction with roof shading or glazing shading

10.4 Solar Power for Hot Water Use

For electric energy production, amorphous and crystalline solar panel performances were investigated and compared. Due to their efficiency losses due to the increase in surface temperature for solar panels in sunny clear sky conditions and hot climates, the amorphous panels were chosen as the best solution. A surface of 24 m^2 could produce about 4.8 kWh m^{-2} per day on annual average. During the summer months the production increases and the same surface could produce 8 kWh m^{-2} per day.

For domestic hot water production, the performances of forced convection solar collectors plants were investigated. Plants with plate glazed solar collectors, water tank as energy storage, with different plant size and different orientation of collecting surfaces, were optimized. The results show that, with a defined profile of hot water consumption per person, 1 m^2 of solar collector is adequate to produce from 50 to 60 l/day during summer months for good orientation of the collecting surfaces and without auxiliary external heather use. The best orientation is south and the best slope of collector surface is 30° from horizontal plane. For east and west orientation and during winter months, it is necessary to use an auxiliary external heater to satisfy hot water needs for a percentage in time between 60 and 30 %.

10.5 Concluding Remarks

We analyzed Multan's Walled City context from different perspectives: outdoor thermal comfort assessing possible actions for microclimate mitigation, indoor thermal comfort and building energy demand for cooling, and the use of solar energy for hot water production.

Considering the Physiological Equivalent Temperature (PET) as the best indicator in order to evaluate the outdoor comfort, numerical modeling with the software ENVI-met shows that the introduction of high vegetation is the best cooling strategy because of the provided shading and the evapotranspiration of plants. Moreover, results show that if the air temperature is above 38 °C, wind increases the heat stress on the human body. For what concerns urban spaces identifiable as public squares and courtyards, the best mitigation strategies are:

- To realize new green spots and high shadowing trees characterized by thick and dense green canopy (bigger than 10–15 m^2), where possible and wherever an underexploited area can be found
- To link green spots (or to make them closer than 150–200 m), realizing a sort of green path
- To realize shadowing tents, with opaque textiles

Wind and solar stress, foliage maintenance (clip and trim), water availability, as well as mature tree dimensions and growth speed must be carefully weighted in the selection of trees species.

For what concerns pathways, then, it is suggested to realize shadowing tents whose geometry does not prevent air movement; with a very low solar absorbance, a very high solar reflectance index, and a very low solar transmittance in the near-infrared spectrum. The best solution is provided by removable tents that can be furled up to enhance heat dispersion during the night and to reduce damages in case of extreme wind events. Tents should be placed as high as possible, over the street, again, to avoid sealing the street canyon.

With a technical textile having enhanced performances, it could be possible to reduce the air temperature—below the sheltered volume—even by roughly 10 °C compared to the unsheltered street. Moreover, with enhanced tents over the street canyons, the solar load on buildings, and the air temperature close to the façade of buildings would be reduced, resulting in a lower energy demand for cooling. In addition, with numerical simulations we observed the need of opening the tents over the street canyons during the night, to allow radiative cooling of built surfaces and air change.

With regard to the building scale, mechanical ventilation can be provided by means of ceiling fans (with upward/downward wind option) or by means of fans placed close to the walls; the efficiency of ventilation—assessed considering indoor air temperature change—is weighted considering the end use (thus the different internal loads), varying period and duration of forced ventilation and air change rate. A variable ventilation profile (lower rate during the day and higher during the night) is more effective than a constant one. Ventilation is an effective cooling strategy if the intake air has a temperature lower than comfort temperature or, at least, if it is lower than indoor temperature. A possible solution is to use, as new air source, internal shadowed courtyards cooled during the night and lightly heated during the day, thanks to evapotranspiration of vegetation and high trees shadowing.

Another basic recommended action is the application of glazing (single glass or double glass) protecting the existing window opening and implementation or refurbishment of existing solar protection and shading devices at window openings. The efficacy of this strategy has been weighted considering 1-year period, with special attention to the hot season and cooling energy savings. The introduction of glazing (single panes or insulating glass units), in the windows, increases indoor air temperature during summer, if windows are kept closed during the day. The high amount of uncontrolled infiltrations are reduced, and a natural or mechanical ventilation is opportune favorable to compensate a lower heat transfer coefficient for the same amount of heat gains and to assure the same comfort level. Shading elements in front of windows or voids are necessary to reduce the solar heat gains, but they have to be permeable to air in order to favor ventilation. If the building is conditioned, the use of glazing is an advantage for what concerns cooling energy need (yielding to a reduction of even 50 % of building energy consumption). It has to be pointed out that the introduction of glazing brings lower ventilation rates (here assumed as constant, equal to 0.3 h^{-1}).

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Chapter 11
Air Quality Measurements at Multan, Pakistan

Elisa Vuillermoz, Paolo Cristofanelli, Davide Putero, Gianpietro Verza, Marcello Alborghetti, Maria Teresa Melis, Ghulam Rasul, Luca Listo, and Paolo Bonasoni

Abstract Urban outdoor air pollution is estimated by the World Health Organization (WHO) to cause 1.3 million deaths worldwide per year. By reducing air pollution levels, it is possible to reduce the global burden of disease from respiratory infections, heart disease, and lung cancer. Air pollution is a major environmental health problem able to produce serious risks to health from exposure to particulate matter (PM) and ozone (O_3) in many cities, including Multan, Pakistan. At present there are no national inventories that estimate air pollutant emissions in Pakistan, and regular monitoring of environmental air quality is still not systematic in this country. According to the Pakistan Environmental Protection Agency (Pak-EPA), a major share of the emissions load from motor vehicles, although not quantified, can be attributed to a relatively small number of smoky diesel and two-stroke vehicles found in many Pakistani cities. The high levels of sulfur in automotive diesel (0.5–1 %) and furnace oil (1–3.5 %) are seen as a major contributor PM in ambient air. Emissions from large-scale facilities and a wide range of small-to-medium-scale industries (brick kilns, steel rerolling, steel recycling, plastic molding, etc.) cause a disproportionate share of pollution through their use of dirty "waste" fuels (i.e., old tires, paper, wood, and textile waste) and the use of diesel electric generators in commercial and residential areas.

E. Vuillermoz (✉) • G. Verza • M. Alborghetti • M.T. Melis • L. Listo
Ev-K2-CNR Committee, Bergamo, Italy
e-mail: elisa.vuillermoz@evk2cnr.org

P. Cristofanelli • P. Bonasoni
Ev-K2-CNR Committee, Bergamo, Italy

CNR-Institute of Atmospheric Science and Climate (ISAC), Bologna, Italy

D. Putero
CNR-Institute of Atmospheric Science and Climate (ISAC), Bologna, Italy

G. Rasul
Pakistan Meteorological Department, Islamabad, Pakistan

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In Multan, the burning of municipal solid waste is also a significant source of air pollution in the urban area, where almost 48,000 t of solid waste is generated each day, most of which is either dumped in low-lying areas or burned at low temperatures, generating PM, but also producing other carcinogenic pollutants.

The air quality monitoring program presented in this chapter aims at providing information for identifying main pollution sources and analyzing pollutant transport dynamics through the continuous measurements of aerosol, trace gas concentrations, and meteorological variables in Multan. Within this project a monitoring station has been installed at Multan Airport: this represents the first permanent air quality station working in this city. The activities have been carried out in collaboration with the Pakistan Meteorological Department (PMD) and the Environmental Sciences Department of the Bahauddin Zakariya University (BZU).

The air quality system performs continuous measurements of meteorological variables, PM 2.5 and PM 10 (atmospheric particulate matter with diameter less than 2.5 and 10 μm, respectively) and O_3. Measurement results will allow to improve knowledge in the field of atmospheric sciences and air quality monitoring in order to facilitate sustainable development resource management at local level. Moreover, in collaboration with the PMD, a preliminary "Air Quality Monitoring Plan" has been defined to collect available information on local conditions and to provide suggestion for the implementation of an action plan to improve air quality in Multan City such as the reinforcement of environmental regulations, infrastructural interventions (e.g., roads) to reduce dust emissions, and the organization of awareness campaigns regarding air pollution control at school and university level.

11.1 Introduction

Air pollution is considered to be primarily an urban problem in the Pakistani region of Punjab, as the rate of urbanization is increasing. In this region, the urban air quality is being deteriorated due to inadequate traffic plans and transport management (which has not been given due importance until now), use of outdated technology including fuel substitution, unavailability of less polluted fuels (e.g., low sulfur fuels, CNG), fuel adulteration, and nonexistence of management tools for effective implementation of legislation on emission control.

Multan is the largest town of Punjab and central Pakistan with a population of three million inhabitants. It is located along the east bank of Chenab River within two deserts, Thal and Cholistan, which are at about 200 km north and south from the city, respectively (Fig. 11.1). The air quality of Multan City is affected by vehicular and industrial emissions. In particular, the total number of vehicles in Multan stood at 77,658 in 2010. Motorcycles/scooters constituted 68 % of the total. The second highest share is that of motor cars, jeeps, and station wagons at around 14 %. Growth rate for others has been recorded at 12 % per annum. The growth of registered vehicles over the past 25 years has been recorded at around 13 % per annum. The growth of other vehicles and delivery vans was recorded at almost

Fig. 11.1 Location of the city of Multan and external view of the air quality station

24 % and 17 %, respectively. Motorcycles/scooters and motor cars, jeeps, and station wagons share 13.5 % and 12 %, respectively. In the urban areas of Multan, industries include textile, fertilizers, pesticides, polypropylene bags, ghee oil and soap, engineering products, fabrics, leather, industrial glasses and medicine, oil mills, poultry, garments, paints and dyes, sugar mill, beverages, and food. Finally, due to its proximity to large desert areas, mineral dust is expected to have a non-secondary role in affecting air quality in the city of Multan. In particular, the synergy between anthropogenic and natural sources of pollution is expected to favor the occurrence of high levels of PM and surface O_3. O_3 is directly involved in photochemical reactions and in determining the overall oxidation capacity of the troposphere (Jacobson 2002). Moreover, it is a harmful pollutant for human health and ecosystems (Conti et al. 2005).

Pakistan Environmental Protection Agency has no air quality monitoring station in Multan; thus the only available data on air quality at Multan were obtained on September 2011 by the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) which established full-fledged mobile air quality monitoring facilities. These include US EPA-designated state-of-the-art ambient air monitoring equipment for sulfur dioxide, nitrogen oxides, ozone, hydrocarbons (methane and non-methane), carbon dioxide, carbon monoxide, and suspended particulates including PM10 and PM2.5. Unfortunately, only 3 days of observations were

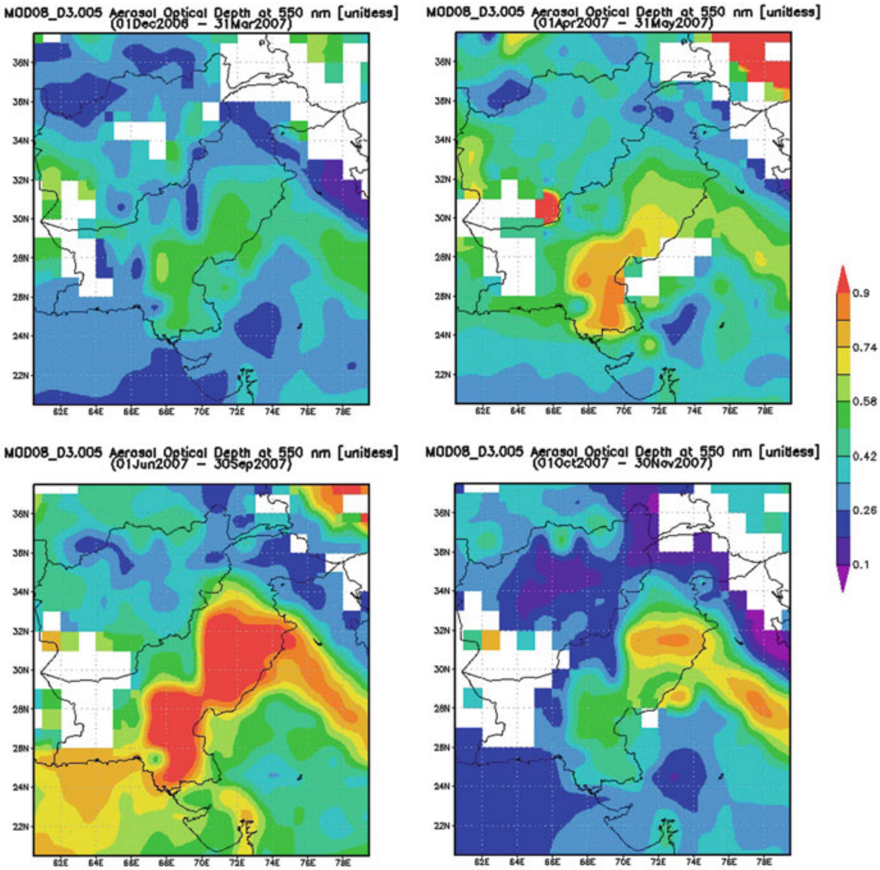

Fig. 11.2 Seasonal averaged MODIS (Terra, Collection 5) AOD550 over Pakistan for 2007: winter (*upper left*), spring (*upper right*), summer (*bottom left*), autumn (*bottom right*)

available. Even if this small amount of data is not sufficient to study the existing air quality of Multan City, nevertheless it provides an early indication about the extremely high levels of atmospheric pollution in this city: as a function of different days or different sampling locations, the 24-h average PM10 (PM2.5) values ranged from 63 to 100 μg m^{-3} (44–64 μg m^{-3}), while O_3 showed average daily values from 52 to 86 μg m^{-3} (i.e., 26–43 nmol mol^{-1}). The European air quality directive assumes a daily limit of 50 μg m^{-3} for PM10 for the 24-h average value.

In this chapter, we provide a description of the air quality station (Fig. 11.2) which has been installed on September 2012 at Multan, in the framework of the Pakistan-Italian Debt for Development Swap Agreement Project: "Sustainable Social Economic and Environmental Revitalization in the historic core of Multan City." This AQS, representing the first permanent facility for atmospheric composition monitoring in Multan, has been installed by Ev-K2-CNR, on behalf of Mountain Equipe Srl, partner of the project, in close collaboration with PMD and

Bahauddin Zakariya University (BZU), which are also involved in the management of the station. The Institute of Atmospheric Science and Climate by the National Research Council of Italy (ISAC-CNR) is also involved in the activities concerning the data validation and analysis. The aim of this permanent AQS is to identify main pollution sources and analyze pollutant transport dynamics through the continuous measurements of aerosol and trace gas concentrations and meteorological variables. In the next section we will provide a technical description of AQS also discussing the first measurements of meteorological parameters, surface O_3, PM10 and PM2.5 obtained during the period September to October 2010. Finally, a description of the preliminary "Air Quality Monitoring Plan" defined by PMD and Ev-K2-CNR will be provided.

11.2 Setup of the Air Quality Station in Multan

The AQS has been installed at the Multan International Airport on September 6–14, 2012. In particular, it has been placed on the roof of the Pakistan Meteorological Department (PMD) headquarters.

Due to the big dimensions and the large weight of the station, the AQS was shipped by sea to Karachi and then transported by truck to Multan. Before shipping the AQS was assembled in Italy (at the FAI Instrument s.r.l. factory), where all the equipment were tested to verify the functioning of sensors, the instrumentation, and the technical facilities. During the testing phase, FAI Instruments also executed the training to Ev-K2-CNR technicians for correct installation, maintenance, and functioning of the station. In turn, during the installation, Ev-K2-CNR technicians trained the PMD and BZU staff who are in charge for the maintenance and functioning of the AQS in Pakistan. In particular, during the operations they could learn how to manage the instruments both locally and by remote software connections.

Before positioning the station, a specifically designed platform has been built on the roof of the PMD building in order to guarantee a homogenous distribution of the weight, to avoid any possible infiltration of water inside the shelter, and to reinforce the structure. With the aim of protecting the instrumentation from electrical surges and to guarantee the power continuity, the power lines have been equipped with surge protections and a UPS system has been installed. An internal conditioning system has been also implemented to maintain the internal laboratory temperatures within the range allowed for the correct functioning of the monitoring instrumentation.

An Internet connection has been activated at PMD offices for allowing the remote control of the instrumentations and acquisition systems from PMD and BZU. In particular, PMD and BZU (in Pakistan) and Ev-K2-CNR (in Italy) perform daily check of data and timely verify the correct functioning of the systems. Moreover, a backup connection via optical fiber to an independent router has been also established.

Once the equipment reached the installation site, each component has been verified in order to check any possible damages occurred during the transportation, and the shelter has been positioned on the supporting platform using a hydraulic crane.

The monitoring station was equipped with the following analyzers and sensors:

- UV-absorption analyzer (model: FAI 400E) for surface O_3 monitoring
- Low-volume sampler (model: FAI SWAM 5a Dual-Channel Monitor) with β-absorption for PM2.5 and PM10 monitoring
- Weather transmitter (model: VaisalaWXT520) for monitoring of air temperature, atmospheric pressure, relative humidity, and wind speed and direction
- Rain gauge (model: VaisalaRG13) for rain precipitation monitoring
- Pyranometer (model: Kipp & Zonen CMP3) for short-wave (λ: 300–2,800 nm) downward global solar radiation

The data collection will be the responsibility of the Environmental Sciences Department of BZU staff, in collaboration with PMD and under the supervision of Ev-K2-CNR. PMD will be also responsible for security operation, and day-to-day maintenance of instruments will be done in collaboration with BZU under the supervision of Ev-K2-CNR.

11.3 First Air Quality and Meteorological Measurements

As reported by the Climatological Data Processing Centre (CDPC) within Pakistan Meteorological Department Climate Profile for the period 1971–2000, Multan is characterized by dry climate: with mean annual rainfall of 209.6 mm. However, an influence of the South Asian monsoon system can be detected with very hot (more rainy) summer and mild winter. In summer, during daytime, air temperature maxima above 40 °C can be recorded. Foggy conditions mostly prevail during winter (DJF), with maxima of occurrence in January. During summer season, from May to September, winds blow mainly from the south and carry heavy loads of mineral dust from the Cholistan Desert sand to the city of Multan. In spring (March to April), occasionally winds prevail from north/northeast and transport mineral dust from the Thal Desert. Dust/sandstorms are a common occurrence in Multan region with the highest frequency in summer. As an example, in Fig. 11.2, we show the seasonal Aerosol Optical Depth (AOD) at 550 nm over Pakistan for 2007. A "hot spot" area can be identified over southeastern Pakistan (around 25°N; 68°E), where the city of Multan is located. This "hot spot" is particularly evident from April to September and, also according with Alam et al. (2010), it identifies the dust emitted from the Cholistan and the Thal deserts. Especially during summer, this large amount of atmospheric dust result into health problems and retarding growth and development of vegetation due to heavy deposits of dust on leaves: the mineral dust stops the sunlight to reach chlorophyll and hence depriving the plants to make food through photosynthesis.

Table 11.1 Average, standard deviation, minima, and maxima values for the parameters collected at Multan during the period September14 to October 30, 2012

Parameter	Average	St. deviation	Min	Max
O_3 (ppbv)	29.4	22.3	2.3	102.8
Temperature (°C)	26.5	4.4	15.1	35.6
Pressure (hPa)	994.6	4.8	981.6	1003.9
Relative humidity (%)	59.1	16.6	22.7	94.9
Wind speed (m s^{-1})	1.9	1.2	0.3	7.4
Solar radiation (W m^{-2})	200.2	269.5	0.0	815.2

Table 11.1 presents the basic statistical parameters for meteorological parameters and surface O_3 during the first period of measurements (from September 14 to October 30), while Fig. 11.3 shows the recorded time series (hourly average values). Average air temperature was 26.5 ± 4.4 °C. Daily maxima were above 30 °C for the most part of the period, while daily minima never decreased below 15 °C. In general, during the second part of October, lower air temperature values were recorded at Multan. Atmospheric pressure showed an average value of 994.6 ± 4.8 hPa, with higher values from October 15 until the end of the month. The influence of synoptic-scale meteorology was evident looking at day-to-day the atmospheric pressure variability. In particular, the minima occurred on September 14 and 24 and October 4 have been concomitant with wind speed increases (up to 6 m s^{-1}), possibly indicating the influence of synoptic-scale disturbances (cyclones or troughs). Relative humidity presented an average value of 59.1 ± 16.6 % with hourly values never exceeding 80 %. Only on September 17, when low solar radiation values were recorded (indicating cloudy conditions), relative humidity approached the saturation value. Wind speed was usually low (mean value: 1.9 ± 1.2 m s^{-1}), with a prevailing direction from SW until the half of October and N–NE until October 30.

Figure 11.4 also reports surface O_3 mixing ratios. An average value of 29.4 ± 22.3 ppbv has been recorded. Two days presented hourly O_3 mixing ratios exceeding 90 ppbv (i.e., 180 μg m^{-3}) which represents the population information threshold according with the European Union air quality legislation. The O_3 average daily diurnal variations show a 24-h cycle which is typical for a suburban area, with maximum during the afternoon (from 16:00 to 17:00 local time, about 60 ppbv) and minima (from 21:00 to 7:00, about 15 ppbv) during the night to early morning (Fig. 11.5). The O_3 mean daily cycle is similar to the cycles observed for the short-wave solar radiation and wind speed. At Multan, daytime maxima have been also observed for the short-wave solar radiation and wind speed (Fig. 11.5), indicating the influence of photochemistry and air-mass mixing/transport.

PM2.5 and PM10 were available until October 2, 2012 (a technical problem related to the malfunctioning of the UPS system prevented the measurement of PM2.5 and PM10 until December 2012). During this period, high levels of PM2.5 (average value: 111.0 ± 37.3 μg m^{-3}) and PM10 (145.0 ± 84.6 μg m^{-3}) have been observed. In particular, for all the days the PM10 daily mean value exceeded

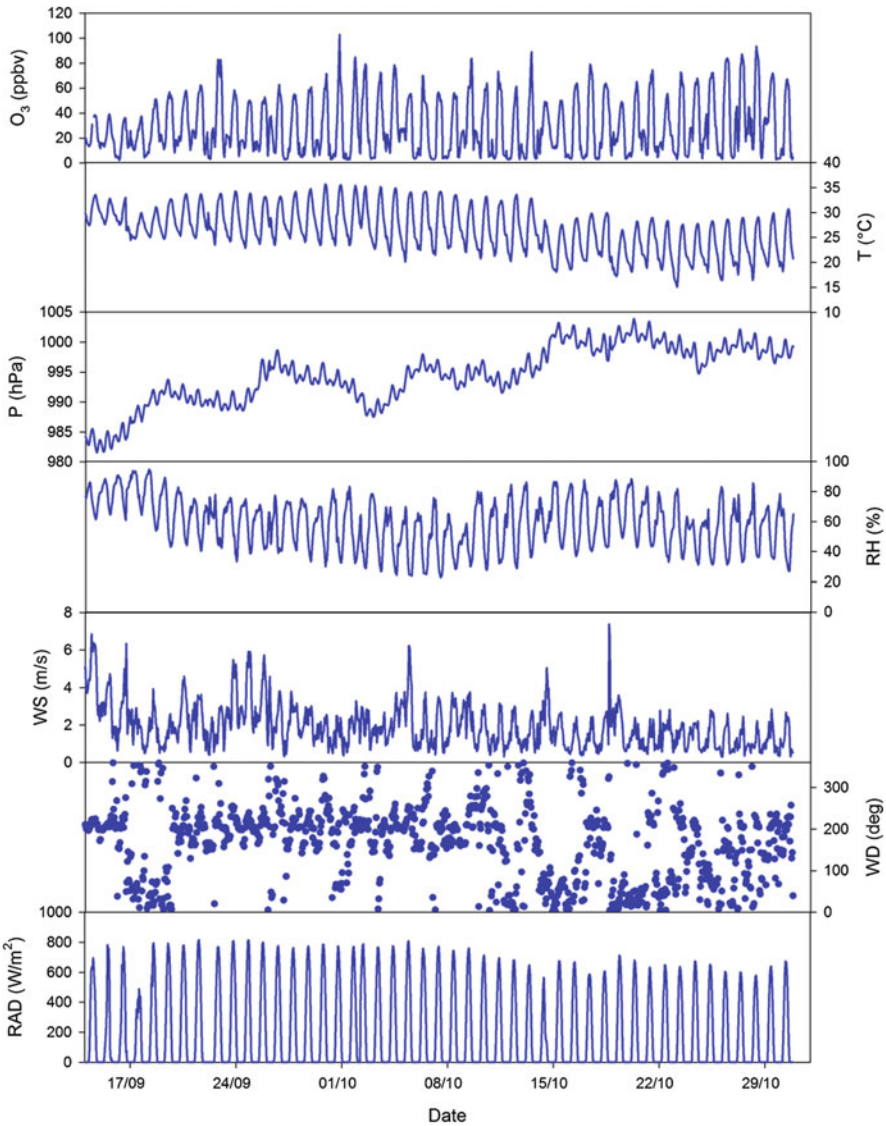

Fig. 11.3 Time series (mean hourly values) of surface O_3, air temperature, atmospheric pressure, relative humidity, wind speed, wind direction, and solar radiation

50 μg m^{-3} (the threshold value adopted by the EU legislation for air quality). The average PM2.5/PM10 ratio was 60 %, thus indicating that a significant fraction of particulate matter is represented by fine aerosol possibly related with anthropogenic pollution emission. These first observations confirmed that Multan air quality is poor, probably due to significant vehicular and industrial emissions, as well as by the occurrence of frequent dust storms. Industrial and vehicular emissions are also

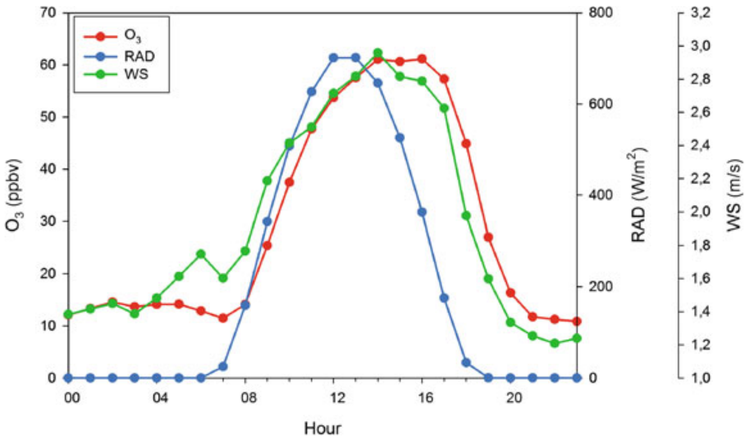

Fig. 11.4 Average diurnal variations of O_3 (*red*), solar radiation (*blue*), and wind speed (*green*) (Colour figure online)

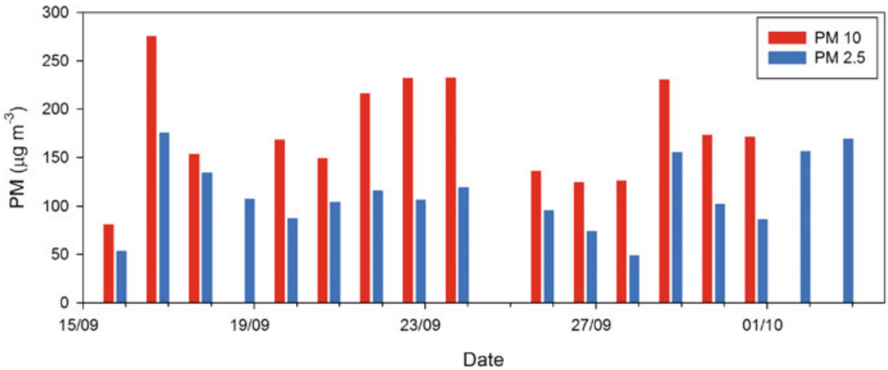

Fig. 11.5 Daily PM10 (*red*) and PM2.5 (*blue*) values at Multan from September 15 to October 3, 2012 (Colour figure online)

responsible for generating nitrogen dioxide and many other chemical compounds, which can lead to the elevated O_3 mixing ratios.

11.4 The Preliminary "Air Quality Monitoring Plan"

The first document aimed to define the air quality monitoring plan for Multan City had been drafted by PMD with consensus of Ev-K2-CNR. In the following a list of suggestions to improve the air quality in Multan is provided:

- It is important for the Pakistan Environment protection Agency (PEPA) to have an air monitoring station in Multan to support the management of urban air quality
- The laws and regulations regarding air pollution must be reinforced in Multan City
- The transport policy must be made and implemented that vehicles emitting smoke will be banned from the city roads
- Green CNG rickshaws and buses must be introduced in the city
- Proper disposal of waste through techniques like composting and landfill will help to minimize the air pollution
- Recycling of bottles, can, paper, print cartridge, and other materials should be encouraged
- There should be check and balance on industries so that they must not emit the air pollutants above the permissible limits of National Environment Quality Standards (NEQS)
- Metal roads must be built to lessen the particulate matter
- The afforestation and greenbelts should be encouraged to minimize the dust concentration
- Use brushes or rollers for painting instead of sprays
- Awareness campaigns regarding air pollution control at school and university level will help to improve the air quality of Multan

11.5 Conclusions

In the framework of the Pakistan-Italian Debt for Development Swap Agreement Project: "Sustainable Social Economic and Environmental Revitalization in the historic core of Multan City," an air quality station has been installed at Multan on September 2012. The first measurements of meteorological parameters, surface O_3, PM2.5, and PM10, confirmed the occurrence of poor air quality levels in Multan. For 2/47 days, the surface exceeded the "information" threshold adopted by the EU, while PM10 continuously exceeded the EU air quality threshold during a 14-day period of measurements. The execution of simultaneous measurements of PM2.5 and PM10 suggested that the high values of airborne particulate matter observed at Multan can be related both by anthropogenic source and the contribution of mineral dust (possibly mobilized over the regional deserts).

In the recent past, field experiments, in situ observations, and satellite monitoring have pointed to the existence of the so-called atmospheric brown clouds (ABCs), i.e., wide polluted tropospheric layers characterized by anthropogenic AOD greater than 0.3 and by absorbing AOD greater than 0.03 (Ramanathan et al. 2007). ABCs typically consist of particles (referred to as primary aerosols) and pollutant gases. Over South Asia, the ABC phenomenon (Ramanathan et al. 2007) has important regional climate impacts, with strong perturbations of the regional radiative balance both at the surface and within the atmosphere and with strong impacts on the hydrological cycle and monsoonal regimes. Also for correctly evaluating the impact of these pollutants to ecosystems, agriculture and local population, the implementation of new experimental monitoring activities is recommended. For these reasons, the air quality station installed at Multan has been included to the observatory network of the Atmospheric Brown Cloud Project by the United Nations Environment Program (UNEP), thus representing the first ABC-UNEP observatory existing in Pakistan.

Acknowledgments MODIS AOD analyses and visualization used in this work were produced with the Giovanni online data system, developed and maintained by NASA GES DISC. We also acknowledge the MODIS mission scientist and associated NASA personnel for the production of data used in this work.
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Chapter 12
Water and Sanitation in Multan, Pakistan

Andrea Soncini, Daniele Bocchiola, Renzo Rosso, Stefania Meucci, Francesca Pala, and Giorgio Valé

Abstract While Pakistan is blessed with adequate surface and groundwater resources, rapid population growth, urbanization, and unsustainable water consumption practices fell out upon the quality and quantity of water resources in the country. Worse water quality and contamination of lakes, rivers, and groundwater aquifers have resulted into increased waterborne diseases and other health impacts. Salinity of groundwater is further increasing. Industrial wastewater polluted with toxic chemicals, organic matter, and heavy metals is discharged directly into public sewers without prior treatment, and leaching of wastes into groundwater results into outbreaks of waterborne diseases. Multan town is among those most stricken by water pollution, and access to safe water is paramount important. In the framework of the Pakistan–Italian Debt for Development Swap Agreement Project: "Sustainable Social Economic and Environmental Revitalization in the historic core of Multan City," we aim at proposing possible strategies for fulfilling such request under a number of environmental constraints. Chenab River is the main stream of the area and as well the main source of surface water and groundwater recharge. Contamination of water supply has become a critical issue in Multan, since the majority of households use their own wells. Concerning sewerage, the municipal facility is serving at present 55 % of the population. Only one treatment plant is currently available in the north of town. Sewers are currently overexploited, with chronic overflowing, arising from the combined effects of low capacity, silting, and inadequate control of industrial wastewater. We design here a water supply network with tanks and wells for the walled city around the three main bazars that will provide water to the buildings. Meanwhile it is important to make water quality analysis on the water actually used by the people. Regarding sewerage, the goal is to

A. Soncini (✉) • D. Bocchiola • R. Rosso
Department of Civil and Environmental Engineering, Politecnico di Milano, Milan, Italy
e-mail: andrea.soncini@polimi.it

S. Meucci • F. Pala • G. Valé
MMI s.r.l, Milan, Italy

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replace the present open drains with a closed sewer system, delivering to the main sewer pipes along the citadel's perimeter. We propose a combined system (waste-water and storm water), which will significantly improve hygienic conditions in the area. In addition, in the past an improper disposal of industrial wastes from fertilizer plants and tanneries has caused a significant pollution of Hexavalent Chromium, posing with severe threats to human health. This calls for accurate analysis of the groundwater in Multan area. As such, one needs to systematically assess water quality both into wells and into sewer pipes. This may provide pieces of information for efficient and sustainable water management.

12.1 Introduction

Multan is one of the oldest cities in the Asian subcontinent. It is located in southern Punjab, at almost the center of Pakistan. The city is located at the intersection of major roads, linking the north and south of the country and the routes linking east and west. Multan is crowded with bazars, mosques, shrines, and superbly designed tombs. Near the town flows the Chenab River, one of the major left tributaries of the Indus River. The Chenab River originates in the Kullu and Kangra districts of the Himachal Pradesh province of India, at an elevation of ca. 16,000 ft (4,877 m) asl. The total length of the river is about 1,242 km, approximately 729 km flowing into Pakistan. Water discharge of the Chenab starts rising in late May and passes the 50,000 cusecs mark in June. A high flow above 50,000 cusecs continues till the middle of September, the peak discharge months being July and August. The city of Multan has seen in the last decades a very significant population growth and a large expansion of the urban area. The ancient part of Multan is called walled city, and in the past it was belted by a wall, almost disappeared today. The inner city is congested with narrow streets and a high population density of mixed housing, shops, and businesses. In Multan, WASA authority is responsible for water supply and sewerage systems. While the walled city stands on a hill, the rest of Multan town rests underneath the river bed altitude. Thus, a line of pumping stations is operative, with 8 h intervals, to discharge sewing waters. This results into frequent water leaking and flooding. Further, drains and culverts are frequently clogged with solid waste, thus providing further risk of overflows. Chenab River flows west of the city, and it is the main source of surface water and of recharge for the groundwater. Unconsolidated deposits spread over a large part of the alluvial plain deposited by the Chenab River. Hydrogeological studies were carried out by the WAPDA, displaying that an unconfined, permeable, fairly thick, and extensive aquifer is present. Tube wells of 100–300 m^3/h capacity dug down to 150 m deep can be installed here, except in the walled city area. Depth of water nap is about 10 m. Water quality is fresh (not saline) and within the limits approved by WHO. There appears to be no monitoring of drawdown, or cones of depression, but the water table is thought to be dropping at some 0.3 m per year. The access to the shallow aquifer is at 30–40 ft depth. The shallow water is polluted with surface water and sewerage. The ADB Consultants for the SPBUS (Southern Punjab Basic Urban Services, ADB 2012) Project apparently tested water at the taps at various sites in Multan and found contamination due to leaking pipes and sewerage infiltration in 15 different areas. Major sources of contamination of the piped water supply include (i) inadequate sanitation and drainage facilities, leading to wastewater ponding and infiltration of viruses and bacteria into the groundwater table, and (ii) improper disposal of industrial wastes from fertilizer plants and tanneries (possible pollution is associated with hexavalent chromium waste, e.g., Tariq et al. 2010).

Contamination of supply has become a critical issue in Multan, since the majority of households use their own wells with motor pumps. In addition to the abovementioned causes of contamination, contamination of aquifer by naturally occurring arsenic in shallow subsoils affects the shallow wells exploited by households. At present, 66 tube wells are operating in the town for 8 h/day. Their total capacity is 279 cusecs, but due to intermittent supply, 31 cusecs (76,000 m^3/day) is being produced and supplied to the consumers. The supply could be increased to 66 cusecs (152,000 m^3/day), by pumping 16 h/day. WASA has 80 tube wells, 66 of which working for 8 h a day. They range in size over 1, 2, and 4 cusecs capacity. The tube wells extract from a deep aquifer located at 400–600 ft depth. These are 400–500 ft. deep. They are supplying water to 60 % population. To meet the demand, 20 tube wells, each with 4 cusecs capacity, are required on average, while at maximum demand 52 tube wells at 4 cusecs are required. The use of overhead reservoirs has been discontinued, and water is now pumped directly from the source to the distribution line. According to WASA agency currently 55 % of the population is served with sewerage system. There is no treatment plant. Presently, wastewater is collected and pumped to five different disposal stations, where solids are screened. Wastewater is then made available for irrigation purposes or disposed of directly into canals. The wastewater collection system operated by WASA entails ca. 900 km sewers, providing 144,000 household connections, with a pumping capacity of about 462 cusecs (13 m^3/s). There has been little expansion or upgrade of this system recently. The sewers are currently surcharged, with chronic overflowing arising from combined effects of (1) under capacity sewers and disposal systems, failing to keep pace with population growing, (2) silting of sewers resulting in choking/blocking of the network, (3) inadequate control of industrial wastewater, discharged directly into towns, and (4) inefficient pump operation due to inadequate maintenance.

12.2 The Target Area: Walled City

It was possible here to gather little information about the water supply network in Multan. Some pipes were found running aside the surface drains, and as well public hold pumping stations are available in some areas for water supply. Sewerage system assessment and renewal for Multan are a very important task, and Pakistani engineers have been striving for some years recently to set up an operating sewer network. In the last decades, many master plans and projects were designed, but it seems unclear what has been actually deployed and what is the current setup of the sewer network. We found several maps with different and contradictory information. However, carrying a general survey with a WASA technician, we could gather an idea of the present situation. Particularly, we could survey a part of the walled city, between Haram Bazar and Sarafa Bazar, while leaving for further on a survey of the entire walled city. For the walled city area, we could find very little information, and the only available map comes from a photogrammetric survey made in 1994, resulting into a 1:2000 map. At present, it is hardly possible to fetch an estimate of population living in the walled city. A rough estimate may point to about 50,000 habitants. Within the walled town there are not any sewerage pipes, but only superficial open drains, and every street is served by open surface drains on both sides. Studies in the area reveal that most households (75 %) still use dry toilets. This system requires disposal through buckets. In practice, however, wastewater is often dumped at street corners, or by households into open drains, resulting in serious environmental hazards. Typically the toilets are at the top floor of the houses and they are linked to the drains with small pipes with a free surface outflow. Along the drains, it is common to find every kind of waste, plastic, glass, and food remains that can choke the channel and cause flooding along the streets. Use of ash, sand, or grit in washing is wrong habit of public, detrimental to efficient operation of sewer system. Introduction of hot water supply for kitchens can be an alternative. The interceptions of surface drains into underground sewer system are another cause of accumulation of garbage and silt in the sewers. Their interceptions without gratings and silt sieves can cause clogging of sewers.

Proceeding from the starting points, the drains increase their flow section. They start with a small rectangular shape (15–20 cm width and 15 cm height), and as the drainage area increases, they increase their section, reaching at the links with the main network a section. The condition of drains in the area east of Chowk Bazar (with the exception of some area along Pak Gate Bazar) is generally better than the rest of the walled city. This area constitutes about 40 % of the total area. On the other hand the drains in as much area west of Chowk Bazar are in worse condition.

12.3 Project Area of Sewerage and Supply Network

The project area has an extension of about 1.3 ha and has been defined inside the 6 ha of the "pilot area," starting from the "focus area," i.e., the small Gali where six buildings are about to be rehabilitated (Fig. 12.1). The project basin is located in the west part of the pilot area and is about 220 m long and 90 m wide. It is characterized by a gap elevation of about 7 m from the lowest point on the circular road to the highest point at the top of the basin.

The project basin covers a homogeneous area inside the walled city, made of narrow alleys through dense old buildings (Fig. 12.2). In almost every street, there

Fig. 12.1 Definition of the 1.3 ha basin inside the pilot area, with detail of the focus area (six buildings)

are open drains and water supply networks. Open channels drain water from the top of the basin down to the disposal manhole on surrounding circular road, where a grid avoids solid waste to get into the sewerage network. The pipe underneath circular road is an old ovoid, brick made one, $3' \times 4.5'$ in size, and an invert level of ca. -2.5 m.

Before reaching circular road, the drainage network undergoes the overhead bridge of Alang Road, receiving on the left side the contribution of a 0.6 ha wide sub-catchment, not considered in the "project area." Moreover, under the Alang Road bridge, there is a connection with the open channel that runs from Haram Gate and along Alang Road; this drain covers a 0.4 ha basin, not included in the project area. The wastewater and storm water contribution of these two basins were also taken into consideration. The existing network is extended also to very narrow alleys, such as some in Galis. This creates problems as the surface drain may clog in some cases almost one third of the road section. Even in larger streets, however, drains can cause problems to motorbikes, bikes, and pedestrian passage. Moreover,

Fig. 12.2 Pictures of the project area. *Left*: the network underpasses the Alang Road bridge. *Right*: the connection with the circular road sewerage, with a large amount of solid waste

lack of hygienic conditions for people is found, most notably for children, both for wastewater with running into open channels and for the bad habit of disposing solid wastes into channels. This may also create clogging of the network.

12.4 Executive Sewer Network Project

The approach to the sewerage and water supply executive project was discussed and shared with WASA. Some surveys and discussion have taken place, leading to shared ideas and criteria for design of the water supply and sewerage networks. Henceforth, we report the main criteria adopted to develop the project. An assessment of wastewater conveyed into the sewer, in lack of direct measurements, can be derived by the population "per capita" daily demand of fresh water and by its distribution in time. The "per capita" water demand was taken here of 180 L/cap/day (40 gallons/cap/day). The distribution of population within the different sub-catchments of the pilot area is assessed by assigning a value of population density $\rho = 1{,}705$ person/ha. The population data were derived by the scheme of the City Plan of Multan. WASA design criteria suggested a design period of operation for civil works, including sewerage and water supply of 20 years ahead. Thus, a projection of population in 2032 was made, by a medium growth rate for the walled city of ca. 1 %/year. This leads to an increase of about 20–21 % in the next 20 years. The design flow for the sewer network pipes was taken:

$$Q = C_p \frac{P \times \text{Pop}}{86400} \tag{12.1}$$

Q is the wastewater flow [cusec], P is the daily per capita flow, i.e., 180 L/person/day (40 gallons/day/person), Pop is the population served by each pipe, and C_p is a peak coefficient, assigned by way of the daily chart of hourly discharge used in literature (max value $C_p = 1.5$, 12 noon). Implementation of a hydraulic model for verification of the sewer system was carried via preliminary ground surveys of the existing sewer network, providing accurate information about the position and geometry of the open drains in the pilot area. A hydraulic model was implemented using InfoWorks® ICM software. InfoWorks® ICM (Integrated Catchment Modeling) is a modeling platform able to incorporate both urban and river catchments. With full integration of 1D and 2D modeling techniques, both the belowground and aboveground elements of a catchment can be modeled. The hydraulic model calculates both the flow based on the hydrological analysis and the unsteady flow hydraulic propagation of the pipe network. The drainage system hypothesized here is a combined system, conveying both wastewater and storm flow (e.g., Geiger 1990). The model of the drainage network was obtained by simulating only the sewage flow conveyed into the pipes in accordance with WASA design criteria. The upstream boundary condition for each section, i.e., the pipe geometry between two nodes, is defined by the wastewater flow based on the population density and the per capita flow. A boundary condition required to carry out the simulations is the level of the final node in which all the wastewater flow is conveyed. Thanks to the ground survey of the pilot area, it was possible to define the sewer network within the project area. The main data needed to implement the model are (a) node ground level, (b) pipes length, (c) node invert level, (d) pipes shape and dimension, (e) roughness, (f) boundary condition, and (g) sub-catchment properties like population density and area. The hydraulic modeling totally includes 44 nodes and 730 m of pipes. The urban basin covered by network has a surface of 1.3 ha, and it was subdivided using Thiessen polygons technique into 43 sub-catchments. A sub-catchment in the network represents the physical area from which inflow node collects water, i.e., it describes an area draining to an inflow node. Figure 12.3 displays the sewerage network defined using the software. Particularly the PVC 6″ pipes are represented in green, the PVC 10″ in red, RCC pipes in magenta, and sub-catchments in blue.

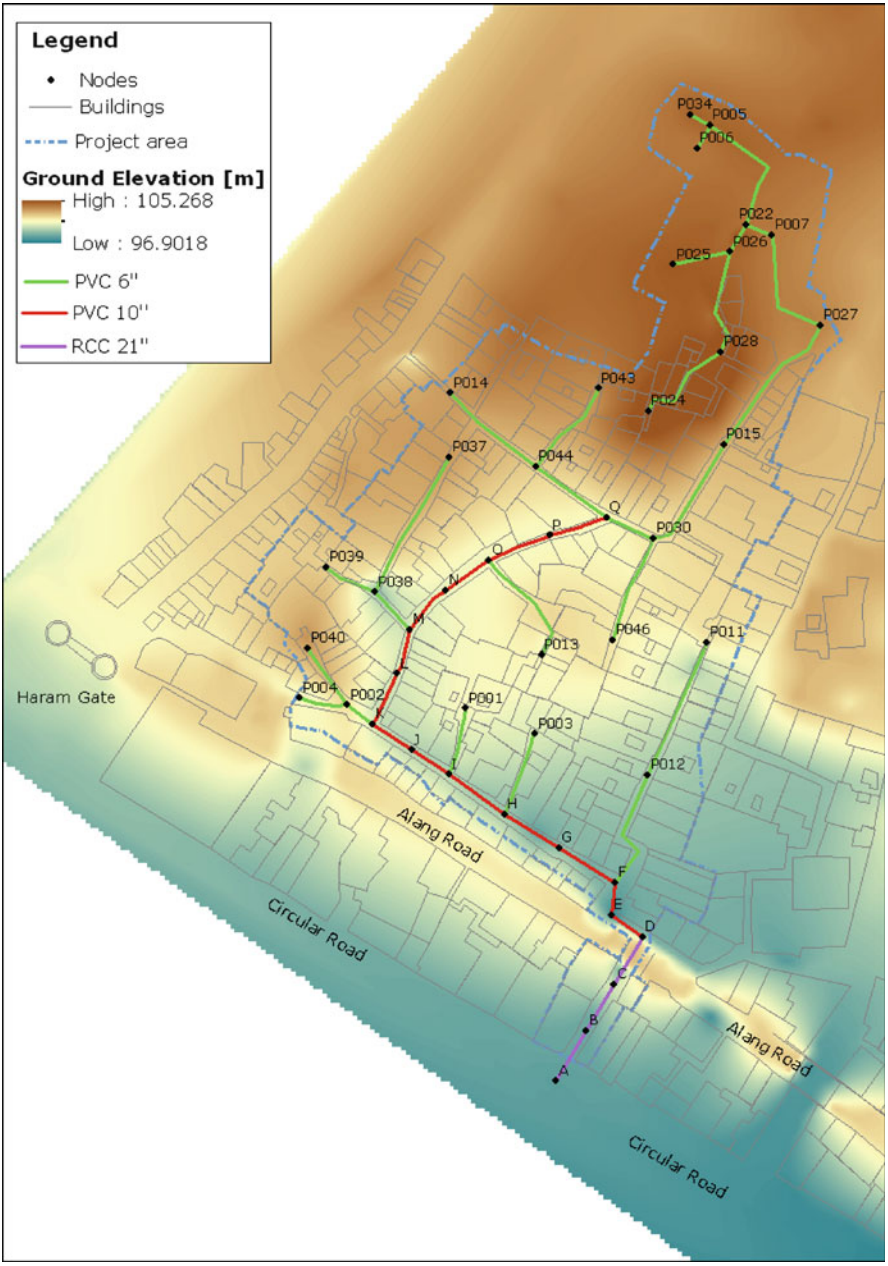

Fig. 12.3 Sewer network of the focus area defined using InfoWorks® ICM

12.5 Water Supply Network

The proposed water supply network reaches all the houses, and it is placed above the sewer system to avoid contamination. In the future all people should use public water supply network, and not the private uncontrolled tube wells, to avoid water-borne disease. It is further important to do systematic water analysis to verify contamination level. For the design phase WASA suggested some criteria concerning pressure, velocity, and other variables, including population growth, as follows:

$$P_n = P_0 \ (1 + r)^n \tag{12.2}$$

with P_n is projected population at year n and r is annual population growth rate. For the distribution system the design period of operation is 20 years from now. Per capita consumption per day is 40 gallons. To take into account the hourly variation of water demand, we applied the abovementioned coefficient (C_p) to daily average demand. The adopted maximum value is 2 (1.5 at 12 noon plus 33 %). Pressure lower limit in the network is 30 ft above ground, and never during the day the pressure in the critical junction has to be lower than this value. Flow velocity into pipes is between 1 and 5 ft/s. Hydraulic simulations of the supply network were carried out via EPANET freeware software from the US Environmental Protection Agency. For the pilot area we propose a hybrid topology. Whenever possible we set close rings, safer and more efficient, and we used a tree (open) network scheme where closure was not possible.

In Fig. 12.4 it is possible to see the proposed network, and specifically water velocity and pressure at greatest water demand (12 noon). It is joint to the main network under the circular road with a main 4″ flexible iron pipe, while all the other pipes are made of U-PVC and feature diameter between 1″ and 3″. Pipes 2 and 12 carry water to an area external to the pilot area, but looking at the actual situation, they are served from this part of the network.

12.6 Master Plans of Sewer and Supply Networks

We provide here preliminary master plans of sewer and water supply network for the walled city. In Fig. 12.5 it is shown the present sewage system along the walled city: in orange color is indicated the ovoid sewer, brick and concrete made, with size 3.0′ × 4.5′, standing under the circular road, in red the open drains, in blue the concrete circular pipes with diameter 18″, in green (continuous line) the concrete pipes, in yellow the sewers under construction (concrete made) and with diameter 30″, and in green (dashed line) the concrete pipe with diameter 54″. In the Figure the arrows indicated the direction of the sewage system. Three final outfalls of the network were identified along the perimeter of the Walled City of Multan:

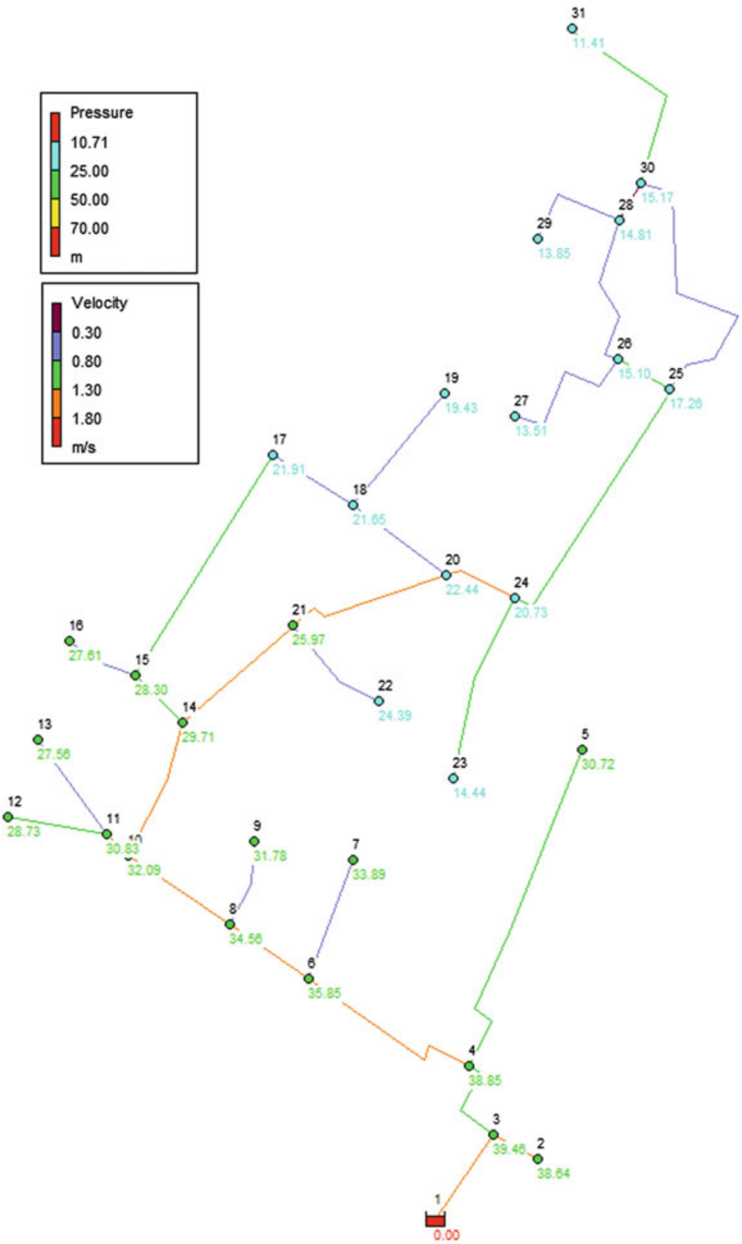

Fig. 12.4 Velocity and head values at maximum water demand

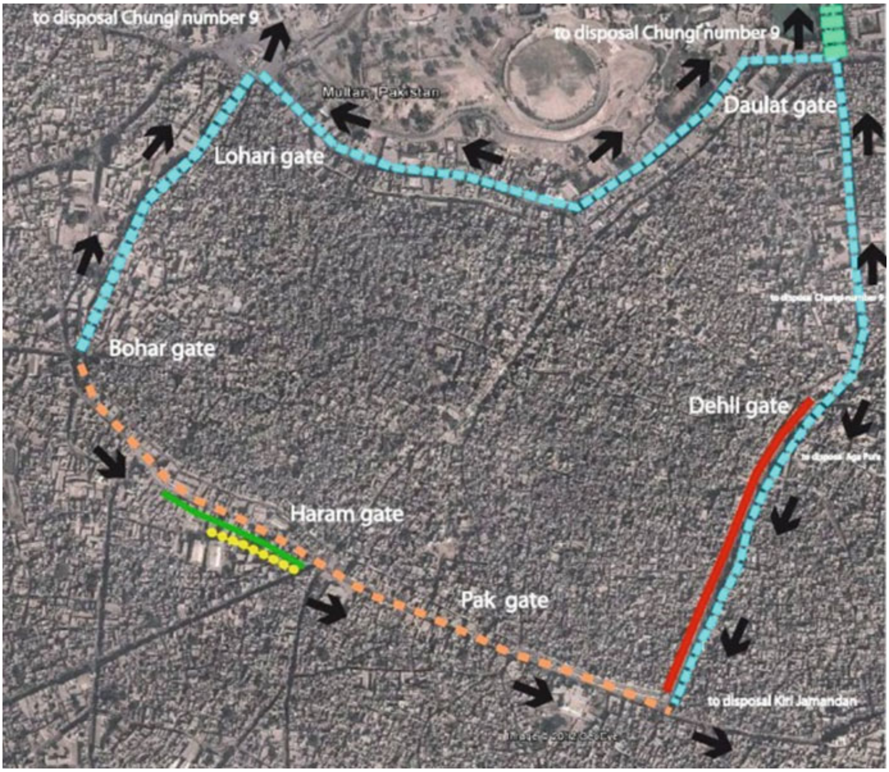

Fig. 12.5 Reconstruction of sewerage main lines, around the walled city

Alang Daulat Gate (Northeast), Chowk Ghanta Ghar (Northwest), and Multan Expressway (Southeast). Figure 12.6 shows the main sewerage network, including 5 km of concrete pipes with diameter 21″, 13 km of PVC pipelines with diameter 10′, and 40 km of PVC pipelines with diameter 6″.

For the supply system (Fig. 12.7), the area was considered hydraulically independent from the rest of Multan City. The goal was the design of a water supply network providing water around the clock, with enough head for reaching all households. We designed the network making large rings along the streets of the walled city. The network is fed by five designed overhead tanks, along the citadel edges. The tanks have volume large enough to buffer the mismatch between inflows and outflows. Tanks are fed by tube wells working 6/8 h everyday, while the outflow follows the demand patterns. We considered a pattern of water demand ranging between 0.3 (5 in the morning) and 2 (12 noon) times the average daily demand. Figure 12.7 shows the main network, including 0.078 km of ductile iron pipes with diameter 10″, 4.61 km of ductile iron pipes with diameter 8″, and 6.80 km of ductile iron pipes with diameter 5″, fivel overhead tanks.

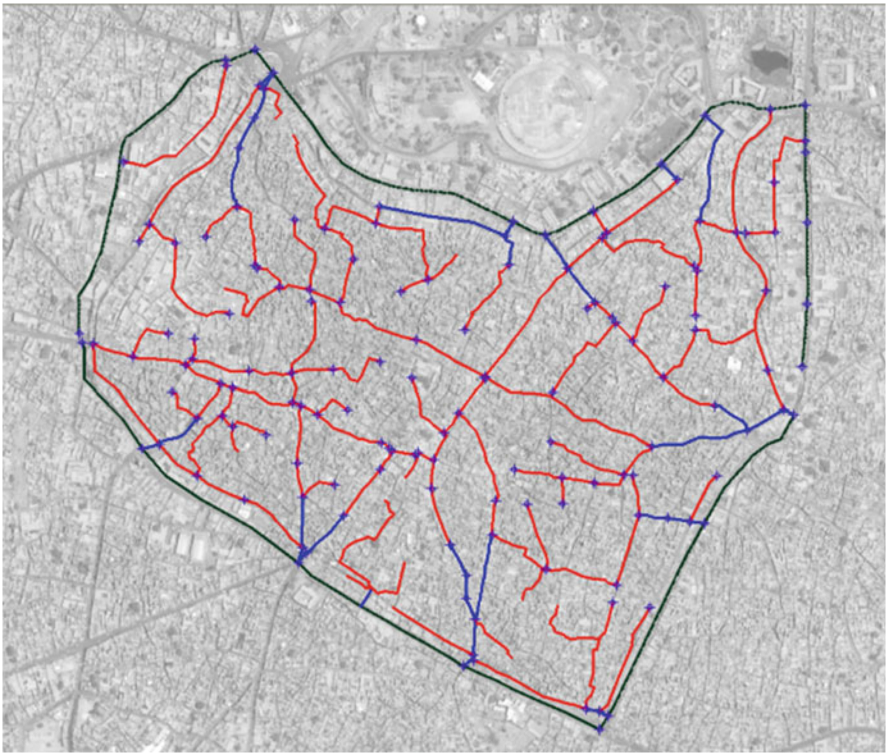

Fig. 12.6 Master plan of sewer network of Multan citadel. *Black*: existing. *Blue*: concrete, 21′. *Red*: PVC, 10″ (Colour figure online)

12.7 Conclusions

Within Phase 1 of the Pakistan-Italian Debt for Development Swap Agreement Project: "Sustainable Social Economic and Environmental Revitalization in the historic core of Multan City," we could reach several achievements. We carried out ground surveys within the walled city and the pilot area to gather knowledge of the present situation of water supply and sewer networks in Multan citadel. We gathered information of topography, demography, and climate, i.e., precipitation within the area, as necessary for design of water supply and sewer webs. We attained executive design of the new proposed networks, delivering project of the sewer network within the pilot area, including explanation of technical choice of use of a combined approach, and proper geometry and size of the stems. We delivered design of the water supply network within the walled city, based upon projection of the future population in the area within a 20 years span. We then provided proposed master plans for supply and sewer networks for the entire citadel. We worked within a complex environment, specifically referring to

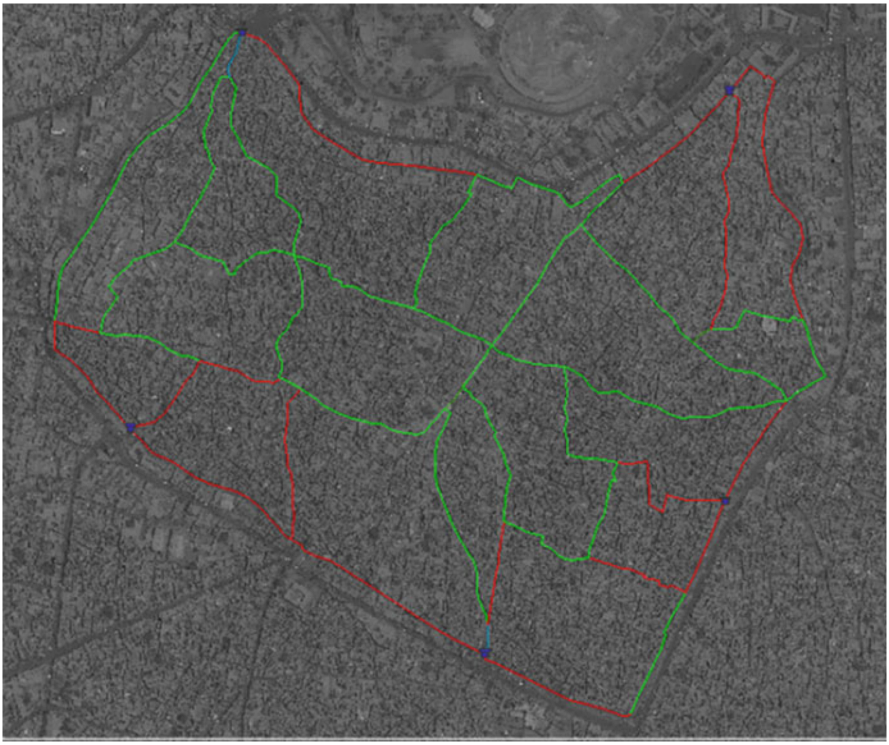

Fig. 12.7 Master plan of supply network for Multan Citadel. *Cyan*: flexible iron, 10″. *Red*: flexible iron, 8″. *Green*: flexible iron, 5″ (Colour figure online)

(i) local activity under security standards and (ii) data retrieval for project development, which may have slowed down projects' development. Unforeseen results concerned mainly (i) the difficulties in clearly depicting the present situation of water supply and sewer system within the walled city, leading to different findings than initially expected; (ii) initial difficulties in defining the target area, due to local issues, which lead to a final choice different from what initially taken; and (iii) differences between the WASA standards for sewer systems development (based upon per capita demand) and international standards (based upon storm design), which provided different results in terms of network design (pipe diameter, flow calculation, etc.). Lessons learned from our groups are mainly concerning interaction with local personnel of WASA and water authorities. Future activity of our group may include (1) estimation of hydrological statistics for short rainfall events, which is a priority in order to gather valid meteoric flows for the hydraulic modeling and proceed with simulations; (2) updating the sewage hydraulic model with new flow and water supply data and subsequent update of the sewage general projects; (3) a specific project in order to assess the feasibility of innovative sewage disposal stations, adopting local treatment and reuse of wastewater for agriculture, which requires water quality field test in spot/grid points; and (4) application of innovative techniques for soil and water pollution remediation: e.g., solution techniques for hexavalent chromium reduction.

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Chapter 13
The Walled City of Multan: Characters of the Settlement Structure and GIS as an Instrument of Urban Analysis

Francesco Bruno

Abstract The aim of the carried out work is the study and the understanding of the urban structure and of the architectures of the city of Multan and the relationship between the Walled City, with particular attention to the pilot area, object of intervention, and the city as a whole.

Considering as essential an approach that can put individual architectures and the overall design of the city in relation, the task aims, through its components, to reach an analytical framework capable to address and motivate the overall strategies of the project of revitalisation of the historic core of Multan.

Searches have been developed near the offices of Multan development authority: with the only acquisition of the "Multan Town" map (printed at the survey of Pakistan offices, Rawalpindi), 1:2000 scale. This map has been surveyed and drawn during 1993–1994. It was noted that, in the part related to the WCM, the map, although georeferenced, shows hard mistakes that do not permit a reliable use for both road layouts and the identification of building typology or in any case of volumes and internal courts.

According to the historical and contemporary maps, satellite images, materials acquired, the city observation and the deeper knowledge of the pilot area located in the south of the Walled City between *Haram Bazaar* and *Sarafa Bazaar*, the following analytical operations were started.

The observations and reflections on the historical city of Multan conducted a series of general considerations that only the availability of iconographic materials of the past could enrich with confirmations and specifications.

The work components are:

– Collection of iconographic and cartographic data and analysis of the Walled City main part structures and of the road system

F. Bruno (✉)
Department of architecture, built environment and construction engineering, Politecnico di Milano, Milan, Italy
e-mail: francesco.bruno@polimi.it

A. Del Bo and D.F. Bignami (eds.), *Sustainable Social, Economic and Environmental Revitalization in Multan City*, Research for Development,
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– Analysis of public spaces and of the monumental buildings and structures in the Walled City
– Assessment of the relationship between the Walled City structure and the town as a whole with particular attention to the pilot area

In the first component, topographic maps on which to tackle the job of analysis and historical images to understand the origin and development of the urban parts of the entire Walled City, down to the scale of the pilot area, were collected and then summarised in an iconographic collection and in a first series of analytical drawings on the urban structure of the Walled City. In addition to this, the purpose of collecting and analysing cartographic and iconographic information was to identify the relationship between the structure of the city and the main street system where it was possible to recognise the presence of monumental buildings and significant public spaces.

In the second part, in fact, the work continued through the identification and the mapping of the major architectural and public spaces within the Walled City with the aim of deepening their role in the formation of the urban structure and the possible synergies in the process of redevelopment of the city. The identification of these monuments has lead to an iconographic documentation of the identified monuments and to a series of drawings showing their relationship with the urban parts of the Walled City (*Mohallas*). Furthermore, a topographic survey with the support of AKTC provided a very useful map of the relationship between the built environment (monument, houses and shops) and public spaces.

In the third component, through the analysis lead on with the realisation of the maps at the 1:10000 scale, passing through the 1:2000 scale, leading to a scale of 1:500 (based on the topographic survey and on the GIS system), the logic, the organisation and then the character of the Walled City, in particular of the pilot area, were clearly identified. In this context, the city portion chosen as pilot area, as known configured as a *Mohalla* unit particularly rich in public buildings, temples and mosques (wealth that has motivated, since 2010, the choice of the area), and its analysis for identifying, besides the general structure, the correspondence between the street and bazaar system, the monuments and the building types assume importance.

13.1 The Results of the Analysis Work on the Walled City and on the Typo-morphological Structure of the Pilot Area

Examining the aerial view of a city like Multan, or when having the fortune of directly observing it from one of the numerous roof terraces arising within the built environment of the historical parts, one can immediately realise how, similarly to the majority of the Islamic cities, besides the apparent uniformity of the urban structure, its properly constitutive elements can be read at a second level, characterised by the complexity and variety of the signs that mark the dense and impenetrable built whole.

The city in its complex seems to be composed by a compact and anarchic agglomeration, but, on a careful reading, not without rationality in the organisation of the general layout as confirmed by the accomplished studies of urban analysis (of general order in respect to the whole city and of specific order in respect to the Walled City with particular attention to the portion of it identified as pilot area) aiming to understand the place with which the following text is going to deal, with specific attention towards the area subject to project intervention.

A layout resulted as constituted by a continuous repetition of the two elementary building types, the block type (a house under a single roof) and the type with courtyard, and carved by a thick net of streets and alleys of different hierarchy and with few voids of public or private nature.

In such complex structure the emerging elements are represented by the monuments and the few open areas provided with a spatial dimension exceeding the ordinary and dense displacement of the buildings along the most different and articulated roads internal to the urban structure.

In the specific case of Multan, a city rich of history and characterised by the continuous overlapping and coexistence of different ethnic groups and cultures starting from the eighth century A.C., the Islamic matrix in its *Sufi* declination, the mystic and spiritual aspect of the Islamic religion, contributed to connote the city as *City of Saints* in which, thanks to the usual construction of the characteristic Islamic monument, the mosque, a great number of monuments constituted by shrines and mausoleums raised in honour of the cult of the *Sufi* religion's saints, can be found within the historical structure.

Such peculiarity directly reflects both on the monumental part of the city represented by the current *Qasim Bagh* (the site of the ancient fort separated from the historical city and almost completely destroyed in 1848 by the British troops) where the most important monumental shrines are, pilgrimage and touristy tour destination, and on the internal structure of the historic city, the Walled City, where the shrines represent an important presence able to define the territorial setting and the characteristics of the different neighbourhoods (*Mohalla*).

This is a first datum that leads to recognise, within the current overall condition, marked by phenomena of grand indiscriminate expansion of the city in its whole along the main traffic roads at a territorial scale, the plausible original condition of Multan's urban structure.

Firstly it is possible to notice the separation of the city in two distinct parts; the monumental and emerging part of the fort, the *Qasim Bagh*, and the historic/commercial city defined by its own system of walls and urban gates, the Walled City.

Secondly, within the historical city, it is possible to identify the presence of various cores (the *Mohallas*), connoted by a clear autonomy and morphological completeness due to their nature of independent settlements grown in relationship with the presence of cult buildings or shrines and therefore ascribable in a specific ethnic or cultural group.

Around these two parts characterised by an extraordinary variety of urban elements, morphologically identifiable despite the continuous modification and stratification of the signs that compose them, lies a third, very dynamic city that can by right defined as diffuse.

This latter, compared to the modes and types that marked the construction of the historical city, characterises, in the expansion over the Walled City, by a compact building texture in continuity with the historical parts according to the logic of the building curtain and of the saturation of the blocks with adjacent buildings, for then defining itself through settlement modes connoted by the use of the isolated block type, built on plots of larger dimensions that for such reason show minimum free portions, and by the recurring in minor proportions of the courtyard type, in the parts right over the compact urban texture.

From the general point of view of the settlement logic of the urban whole, it appears a continuity of the main territorial routes, connecting Multan to its territory, with the system of streets within the compact city in a design of crossing and communication to which it corresponds the main urban subdivision along the directions north–south and east–west, routes almost completely coincident with the main direction Lahore to Delhi (see Fig. 13.1).

This system of territorial routes defines the structure of the east–west and north–south streets and clearly shows the relationship between soil morphology and shape of the city in its most minute definition, related to the system of slopes and drainage (see Fig. 13.2). Moreover the strict relationship between communication routes and edification is witnessed by the almost uninterrupted facing of the buildings along the commercial roads and the bazaar and by the progressive saturation of the internal parts, defined by secondary tracks.

To the north–south direction identified by *Chowk Bazaar* (almost an urban *cardo* whose section expanded in British era) and its subdivision to the south in two additional strokes *Haram* and *Sarafa* in connection with the two respective gates (*Haram Gate* and *Pak Gate*), corresponds a more articulated east–west structure that while crossing the city in its more recognisable portions connects and divides formally and socially. That is the *Mohalla*, which structure, more than the one of a neighbourhood, recalls that of an independent community and the dense and juxtaposed repetition of which within the Walled City gives body to the various components of the compact city.

The dual system of “decumani” identifies measures similar to the size of the *Mohalla* isle and to the typo-morphological system that defines the pathways that, at the end of progressive penetration, end in the characteristic *cul de sac* according to an idea of city at the same time domestic and urban (Fig. 13.3).

Next to the preliminary analysis on the whole Walled City, the investigation efforts were oriented to the comprehension both of the settlement logic of the pilot area (the proper study area subject to interventions) configured as a *Mohalla* unit particularly rich of public buildings, temples and mosques, and, besides the general structure, of the correspondence between the street and the bazaar system, the monuments and the building types.

For the urban investigation on the pilot area, next to the traditional instrument of analysis, great importance assumed the use of the Geographic Information System (GIS) that was taking simultaneously shape during the working period on the city.

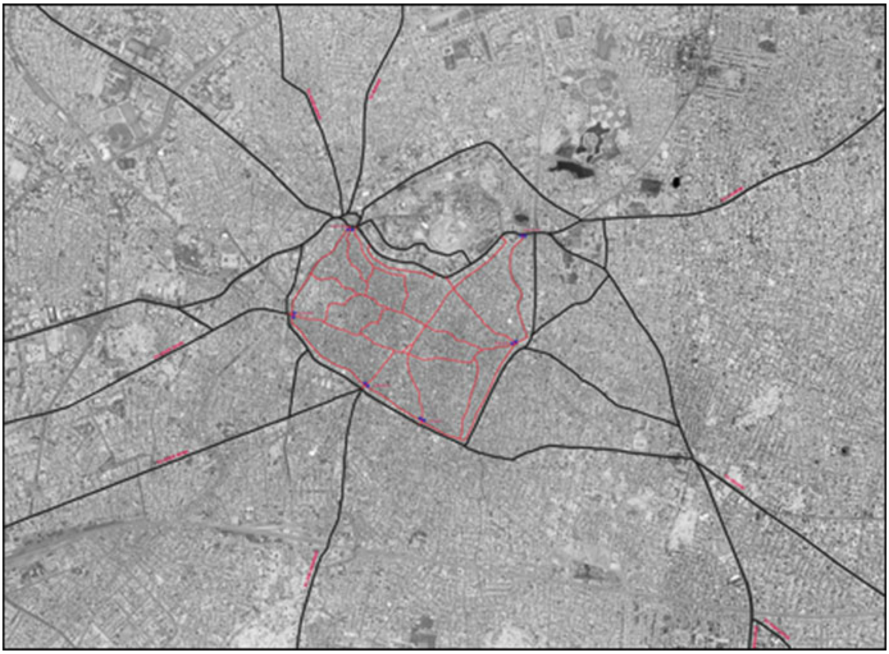

Fig. 13.1 Territorial main road related to Walled City urban structure

The extrapolation of certain thematic maps, some of which presented in this study and obtained by crossing the data collected through on site surveys, allowed a focused reading of the numerous components that characterise the pilot area.

As it is shown in the plan of Fig. 13.4, the pilot area is defined on the inner sides of the Walled City by two bazaars, the *Sarafa* and the *Haram*, which are joined just to the north of the end of its perimeter in the proximity of the *Chowk Bazaar* (axis Cardinal direction NS). The pilot area is bordered towards south by *the circular road* which course takes up the arrangement of the defensive walls of the Walled City, where the traces are now forming a long block facing the *Allang Road*.

Both bazaars are characterised by the presence of urban gates, towards west the *Haram Gate*, under restoration; the *Pak Gate* towards east does no longer exist. The structure of the pilot area, and its relationship with the city outside the Walled City, is identified by the description of the street system.

The bazaars define every axis of penetration and crossing into the Walled City and distribution with respect to the secondary systems.

A first type of analysis carried out using GIS[1] (Fig. 13.5) allows us to understand—through the reading of the Digital Terrain Model—the arrangement and shape of the plot that the displacement of the two bazaars is oriented favouring the natural slope of the ground, basically oriented north–south in order to ensure the

[1] For GIS deeper description, see next two par.

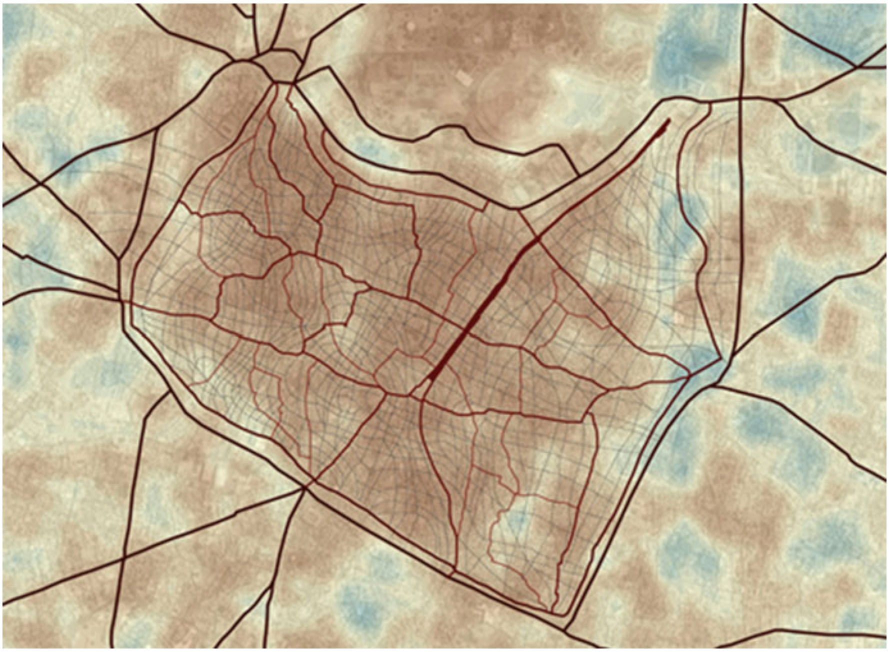

Fig. 13.2 Main urban structures related to morphological soil pattern

natural flow of water. The two bazaars, which slope is oriented according to the maximum slope line, have a slightly lowered position compared to the adjacent urban parts in order to allow the functioning of the drains of the innermost parts of the city.

Within the pilot area like a centre of mass position of the two bazaars, next to the circular road, a depression takes place with its northern part rising up to the higher ground where the monumental complex of the *Mohalla*, known as *Moosa Pak*, is.

These first elements confirm the leading position of the monumental structure of *Moosa Pak*, primary architectural complex developed in the urban structure of the *Mohalla*, and consequently the corresponding of the primary paths related to it; the gateway to the system of mosques and shrine is in fact the *Gate of Sarafa Bazaar*.

Each plot, compared to the system of the gradients of the ground, and therefore of the arrangement of the main roads, takes place perpendicularly occupying the building portions in depth.

The analysis of building types still operated using GIS (see Fig. 13.6) shows this type of arrangement and introduces an additional reasoning.

The identified building types are represented by the large or small court building, the *Haveli*, normally composed of two floors, and the block building named *Makaan*, with or without the inner court, normally about 3–4 floors high, in which the commercial and residential functions coexist (as in the case of the gothic

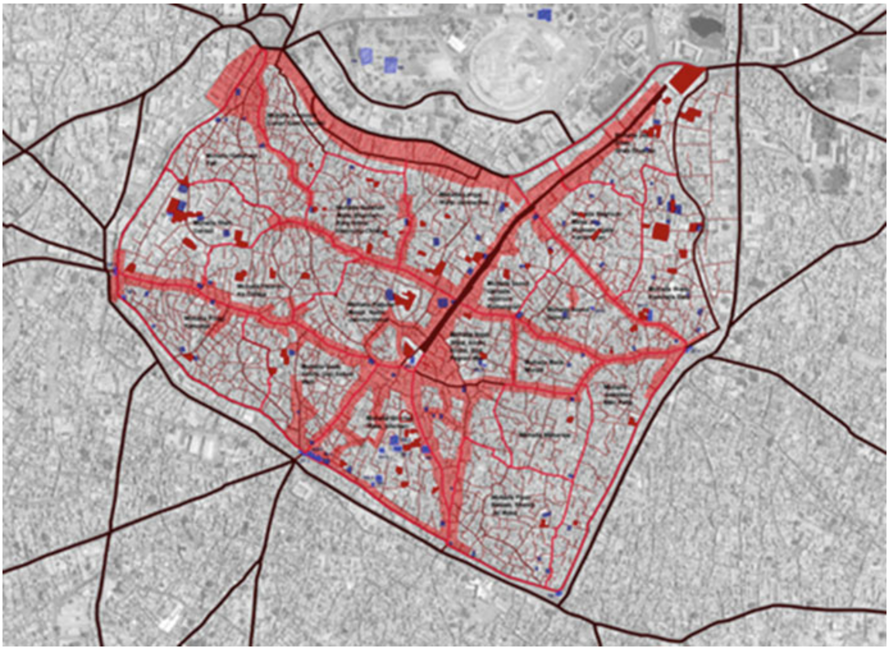

Fig. 13.3 Identification of Mohallas related to the monuments and major buildings, bazaars system and secondary street system

house of the European city from which it differs because of the smaller dimensions of the fronts originating a strong verticality effect).

A recent modification of *Makaan*, developed by the needs of commercial activities, led us to identify the type of *Dukaan*, a nonresidential building with exclusive commercial purposes.

While the buildings characterising the emerging and constitutive points of the urban structure of the *Mohalla* are represented by religious monuments, first of all the shrines to which mosques associates in strict relationships and then the graveyards, the analysis of the building types related to the urban pattern of the pilot area (see Fig. 13.6) leads to identify a more dense system, made up of *Makaan* and *Dukaan*, which insists on the main axes and the bazaar. Here the buildings have predominantly narrow fronts, from 2 to 4 m, and extend themselves in depth. The value of the facing on main axes and the public nature of the assets determine the correspondence between the building type and the specific location.

On the other hand, the area flanked by the two bazaars, in correspondence of the monumental sector and of the ground depression, is mainly occupied by *Haveli* and monumental structures.

All this seems to confirm the typical structure of *Mohalla*, developed by aggregation around the monumental shrines and mosque of residential parts primarily formed by the settlement type of the *Haveli*. The analysis of the urban pattern also validates the hypothesis of a more private character of the residences through the

Fig. 13.4 Pilot area definition (GIS)

presence of the *Haveli* rather than the *Makaan*, a character that reflects on the narrow width of the tracks onto which the buildings wall are facing.

The analysis of the dating of the buildings and their use within the pilot area—in addition to confirming the role of business in the majority of the bazaars and the principal axes—shows the process of replacement and transformation of building types and/or use of the buildings (see Fig. 13.7).

The historical buildings, built before the 1947, remained mostly in inner areas next to the minor tracks of the major axes represented by the bazaar (see Fig. 13.8).

This proves the great modification and/or replacement of many *Makaan* with *Dukaan* and the later use of commercial buildings. In fact bazaars and shopping streets on the upper floors, once dedicated to the residence, are now being converted into warehouses or laboratories and in some cases are in a state of abandon. The residences on the other hand occupy the inner parts and, even in the case of commercial ground floors, still maintain the presence on the upper floors.

Next to the previously described settlement rule, deducted from the analysis operations, it is necessary to remember a recent episode of urban transformation that has affected the centre of the pilot area. Demolitions produced in the urban

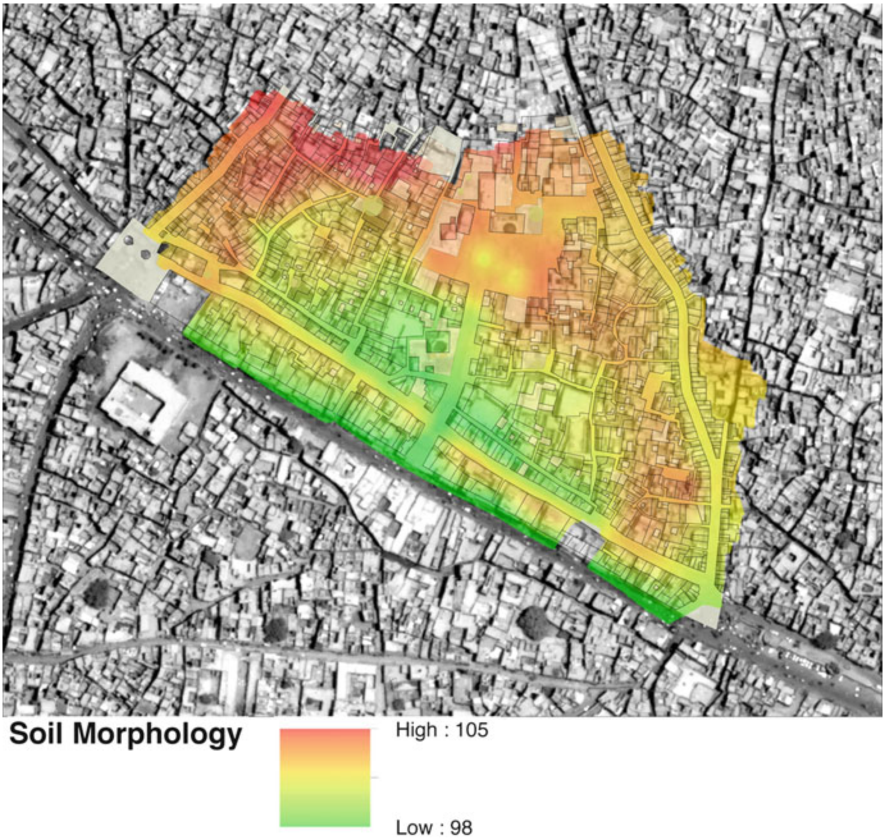

Fig. 13.5 Pilot area soil morphology (GIS)

system created major axis of penetration that works as a liaison between the circular road and the monumental part of *Moosa Pak*. This episode represents a moment of urban structure transformation inside the Walled City; a widespread system of Haveli has been replaced with a large urban void.

The description of the operation of reconnaissance and the construction of numerous analysis thematic maps partly described above and determined by direct observation, through the iconographic collection and important qualitative and quantitative data summary of the GIS system, allowed, besides the projects and report having more strictly technical data or related to the urban scale, the creation of some suggestion and hypotheses of architectural redefinition in some parts of the pilot area which have been developed.

The particular proposals, part of the general project of intervention, intend to provide precise solutions (like the proposals for the *Bazaar* and the *Haram Gate*, for *Moosa Pak* and adjacent areas subject to demolitions) and general explanations (see proposals for the collapsed buildings and guidelines about the built environment) in order to provide a framework of interventions which value lies into the overall

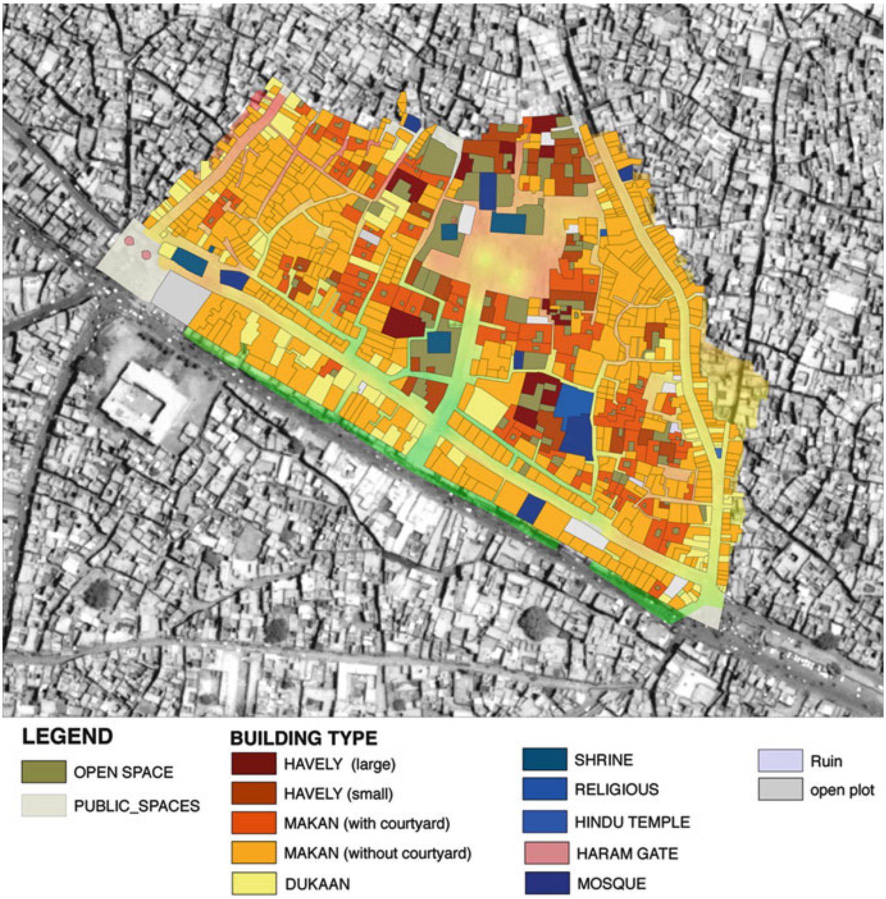

Fig. 13.6 Localisation of building types (GIS)

significance of an architectural and urban revitalisation of the pilot area, which also aims to represent a paradigmatic process to design the architectural reconstruction possibilities for the entire Walled City.

13.2 Tools and Method of Urban Analysis: Cartography and Direct Surveys Oriented to the Realisation of the Geographic Information System

The preliminary analysis work undertaken on the city body in its complex, next to a first reconnaissance phase accomplished through the iconographic collection of historical maps able to allow a reconstruction of the city's urban events, was carried out, besides the direct observation of places, through the use of two types of

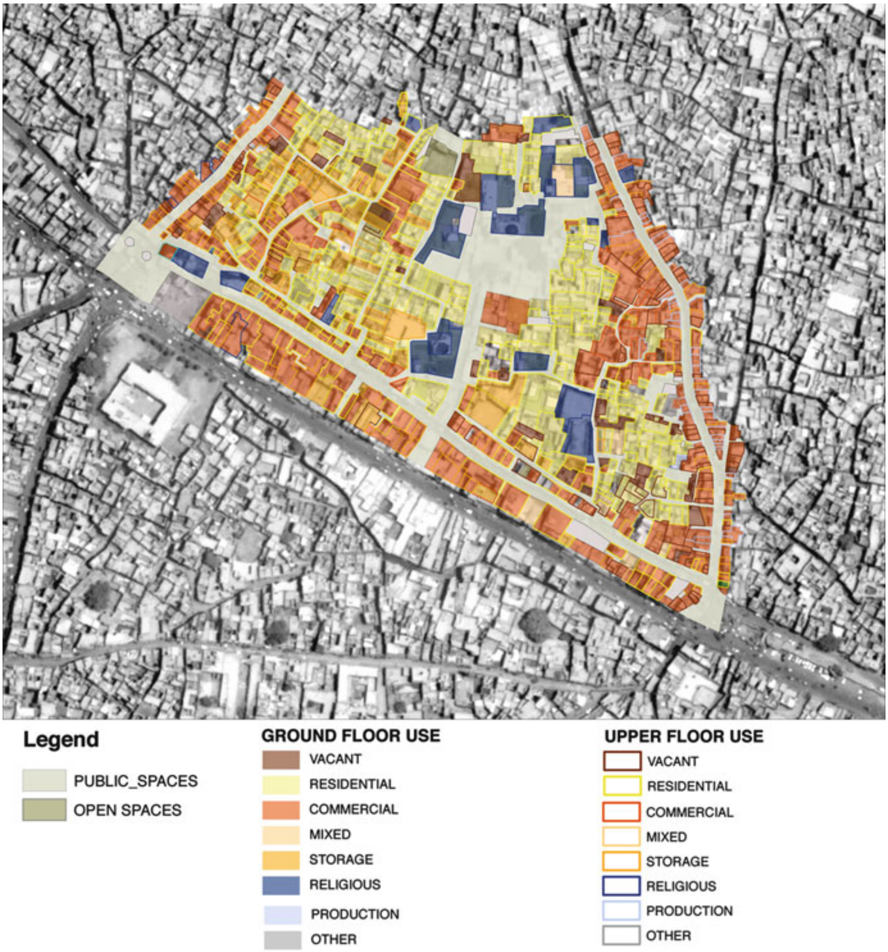

Fig. 13.7 Building use (GIS)

cartography: the available one and the one achieved through direct surveys oriented to the construction of a reliable topographic base able to support the operations of individuation of the architectural and constitutive characters of the pilot area and the simultaneous realising of the GIS system where to merge the deducted specific information collected through a minute work on the urban body (see Chap. 9).

For the first category of cartographic bases, searches have been developed near the offices of Multan Development Authority with the only acquisition of the "Multan Town" map (printed at the survey of Pakistan offices, Rawalpindi), scale 1:2000. This map has been surveyed and drawn during 1993–1994. It was noted that, in the part related to the Walled City, the map, although georeferenced, shows hard mistakes that did not permit a reliable use for both road layouts and the identification of building typology or in any case of volumes and internal articulation.

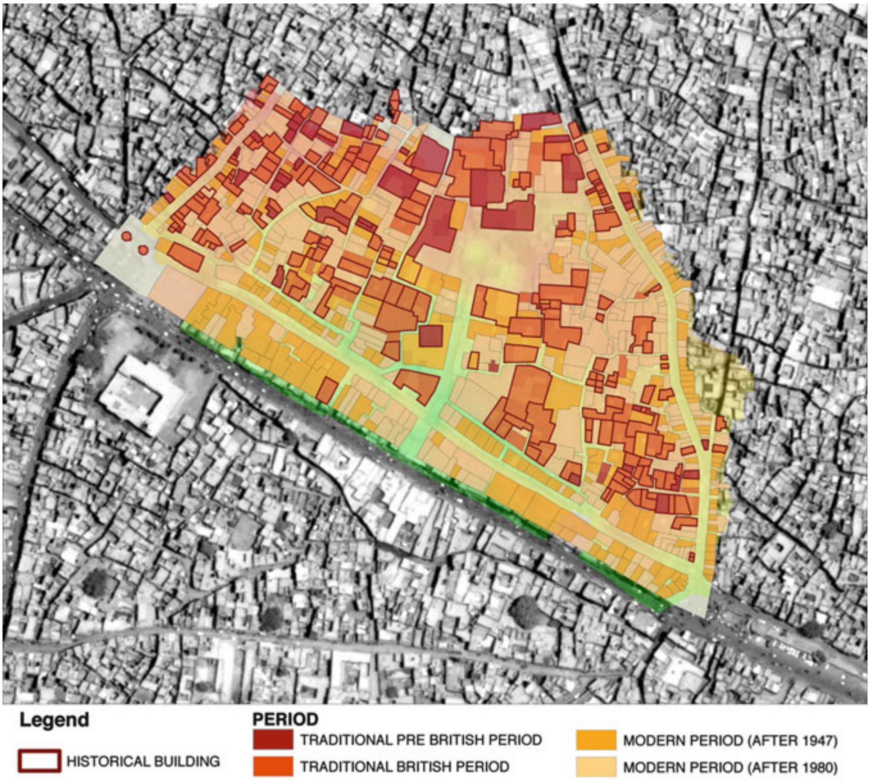

Fig. 13.8 Building's period of construction (GIS)

For what concerns the found satellite images, given the level of inaccuracy and low readability of the available web sites, a satellite image was acquired (for reference and information about the satellite image and the digital process connected to georeferentiation, see Chap. 8) and then processed through specific subsequent digital processing in order to obtain a basic point of reference which is capable of allowing a likely reconstruction of urban environment, although far from aerial photography or aerial images taken from laser scanner. To afford on site analysis operations, a basic map, based on the satellite image, has been preliminarily drawn to help surveyors to identify buildings and collect the necessary information about the buildings in the pilot area.

The consequent operation was therefore to realise a cartographic base, starting from a topographic survey,[2] provided with a level of definition capable to return and

[2] For the realisation of the topographic base on which to set the work, the efficacious collaboration Aga Khan Trust for Culture/Aga Khan Cultural Service—Pakistan allowed to push the process of definition and accuracy of the base plans much further than the level subjected to the preliminary contracts.

Table 13.1 List of the Shapefile in use

Shapefile	Fields N. (Excluding conversion and default fields)	Features
PLOTS.shp	44	763
PROPERTIES.shp	18	867
BUILDING.shp	18	761
OPEN_SPACES.shp	4	130
PUBLIC_SPACES.shp	–	6
METERS.shp	6	1,458
FACILITIES.shp	3	259

therefore understand with dimensional precision both the morphological and the typological character of the building fabric of the pilot area.

The successive pace was the one related to the realisation of the proper GIS intended as general survey tool, able to return the physic-geometric characters of the city, and also as an instrument of analysis focused on the project, thanks to the possibility of visualising and crossing the data of qualitative and quantitative order.

Indeed the pilot area of Multan Walled City is a district so rich in construction details and solutions that a conventional layout from a traditional topographic survey cannot be enough: buildings have their own geometries and their own positions, but it is necessary to add information able to reveal all the richness of this place. The result is a talking map, able to display information and at the same time to welcome anytime new information and new details.

To appreciate this richness, a GIS with a very high level of detail has been carried out, in order to provide not only quantities and measure but also data about the use and the history of each building.

This latter has been very important for registering all the observations and remarks acquired on the spot and for providing them to all the architects and engineers involved in specific analysis and different projects concerning the Multan Walled City.

The realisation of the GIS involved the survey of every plot (more than 750) inside the pilot area in the Walled City of Multan[3] and has been done through a field form (see Table 13.1 which represents the information collected and the structure of the records, which compose the GIS database) predisposed with the aim to collect information on the characteristic, on the condition and on the useful information of each urban residential and commercial ~~buildings~~ located in the pilot area, referring to size, condition, occupation, type of ownership, building types and population statistics.

In addition to this useful information, a survey of the property codes and electrical metres, referred to each building, has been done with the aim to provide a base map to identify every property as a physical element and to associate to them the information about the electrical utilisation.

[3] For buildings survey, see Chap. 20.

It is mainly possible to divide the collected information in qualitative ones and quantitative ones.

The qualitative ones represent the architectural characteristics of every building, like historical qualities, type of buildings, material and characters of the façades and the condition of decay with the aim to provide also a background for the redaction of a complete set of guidelines for conservation project.

In addition to the architectural characteristic of every building, the conditions of use, in terms of commercial, productive and residential utilisation; the hygienic conditions, in terms of maintenance and presence of environmental facilities; and the information about ownership and tenure were surveyed.

The quantitative ones represent the dimensional aspects of every building (height and dimension of the fronts), the number of inhabitants and the possibilities of associating to every plot the amount of the electrical utilisation in order to monitor the energy consumption related to the strategies dealing with the energy problem of the buildings within the pilot area.

13.3 Description and Structure of the Geographic Information System[4]

13.3.1 Acquisition of the Information

The nominal scale adopted in this project is 1:500, even if some shapefiles (file that mainly spatially describe the characters of the surveyed information here included - in particular PLOT and PUBLIC_SPACES) can also support scales up to 1:5.000, and with a very simple passage, they could be used even in maps at 1:10.000 scale.

The geometrical information derives from three datasets, which, in order of accuracy, are:

– Laser scanner acquisition
– Total station topographical survey
– Remote sensing imagery (Ground Sample Distance 0.5 m)

The so-called attributes have been acquired through on the spot investigations carried out in 3 months by a group of trained students from BZU, using a specific form filled in for each plot. A general check of the compiled forms was carried out in the area in April 2012.

[4] Next to all the components of the working group that contributed to the project and realisation of the GIS, the work undertaken by architect Nelly Cattaneo, who contributed to the drafting of the present paragraph, is to be particularly remembered.

13.3.2 Structure of the Information

A big effort has been made in order to preserve a simple and clear organisation of the dataset (the file in which all the collected information are saved). In fact a simple structure is sustainable in case the GIS is carried out for wider portions of the Walled City or in case some shapefiles need to be used in lower scale GIS.

The leading shapefile is PLOT.shp. A plot refers to the smallest portion of a block which is able to maintain a unitary identity and a certain boundary. The set of conterminous plots makes a block; the areas not included in these blocks are part of PUBLIC_SPACES.shp.

Within the single plot, BUILDING.shp (the built-up portion of the plot) and the OPEN_SPACES.shp (courtyards, backyards. . ..) have been specified.

Inside the plot it was necessary to provide information concerning the property partitions, so a specific shapefile has been produced (PROPERTIES.shp) which represents a more abstract aspect of reality but strictly connected to commercial activities.

The collection of MEPCO metres, displayed in METERS.shp, has been very interesting and hopefully very useful. Each point is located inside the plot it refers to in order to enable spatial queries. How useful these data may be is explained in paragraph on Next Steps.

Four extra shapefiles are included: FACILITIES.shp mapping sewerage, electric and water pipes lines surveyed with a total station; NAMES.shp used to display the names of the streets on the map layout; and TREES.shp to point out the presence of meaningful trees with their own crown represented in TREES_CR.shp

In the DTM folder contour_06 simple.shp, made up by the contour lines extracted from the Digital Terrain Model, is included. The step is 0.5 m, which is the conventional step for 1:500 scaled maps.

In order to guarantee a normalised content of the attribute table during the data entry activity, part of the fields (excluding the NOTES ones) has been filled in using specific numeric codes. Attribute tables are thus present attributes that must be read using their own conversion tables. To simplify interrogations and queries, “translation” fields have already been added.

13.3.3 Pilot Area Shapefiles Details and Specifications

In order to understand the nature of the reconnaissance work and the consistency of the data examined in the definition of the characters of the pilot area, resuming charts for the dataset are synthetically reported.

In the Table 13.1 the list of the shapefiles in use is displayed. For the main files the amount of features and the number of fields have been provided.

In the Table 13.2 the content of shapefiles Plots and Properties is listed and explained.

Table 13.2 Content of the shapefile Plot and properties

FIELDS	CONTENTS	Code table	PLOT	PROPERTY
ID_plot	Plot progressive number			
SURVEYOR	Surveyor's identification code	x		
S_DATE	Survey date			
C_DATE	Check date			
EX_N	Initial numeration			
BLOCK	Blocks	x		
PLOT_PROP	combination of Plot code and Property Number			
PRN	Property Number			
PL_CODE	Plot identification's code			
PRN	Property registration number			
HIST	Historic buildings	x		
HIST_NOTE	Historic buildings note			
CAT	Building category	x		
CAT_N	Building category's note			
FACE_WIDTH	Building front width			
FLOORS_N	Building floor number			
BASEM	Basement presence			
BUILD_TYPE	Building typology	x		
BT_NOTE	Building typology's note			
FACING	Building's face	x		
OWNERSHIP	Single or multiple ownership	x		
OWNER	Owner	x		
OWNER_NOTE	Owner's note			
RESID_N	Number of resident people			
TENURE	Tenure	x		
TEN_NOTE	Tenure's note			
USE_BASEM	Basement use	x		
USE_BA_N	Basement use note			
USE_PAST_B	Past basement use	x		
USE_NOTE_P	Past basement use note			
USE_GRND	Ground floor use	x		
USE_GRN_N	Ground floor note			
USE_PAST_G	Past ground floor use	x		
USE_NOTE_1	Past ground floor note			
USE_UPPER	Upper floors use	x		
USE_UP_N	Upper floors note			
USE_PAST_U	Upper floors use	x		
USE_NOTE_2	Past upper floors use note			
COMM_OPER	Nature of operational commercial use	x		
COMM_OP_N	Nature of operational commercial use note			

(continued)

Table 13.2 (continued)

FIELDS	CONTENTS	Code table	PLOT	PROPERTY
COMM_CLOS	Nature of eventually closed commercial use	x		
COMM_CL_N	Nature of eventually closed commercial use note			
AGE	Date of construction			
AGE_HYP	Mark if date of construction is Hypotetical	x		
PERIOD	Period of construction	x		
MAT_BR	Brick presence and character in the facade	x		
MAT_PLAST	Plaster presence and character in the facade	x		
MAT_WOOD	Wood presence and character in the facade	x		
MAT_NOTE	Material note			
DECOR	Presence and type of decoration	x		
DECOR_note	Presence and type of decoration note			
HIST_CHAR	Persistence of historical character	x		
HIST_INTER	Building historic or socio cultural interest			
DECAY	Building's condition of decay			
F_WATER	Presence and type of water supply	x		
F_SEWER	Presence and type of disposal supply	x		
F_SANIT	Presence of sanitation facilities	x		
F_ELECT	Presence of electrical connection	x		
F_GAS	Presence of gas connection	x		
F_NOTE	Notes on facilities in general			
MAINT_HYG	Hygienic and mantenance condition of a building	x		
PHOTO_name	Name of the photo of the plot			
PH_LINK	photo file path			

13.3.4 Next Steps

In a GIS queries can be made upon position of features, spatial relations between features from different shapefiles (distance, intersections, inclusion...), upon the shape of features (area, perimeter, form factor...) and upon the content of their attribute tables. The rich content of these shapefiles enables such a variety of analysis and queries that a part of them must be still experienced. As reported in the illustration, many thematic maps have been produced by the groups involved in planning.

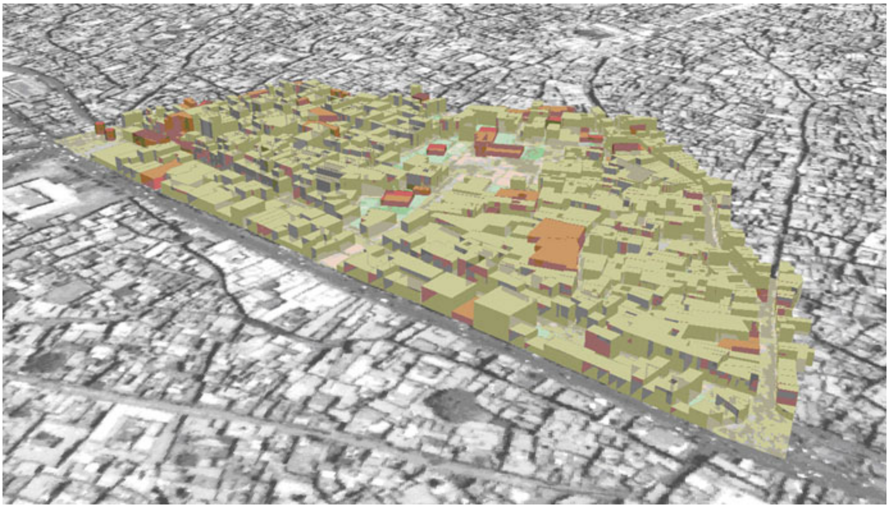

Fig. 13.9 Pilot area 3D model based on GIS information

But besides analysis the aim of this GIS is to provide planning strategies, such as thematic itineraries for touristic purposes and detection of traditional building solution.

In particular the use of METERS.shp and its future implementation with the electricity consumption can be related to the location of potential green areas and building shapes (floors number and surface) in order to build up a strategy in the positioning of photovoltaic panels. In fact it is possible to exploit the 3D data contained in the dataset to point out the best solutions (see Fig. 13.9).

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Chapter 14
Two Design Proposal For Haram Gate and Sarafa Bazaar

Stefano Perego

Abstract Project proposals described here relate to the area of the Haram Gate, one of the main entrances to the Walled City, and a stretch of the Sarafa Bazaar in which there are significant handicraft activities. Both projects are part of an integrated program of interventions in those areas that relate to the underground infrastructures, conservative restoration and new construction buildings.

The proposals tends to a continuity with the Punjabi architecture tradition. The elements present in this tradition are an expression of a figurative and formal corpus but also are demonstratives of a close relationship with the climate, an inseparable aspect from architecture.

As well as the main rest places and transit are covered by large canvases for protection from the sun, even in the both proposals for Haram Gate Pavilion and for the Sarafa Bazaar Canvases Mobile System, the solar control take on a constitutive role.

Two completion and reorganization projects focus on some public places of great interest for the city of Multan, Haram Gate and Sarafa Bazaar. Today, Haram Gate is one of the main entrances to the Walled City, a place of traffic congestion with parked trucks and cars intent to the exchange of goods, and it is also a resting place. Sarafa Bazaar is significant for its location related to the walled city urban structure and for the presence of craft activities (for example, jewelry making). It is an interesting sphere of action from a socioeconomic point of view.

The projects advanced in Haram Gate and Sarafa Bazaar emphasize in the framework of the activities carried out during the first phase of the program an urban nature strategy of interventions, which also include those of conservation and infrastructure that recognizes the inverted “Y” composed by Haram Bazaar, Sarafa Bazaar, and their confluence in Chowk Bazaar crossing the center line of north-south

S. Perego (✉)
Department of Architecture, Built Environment, Construction Engineering, Politecnico di Milano, Milan, Italy
e-mail: stefano.perego@polimi.it

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(which, by analogy with the city founded by the Romans, may be considered as the *cardo* in the city of Multan).

The purpose of acting directly on the bazaars and spaces relating to them also derives from the recognition of these urban places as *civil institutions* of the Islamic city, which is supported as well by Ludovico Micara (1985).

Understanding of and adherence to the Islamic character of the city (as with a large building) are essential prerequisites for acting consciously in a cultural context, which is not the usual practice for those who have always operated in Western areas. The activities of land survey and redrawing of parts of the city have been indispensable tools for urban and architectural knowledge, along with of surveys aimed at building a geographic information system (GIS) document for the pilot.

The understanding of the nature of these spaces, their size, the relationship between buildings, and their character was made possible through the cognitive analysis undertaken through a survey with the laser-scanner machine that showed the spatial complexity of the detected parts and generated a database from which to extract meaningful information.

By redrawing as transformation projects the parts of the city that were surveyed, a progressive understanding was acquired of the complexity of Multan in particular and more generally of the Islamic city.[1]

Haram Gate today is a place of traffic and multiple activities. The west side towards Alang Road has been subject to recent demolitions of a part of the urban fabric built on the original site of the ancient walls. Together with the gate conservation project, there is the necessity to act with a plan for reorganization of the place. The maintenance of the current character of the place, a strategic crossroads between the Walled City and the city of Multan, was a guiding aim of this project. Also, it was suggested as a starting point of a tourist route, which is also defined in the program.

In addition to the conservation of the gate, the Haram Gate Place project provides for other interventions that can be categorized into three levels: (1) infrastructure and paving (meaning primarily the first reorganization of the sewer and water system), (2) completion (redefinition of the west front of the place with the introduction of a public toilets, and (3) new construction (design of a pavilion, a place of rest and shade).

The issue of improving infrastructure networks has taken on a considerable importance in the program developed for the city of Multan, which was lacking in this respect. All interventions in public spaces therefore consisted of a portion of the work devoted to the new building of underground networks. The Haram Gate Place, in particular, required that the sewer connection that collected the waste of Haram bazaar's backbone engages the larger collector of Alang Road.

The logic of the hydraulic works follows a precise sequence. It provides for, firstly, the realization of so-called "downstream" interventions, which, in this case, coincided with the reconstruction of the fitting under Haram Gate Place. In addition to the sewers, the project involves the construction of collector rainwater networks that, as

[1] *Ibidem*, said Micara: "Speaking of the Islamic civilization will mean talk about Islam builder and its buildings, their composition according to certain ways constants or their simple approach or, at times, their contrast to determine the character and quality of urban space in Islamic cities" (T.d.A.), p. 6.

shown more specifically in the drawings for Sarafa Bazaar, through several siphoned catch-basins, discharge into the main sewer. Finally, the whole place will be paved with bricks laid edge on a bed of sand. Brick is the main building material and, even today, it is widely used in construction thanks to the growth of brick furnaces in the countryside around Multan. In addition to the brick, to emphasize the direction of the axis of the bazaar and the southern boundary of the square, some inserts of pink granite were provided that comes from the Pakistan's northern mountain areas.

The east side of the square is currently used for parking. This destination remains the same in the project even if it is regulated use. Moreover, in the incorporation of a new public transport system into a program of traffic regulation, it is expected that a bus stop that will connect the railway station to the Walled City.

In addition to the fronts regularization and the toilets insertion it was designed a small pavilion of 6×12 m was designed for the empty space on the west side. The square at the south of the gate follows a constant gradient in continuity with the bazaar while taking the old gate building line to constitution, in the west side, the podium on which stands the pavilion.

A small covered hall reflects some episodes of Mughal architectural tradition. In fact, it refers to the architecture of the *diwan*, a pavilion construction that can be found among the elements in the great gardens built between the fifteenth and seventeenth centuries by the great emperors. In the Qur'an, the gardens are described as places thickly shaded by lush vegetation, with pools, canals and the presence of small pavilions posed in relation to each other through a geometric pattern that defines paths and the large pools.

The *diwan* is traditionally placed on a podium that raises it from the gardens at ground level. It, at the time of the great emperors, was the appointed place for public ceremonies and from which the lord proclaimed his speeches. Today, the great royal gardens, such as Shalimar's gardens in Lahore, are real collective places in nature (Hattstein and Delius 2004). Here in the shade of the many *diwan*, women and men gather in their free time. Over time, the *diwan* has come to mean a small collective place of leisure. It is thus a reference point for the design of Haram Gate Place. In effect, the pavilion aims to collect different groups of people that randomly form throughout the day, creating a recognizable place appointed for meetings.

The Haram Gate Pavilion is built by a fence of poles approximately 4.5 m high and free of structural elements in the middle. The preformed sheet beams, the resistant portion of which is identified by the two bases of the trapezoidal cross-section, absolved of their structural role, contain and support a complex system of elements (Fig. 14.1). The beams' side closures are formed by two wooden panels with diamond-shaped holes that provide the inside aeration of the beams. Here, in the hollow section, are the transformers' photovoltaic panels placed on the extrados of the same beams.

Photovoltaic panels collect solar energy in their batteries for lighting LED lamps placed in the beams to illuminate the covered square. A system of mobile canvases located between the horizontal structural elements ensures shading during the day and, if packed to the margins, allow a view of the sky at night. The height of the pavilion is determined not only by the relationship with its width and depth but also from the relationship with the solar path.

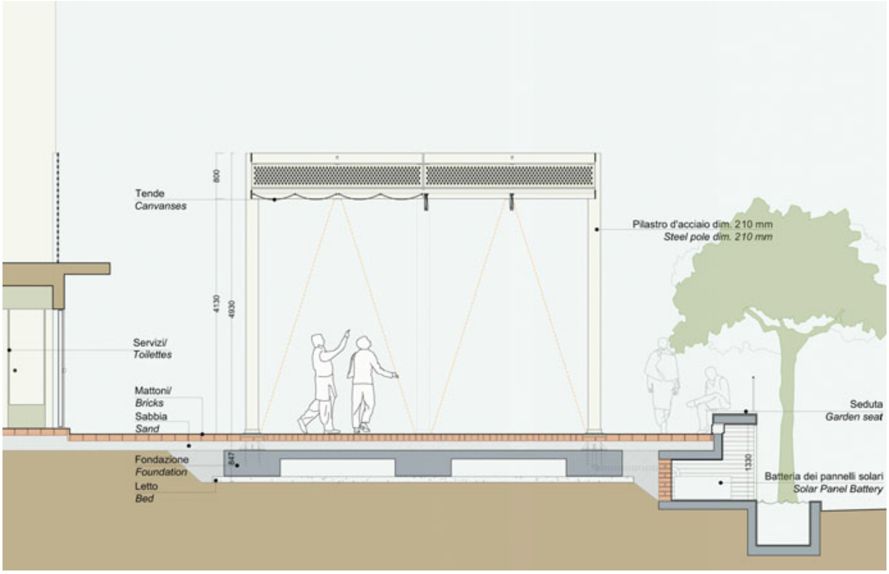

Fig. 14.1 Haram Gate Pavilion, work section

The empty steel structure allows wiring of the electrical connection between the photovoltaic panels and storage batteries (inspected from Alang Road) located below the seat post to the delimitation of the square on the south side. In addition, a row of trees provides improved protection from the sun.

The north side, defined by the recomposed fronts of the still-existing buildings, is partially occupied by the one-story public toilets. Placed in safety there are the oil transformers for public electricity, currently placed on wooden or steel poles randomly inside the square.

We included some elements of tradition, especially in details in the patterns of the side closure beams of the Haram Gate Pavilion and in the connections between the structural elements. As frequently found in traditional pavilions and in large porches in buildings' inner courtyards, there is a continuity of the structural elements beyond the arc set that highlights a greater emphasis on the role of structural vertical elements. This detail has been interpreted also in the design of the trapezoidal head of the beam that is posed on half of the pole section shaped for this purpose (Fig. 14.2).

The Sarafa bazaar project has profound similarities with that of the Haram Gate Place. The stretch under consideration extends from Musafir Khana, a historical resting place for pilgrims and a mediating element between the bazaar and the Musa Pak Square, for about 100 m, corresponding to the portion surveyed with laser scanner and subsequently redrawn. For these reasons, the urban value of this part of the city (for the character of its own and for the relationships it establishes with other parts of the city) has been considered as a place of great interest to advance a pilot reorganization proposal for the bazaar.

The character of the bazaar is determined by a combination of different architectures in the composition of the facade, designed according to rules that show different

Fig. 14.2 Project of the Haram Gate Pavilion, view from east to west

heritages. This condition tells the complex story of the city of Multan. It may be observed, however, that there has been a substantial loss of such evidence in Sarafa Bazaar, where historic buildings have been replaced by low-quality construction in the last three decades. However, there remain interesting parts, of which Musafir Khana it is undoubtedly the emblem, along with some Sikh and British period buildings.

The bazaar, in accordance with its commercial nature, presents on the ground floor spaces used for shops (often interconnected with an underground storage facility accessible by a steep staircase). Dwellings, in the typical logic of the mercantile city, are located on the upper floors. This division is highlighted by the overhang toward the street of the upper part (dwelling) to create a small shelter for the shops.

As is so with Sarafa, bazaars are traditionally covered to protect merchants and passersby from sunlight by canvases attached to the façades above the shops. The canvas in the great Islamic culture is a defining element of space and even for limited periods during festivals or special occasions (Fusaro 1984).[2]

[2] Fusaro writes, “In addition to permanent coverage, mobile or stationary, which are, in streets and squares, in Islamic cities are in use today canvases removable multicolored squares to protect open spaces for temporary uses related to festivals or special occasions. In Ahmedabad whole squares are covered with canvases supported by slender wooden poles during public holidays. In Cairo, for weddings and other private parties, is mounted a large canvas for the reception hall in the shape of a parallelepiped, made up of multicolored carpets supported by a structure of wooden poles, easily removable and transportable, is an extension of the temporary home on the road it offers, those who do not have their own, a mobile environment, to rent full furniture, and appropriate to the size and decor of the reception of numerous relatives and guests. The temporary occupation of the road district is consistent with the quality of semi-public space of this road” (T.d.A), pp. 74–75.

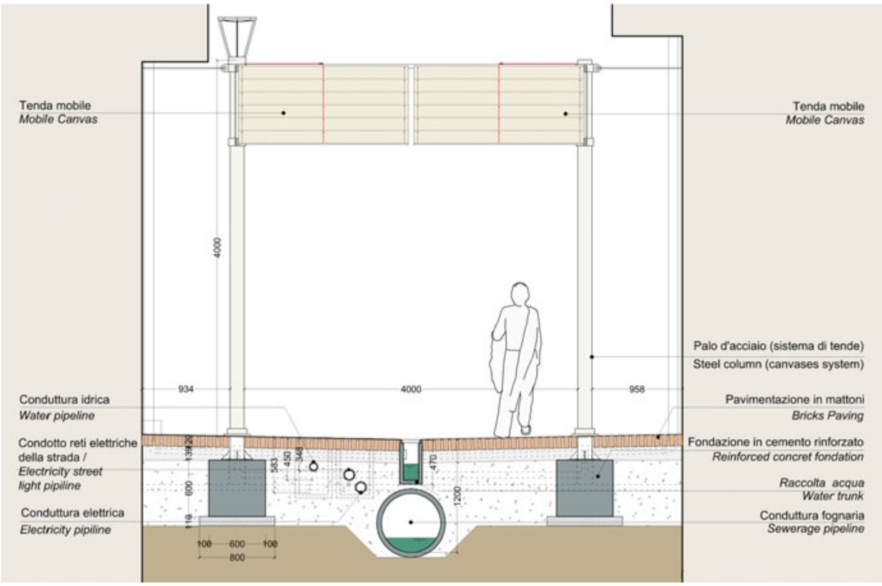

Fig. 14.3 Sarafa bazaar, work section

The aim of the project was to bring order to the bazaar through a repeatable canvases system—adhering to local tradition to fill those spaces with specific elements and materials—with its own structure independent from the buildings (a necessary solution because of the critical condition the existing façade). This was within a larger project of infrastructure in the bazaar that followed the rules described in the case of the Haram Gate.

This support system consists of steel trestles and braided steel wires, and the minimum module consists of two consecutive portals that support two canvases. The step of these elements varies between 3.5 and 4 m. The trestle sequence registers the windy variations of the bazaars. The width of each portal, to ensure the passage of traffic, is 4 m (at a height equal to those currently used, Fig. 14.3). At the upper end of the steel poles and arranged in alternation along the entire system are placed lamps whose shape reproduces, for continuity, the design of the beam heads of the Haram Gate Pavilion.

On the upper part of the trapezoidal plate, a veil made of sheet steel reflects the light coming from the lamp placed in the hollow section of the pole.

The curtains in this case are handled manually by a cable system with counterweights, which alludes to the control systems of the sails of a boat. The choice of using two curtains independently for each pair of portal arises from the situation of Sarafa bazaar. The orientation is approximately north-south (with a slight rotation to the west), a condition that puts the two sides of the bazaar in the light of the sun at different times of the day, the west side during the morning and the east in the afternoon. Thanks to the independence of the two canvases, it is possible achieve many different arrangements according to the needs of activities taking place in the

Fig. 14.4 3D simulation of the new Sarafa bazaar

bazaar. In addition, the canvases have a 20° inclination to the south, which allows air circulation and the observation of the fronts on which, in the project of revitalization the bazaar, there will be some interventions (Fig. 14.4).

The first intervention is the wiring of the electrical network, which rises in an anchor on the wall, and is required because current conditions are complex and insecure. The second intervention is the removal and subsequent repositioning of the signs according to the simple rules of order.

Last but not lease is the implementation of solar control devices, especially for new buildings on the east front (therefore exposed to the west), finished in adherence with the rich architectural tradition of these elements. It is meaningful from this point of view to reference the experience of Le Corbusier. He acknowledged the attention given to climate, such as solar path, as a principle laid on the constitution of architecture in history in general but especially in an area such as the Indian subcontinent. This principle is contained in his most important experiment carried out in the Indian area: Chandigarh. Here, in the so-called *Fosse de la Consideration*, he realized a built manual to allow the study of solar control elements, called the Tower of Shadows. With this building, Le Corbusier aimed to demonstrate each solar control element in relation to orientation and composition (Perego 2012).

In the architectural history of Multan, from Mughal to the British period, through Sikh architecture, a constant relationship is very clear between the typo-morphological layout and climate, particularly with solar path and the different solutions adopted for the definition of elements and the composition of fronts. These experiences show different formal solutions.

The lodge, for example, is a dominant element within the British experience, a wooden structure, tripartite, high buffered in the lower and upper parts with wood shutters inlaid with drawings of the local figurative tradition that provide protection from the sun and also permeability to light breezes. The middle section is open to view of the city and allows the illumination of the interior parts of the buildings. The Sikh façade composition (some examples are still present in the city of Multan) is defined by a single minimum size window such as to ensure the least solar gain in the interior of the house. In contrast to the experiences of British, in Sikh period juxtaposed architectural elements cannot be found, and there is, therefore, a different relationship between solids and voids (Burton 2009).

The complex design of the windows and the wealth of structures within an expression reflects the artisans' attention to detail typical of the tradition of this city, like many others in the Indo-Pakistani territory, where solar control solutions were adopted in relation to the usage of space and orientation.

The proposals for the Haram Gate Pavilion and the Sarafa Bazaar have been measured against the requirement for solar control. This has been a primary interest in architecture and is a continuation of the tradition of the city in the Indian subcontinent. In addition, solar control today must be considered a necessary interventions related to the energy conservation.

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Chapter 15
Designing the Master Plan for the Pilot Area in Multan Walled City

Maria Vittoria Cardinale

Abstract In such a reality rich of history and rituals, as Multan Walled City is, a deferential and valid project of renewal has to take in account the delicate and precious dichotomy between the collective world and the private dimension. The project of transformation in keeping with the character of the city, has been guided by the understanding of the main building types from the analysis of the urban structure, that follows the typical Islamic urban aggregation and the shape of the territory.

The Pilot Area chosen for the urban renewal project contains all the main elements of the Islamic city: an historical gate, two important bazaars and the main public buildings represented by the shrines and the mosques. The project linked technical issues to the architectural ones and it represented an indication of renewal whose principles are applicable to the whole city. From an urban analysis of the whole city on its type-morphological characters, and through topographic and geometric surveys, more detailed data of each building were obtained to constitute a GIS document usefull to design the Masterplan. The Plan contained projects of new buildings and new public spaces related to the renewal of the public and worship places and to the restoration of interesting historical buildings. The project focused in particular on the design of the central Musa Pak Complex, placing new public buildings for the redefinition of the urban space, now deprived of some spatial references. A new pilgrim's house, the Musa Pak Pavilion and a new commercial building were designed in continuity to type-morphological characters of the city and according to the principle of improving local materials and traditional techniques of construction.

M.V. Cardinale (✉)
Department of Architecture, Built Environment, Construction Engineering, Politecnico di Milano, Milan, Italy
e-mail: mariavittoria.cardinale@gmail.com

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The Walled City is the historical part of Multan that, according to the Islamic tradition, is surrounded by the walls in order to be protected from the profane and enemy world outside. Even if the walls today are no longer present, they are represented by the historical gates and attested by the shape of the urban blocks at the perimeter.

Through these historical gates the main roads penetrate into the Walled City and become the trade routes called *bazaar* that constitute the main structure of the city even today. The commercial life of the city is organized through streets more and more domestic according to the increase of the good's preciousness, and crossing worship places, it combines the sacred and the profane.

In such a reality rich of history and rituals and in which the physical space shows the complex relationship between the collective world and the private dimension, a deferential and valid project of renewal has to take into account this delicate and precious dichotomy. Here the relationship between the building type and the urban shape is dense and inseparable. The architectural scale defined by residential buildings corresponds with the urban scale shaping the character of the city also with the relationship with the worship spaces.

The city of Multan is located at the foot of a small hill on which was placed the Sultan's Walled Citadel and later the British Fort (the *Qasim Bagh*). Its construction follows the slope land's lines with the north-west/south-east orientation given by the ancient river valley and the north–south direction of few high points in the city. These points, probably formed by the accumulation of the ruins from previous periods of the city, were gradually selected for their highness as sites for the main worship places, mosques, and shrines that made this city famous.

Around these polarities and following a layout of increasing privacy of the streets that end in a "*cul-de-sac*," it developed the urban structure divided by *mohalla*, residential unity surrounded by the main streets and related to family and ethnic identity.

The understanding of the main building types from the analysis of the urban structure that follows the shape of the territory and at the same time the typical Islamic urban aggregation has guided our project of transformation in keeping with the character of the city.

The dense and intricate urban shape reflects at the same time the social, functional, and physical organization of the Islamic city and also the characteristics of warm climate cities that are compact to take advantage from the best conditions of the sun and prevailing winds' exposition.

In this morphological structure, often so complex that it could be very difficult to distinguish the different architectonic units, although groups of buildings grew or were modified by additions of parts according to the growth of the families; it is, however, possible to distinguish the presence of the two main types that built the city everywhere: the *block* and the *courtyard*.

Along the bazaar the *block type*, with a predominantly narrow front and commercial ground floor, benefits from the same relationship with the road that is present in the European middle ages' cities. The section of this building's type, articulated in the sense of verticality, often includes a half or full underground floor, and it has steep stairs leading up to the flat roof where another city and another world are revealed on the sky level.

As you move away from the trade routes, the buildings assume an increasing private character, and they use internal courts as an element for lighting and air control. This variant of block type, called *makaan*, sometimes has a shaft or a small courtyard, but it mainly establishes a relationship with the street through windowed fronts; further introversion's degree is represented by the courtyard type called *haveli* which exposes itself almost entirely to the interior patio, the primary source of air and light.

The increasing degree of introversion explains itself in a more and more private road's structure that encloses in urban blocks the buildings belonging to the same family or ethnicity and local worship places.

Although the diversity of each case, the Islamic cities have similar characteristics related to religious rituals and the particular conception of the public and the private spheres. The history of the Islamic city is in fact strictly linked to the cult, "will be these buildings, their composition according to certain fixed ways or their simple combination, or sometimes their contrast, to determine the character and quality of the urban space in Islamic cities" (Micara 1985).

The relationship between the parts of the city is here the relationship between the different levels of the public and the private, and between the sacred and the profane, distinct yet intertwined in the thick and dense urban morphology.

Among these spaces the *mosque* is the catalyst place of the Islamic society, and it is not only a place of prayer but also of collective activities of the community. For the existence of such functions together, the mosque has always had a centralizing role in the city: toward the principal mosques are oriented the main roads and in its proximity are concentrated the most important public places, such as the Koranic schools and the pilgrim's houses.

In the Pilot Area chosen for the urban renewal project, all the main elements of the Islamic city are present together. Surely it can be said that its unique location, at the entrance of the two gates of the city between two important commercial roads, makes it an interesting occasion to interpret the principles of urban composition in the Islamic city. Here the private and the collective dimension experience the changes in the urban shape starting from the occasion given by the important demolition of houses in the central Musa Pak area. This area is full of buildings and public spaces that are interesting both from the architectural and religious points of view. Here the sacred and the profane blend into the new empty space as a rare occasion of a significant new urban construction in a reality in which the open space is usually smaller in relation to the dense Islamic urban structure.

The eight mosques and two important shrines of this area that enliven the public life of the city are ideally joined by a route from the *Haram Gate* to the *Musafir Khana*. This route, identified as one of the most important itinerary in the Walled City for a tourism revival, keeps together elements with potentiality and urban value whose relationships and synergies' understanding is very useful for the design of the Master Plan.

This remarkable framework required a deep analysis of its more intrinsic characteristics because the new urban plan of this area is the interpreter of the themes and issues of the whole Walled City.

The considerations that emerged from an urban analysis of the whole city on its type-morphological characters, starting from its relations with the territory, were confirmed in this area by topographic and geometric surveys to determine the exact urban shape of this part and by an analysis on site to obtain more detailed data of each building.

The information about the age of the buildings, their kind of type and shape, their relationship with the different hierarchies of streets and open spaces, their main use and the number of inhabitants, their architectural and cultural heritage, and also the conservation status and the presence of infrastructural facilities and services were all useful to understand the urban character of this part of the city.

The organization of the data through the constitution of a GIS document, as well as confirm and deepen the knowledge of that part of the city, was essential to engage synergism between the various critical issues and the potentialities in the area on which we designed the urban renewal plan represented in the Master Plan.

In it technical issues such as the provision of a sewerage system and electrical networks (that are now mostly absent) or new paving and new lighting for the public spaces are linked to the architectural ones; together with the projects of new buildings are also highlighted in the Plan the public and worship places, the new open spaces system derived from collapsed houses, and the interesting historical buildings that have to be restored.

Through such a synoptic view of the individual parts, they are determined the potentialities arising from the relationship of these parts to each other and it is confirmed the coherence of the project. The Master Plan, which keeps together in an urban scale the presence of the public building and our proposals studied in a detailed scale, is thus verified on the value of its individual components, and it is an indication of a renewal project of the Pilot Area whose principles are applicable to the whole city.

As Aldo Rossi wrote in his book *The Architecture of the City*, the role of the monuments is in fact a key one in the urban composition:

> Images, engravings, and photographs of these disemboweled cities, record this vision. Destruction and demolition, expropriation and rapid changes in use and as a result of speculation and obsolescence, are the most recognizable signs of urban dynamics. But beyond all else, the images suggest the interrupted destiny of the individual, of this often sad and difficult participation in the destiny of the collective. This vision in its entirety seems to be reflected with a quality of permanence in urban monuments. Monuments, signs of the collective will as expressed through the principles of architecture, offer themselves as primary elements, fixed points in the urban dynamic (Rossi 1982).

The urban development of Multan preserved, in addition to the most important worship places, also the gates at the entrance of the Walled City as reference elements in the urban complexity. These monuments, as well as to act as witnesses to the sense of sacredness and introversion of this culture represented by the role of the walls, are the starting points for a widespread project of urban renewal.

Placed at the southeast side of the Pilot Area, the *Haram Gate* represents the main entrance to the Walled City from the south of the country. To the restoration project of the monument, whose conditions are bad, a project of renewal of the connected open spaces designed in the Master Plan was added. A new pavilion for the rest of the people provides shelter from the strong sunlight through a system of tends connected to the structure. On the roofing beams are placed the solar panels designed to provide the power for the public square lighting. For the new paving of the Haram Gate and also of other parts of the Pilot Area, bricks have been chosen because they belong to the traditional construction systems, to underline the entrance to the *Haram Bazaar* that is one of the main bazaars of the city. This bazaar surrounds the Pilot Area joining the *Sarafa Bazaar* that is on the opposite side.

The bazaars are an important collective space for the Islamic culture where housing and commercial activities blend with the road, whose narrow section reflects its semipublic character. Florindo Fusaro (1984) describes in his books *The Islamic City*: "The road section tends to close up, partially or fully, for the projections that extend the first floor of the houses and create pleasant shadows and also allow to obtain that densification of the urban fabric which we know to be one of the leading ideas of the construction of the Islamic city. [. . .] This system, in the clarity of its isolation and its simplicity, is representative of the training system that guides the construction of the most complex urban fabric."

The collective space of the bazaar, which structures the Islamic city as a permanent expression of this culture and represents a prominent aspect of the character of the city, has to be included in a renewal plan that aims for incisive interventions.

A new system of street lighting[1] combined with solar control devices has been studied with an attention for the technical details for the two main portions of the two bazaars. The design concerned a new road section on which were not only solved the technical issues related to the sewerage infrastructure, electricity networks, and the new paving but also the architectural one's for the renewal of this collective space.

Another important public space in the Walled City is the Musa Pak Complex that is placed in the center of the Pilot Area. This is a rich system of public buildings with a significant architectural and cultural value, accessible from the Sarafa Bazaar through a beautiful building, the Musafir Khana that houses the reception of pilgrims and constitutes the east gateway to the complex. An irregularly shaped open space is actually located in front of the main mosque, the shrine, and the cemetery complex, and there are also placed other activities and residential buildings in a continuous relationship between the sacred and the profane worlds. In the south side of the complex, a big empty space, created by the demolition of residential buildings, represents a significant change of scale in the typical open

[1] Florindo Fusaro (1984), p. 74: "The protection system that uses protruding volumes, with the other which provides for recourse of simple tents, is absolutely widespread in all Islamic countries," translation by the author.

Fig. 15.1 The new Pilgrim House

space size of the city and it is connected with a wide street to the southern edge of the Walled City.

The transformation project of this area, as an indication for other future interventions in the city, focused in particular on the design of this part, placing new public buildings for the redefinition of the urban space now deprived of some spatial references. The project underlines the relation between that space and the other catalysts of social life of the area represented by the other public places. The renewal project considers also a number of punctual interventions on the whole area related to the houses' restoration and the design of the new open spaces formed on the collapsed houses areas.

In the area overlooking the shrine, facing the smaller open space, it has been proposed a new building for pilgrim's hospitality near to the old one at the entrance of the complex and leaning the blind side against a wall created by the demolition of a building (Fig. 15.1). The new building, tight and three stories high with the addition of the terraces on the roof and distributed by a small gallery, may contribute to the redefinition of the open space still ensuring the accessibility of the ground floor toward the shrine and giving direct connection between the entrance of the Musafir Khana and the shrine. According to the principle of improving local materials and traditional techniques of construction, we decided to build using brick and wood shields that have low energy consumption, thanks to their material properties and the possibility of their relative construction systems to ensure micro-ventilation and wind chimneys. In addition to these advantages, already understood by the local building traditions, the availability of this local material reduces considerably the transport consumption.

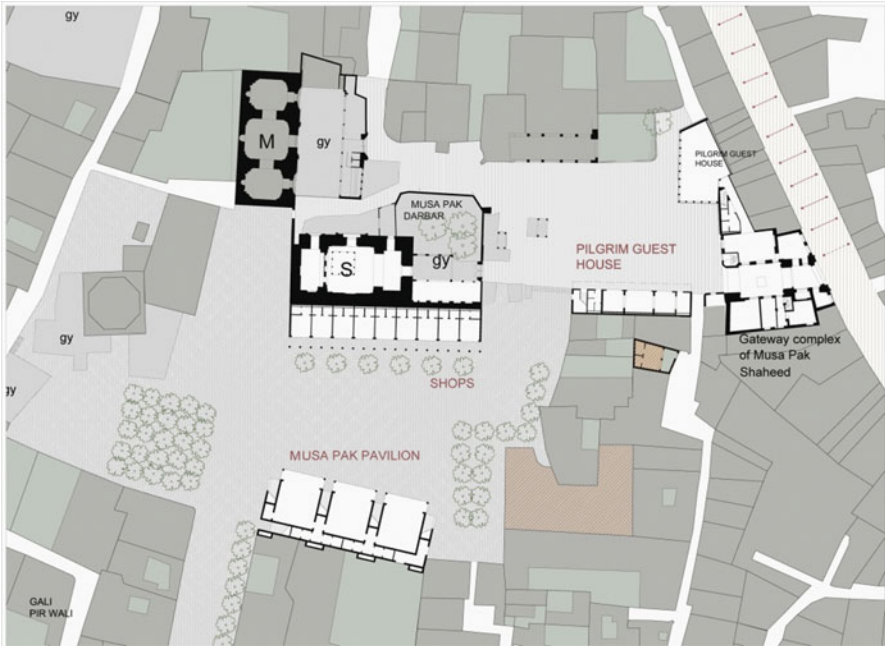

Fig. 15.2 Musa Pak, master plan

The most suitable proposal for energy saving is moreover represented by the increasing of the trees with the aim of lowering the average temperature and creating new shadows. In the empty space in the south of the mosque of Musa Pak and in the wide southern street that introduces it were designed rows and groups of trees to project the space in which are collocated the new collective buildings represented by the Musa Pak Pavilion and a new commercial building to redefine this new open space (Figs. 15.2 and 15.3).

The Musa Pak Pavilion houses private garages[2] on the colonnaded ground floor and the possibility to stop for public transport (Fig. 15.4). At the first floor it presents covered public terraces that provide shelter from the sun and a space for collective activities that directly face on the big public space. This floor is accessed through big stairs on the main front, while the wall system behind contains the stairs to the roof. Here the placement of solar panels as well as the specific advantages of this system is an opportunity to use an autonomous system for public lighting that prevents the additional detraction of power from the public electrical network already subject to numerous blackouts.

[2] The projects of transformation of this area designed in recent years included an area entirely used as a garage. This technical requirement has been embraced just for a small part and it was preferred to design buildings and public spaces with a civic value for the city and its people.

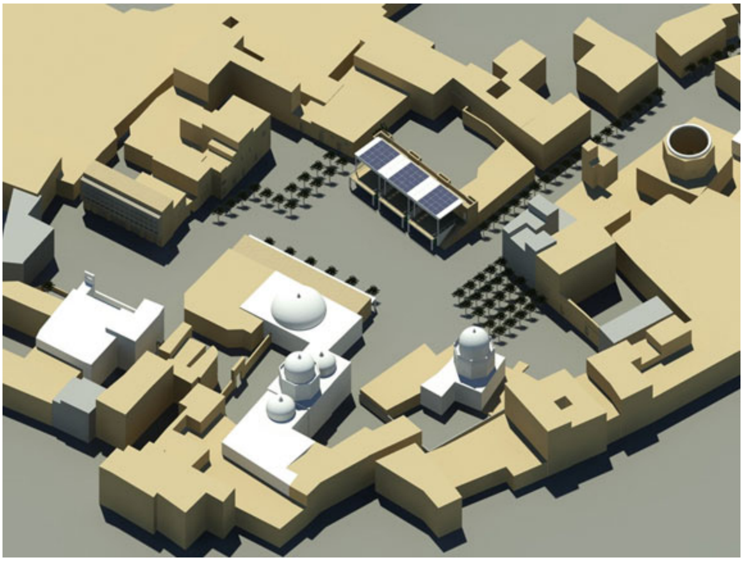

Fig. 15.3 Tridimensional view of the new Musa Pak space

Fig. 15.4 Musa Pak pavilion

On the other side of this big open space in Musa Pak, identified as an important new collective space, the project indicates a one-floor-arcaded building that closes the northern front leaning against the wall of the shrine and houses small shops, a solution often adopted in the Islamic world as further evidence of the relation between the sacred and the profane.

They have been included in the Master Plan and also the specific interventions on the collapsed houses that we identified: in some cases the need to restore the continuity of the front through the construction of a new building was established; in other cases the transformation of the empty spaces in new open spaces was indicated.

The new buildings replacing those collapsed were designed in continuity to type-morphological characters of the city and in total compliance with the volumetric, architectural, and material characters of the adjacent buildings, according to the guidelines given by the team that worked on the building's conservation.

New open spaces, resulting from the ruins of old houses, were thought as a system of small open spaces that interrupts and reveals the so dense urban morphology, and it becomes a place of meeting and resting for the people. Furthermore, the new open spaces allow a new ventilation, and between new effects of light and shadow created both in these private and collective places, they keep alive the secret value of this city.

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Chapter 16
Traffic Analysis and Solutions

Vincenzo Donato, Samuele Camolese, and Alessandra Terenzi

Abstract Urban mobility offers a unique opportunity to ensure development and radical improvement to the quality of urban life in the Multan City center. The traditional approach to transport planning usually aims only at solving technical issues, finding the solutions within its own discipline. On the contrary, we believe that transport planning is an integrated discipline within town planning and aims to promote an approach based on a reasonable and documented assumption. The scientific method aims to quantify the phenomena through the formulation of a hypothesis and the development of forecast scenarios.

The rapid increase in individual income leads to a physiological increase in the use of private vehicle: to curb this phenomenon it is necessary to develop an adequate, effective, modern, and high-quality public transport network and to limit the uncontrolled growth of road infrastructure. Moreover, together with the new public transport network, it is of paramount importance to redefine road sections incorporating lanes for unmotorized mobility, hence enhancing and regenerating public urban space. There are many recent examples, such as Delhi (India) or Bogotá (Colombia), among others, that show the effectiveness of similar interventions.

We propose a plan that consists of three steps: (1) a cognitive and qualitative analysis of the project area, (2) analysis of the existing transportation system, and (3) an implementation strategy divided in different phases (short, medium, and long term); for each scenario numerous design solutions and use constrains of the city's street network have been developed. Our project also aims to characterize Multan's

V. Donato (✉) • S. Camolese • A. Terenzi
Department of Architecture, Built Environment, Construction Engineering,
Politecnico di Milano, Milan, Italy
e-mail: vincenzo.donato@polimi.it

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roads and squares for achieving “re-balanced urban space”: multifunctional and multidimensional spaces not just only for motorized traffic but also carefully studied for public transport, pedestrians, and cyclists.

The proposed scenario is analyzed with GIS mapping techniques through which it is also possible to reconstruct the isochronous accessibility maps (comparative travel time analysis) and the PTAL (public transport accessibility level); this kind of scientific analysis permits highlighting the level of service and the index of accessibility in the Multan urban area.

A cost/benefit analysis of the proposed interventions (such as shuttle buses and MRTS) has also been developed, in order to verify the potential sustainability of the investment.

16.1 Current Situation and Critical Aspects

Cities are growing all over the world. According to UN estimates, more than 50 % of the world population will be living in urban agglomerations by 2025 (Kaltheier Ralf 2002). The transport situation is catastrophic in most cities, especially in developing countries as a result of the negative impacts of urban economic growth, often leading to increasing environmental pollution through the emission of harmful substances and the high degrees of road accidents. The increasing demand for mobility due to a growing local economy will soon lead to a situation of total collapse of the road network, in particular around the Walled City of Multan. Sustainable revitalization (a contradictory term with regard to the grave situation of the Walled City at the present time) cannot be separated from resolving issues, briefly described below, mainly regarding restructuring micro- and macro-urban issues, reduction of traffic and redesigning of some roads, public transport, and evaluation and analysis of the potential development of productive activities in the district of Multan (mainly farming and dairy production compared to changes in the agro-industrial sectors). Reorganization of the logistics supply to the city and the Walled City and the locations of distribution centers and internal warehouses is deemed necessary also in short-term interventions.

The district of Multan, with a population of 3.9 million inhabitants at 2008 (1.8 M/in. only for the MDA area), is characterized by a precarious urban mobility (NESPAK 2009a). The road network around the Walled City suffers from the consequences of a growing demand for mobility that is not satisfied by adequate infrastructure systems and services. The use of different types of vehicles and the lack of urban traffic management schemes result in increasing traffic congestion. The road system around the old town is obstructed by narrow road sections, and the location of the main commercial zone and the surrounding ones in the old city generate a high demand for mobility with regard to goods and people. Outside the central area, the inner ring road is an important arterial road that distributes traffic flows all around the city and connects the different neighborhoods. The most important interventions need to be made on infrastructures to improve roadway network capacity, in particular a new overpass (e.g., along Kachehri Chowk road) that would divide through traffic from local one. A particular critical problem regards crossroads that are undersized or unregulated.

16.2 Mobility Demand and Transportation Supply in Multan District

Data given by a Multan operator office have been elaborated in order to better understand the modal share of the city. The number of registered vehicles has been converted to equivalent Passenger Car Units (PCUs) for a better comparative analysis.

The current fleet that circulates daily consists mainly of 575,000 motorcycles corresponding to 77 % of vehicles operating, out of a total of 745,000. The component of cars is currently limited to 82,000 vehicles equal to 11 %. If we consider equivalent vehicles in order to compare the different modes of transportation, the component of the motorcycles goes down to 53 %.

Public mobility demand during the peak hour in Multan District has been estimated in Table 16.1:

From the above data the following considerations can be extracted:

- Motorcycles represent 78 % of the vehicles and 36 % of equivalent Passenger Car Units.
- The vehicles dedicated to public transportation (buses, minibuses, motor cab rickshaws, motor cycle rickshaws, and motor cab taxies) represent 2.7 % of vehicles in circulation and 4.5 % of equivalent vehicles. In short, public transport, in terms of equivalent vehicles, is absolutely marginal with respect to the rest to equivalent Passenger Car Units (PCUs) on the road network.
- Given a medium average car occupancy of at least 1.8 individuals, and given that peak hours represent at least 12 % of mobility demand, we can deduce that during rush hours at least 104,000 individuals are in transit. An important part of this traffic is concentrated in the city center of Multan as incoming and outgoing flows.
- To summarize, equivalent PCUs dedicated to public transportation represent 4.5 % of the total number of vehicles and satisfy at least 38 % of the mobility demand. At the present time this represents a significant amount of the total demand, without taking into consideration the level of the service.

The current road network and the morphology of the historic center of Multan is in no way capable of absorbing changes without significant urban planning interventions and in particular upgrades in the public transit sector.

Table 16.1 Source: Elaboration of data from: Excise Taxation Officer Multan

	Equivalent vehicles			Passenger/Peak hour		
Type of vehicle	Total	%	VHL/Peak hour	Pass/Vehicle (1)	Pass/ hour	%
Motorcycle/scooters	172,459	35.7 %	20,695.1	1,8	37,251	25.8 %
Motor cars	77,492	16.0 %	9,299.0	2,5	23,248	16.1 %
Jeeps	3,293	0.7 %	395.1	1,8	711	0.5 %
Station wagons	2,144	0.4 %	257.3	1,8	463	0.3 %
Buses	9,258	1.9 %	1,111.0	40	44,438	30.8 %
Mini buses	5,196	1.1 %	623.5	8	4,988	3.5 %
Station wagons stage carriers	264	0.1 %	31.7	1,8	57	0.0 %
Motor cab rickshaws	6,441	1.3 %	772.9	10	7,729	5.4 %
Motor cycle rickshaws	10	0.0 %	1,2	5	6	0.0 %
Motor cab taxies	1,015	0.2 %	121.8	5	609	0.4 %
Pickn ups	5,520	1.1 %	662.4	1	662	0.5 %
Delivery vans	4,117	0.9 %	494.1	1	494	0.3 %
Trucks	13,312	2.8 %	1,597.4	1	1,597	1.1 %
Tractors	179,148	37.1 %	21,497.8	1	21,498	14.9 %
Ambulances	198	0.0 %	23.8	3	71	0.0 %
Bowsers (petrol & diesel)	2,308	0.5 %	277.0	1	277	0.2 %
Bowers (water)	28	0.0 %	3.4	1	3	0.0 %
Luxury vehicles	79	0.0 %	9.5	1,8	17	0.0 %
Other vehicles	996	0.2 %	119.5	1,8	215	0.1 %
Total	483,278	100.0%	57,993		144,336	100.0%

16.3 Reference Scenario by Multan Development Authority

The urban plan report (Multan Master Plan 2008–2028 prepared by Nespak) estimates a population growth forecast for 2020 at 2,570,000 in the MDA area arriving at 5,480,000 for the entire district (NESPAK 2009a). The main strategy developed to improve the transportation system is exclusively based on improving the road network. It proposes the realization of a series of new roads and external ring roads to develop the growth of the city in concentric rings. Short-term planning foresees construction defined as "*The Prime Minister's Package*" (NESPAK 2009b) which for the central area consists of upgrading certain intersections and the implementation of a one-way traffic direction system. As regards the long term planning, the most important work will be the completion of a new highway that will connect Lahore and Karachi that go through Multan by new a bypass outside the urban area. As for the public transportation system, new regional bus terminals are proposed. Other proposals for the public transport network to serve the urban areas are new mass transit routes along the inner ring road such as a monorail link between Double Phatak and Jinnah Chowk (NESPAK 2009b).

The land use punctually described in the Multan Master Plan shows the current distribution of the main functions (public/private) and the density of the population in urban Multan, basic elements to understand the demand for mobility, and the distribution for daily trips. The highest density of population lies inside the Walled City or in areas immediately adjacent. The spatial distribution of the main functions of public and private sectors shows how the commercial areas are predominantly concentrated along the major axis of entry to the inner ring road. Warehouses and trunk terminals are located in the area near the bus terminals along the main Vehari road. The highest concentration of industrial areas is located south especially along Sher Shah road and Multan bypass. The large industrial fertilizer factories are located in the northeast. The health facilities are distributed uniformly in the city with a greater concentration in the northwest (between the Walled City and the airport) where a number of clinics and hospitals are located. With this city configuration and without the delocalization of major traffic generators (with a better public function distribution in each city neighborhood), the pressure of mobility demand will be destined, in the next few years, to increase more rapidly.

16.4 Best Applicable Example

We analyzed exemplary cases of cities in developing countries in which mobility issues have been successfully resolved. The most interesting example is that of Delhi because of its motorization index and strong cultural similarities to those of Multan. If we take Delhi's main data (population 16,753,000, density 11,297 in./km^2, motorization index 50 cars per 1,000 persons, 74 motorcycles per 1,000 persons) and compare it with that of Multan (density 4,933 in./km^2, 21 cars per 1,000 persons, 74 motorcycles per 1,000 persons), the motorization systems background is very similar (Carlos et al. 2008).

In Delhi, mass motorization was a spontaneous consequence of rapid economic growth over the past two decades within the limits of a low-income country. In Delhi the population is much more heterogeneous in composition (socioeconomic background and income), and this mix is reflected in the heterogeneous use of street space. Delhi's roads have to cater to cars, hand carts, cycle rickshaws, a very high proportion of motorcycles, and three-wheeled scooter taxis. Between 1951 and 1961, the population of Delhi increased from 1.7 to 2.7 million, and the city was characterized by a combination of high population density in relatively small area, and low population density in large areas. Over the past few years, the economy of Delhi has been growing by about 10 % every year and vehicle ownership (cars and motorcycles) by about 15 % in the last few years (Pendakur 2002). This trend in urbanization and its associated problems were intended to be tackled by the development of a Regional Master Plan for Delhi. Public transport networks and land-use patterns were reviewed to complement the plan. The idea of the introduction of a BRT system (bus rapid transit) began in 1996; at that time Delhi was abuzz with new plans for a mass rapid transit (MRT) system to provide the city with a new

Fig. 16.1 Delhi: before and after the introduction of BRT system

public transport system. By September 2002, a detailed design project for the first corridor was ready, the first lane opened in 2008, and 16 corridors (310 km) were planned for the next 10 years. In 2002, the first line of the MRT was opened to public use; ever since, six other MRT lines were implemented in the urban area and are operational (2012). The introduction of a structured public transport system such as the BRT and MRT encouraged and promoted the use of collective public transportation that still, however, represents the majority of total trips in urban areas (Carlos et al. 2008) (Fig. 16.1).

Another model of a successful mobility program is that of Bogota city where safe dedicated lanes for cyclists and pedestrians were provided, separated from those of the motorized vehicles, hence improving the quality of urban public spaces and structuring a network of sustainable mobility; all this resulted in a significant economic benefit as well as in restoring social dignity to places and to people who live and work there.

16.5 A Proposal for a Mobility Strategy in Multan

The revitalization of the old town of Multan remains incomplete without the support of an adequate policy for transport and mobility policy in order to facilitate the movement of people and goods. The proposed strategies for sustainable mobility for the city of Multan are divided into three different phases with different timeframes: Phase 1 (8 years), Phase 2 (15 years), and Phase 3 (20 years).

16.5.1 Phase 1: Short-Term Scenario

The main goal to be achieved on the road network, with a limited use of public resources, is to ensure maximum efficiency of the existing infrastructure. The limited road sections around the historical center often witness conflicts between vehicles improperly occupying the wrong lane of traffic in both directions and vehicles that impede traffic flow for performing loading and unloading activities. The introduction of one-way streets would lead to a more fluid traffic flow and a reduction of conflict in maneuvering at intersections. The travel time saved would compensate the prolongation of the routes. Streamlining traffic would be beneficial in reducing emissions of exhaust gas.

The structural reconfigurations to the road network will furthermore comprise limitations in terms of transit of certain categories of vehicles, at least inside the most critical areas of the city. Animal-drawn vehicles with large loads will not be permitted to move as freely as they do today but only at certain times (possibly with permission to transit for loading and unloading purposes and only at night) to homogenize traffic circulating on the road network. This kind of limitation in a preliminary phase should be done through time limitation during the day (i.e., during the peak hours) then later, as a result of increasing economic growth and relating increase of motorization; animals will be banned as in the Delhi case study.

Urban environment and urban mobility can rarely be successfully addressed through a single project or focus on a single transport mode. Typically, the synergies gained from a package of complementary measures are required to encourage behavioral change. Promotion of nonmotorized transport could be a complementary strategy for a better mobility system. The recovery of sidewalks and squares is the first step. In most instances public space has been invaded either by informal trades or by parked vehicles. The goal is to give back these areas to public use.

16.6 Introduction of Shuttle Bus System

The current system of public transport in the city center consists mainly of rickshaws and minibuses. The proposed project is based on the awareness that the increasing number of private vehicles in the country requires the programming of a structured public transport system in order to avoid the collapse of the fragile road network. A bus shuttle system that connects the main railway station to the Walled City should be the first pilot project in order to initiate a public transport system in Multan (Fig. 16.2).

The shuttle bus ensures a direct connection between the main arrival point of the city and the Walled City; the bus stops at the gates of the city to ensure a service for both residents and tourists who come to visit the old town, discover, and buy something to the ancient bazaar. To better integrate the new public service with the tourism development, the main cultural itineraries, analyzed in "*Studies and documentation on tourism*," begin from the shuttle bus stops. The map below ideally shows the catchment area of the proposed new public transport system. The catchment area has been identified within a 15-min walking distance from the public transport stops. The configuration of the proposed network can serve all the historic core of the city, where is located the main part of city mobility demand. The Walled City will then be totally accessible on foot (Fig. 16.3).

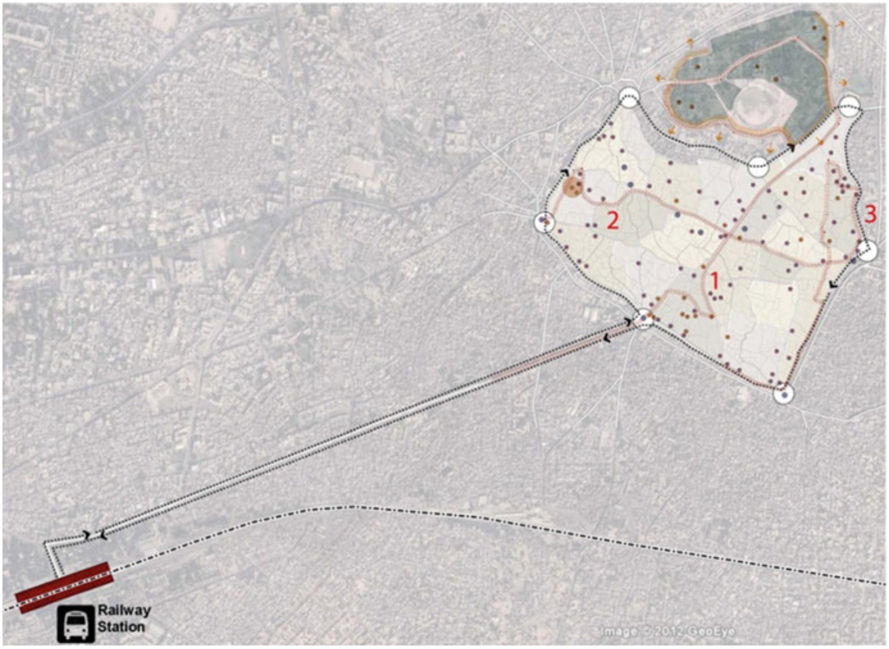


Fig. 16.2 Bus shuttle system proposed path

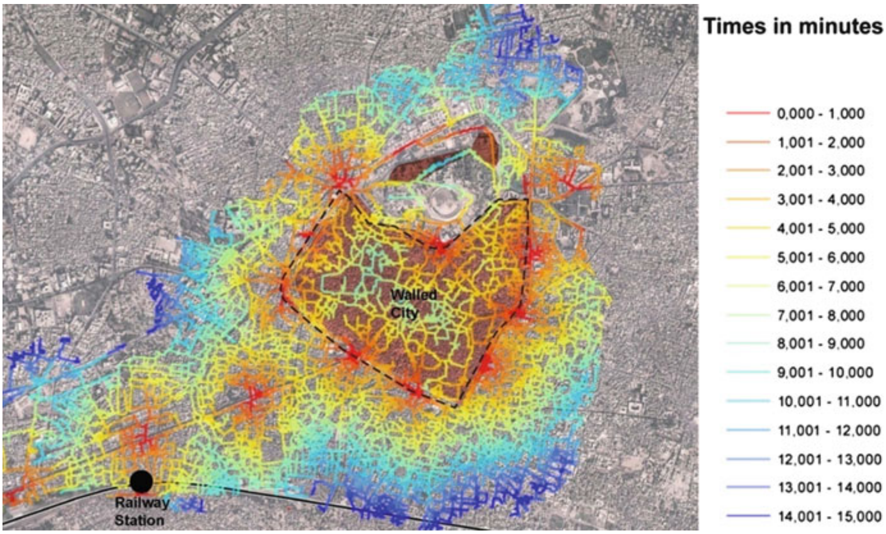


Fig. 16.3 Accessibility map analysis in 15 min by foot from each bus stop

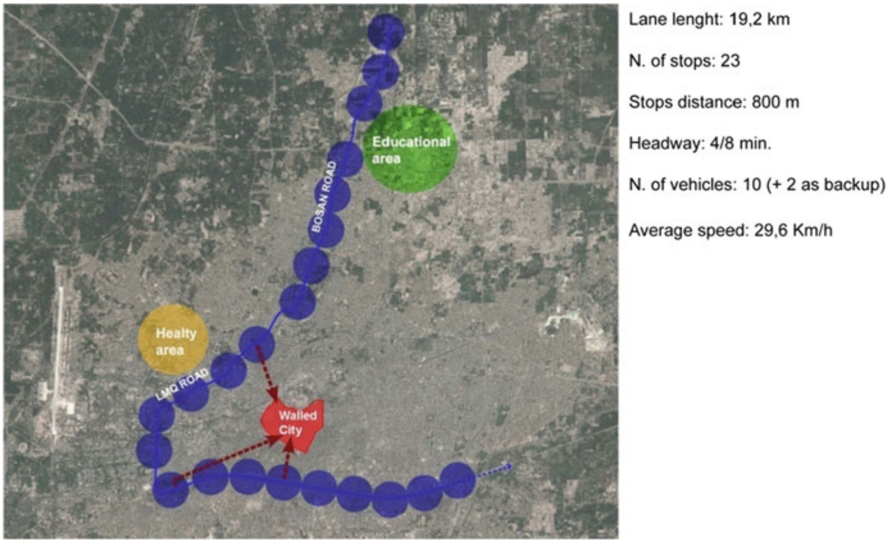


Fig. 16.4 Multan mass rapid transit system proposed path

16.6.1 Phase 2: Medium-Term Scenario

The implementation of a high-capacity transport system will lead to a series of direct and indirect improvements to the city center. The proposed MRT line will connect the education centers along Bosan road and continue along the "Inner Ring" road giving access to the hospital area. It will also connect to the main train station, after which the route will run alongside the actual railway line to reach the existing bus terminal in Vehari. In sum, the described line connects the main public functions with the major intermodal hubs for city inbound and outbound traffic (Fig. 16.4). The proximity of the MRT station to the city station will then allow for a direct link to the Walled City and the areas comprising hospitals, schools, and universities along the Bosan road. The direct connection to the bus terminal and railway station will help ensuring a high level of accessibility in relation to the main urban centers and facilitate the arrival of domestic tourists. The proposed reduction in pressure will result in a better quality of life and reduce air pollution. The transport system is similar to that currently underway in Lahore with the Mass Rapid Transit design revised and adapted to the city of Multan (Fig. 16.5).

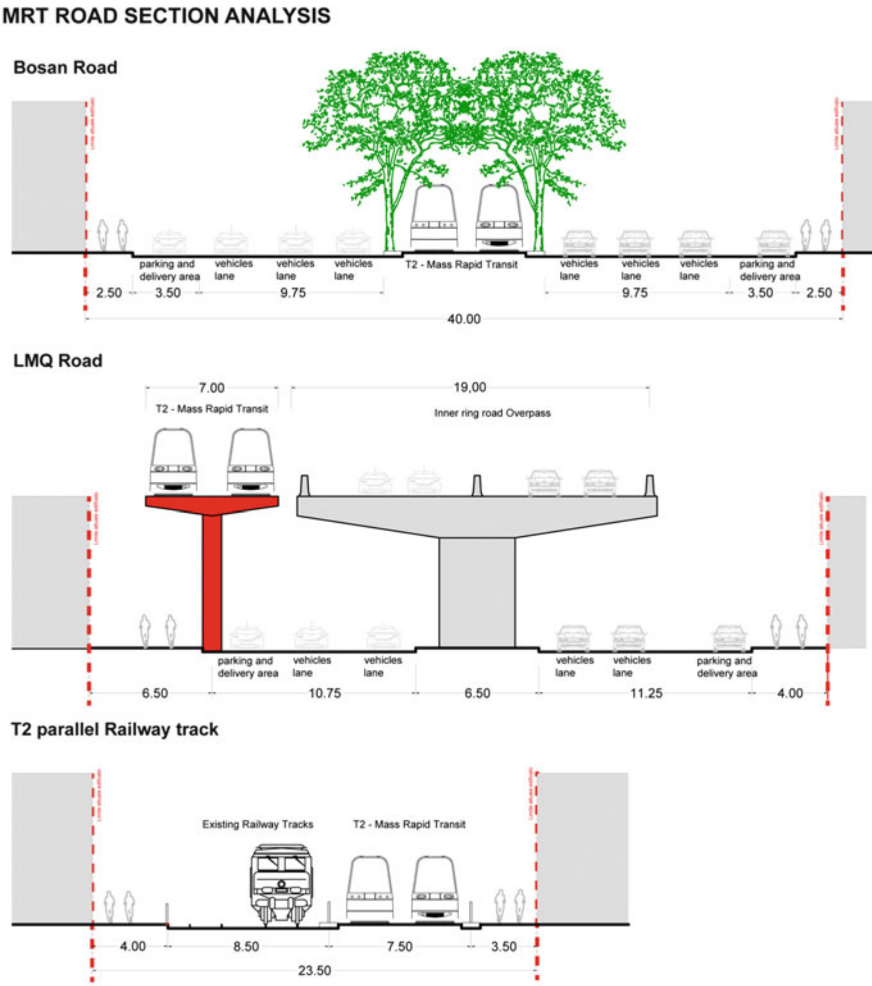
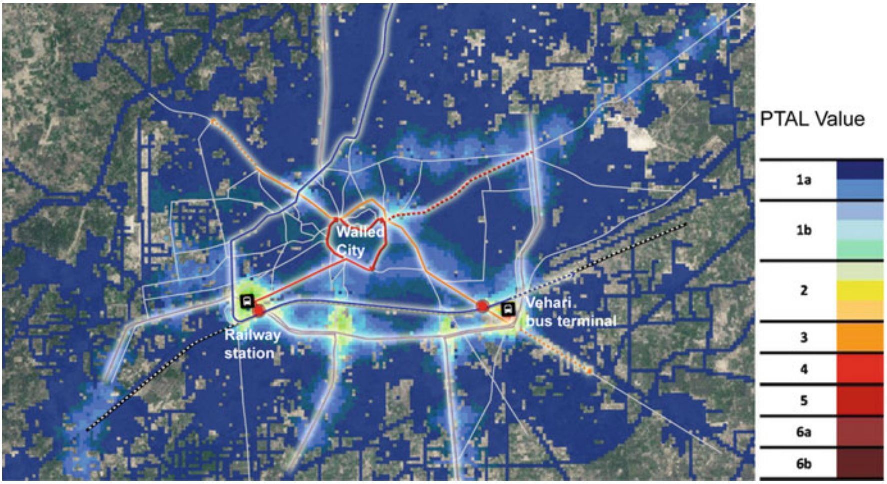


Fig. 16.5 MRTS road sections analysis

16.6.2 *Phase 3: Long-Term Scenario*

The new public transport network will be completed with the upgrade of the shuttle bus to a higher capacity lane that links the northwestern to the southeastern neighborhoods of the city. The new network is proposed as a support structure that contains three main lines on which a number of minor lines will rely ensuring widespread service throughout the urban area. The three main lines will be of a high capacity, capable of carrying from 18,000 to 25,000 passengers per hour on reserved tracks so as to ensure higher driving performance and commercial speed making it competitive with private vehicles.



Public transport accessibility level in Multan urban area in the proposal scenario

16.7 Mobility Index Analysis

To better understand the existing use and mode of travel in Multan, we analyzed the urban area using the PTAL method, which stands for public transport accessibility level. It is a method used in the main European transport planning departments to assess the access level of geographical areas to public transport. PTAL is a simple, easily calculated approach that hinges on the distance from any point to the nearest public transport stop and service frequency at those stops. The result is a grade from 1 to 6 (including subdivisions 1a, 1b, 6a, and 6b), where a PTAL of 1a indicates extremely poor access to the location by public transport and a PTAL of 6b indicates excellent access by public transport. The analysis shown in the PTAL 16.6 considers the public transport network as long-term proposed scenario.

The maximum PTAL level is in the vicinity of the main interchange point with PTAL 4 (main station and Vehari bus terminal), in the entire city center area PTAL is 3, and along the main public transport lines PTAL goes down to 2–3. If we compare it with the existing situation, the maximum level which is the area of the main station and bus terminal with value PTAL 2. Several studies have shown that if the supply of public transport is increased, a consequential reduction occurs in the use of private transport modes. The international database identifies a reduction of about 10–12 % in the use of cars, resulting in the increase of each single grade of a PTAL.

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Chapter 17
Guidelines for the Walled City of Multan: Knowledge, Conservation, and Relationship Ancient/New for a Sustainable Rehabilitation

Maurizio Boriani, Mariacristina Giambruno, and Sonia Pistidda

Abstract The buildings of the Walled City of Multan come from different historical ages with important examples of materials, traditional building types, and construction techniques. This is a great wealth but at the same time it raises several problems for the complex issues involved. In a such complex context, if we want to preserve the past as a foundation for the future, it is important to start a virtuous process through synergistic actions for the improvement of housing conditions. The guidelines don't consist of individual projects but in a real and operative approach method: a friendly tool but at the same time a technical guidebook addressed to different types of users (owners, specialized workers, and technicians) for different levels of intervention: maintenance, repairs, and restoration.

17.1 Guidelines Versus Handbook

The historic centers and the existing city are the result of complex stratifications occurred over time, and they are the evidence of the past and current human events. They are diachronic organisms, a kind of "beating hearth" where ages, periods, monuments, palaces, and buildings connected by deep relations with streets, squares, and open spaces are overlapped.

They reflect the identity of the community that lives there.

The historic city is made by the continuous juxtaposition between "the monument," the representative building, and the "simpler constructions," the common houses in which people live.

The monuments could not be so defined without the minor fabric around them.

We are talking about buildings formed by simple materials and techniques, often without decorative elements, but at the same time testimony of the material culture

M. Boriani (✉) • M. Giambruno • S. Pistidda
Department of Architecture and Urban Studies, Politecnico di Milano, Milan, Italy
e-mail: maurizio.boriani@polimi.it

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of a place. This heritage, extended as representative of an entire community and not of exceptional events, is certainly subjected every day to substantial changes or destruction.

These transformations, in most cases, come from the lack of understanding of the role of these buildings for the history of a community, often the result of wrong adjustments for the improvement of the life conditions. A collection of small transformations that, added one by one, hide the historic substance of these buildings. But if the monuments, for which we have more attention to their preservation, were the only survivors, could the city still be called that?

For these reasons, the widespread heritage should have the same attention, care, and respect reserved to the most famous and important buildings. It's important to allow their adjustment to the contemporary needs without losing their historic substance.

The inhabitants should become the first guardians of the buildings, should learn to read the importance for the community, and should be proud to transmit the history. But, the protection of so vast cultural heritage can't be imposed. It should be slowly achieved by sensitizing every inhabitant, helping them with a sort of "practice code" to make the necessary transformation in respect of the morphological and material characteristics.

These buildings are made of simple and poor parts that live in close relationship with each other and together constitute the uniqueness of each building. To preserve them, a handbook with always identical solutions is not necessary; on the contrary we need guidelines that can lead, through examples, indications, and virtuous suggestions, to recognize every building as an important legacy to pass on to future generations.

17.2 Goals and Structure of the Guidelines

The Guidelines want to suggest and guide designers and inhabitants to rehabilitation and valorization of the Walled City of Multan. The Walled City of Multan is made up of buildings from different historical ages. Some of them have a lot of interesting elements, and they are important examples of traditional building types; others don't have great interest and architectural quality.

The state of preservation of many historic buildings is, in many cases, precarious not only for the materials and structures but also for the hygienic-sanitary and housing conditions. The enhancement of the Walled City of Multan should provide synergistic actions for the conservation and rehabilitation of historic heritage and a general improvement of housing conditions. Therefore, it is necessary to address complex issues and problems:

- Recognize the architecture of the historic City of Multan
- Identify the decay phenomena and the sanitary conditions of the buildings

- Develop conservation plan and enhancement projects economically sustainable that are capable at the same time to achieve a high level of livability, to preserve the morphological and textural characteristics of the historic architecture, and to provide valorization works for the Walled City for the inhabitants and also for potential local and international tourist trails.

For this reason, the Guidelines are addressed to three different types of users: on the one hand, they can be extremely useful for monitoring changes in the Walled City by the administrative bodies; on the other hand, they can give indications to designers and artisans not always prepared for work on existing buildings with conservation and reuse project. At last, but not least, the Guidelines are addressed to the inhabitants to enable them to participate in the conservation of the place where they live, encouraging the knowledge of the specificity and uniqueness of the historic widespread buildings.

The setting of the Guidelines' structure is designed to achieve, first of all, the goal of knowledge and awareness of designers and inhabitants about the importance of the historic context in which they live. For this reason, the first part of the Guidelines is dedicated to the knowledge process of historic buildings. In fact, any restoration work of a building should be anticipated by careful studies in order to define the sizes, geometry, and materials and decay phenomena.

The study of the historic development and the transformations suffered by the building over time are essential to understand its present condition. The section includes information for performing the historical research, which documents should be found; the geometrical survey; and the materials and decay phenomena survey. These studies must be carried out by technical experts, such as architects and engineers.

The knowledge and awareness process goes through the description of locally available building materials, and the construction techniques characterize the historic buildings of the Walled City. This is essential to achieve proper conservation and reuse projects.

The knowledge and description of the materials historically used in the construction of buildings is followed by the glossary of *Materials decay and structural phenomena* observed in the historic buildings of the Walled City. This tool can be useful both to designers, engineers, and inhabitants to understand if their buildings are affected by serious phenomena that require urgent actions or by only superficial decays.

The following part *Best and bad practices* contains the best and bad practices for the conservation and the reuse of historic buildings. It is an immediate and simple tool, illustrated with the pictures of the major errors that can be made on the materials and architecture of historic buildings. The goal of this tool is to sensitize the inhabitants and to guide them to correct conservation and reuse interventions.

The *Technical sheets for maintenance, conservation and reuse works* is dedicated to the description of the main correct interventions for the conservation of the historic buildings of the Walled City. The data sheets describe the problems and give possible solutions through interventions step by step, explaining what are the problems and what people can do.

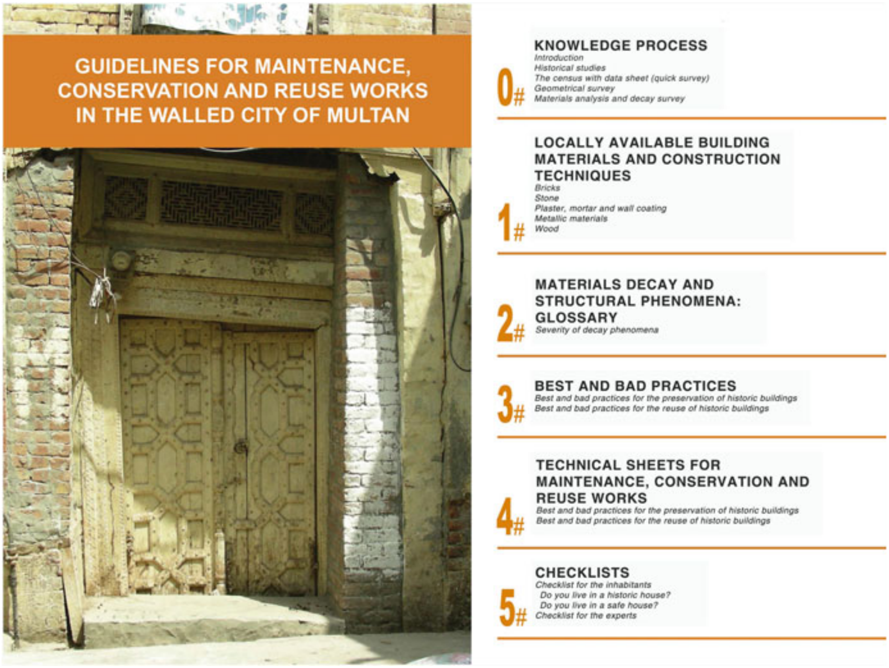

Fig. 17.1 Guidelines for maintenance, conservation, and reuse works in the Walled City of Multan: the structure of the book

The technical sheets don't want to be executive projects. In fact, it is not possible to establish in advance the interventions on punctual buildings without proper studies about the causes of decay. They are, instead, a guidance on appropriate practices to be implemented.

The interventions are described in a simple way and illustrated by drawings that show how to conduct the operations. The aim of the fact sheets is to give support for the restoration works, with simple and easy operations that can be made also by unskilled workers. The fact sheets also indicate which skills can perform the intervention: inhabitants, craftsmen, and experts (architect or engineers).

At the end of the Guidelines, some *Check lists* for technicians or inhabitants are designed. The first, through simple questions and illustrations, is dedicated to the inhabitants in order to verify if they live in a historic building: in this case it is necessary to follow the indications described in the Guidelines.

The second, divided in two different parts, one for the inhabitants, the other for the technicians, wants to help to recognize the risk of structural collapse that could involve the building.

The third, dedicated to the inhabitants, gives simple indications for the maintenance of the buildings, referring to the technical sheets for the specific interventions (Fig. 17.1).

17.3 The Knowledge as a Precondition for the Conservation: A Glossary of the Construction Elements and Decay Phenomena

A recovery for the Walled City of Multan, socially and economically sustainable, must necessarily start from a deep knowledge.

Conservation plans and valorization projects from one hand have the purpose to improve the level of livability for the inhabitants, but at the same time they have to preserve the morphological and textural character of the historic architecture. The synergy of these two actions is fundamental to ensure a proper balance between conservation of the local identity and necessary transformation with the improvement of living conditions.

To avoid this irreversible process is essential to sensitize users and designers in respect of morphological and material characteristics, and the first step is represented by the acknowledgment of the value of these elements. The role of the glossary of materials and decay phenomena (the Chaps. 2 and 3 of Guidelines) is intended to be just that: a valid help to recognize materials, construction techniques, and problems related to their conservation. The knowledge and the awareness of the value of the historic buildings is the first step towards their preservation.

The wealth of the Walled City of Multan is represented by buildings from different historical periods with important examples of traditional building types: to recognize them and to identify the main decay phenomena allow to develop correct and focused conservation plan and valorization project.

Each step of the survey campaigns (historical researches to understand the transformations over time, geometrical survey, material and decay phenomena survey) gives us important information about the present condition of the buildings.

The section of the Guidelines dedicated to "locally available building materials and construction techniques" describes the most important materials used in the Walled City of Multan: bricks, stones, plasters and mortars, wall coatings, finishes, metals, and woods. A first general description gives information as composition, characteristics, and techniques used for the assembling and preparation. A rich photographic collection helps the users, designers, and workers to recognize these elements through many examples; by this way also the inhabitants can recognize the feature of their home, and they can be actively involved in the conservation process. So, not only exceptional buildings (normally known as "monuments") become actors of this process but also all works created in the past, testimony of people and its daily life.

Preserve the "material" (and not the "image") means to respect the authenticity of the work. For this reason it is so important to know the characteristics of materials and their decay phenomena: in order to plan successful interventions for their conservation.

The Walled City of Multan is made mostly of bricks buildings, with various types and assembled in different ways: small bricks, large bricks, and small bricks with large brick patches, but the bricks elements are also used for openings, natural freshening system, and decorations. Instead, the buildings don't have a lot of structures or elements in stone; it is mostly used for decorative elements (the most diffused are sandstone, limestone, and marble). Then there are different kinds of plaster (air lime mortar, hydraulic lime mortar, plaster cast, mud mortar plaster) according to the type of mortar used (not hydraulic lime, fat lime putty, hydraulic lime, kankar lime, pozzolanic aggregate, and surkhi). The metals are mainly used in the structures and in the decoration elements (grid, parapet, doors).

The wood is another important material used in the architecture of Multan, in a lot of different ways: façade, windows, doors, ventilation system, balcony, decoration with rich typologies with different forms, dimension, and decorative characteristics. The material and decay survey and the structural survey permit to have a deep knowledge of the conservation status of the masonry. A first identification takes place with a visual analysis (with the support of drawings based on geometrical support): this permits to identify the forms of alteration and decay macroscopically recognizable. As reference, normally it used the lexicon ICOMOS_ISCS: illustrated glossary on stone deterioration patterns for ceramic material and ICOMOS principles of practice for the preservation of historic timber buildings for the wood.

A glossary of decay phenomena divided by levels of severity is essential to classify the buildings conditions and to identify priorities for actions.

Four categories are able to establish in a first analysis the state of preservation of the buildings: starting from no worse condition (staining, deposit, soiling, bleaching), to formation of secondary products (filling with cement mortar, efflorescence), progressively to loss of material (powdering, detachment, erosion, mechanical damage, missing part, hair crack) up to, in the most serious cases, reduction of the structural strength (crack, fracture). Also for the wood elements are established four categories: the first includes wood defects (as knot, slope of grain, shrinkage) and the other three decay phenomena (no worse condition, loss of material, and reduction of the structural strength).

In this section of the Guidelines, with the help of photography collection, the users and designers are able to recognize the problems that affect the buildings and to identify their level of severity, getting all the important tools for a correct conservation project. The most problems observed in the Walled City of Multan are connected to various kinds of deposits resulting from pollution and by the presence of water from different ways. The pollutants in the atmosphere, interacting with water and porous materials, induce mechanisms of alteration that lead to a deep erosion of plasters and bricks with phenomena as disgregation, loss of parts, and erosion of the joints.

The main problems concern the detachment of layers (that lead to the loss of many plasters and finishes) and the use of incompatible cement mortar for maintenance interventions that stops the transpiration of the masonry consequently producing other problems (efflorescence, powdering, erosion, and so on). Another big problem concerns the general instability of the buildings, with consequent acceleration of the problems, not only at a surface level but also static: mechanical damage, missing parts, cracks, and out of plumb are all alerts of more serious problems (Figs. 17.2, 17.3, and 17.4).

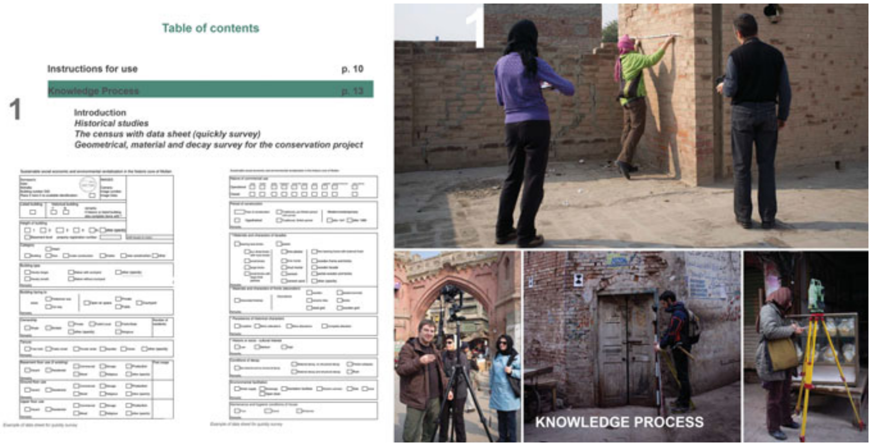

Fig. 17.2 The knowledge process with an example of data sheets for quickly survey

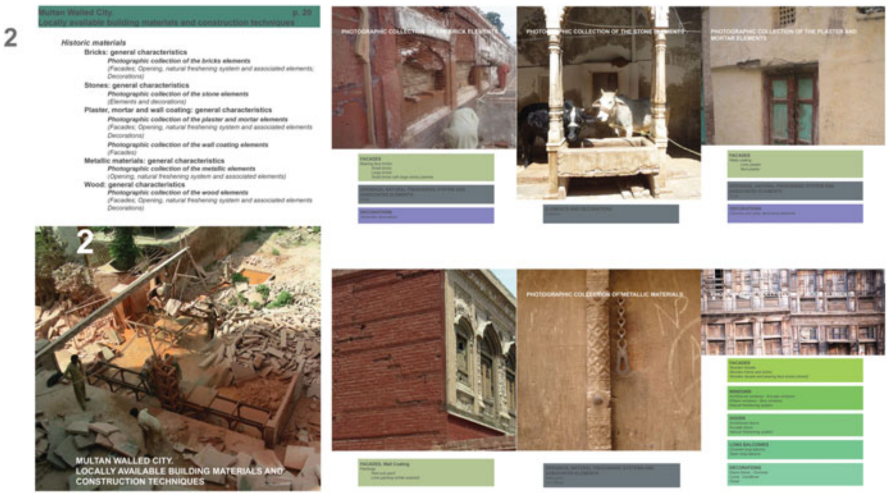

Fig. 17.3 The locally available building materials and construction techniques: list and photographic collection of the elements

17.4 Guidelines, Operational Tools: Best and Bad Practices, the Technical Fact Sheets, and the Check List

The Guidelines, in order to be efficient and of rapid application, need simple, immediate, and friendly tools to sensitize the inhabitants and to guide them to correct conservation and reuse works.

Fig. 17.4 Glossary of materials decay and structural phenomena. Definition of the severity of decay phenomena

They are organized in three levels of help: from one hand a section dedicated to *Best and bad practices* that contains a list of accepted and not recommended interventions for the conservation and the reuse of historic buildings; the *Technical fact sheets* with a description step by step of the main correct interventions; and finally the *Check list*, a simple tool for preliminary verification.

The tool *Best and bad practices* for the preservation of historic buildings wants to illustrate, with a rich photography collection, the main errors that are commonly made in the interventions on historic buildings.

Starting from general standards, the goal is to put the attention on materials and historic characters (finishes, construction techniques, and so on) that will be retained and preserved as examples of material culture and, on the other side, practices that will be absolutely avoided, as replacement and alterations. The general standards contain a real method declaration: recognition of the value of historic elements to be preserved, the evaluation of existing conditions in order to plan appropriate interventions, the development of conservation and consolidation projects to stop the deterioration, and the design of new uses compatible with the existing one.

A list of YES and NO establishes the recommended interventions and the actions to be avoided to guarantee the preservation of historic building elements as masonry, interior features, and decorative elements, always favoring the repair rather than the replace, allowed only if the decay is irreversible. The list of NO contains practices that normally are performed without a real knowledge of the effects as total replacement, filling with cement mortar, use of improper and dangerous techniques, and removal of part that could be repaired.

The best and bad practices are developed with the system YES/NO for the main building materials: bricks, stones, plasters, mortars, coatings, irons, and wood.

Specific suggestions are provided to realize better interventions on each material as use of proper consolidants for the bricks erosion, the removal of salts, the use of light cleaning for the stones, the use of compatible mortars for the plasters, the use of paints based on natural lime, the use of proper paint systems for the protection of iron elements, and the specific treatments for the wood. The last part of best and bad practices is dedicated to the reuse of historic buildings. In this section every issue related to the reuse is described by YES and NO, with special attention to concepts such as compatibility, not invasiveness and recognizability of new interventions in relation to the existing buildings.

This kind of approach is declined to different aspects: the distribution of the interiors which should be compatible with the historic and planimetrical features (therefore it's not possible to place new functions that involve the demolition of walls, floors, and so on), the rules to be followed in case of additional parts, and suggestions for cooling systems, for systems as drainage and electrical. Some simulations made with the help of pictures show before and after some examples of best and bad practices.

The tool *Technical sheets* for maintenance, conservation, and reuse works wants to be an operative support to different kinds of users: inhabitants, craftsmen, and experts (architects or engineers), in relation to different type of interventions. The

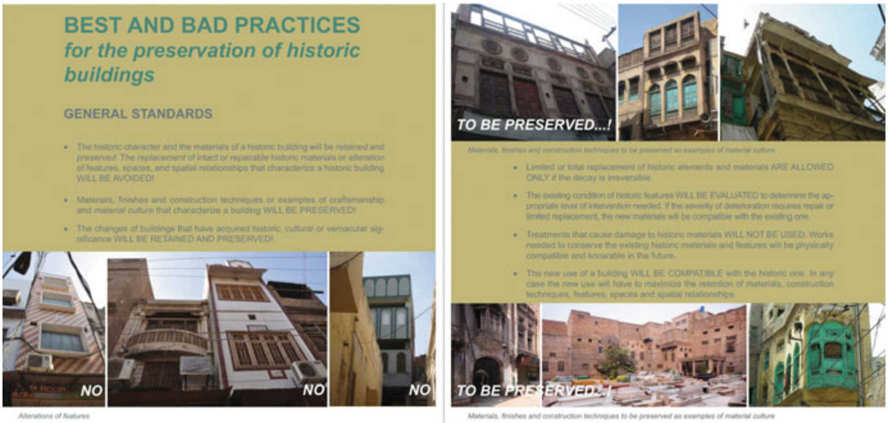

Fig. 17.5 Best and bad practices for the preservation of historic buildings: general standards

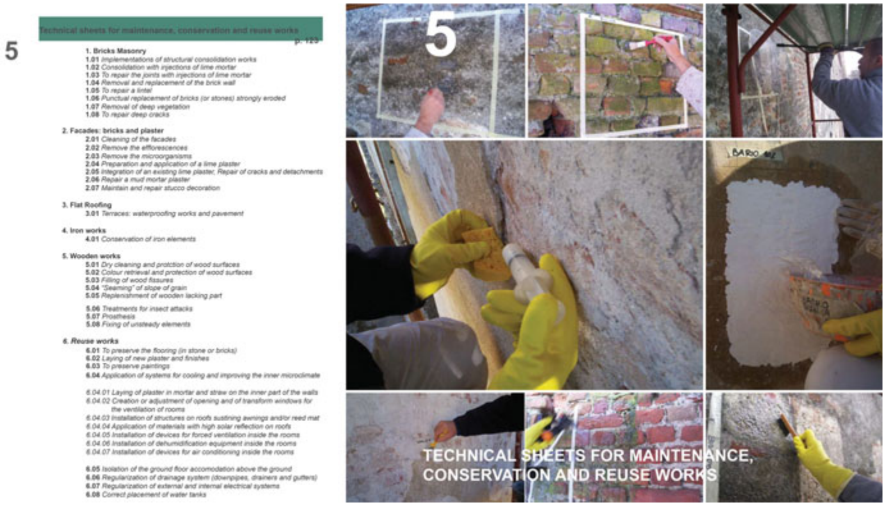

Fig. 17.6 Technical sheets for maintenance, conservation, and reuse works: list of the interventions

goal is to give support for the restoration works, describing easy operations that can be made also by unskilled workers. The data sheets describe the problems and give solutions to be carried out easily, clearly explained step by step with the help of simple drawings that show how to perform the operations, also with the indication of the skills that can perform the works. The data sheets are divided for elements: bricks masonry; facades: bricks and plasters; flat roofing; iron works; wood elements; and guidelines for the reuse. A first part of the data sheet includes the implementation of structural consolidation works with a guide to read the cracks'

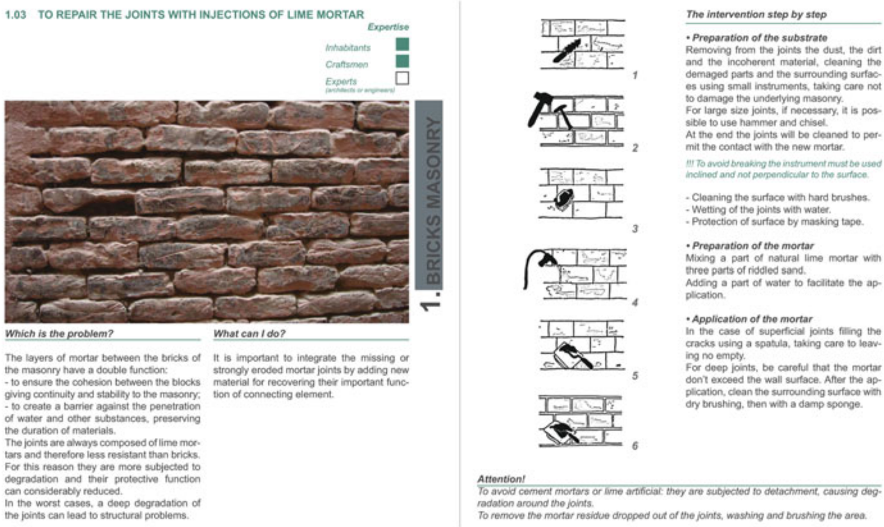

Fig. 17.7 Example of technical fact sheet for the intervention on bricks masonry: repair the joints with injections of lime mortar

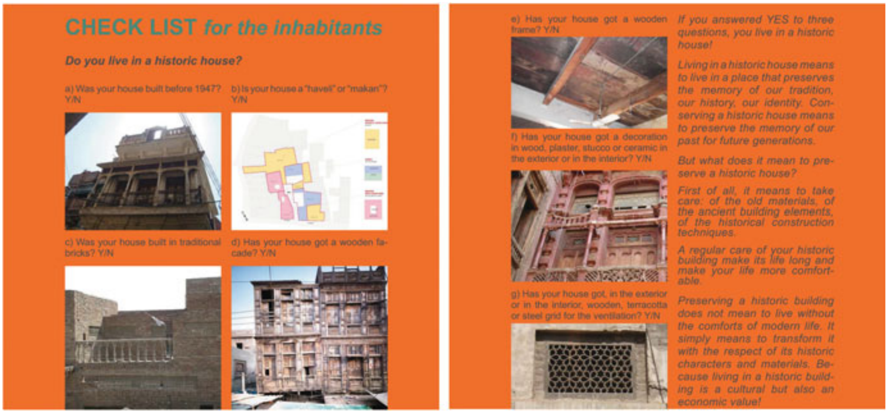

Fig. 17.8 The check list tool to sensitize the inhabitants to recognize their heritage

pattern. Three different kinds of instabilities can be identified: observing the effects, it is possible to try to identify the causes with the help of a pattern and drawings that describe the relation between causes and effects.

The last tool consists of five *Check lists:* four for the inhabitants and one for the experts. By the first, answering to simple questions, the inhabitants can verify if they live in a historic house: a short description put the attention on what it means to live in a place that preserves the memory of their tradition, history, and identity. In this case, the inhabitants should follow the indications described in the Guidelines.

From here the importance of conserving the historic buildings is to preserve the memory of our past for future generations. The second check list is divided into two parts, one dedicated to the inhabitants and one for the technicians to establish if they live in a safety house. A guided step helps to recognize the risk of structural collapse starting from a visual inspection. A specific check for the experts helps to verify the level of security through indicators of vulnerability. The last two check lists concern the wood and masonry structure, giving simple indications for the maintenance, referring to the technical sheets for the specific interventions (Figs. 17.5, 17.6, 17.7, and 17.8)

17.5 Multan as the Opportunity to Test the Guidelines: The Results of a Practical Experience

Since the first surveys in the Walled City of Multan, we realized that we were facing with a very complex reality but also that the real wealth of the city was just in its stratification and in its rich variety of materials and construction techniques. So, from the beginning, we have been persuaded that the project would preserve this great complexity. But at the same time, we realized that also the problems were not just a few and from different level.

From one hand there are large-scale problems such as lack of proper sanitation and high water and air pollution.

There are problems related to interventions carried out without a general project as electrical installations arranged randomly, not designing air condition systems, the intricate system of curtains that cover the fronts of historic buildings.

There are problems related to materials decay not only for natural deterioration and absence of maintenance but also for the execution of wrong interventions. And there are problems connected to the relationship between existing buildings and new projects as the elevation, parts added, and construction of new buildings in the historic centre.

The historic city now contains a necessary duality related to the use and transformation of the places and to the conservation of its identity: the project has to combine these two needs.

To manage this complexity in a right way, an urban regeneration process has to start from the main users of the city: the inhabitants. In a such difficult context, where different levels of problems impose choices easily feasible, the possibility to realize the works in self-made represents a great opportunity: economic, easy to implement, and capable of activating a process of regeneration in short times. This is the challenge of these Guidelines.

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Advice The article is the result of the joint discussion of all authors; the individual parts have been edited as follows: the section "Guidelines Versus Handbook"by Maurizio Boriani and Mariacristina Giambruno; the section "Goals and Structure of the Guidelines" by Maurizio Boriani and Mariacristina Giambruno; the section "The Knowledge as a Precondition for the Conservation: A Glossary of the Construction Elements and Decay Phenomena" by Sonia Pistidda; the section "Guidelines, Operational Tools: Best and Bad Practices, the Technical Fact Sheets, and the Check List" by Mariacristina Giambruno and Sonia Pistidda; and the section "Multan as the Opportunity to Test the Guidelines: The Results of a Practical Experience" by Sonia Pistidda.

Chapter 18
Conservation Actions for Wooden Building Elements in Multan

Francesco Augelli, Roberta Mastropirro, Letizia Ronchi, and Christian Amigoni

18.1 Wooden Elements in the Walled City of Multan

Francesco Augelli and Roberta Mastropirro

Abstract. In the guidelines for maintenance, conservation, and reuse in the Walled City of Multan, there are also the descriptions of the wooden elements, their decay, and structural phenomena, the best practices and bad practices for the preservation, and a technical sheet for interventions for wooden elements.

Throughout the Walled City many wooden elements in the building can be seen. This material is also used in structural elements of the building. It is not unusual to see continuous street facades of pure timber curtain walling with vertically sliding shutters. These shutters are used both externally for climate control and as partitions for interior spaces.

The facades of buildings can be characterized by different and important wooden architectural elements. In the glossary of materials, the wood elements are divided into these categories and the categories are further subdivided to explain the differences and varieties of these elements. The elements present different types of decay or defects, so the guidelines provide a glossary of these phenomena. Every defect or decay is described and illustrated.

The best practices and bad practices for intervention with wooden elements are explained and the rules and method of inspecting wooden structures are described. In addition, the principal interventions are organized and explained in the technical sheet, where problems are identified along with their corresponding solutions. The phases of intervention are described in a step-by-step manner with accompanying drawings and important prescriptions are highlighted.

F. Augelli (✉) • R. Mastropirro • L. Ronchi
Department of Architecture and Urban Studies, Politecnico di Milano, Milan, Italy
e-mail: francesco.augelli@polimi.it

C. Amigoni
Amigoni's Engineering Studio, Lecco, Italy

A. Del Bo and D.F. Bignami (eds.), *Sustainable Social, Economic and Environmental Revitalization in Multan City*, Research for Development,
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Finally, the guidelines present a checklist for the inhabitants titled, "Has Your Home a Wood Structure?" This document can help inhabitants to recognize the principal problems of the wooden elements and structures.

18.1.1 Wooden Elements

Wood is an important material used in the historical architecture in Multan. There are many local timber trees used in the architecture, with different characteristics and uses. The most important types of wood are *shisham, tali or sissu*, mango, *babul,* and teak (*Tectona grandis*), famous for its durability.

The buildings of the Walled City are characterized by many wooden architectural elements that comprise the facades. In the glossary of materials, the wood elements are divided into the following categories: facade, windows, doors, transom (ventilation system), balcony, and decoration. These single categories are further subdivided into other classes to explain the difference and variety of these elements.

Facades include wooden façade, wooden frame and bricks, and wooden facade and bearing face bricks (mixed). Generally, buildings with a wooden facade are characterized by the presence on the ground floor of brick masonry and by the exclusive use of wood material for the other floors.

The wooden facades are made of wooden frames, the ends of which are often tenon-mortise jointed, within which there are provided seats for the insertion of thin wooden panels. Sometimes, the wood does not show traces of finish. In other cases, it is possible to see a façade with a wooden frame and bricks, where the masonry of bricks are slim horizontal elements inside of containment (bracing) in wood.

There are also mixed systems characterized by a wooden facade and bearing face bricks; for example, a bearing face brick structure with large wooden windows crowned by a decorated wooden cap. In the majority of buildings, it is possible to observe wooden windows that characterize the facade.

There are different window typologies with different forms, dimensions, and decorative characteristics: architraved windows (divided in single, twin, and multiple wooden windows), arcuate windows (round arch, pointed arch, etc., divided in single, twin, and multiple wooden windows), ribbon wooden windows, and wooden bow windows (square shape, polygonal shape, etc.). Generally, traditional windows don't hold any glass but are sometimes decorated with frames and bevels that can be embellished with patterns in the wood.

Sometimes, the compartment of the window is characterized by the presence of a low parapet consisting of a handrail supported by turned columns or by elements with other design. Many types of parapets can be observed: full, grid, small column, and mixed elements parapets.

Traditional building entrances are characterized by wooden doors that are sometimes decorated with different patterns. Most doors have two shutters and the most important entrance also has a decorated frame and is sometimes set in a wooden portal. Doors are subdivided as architraved doors and arcuate doors.

Windows and doors often have at the top a sort of transom with different forms and dimensions. This element often is a wooden or metal grid and is an optimal system of ventilation and a natural freshening system for the interior space.

Some building facades have a long wooden balcony; this element is sometimes used for the distribution of the interior local. These balconies also allow one to admire the interior courtyard of the house from a higher floor. In such cases, the balcony can be served by a staircase and permit the entrance to the room at the superior floor. Long wooden balconies are divided into open long balconies and closed long balconies and present parapets with full windows, grid elements, or small columns.

The facades present a number of wooden decorations that can be divided as follows: door frames, cornices, cyma, cantilevers, and wooden portals. Some building facades have different element to embellish the architecture. In many cases, the top of the building or of the bow windows are decorated with wooden cyma and the projection of the façade is supported by a decorated cantilever. Important doors are characterized by a decorated frame. In all these cases, it is possible to admire different designs in the decorations, geometrical and floral, created through refined manual techniques.

18.1.2 Decay and Interventions

The work guidelines identify the different types of decay and defects of the wooden elements and explain these phenomena with a definition and pictures. Wood defects include knots, slope of grain, and shrinkage. The severity of wood decay is noted with the following categories: no worse conditions (patina, change in color, deposit, incongruous elements), loss of material (painting detachment, lacuna, missing part, wood erosion, rot, insects attack), and reduction of the structural strength (instability/disconnection).

The work guidelines attempt to lay the best practices and bad practices for the preservation of wooden elements. Some principals and step-by-step instructions are provided for dry cleaning and protection of wood surfaces, color retrieval and protection of wood surfaces, filling of wood fissures, “seaming” of slope of grain, replenishment of lacking wooden parts, treatments for insect attacks, prosthesis, and fixing of unsteady elements.

For the inhabitants, a list of some bad practices is provided and some steps for a preliminary analysis of wooden structures are provided to help in the understanding of the major problems found in the wooden elements (Figs. 18.1, 18.2, 18.3, and 18.4).

Fig. 18.1 Wooden facade

18.2 A Traditional Wooden House in the Center of Multan: Surveys and Diagnostics

Roberta Mastropirro and Letizia Ronchi

Abstract. The wooden house that is the subject of this discussion is located inside the historical city center of Multan, near the Haram Gate, on the right-hand side of Haram Street Bazaar. There is no historical knowledge about this house. From oral information obtained from the inhabitants, it seems that this building is about 150 years old. It was lived in until 1984, when some maintenance was done, as is detailed in a plaque in cement mortar that is engraved above the entrance located on the back of the house.

This traditional building of great historical and architectural interest is the subject of work that started with an architectural and materials survey and continued with a decay survey to complete the fact-finding inquiry that made it possible to draft the conservation project.

The architectural measurements are based on a laser-scanner survey. For the integration of the vertical and horizontal profiles, all the detail measurements necessary for the restitution of the 1:50 scale drawings were taken by means of a laser distance measurer and traditional measuring rulers.

The architectural survey was essential for the development of the material and decay surveys. The house is the last of a long and uninterrupted building curtain and is bordered by similar construction on one side and by a back alley on the other side.

Fig. 18.2 Wooden frame and bricks

The building consists of three floors plus a roof level. The plan of the house is trapezoidal. Looking onto the Haram Street Bazaar, the facade is entirely made of wood with numerous openings protected by shutters. The rest of the building is made of thin walls of bricks inside of which slim horizontal wooden elements of containment were inserted for aseismic purposes.

Fig. 18.3 Wooden window

On the ground floor facing Haram Street Bazaar there are two shops. On the back side, a lane disengages other shops and houses. Access to the wooden house is now possible only from the back lane, through a small door that opens to a restricted hallway where narrow stairs lead to upper floors.

The first floor consists only of one room as does the second floor, where on the south wall there is a fireplace.

The building is in a bad state of conservation. Lack of maintenance has allowed rain to leak in, especially on the second floor, where some of the plaster and the wooden floor are compromised. Considerable damage is also visible on the wooden wall of the facade. Lesions on the brick walls and disconnections of the bearing wooden elements have been determined to be in an extremely critical situation from the structural point of view.

18.2.1 Construction Techniques and Materials

The building consists of three floors plus a roof level and measures 10.5 m in height. On the south side of the house, facing the back lane, the square body of the staircase is annexed to the principal body, which has a trapezoidal shape. The front is on the main street, the Haram Bazaar Street, and is 4 m wide. It is characterized by the presence, on the ground floor, of two shops (one in use, the other unused) closed off by two rolling iron shutters. The ground floor was difficult to inspect because it was hard to obtain access.

Fig. 18.4 Wooden door

The facade on first and second floor is characterized by the exclusive use of wood and is made of wooden frames, consisting of elements connected by means of tenon-mortise joints. Each side of the elements shows seats for the insertion of thin wooden panels, about 1 cm thick.

The wooden front does not show traces of finishing. The material widely used for bracings, beams, shutters is a conifer, spruce, most likely *Abies alba*. Other elements like windows and parapets are made of *Dalbergia sissoo* (*Shisham*).

The building roof is flat and the system of horizontal elements of the three levels (first, second, and terrace) is formed by floors supported by wooden beams. The intrados is coated with wooden planks to create a false ceiling.

The remainder of the building is made of brick with the insertion of slim wooden horizontal elements for aseismic purposes. The floors are made of wrought-cement mortar.

We believe that the exterior masonry walls were once plastered, although at present only traces of plaster can be detected on the back-lane facade. The walls of the inside are all plastered, although degradation has compromised large portions of the coating. The mortar used for the plaster is made of fine sand (apparently of hollow and therefore earthy) and lime. This does not exclude the presence of gypsum. The plaster of the interior still shows a white paint made of milk of lime.

The building does not have glass windows. Openings are protected by shutters, frames, and bevels that, on the first floor, facing the road, are embellished with diamond patterns carved from wood.

The openings at the first and second floor looking onto the Haram Street Bazaar show three different compartments: the upper compartment is closed by fixed wooden panels, the medium compartment consists of shutters opening toward the interior, and the bottom compartment is characterized by the presence of a low parapet consisting of a handrail supported by turned columns.

On the south wall of the second floor there still exists a fireplace decorated with rich mouldings, whereas on the first floor the former fireplace has been filled in with bricks.

18.2.2 Decay

At a first observation of the street facade, a marked out of sheer in the north direction is immediately evident. The wooden facade shows a diffuse discoloration caused by exposure to solar radiation, and a diffuse surface erosion caused by runoff. The areas that are not affected by leaching are blackened (coated) by the action of ultraviolet (UV) and infrared (IR) components of solar radiation. Phenomena of aggression by roots of fungi were observed in a few limited points. Extreme changes of temperature and of moisture and exposure to the atmosphere in the absence of protective treatments have caused meso and micro cracks on all the wooden components

The interior side of all the components of the wooden facade is completely darkened. We cannot exclude that the darkening has been caused by the oxidation of oil-based protective treatments.

The wood-wood and the wood-masonry assemblies often reveal situations of precariousness and instability. Some closure elements (shutters) or panels are missing, especially on the second floor. All systems of rotation and fastening of shutters and doors are inefficient due to the deformation of wood and lack of maintenance.

The deterioration of the screed of the terrace coverage does not guarantee the waterproofing of the floor. As a consequence of this, the intrados of the second floor shows spots of infiltration, particularly in the southeast corner. An advanced deterioration of the plaster and of the bricks was observed in this corner, on both the first and second floors, where gaps and deficiencies, phenomena of efflorescence and erosion, are widely present.

The presence of the false ceiling prevented investigation of the conditions of degradation and reliability of the structures of the floors. No attacks by boring insects were observed on the inspected wooden components. Only one attack, likely by termites, was detected in a joist of containment in the masonry of the stairwell.

The paving of mortar screed of the two floors is cracked, highly disjointed, and out of plane. The most severe degradation was observed on the brick walls due to the thinness of the partition that is equivalent to the head of a brick, the extension in height, and numerous openings. Moreover, the absence of external plaster is worsening the decay process because the leaching of the mortar joints produces frequent misalignments and lesions with predominant displacement toward the north (Figs. 18.5, 18.6, and 18.7).

18.3 A Traditional Wooden House in the Center of Multan: Conservation, Consolidation, and Reuse Design

Francesco Augelli and Christian Amigoni

Abstract. The reuse design provides for the wooden house in the Haram Bazaar Street to function as a museum, an example of a typical old home in Multan. To this end, actions were planned for structural consolidation and conservation. The project includes operations necessary for the safety of the building, which was in a serious condition of structural instability with a strong inclination toward the north. The project also includes conservation intervention of materials and reuse design.

18.3.1 Consolidation Design

The structure of the building is very slim, made by masonry composed of 10-cm-wide tile bricks. An analysis of the current situation, examined by a push-over model, has confirmed the inadequate seismic resistance, connected with the combination of bending moment and axial compression. The model also showed remarkable deformation under horizontal forces, more than 10 cm.

Fig. 18.5 Facade on the Haram Street Bazaar

The philosophy of the consolidation project was to be flexible, light, and removable in case modification of the building was required. The poor quality of the masonry pointed to the necessity of a new structure that could bear the weight of the floors and, at the same time, could hold up to the horizontal forces generated by a potential earthquake. That new structure, more rigid than the masonry, must activate before the structural failure of the existing structure.

An important focus of the project is the design of the connections between the floors and the timber structure, made by steel bolts and screw jointed with He-type steel beams.

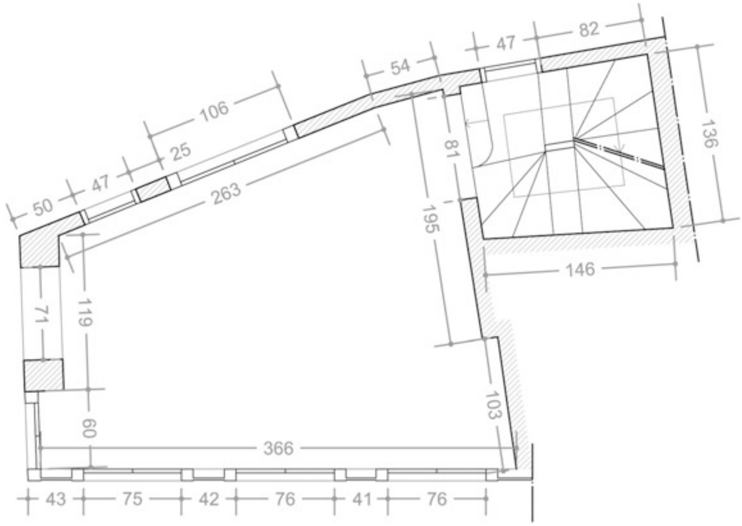

Fig. 18.6 Architectural survey—plan of the first floor

The material chosen for the strengthening structure is teak wood. The columns and the beams will be placed partly inside and partly outside the walls; in the displacement of the new elements, the structure is hidden from the main street of the Bazaar, and, in addition, is partly hidden inside the building.

The horizontal strength is mainly provided by some wind bracing, made by stainless steel strands and turnbuckles, that joint the timber columns. Those steel elements are taken from nautical engineering in order to provide great resistance and durability.

The building site was kept in mind in planning the work in several phases. This can be seen in the design of the steel junctions, designed as a ready-made framework that can be placed on site and fixed by steel bolts and screws (Fig. 18.8).

The definitive structural scheme, such as the precise position of the columns and the beams, was chosen after much reflection about the shape of the existing building, about the on-site work, and finally the seismic analysis made by WinStrand, a finite elements software made by EnExSys Company (Fig. 18.9).

The new concrete slabs, made from lightweight concrete, are designed to reinforce the floors and joint all the parts of the building like a rigid box. That purpose was determined by the seismic model, which was also used to analyze the seismic deformations connected to the different positioning of the columns and the wind bracing. The main purpose was to prevent twisting movements, bringing the center of rigidity near the center of mass.

The support of the timber structure is provided by steel joints connected under the base of the pillars, connected by steel screws, hidden from the rain. These connections, supported by the concrete foundations, can separate the timber parts

Fig. 18.7 Material survey—facade on the Haram Street Bazaar

from the soil, preserving them from soil humidity and preventing unwanted rapid deterioration.

18.3.2 Conservation and Reuse Design

As part of the conservation design, the wooden parts will undergo dry cleaning of all surfaces to avoid further damage. The areas lightened by being washed away with rain water will be replenished by the application of pigmented primer of the same color as the patinated areas.

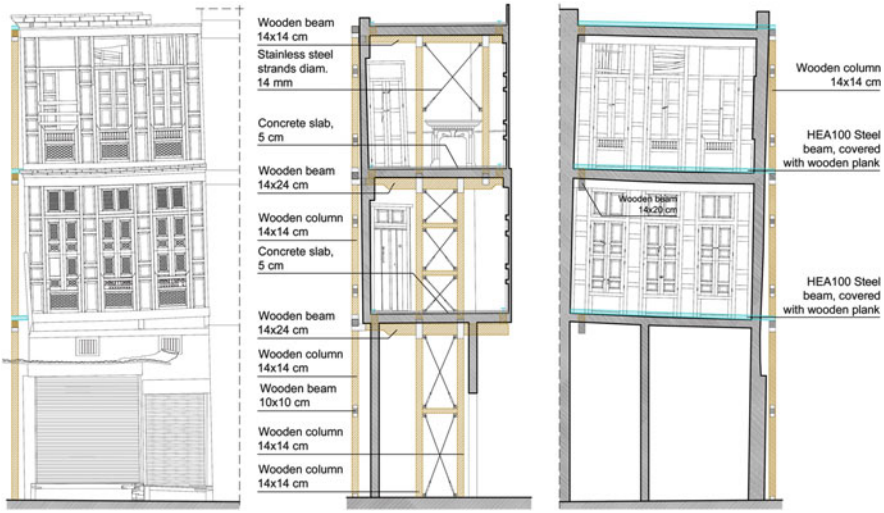

Fig. 18.8 Consolidation intervention general design: main front and sections

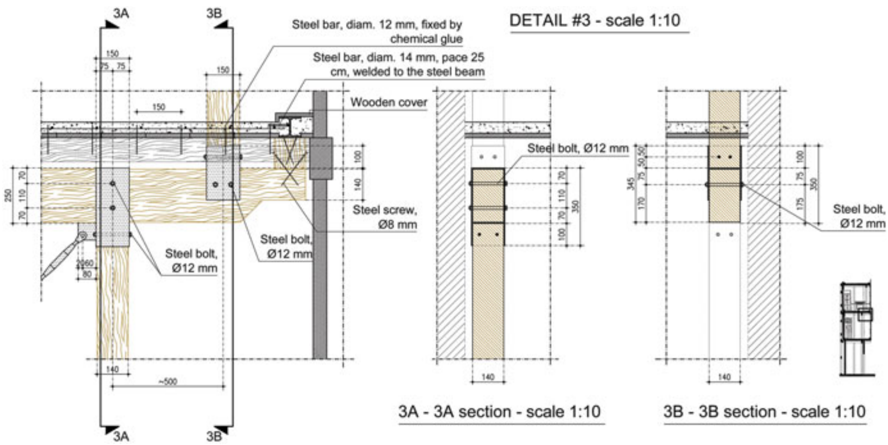

Fig. 18.9 Details of consolidation interventions

Incongruous elements will be removed, unstable parts will be mounted by steel screws, the seam of slope of grain on the structural elements, and discontinuities will be grouted with a filler capable of withstanding the thermal stresses to which the building is subjected. In addition, required integrations of missing elements will be reproduced in wood dimensionally on the basis of existing work. The final intervention on all wooden components will provide a transparent protective coating and that is not film forming.

The wires that run in a disorderly manner along the front will be checked and those that are still working will be collected in a single PVC conduit anchored to the bottom of the overhanging wooden facade and hidden by a wooden frame carved out to hold the gutter.

For masonry facades, cleaning by brushing will be performed with subsequent application of new plaster made of lime in order to impart greater strength, increased insulation, and to protect the thin walls. We opted for a mortar made of lime, sand, and straw. The plaster must be smoothed and then painted with milk of lime. Weaknesses in the internal plasters will be replenished with lime mortar similar to the existing one. All of the inside walls of masonry, after cleaning and localized consolidation, will be painted with milk of lime.

The paving of the ground floor, first floor, second floor, and terrace, all in concrete that is extremely degraded, will be removed and replaced, after having done interventions of structural consolidation, with a lightweight screed made from lime and brick dust. The remake of the substrate will also allow to placement in the underfloor of a few technical systems provided in the reuse design. The paving of the terrace will restore a suitable slope toward the single drainpipe present, and that will be replaced with a copper drainpipe of suitable diameter.

Reuse provides, as mentioned, the setting of a traditional house in Multan. The current entrance to the house from the alley does not allow adequate signage or a suitable location. Therefore, access will be through the unused store on the Haram Bazaar street. The former shop, the gate of which will be replaced with a wooden door and glass, will become the new access to the museum house and can be set up as a ticket office and information point for the distribution of maps for tours of the city. This new entrance leads to back and to the stairs leading to first floor.

The first floor will be set up as a room with large pillows on the floor and rugs on both floors and walls; there will also be a bedroom with traditional wooden beds and network of braided cords. The terrace will be made safe for visitors to view the city and the bazaar from above. To make the terrace available, in addition to actions already described, we will provide it with a wooden railing. The interiors will be equipped with a LED lighting system and power outlets on all floors in sufficient number to ensure the supply of a vacuum cleaner for the regular cleaning and maintenance of the rooms and, in general, of the building. The electricity supply system will be self-sufficient with a photovoltaic system located at the landing of the staircase on the terrace, in such a way as to also create shelter from water in case of rain inundating the stairs. For lighting, floor lamps will be powered from a switched outlet.

The shop on the ground floor will be maintained. The crumbling wooden platform at the level of the street will be replaced with a new wooden platform and the canopy of corrugated iron will be replaced with a corrugated sheet of transparent fiberglass. For control against possible attack by termites, we provided for the placement of five baits on the wall (two on the ground floor and one on each floor, including the terrace), which must be periodically (every month) checked and maintained (Figs. 18.10 and 18.11).

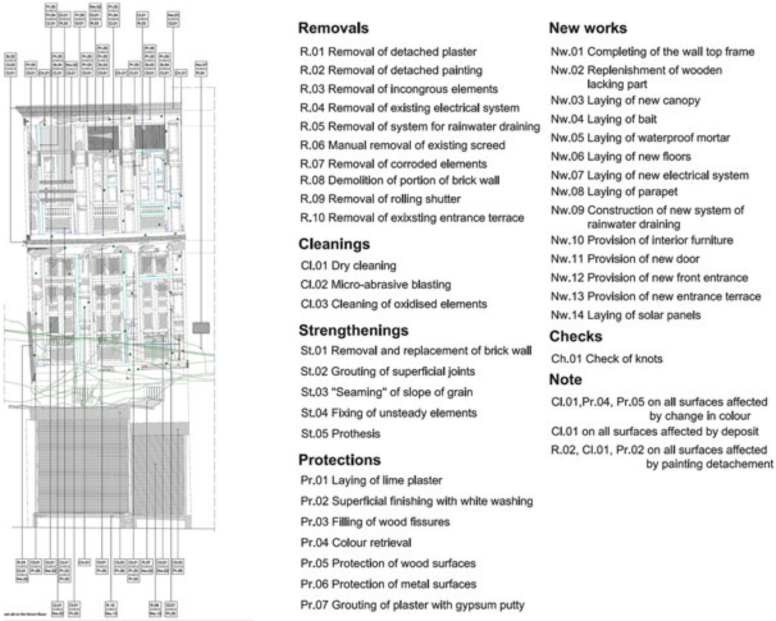

Fig. 18.10 General conservation design of the facades

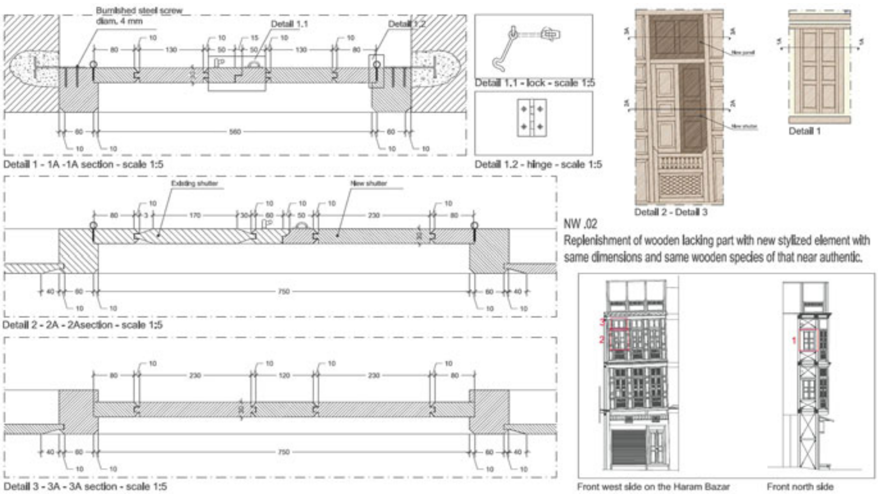

Fig. 18.11 Details of the integrations design of windows

Acknowledgments Special thanks are due to Giorgio Binda of Amigoni's Engineering Studio, Lecco, Italy.

Chapter 19
The Conservation Project of Haram Gate: Material Authenticity and Recognizability of the Project

Mariacristina Giambruno, Sonia Pistidda, Christian Amigoni, Andrea Garzulino, and Matteo Tasinato

Abstract The conservation project of Haram Gate represents a great challenge on an important landmark of the Walled City of Multan. For this reason and with the aim to test a method on a concrete pilot project, chosen in agreement with the MWC PMU, the work on Haram Gate has been developed as an executive project. Starting from a careful knowledge of materials and construction techniques, detailed studies on decay phenomena and set of cracks, the goal has been to define proper strategies for the interventions with specific solutions and proposals, always with the aim to preserve the existing building through sustainable, compatible, and noninvasive interventions. The difficulty of transferring the Italian experience to specific needs and problems of the local context as the weather (many products can't be applied at high temperature), the availability of products normally used in restoration, and the lack of skills for the execution of the works have been the real challenges of the work.

19.1 To Restore Today. What Does It Mean?

Reconstruction, *Restoration*, *Preservation*. Not only words but also operational practices are often equally used in the interventions on historic architecture.

Let's try to analyze their meaning.

Reconstruction can be defined as a "building copy" that no longer exists in the form and in the place where it was in the past.

Restoration can be defined as operation that brings back a building to the original characteristics, deleting the parts added and rebuilding those no longer existing.

M. Giambruno (✉) • S. Pistidda • A. Garzulino • M. Tasinato
Department of Architecture and Urban Studies, Politecnico di Milano, Milan, Italy
e-mail: mariacristina.giambruno@polimi.it

C. Amigoni
Amigoni's Engeenering Studio, Lecco, Italy

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Preservation means maintaining and extending the life of a building in its current morphological and materials characteristics, as well as the time and the man have transmitted it to the present (refer to NPS websites *Standards for restoration and guidelines for restoring historic buildings*).

Is it possible to work in any way on the historic architecture?

What is the value of a historic building for the present and for future generations?

> "*The value of architectural heritage is not only in its appearance, but also in the integrity of all its components as a unique product of the specific building technology of its time*." (ICOMOS charter—Principles for the analysis, conservation, and structural restoration of architectural heritage—2003)

So, if we accept this definition, there are many ways to work on the historic buildings, but not all would ensure "the integrity of all its components as a unique product of the specific building technology of its time."

To work on the historic heritage, to restore it, first of all means taking care of the matter of the building, not of its image.

So the reconstruction or the restoration doesn't guarantee the physical integrity of the historic buildings, the respect of time stratification, of history, of the people who created it.

Therefore, today the restoration should be intended as a preservation project, an architectural project that works on the existing buildings, that develops techniques to allow the care and the preservation of the material substance, allowing the use through aware and careful interventions.

This is a complex architectural project that requires expertise of the tools, of the preservation techniques, and of the ways of the new project.

The first step is understand in order to preserve: we have to know historic construction techniques; we have to test the proper techniques, materials, and treatments in order to be able to add and not subtract matter.

19.2 A Methodological Approach

> "*The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documents. It must stop at the point where conjecture begins, and in this case moreover any extra work which is indispensable must be distinct from the architectural composition and must bear a contemporary stamp. The restoration in any case must be preceded and followed by an archaeological and historical study of the monument*."

(The Venice charter—International charter for the conservation and restoration of monuments and sites, IInd International Congress of Architects and Technicians of Historic Monuments, Venice, 1964; adopted by ICOMOS in 1965)

If the restoration should be intended as a "preservation project," the first step consists in the knowledge of what we have to preserve: so the conservation project should be preceded by careful and accurate studies.

These investigations, which obviously depend on individual building characteristics, should take place according to guidelines that ensure a correct work.

Every intervention on the heritage should include:

- Historical studies (bibliography, archival, and iconography; stratigraphic analysis): they are necessary to understand the current state of the building in relation to the historical events.
- Geometrical survey (topography, direct, photogrammetric, and photographic data): they are necessary to know the geometry of the building. The geometrical survey has to represent the building in its current geometries and forms and not in its idealized image; it should be performed with minimum margins of error and represented at least in a scale 1:50.
- Materials and decay survey: it is necessary for a preliminary knowledge of the degradation process in order to plan a correct project. It has to produce a punctual evaluation of the conservation status of each element of the buildings. The survey performed in situ should be transferred on special layouts to allow an overall reading of the phenomena in order to interpret the causes.
- The diagnostic studies, in situ or in laboratory, are required to verify the previous observations, to know the characteristics of materials and to test techniques for their conservation.
- Structural studies are necessary to check the real condition of the building.

These studies, with the collaboration of experts in different disciplines, are essential to develop the conservation and reuse of historical buildings.

Only with a deep knowledge of the building, documented with layouts and relations that tangibly testify the observations and conclusions, it's possible to develop a correct intervention project, respectful of the building, manageable on yard, and durable.

The project must be performed on opportune layouts, easy readable on yard, in a scale at least 1:50 and accompanied by the necessary technical details. The project has to define, for each part of the building, the necessary intervention to stop the decay with opportune techniques, to avoid as much as possible modifies during the yard.

Now our goal is to act on the evidences of the past through a project compatible, recognizable, and respectful of all stratifications.

It means, therefore, to respect the material and the memory of the building, performing necessary studies and researches to reduce the cost of interventions.

To preserve means to satisfy the needs of our society without compromising the heredity for future generations.

This is the only right attitude that ensures the conservation of our heritage. To preserve buildings is not only economical but also culturally correct and more sustainable.

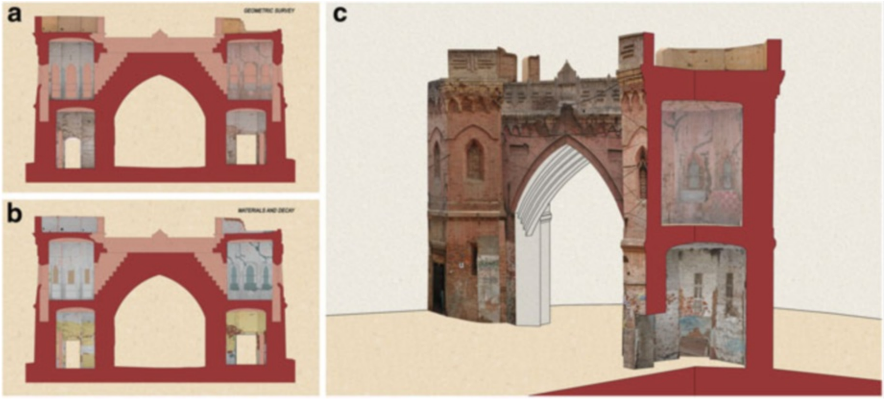

Fig. 19.1 Geometrical survey and photo rectification: (**a**) longitudinal section; (**b**) mapping of materials and decay phenomena; (**c**) three-dimensional model of the Gate with a section of the tower

19.3 The Studies on Materials and Decay Phenomena

During the recent studies and projects related to the city of Multan, more specifically on the Haram Gate building, detailed analysis and researches were performed in order to highlight the own characteristics of the object. These actions as historical, geometrical, material, and decay investigations are to be considered as fundamental basis for the successive conservation project of the building (Fig. 19.1).

The gate, at the entrance to Haram Bazaar, is constituted by two specular towers of about 10 m in height, connected by a bridge wide around 1.50 m, which allows the passage between these two structures. The towers are composed of one room on the ground floor and of an intramural stairwell leading to the first floor that give access to the bridge and to the top of the tower, a space bounded by a masonry bulwark.

The Haram Gate is built in brickwork, an assemblage of bricks in mortar bounded together to form a homogeneous mass of the structure: in this kind of masonry, the loads and stresses are distributed throughout mass. Externally the masonry is covered with fairly homogeneous layer of red oxide paint with the exception of some lower areas, the terminal part of the two towers and the bridge that are finished with lime plaster.

Internally, however, the situation is more complex because at the ground floor there is a mixture of lime painting (white washed) and lime plaster with acrylic painting, while the two rooms on the first floor present a finishing in lime plaster with acrylic painting. Finally, the top of the two towers and the inner part of the bridge are finished with lime plaster.

Following the identification of the material and constructive characteristics of the elements forming the analyzed object, the current state of conservation of the building has been examined, finding both disseminated and punctual decay events heterogeneously dispersed on the surfaces.

Overall, it is possible to notice a widespread surface deposit (soiling) consisting of a very thin layer of exogenous particles giving a dirty appearance to the surface; it has a variable thickness, poor consistency, and poor adhesion to the underlying material as, for example, bricks and plasters.

Internally it is also possible to find a deposit of exogenous material of variable thickness as blast and waste materials placed on the floor and inside the openings.

A very common and diffuse decay event consists in the erosion of the mortar joints between the bricks, a loss of the original surface of the materials; this event results much more marked outside, where, in some portions of the towers, it is easily distinguishable by the naked eye.

Also in relation to the masonry, it may be established the presence of certain limited areas, internal and external, affected by efflorescence, generally whitish, powdery, or whisker-like crystals on the surface.

Even the state of conservation of the plaster appears partially compromised; in fact it is possible to notice a general discoloration of limited extent with the presence of foreign materials (staining) and a light detachment of single grains or aggregates of the plaster (bleaching). In addition the plaster shows a diffuse detachment of the superficial layer materials (a prelude to the loss of the layer), especially inside where the lime plaster finishing and the acrylic painting cover almost all surfaces.

Another action of decay that affects the plaster is the hair crack, very small cracks not visible by the naked eye, with a dimension of 0.1 mm or smaller: this problem is concentrated in the upper part of the inner walls, in the ceilings, and in the bulwark placed on top of the two towers.

In addition to the abovementioned, other types of decay phenomena are present on Haram Gate more punctually; these are heterogeneous, positioned in different portions of the building and, in some cases, do not depend on the material but on external actions or damages caused to the building. These events are often generated by incorrect repair works of structures and materials or from natural external actions that stress the structure during the period of its life.

Some examples can be the mechanical damage, a loss of material clearly due to a mechanical action, and the deterioration caused by actions in fixing the damaged or missing parts with incompatible materials. It is possible to notice it at the first floor of the east tower where a cement mortar was used to repair some cracks and some lack of plaster.

Finally there are missing parts, empty spaces, obviously located in the place of formerly existing part and individual fissure (cracks or fractures, depending on the dimension of the damage), clearly visible by the naked eye, resulting from the separation of one part from another (Figs. 19.2 and 19.3).

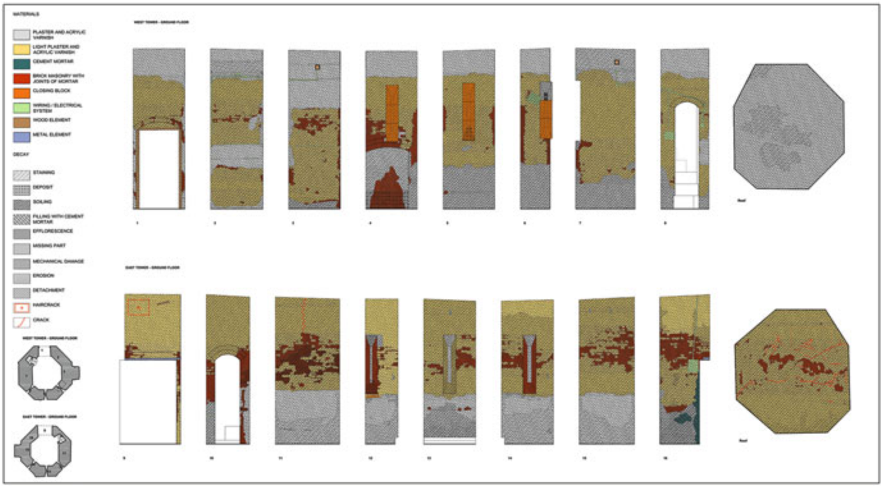

Fig. 19.2 East and west tower, interior spaces of ground floor: mapping of materials and decay phenomena

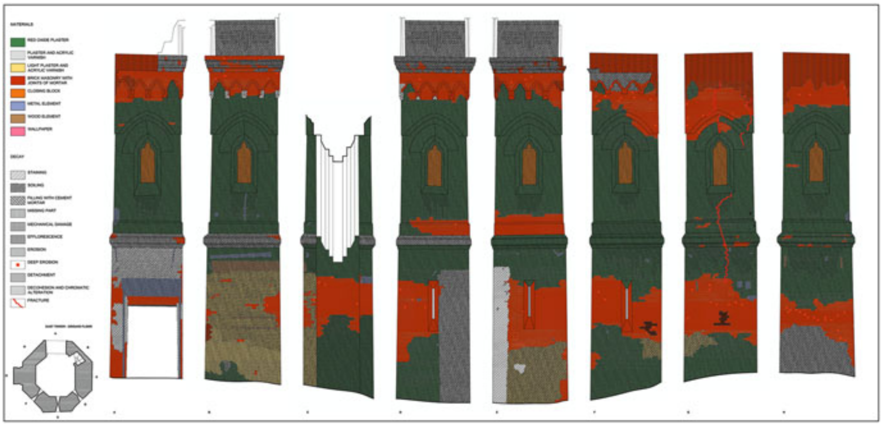

Fig. 19.3 East tower, exterior fronts: mapping of materials and decay phenomena

19.4 The Investigation on Structural Phenomena

Parallel to the reading of the decay phenomena macroscopically observable, investigations on structural phenomena were carried out and crossed.

The first step was the structural analysis of the building through the analysis of the dimensions and the loads, in order to understand the structural scheme, the withstanding elements, and the possible unbalanced forces. The attention first pointed to the pushing elements, such as the great central arch and the vaults of the first floor and the roof inside the two towers; the low grade of these vaults generates a remarkable horizontal thrust. Meanwhile, we focused on the survey of the maintenance level of the structures, including a precise survey of the fissures that showed a remarkable difference between the northwest tower, well preserved, and the southeast tower.

That part of the building shows an impressive vertical fissure placed opposite the central arch. Furthermore, at the top of that tower, an important structural damage of the masonry points to an overturning movement of the walls in two different directions, separated by the fissure previously described. By the analysis of the structure, it's quite easy to notice that the fissure is placed outside the hole of the stairway, placed into the walls of the tower and partly on over the first floor vaults. This part of the masonry represents a weak point of the whole structure: here, the walls are thinner than the other parts of the building, so the resistance to the forces of bending moments and axial compression is considerably lower. The thrust of the inner vaults, combined with the thrust of the central arch, generates a horizontal force that pushes in the direction of the points beside the stairs, generating the fissure. Those forces and movements also generated the misalignment of the bricks, due to the overturning movements of the wall in radial direction. The northwest tower does not show problems like fissures or disintegration. The difference between the two towers is probably due to the presence in the north tower of a timber tie beam placed under the first floor vault that could almost partly balance the effect of the horizontal forces. The scan laser survey supported the realization of detailed sections and, further on, some streamlined but accurate structural scheme. The analysis of the arch, the vaults, and the whole building was carried out by finite elements models. The vault model was generated with a higher precision, in order to evaluate better the forces and the deformations of the vaults and to see the difference between the vaults with and without the hole of the stairs. The overall model, realized with the support of EnExSys WinStrand, includes all of the structural elements of the building and can highlight the stresses and the deformations generated by elements such the arch and the vaults. The results confirmed the first analysis, underlining some traction stresses corresponding to the hole of the stairs. The seismic way of movement of the building, studied through the overall model, showed no twisting deformation, thanks to the symmetry of the building (Figs. 19.4 and 19.5).

19.5 Project Steps

The design process has been developed to ensure the maximum preservation of the material substance of the building. All the preliminary survey phase allowed to set up a specific conservation project with the goal to stop the decay phenomena and to guarantee a better performance of the materials from a chemical, physical, and mechanical point of view. All the technical and operational solutions provided want to solve the ongoing problems and to guarantee a better durability. The interventions are divided into two phases and provide removal, cleaning, consolidation, and

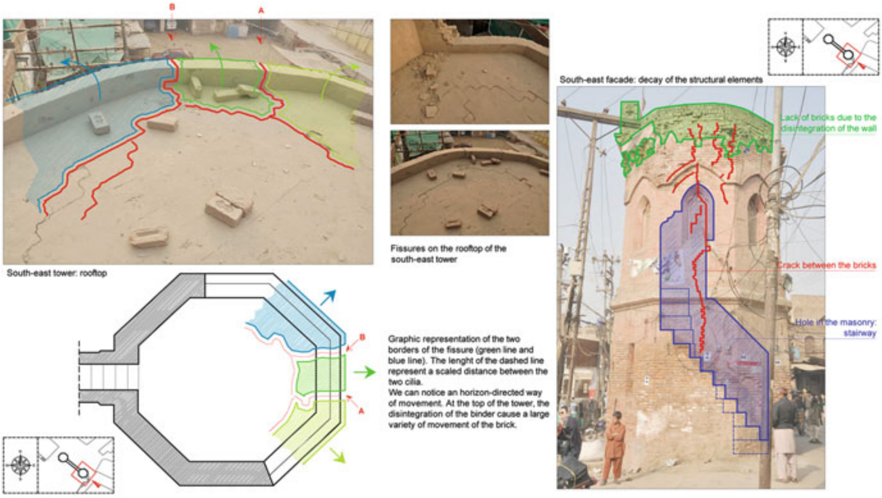

Fig. 19.4 Survey of the structural decays: overturning of the walls and fissure nearby the stairs

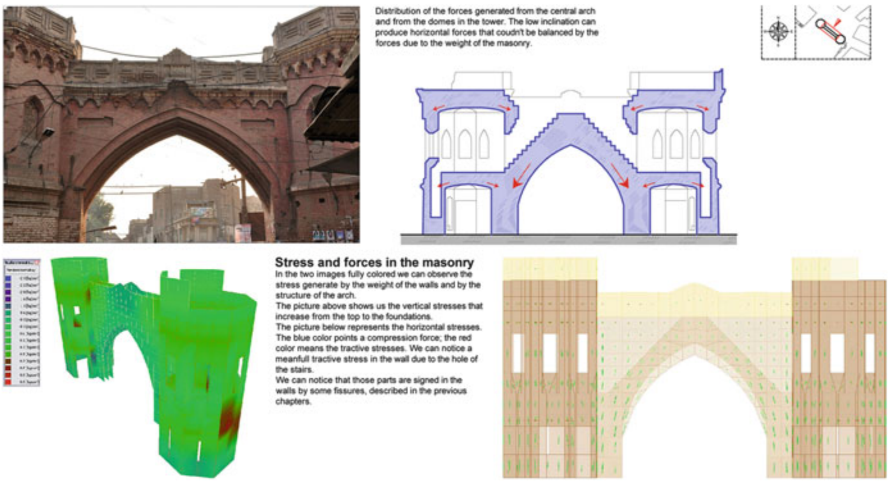

Fig. 19.5 Structural schemes (section) and the finite elements model

protection phases. The removal interventions help to liberate the surfaces and site from all incompatible elements, to prepare the next steps of the project. Some pre-consolidation works are necessary before the start of cleaning works to avoid the loss of material and prevent the failure of following operation. Cleaning works help to remove from the surfaces damaging deposits; consolidation works have to reestablish the mechanical consistency of the materials, and the final protection gives unity to all interventions.

In the interior spaces (east and west tower, ground floor) the first steps concern the removal of all incompatible elements as added materials, filling with cement mortar, exogenous deposit. In some areas the plaster is strongly detached and the conservation is not possible: for these parts the project includes the removal and the laying of lime plaster with surkhi. The parts of the surfaces and roofs covered by a painting film of light plaster have strong detachment for incompatibility with the masonry: the project provides the removal of the film to prepare the support for new compatible plaster. The parts of masonry not covered by the plaster show problems related to the decay of bricks as general erosion, erosion of the joints, and loss of parts: the consolidation works included in the project as the grouting of joints want to reestablish their better performance. In the lower part of the interior surfaces (probably due to recent interventions in cement mortar), the plaster is strongly detached: the project provides (for about one meter from the ground) the laying of lime plaster with surkhi (powder burnt bricks) to underline the basement, for the other parts finishing with white washing by adding surkhi (for the roofs by adding blue pigments to differentiate the solutions). Cracks and hair cracks as signs of structural decay will be sealed and filled with hydraulic lime mortar (with injections in the deepest cases) and subjected to further studies.

Considering the advanced decay of the floors, the project provides the manual removal of existing floors and the laying of new floors in earthenware. For the upper floor, considering the problems related to the humidity, the project provide the laying of a waterproof membrane and the construction of a new system for storm water removing. The loss part of wall coating in the upper floor will be completed with new bricks walls with a different design from the existing one to underline the new intervention. Some of the windows of the towers are missing; others are closed (in particular at the first floor); in some cases the existing ones are lacking in parts. The project provides punctual interventions on existing windows in bricks, removal of wall plug, and construction of new system of closing. The new elements will be in perforated wooden board, painted with RAL: the design wants to invoke the traditional Mashrabiya but at the same time to be clearly recognizable as new intervention. The access doors in good condition (west tower) will be recovered; the missing one (east tower) will be redesigned with perforated elements with pattern inspired to the tradition in according to the Mashrabiya.

For the exterior part of the towers, the project developed punctual interventions in order to preserve the characters of the surfaces: specific treatments are designed to ensure the maximum conservation of the matter and to guarantee its durability over time as the general consolidation with ethyl silicate. The protection works provide the laying of light plaster with pigments (red oxide or yellowish brown) in the lower part and the preservation of the existing film in the upper part.

Finally, the project faces the generation of electric power through a photovoltaic system using the steel strand (provided in the consolidation project) as supports for the light system and the steel plate as supports for the led: in this way the project wants to be as much as possible recognizable, noninvasive, and compatible (Figs. 19.6, 19.7 and 19.8).

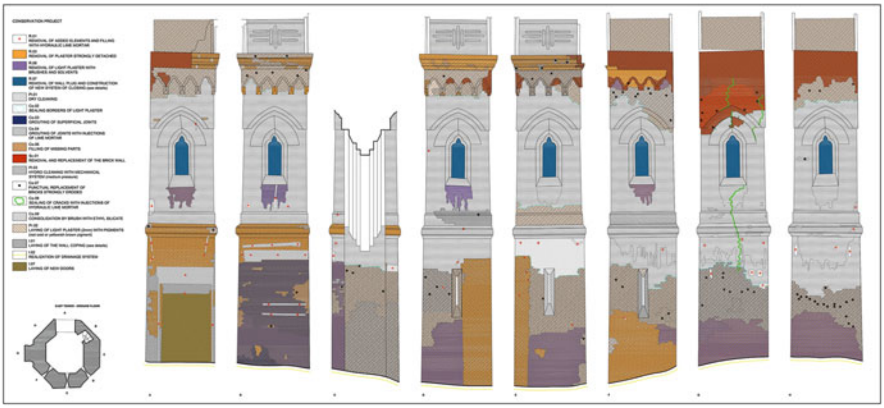

Fig. 19.6 East tower, exterior fronts: conservation project of the surfaces

19.6 The Consolidation Project

In order to contrast the structural weakness of the building, the project provides a series of elements with the purpose of balancing the horizontal thrust of the vaults, focusing on the weaker parts such as the holes of the stairs. The whole project was thought according to the philosophy of the flexibility of the works and the possibility of removing the new elements. So on, the new elements don’t want to hide themselves, but they should declare the different time from the present elements. Another important issue is its durability and the maintenance requirements. The purpose is to preserve the building in the current situation, improving the safety condition and consolidating the structural elements, without trying to bring the parts in the original shape applying important external forces.

So, the project includes a series of strands applied under the inner vaults at the edges of the rooms, jointed together by a central steel plate and connected with the walls by stainless steel bars fixed into drilled holes by fluid expanding mortar, fulfilled without salt elements. Those bars are fixed inside the building by a UPN200 steel beam and outside the building by some pierced plates that will be widespread enlightened. The UPN200 steel beams help to spread the forces generated by the strands and to better connect the strands themselves, avoiding the radial deformation and the overturning. With the same purpose, the project includes two new 20 mm. wide strands placed over the stairs of the central arch.

The strands and the turnbuckles are generally used in the nautical engineering, in order to provide great resistance and great durability, without important maintenance works. Further on, the connection with the walls are designed to respect the chemical composition of the masonry, using mortar without salty elements, in order to preserve the masonry itself and to avoid unexpected phenomenon like efflorescence.

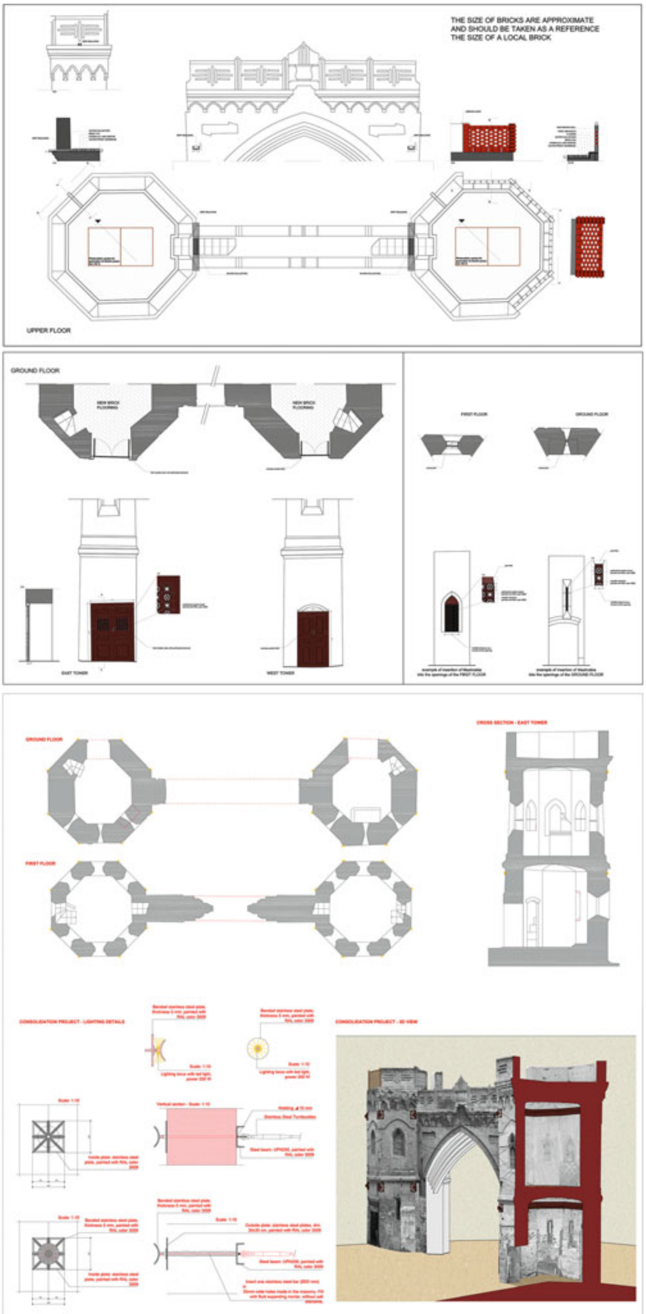

Fig. 19.7 Details of the new bricks wall on the upper floor and indication of the water collection system; detail of the doors and windows project with insertion of Mashrabiya in the openings of the ground and first floor; details of consolidation project and the lighting design

Fig. 19.8 Project of outdoor lighting with three-dimensional simulation

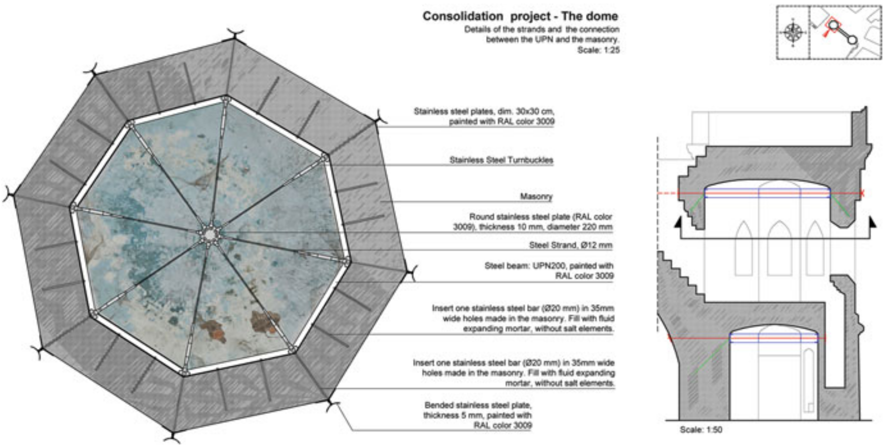

Fig. 19.9 Consolidation project: plan and section of the strands

The model of the modified building, including all the new elements, shows a deformation mode comparable to the model of the current state, without twisting movements. The traction forces distribution generated into the new structural elements, such as the strands, are similar to the one expected before the realization of the model (Figs. 19.9, 19.10 and 19.11).

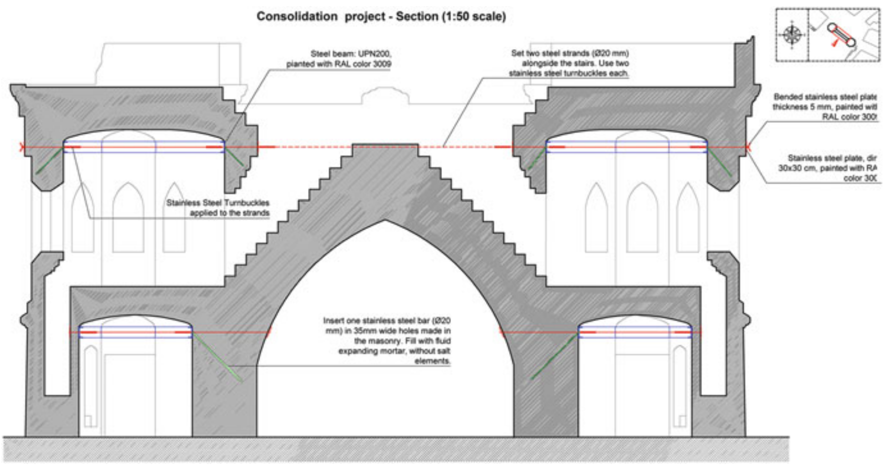

Fig. 19.10 Consolidation project: overall section

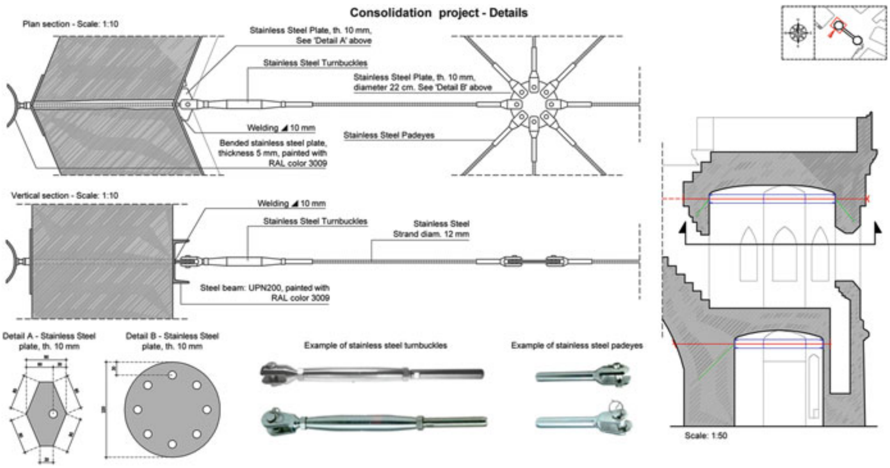

Fig. 19.11 Details of the turnbuckles, the plates, and the connections

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Advice The article is the result of the joint discussion of all authors; the individual parts have been edited as follows: the section “To restore today. What does it mean?” by Mariacristina Giambruno; the section “A methodological approach” by Mariacristina Giambruno and Sonia Pistidda; the section “The studies on materials and decay phenomena” by Andrea Garzulino; the section “Investigation on structural phenomena” by Christian Amigoni; the section “Project steps” by Sonia Pistidda and Matteo Tasinato; the section “The consolidation project” by Christian Amigoni.

Chapter 20
Pakistan-Italian Resource Centre and the Enhancement of Multan Walled City

Eleonora Bersani, Ermes Invernizzi, and Michele Locatelli

Abstract The Pakistan-Italian Resource Centre is a facility that will be tasked to promote the cultural, economic and social development of the city of Multan. It supports the exchange of knowledge and increasing the productive sectors through relations, trade and finance between Pakistan and other countries, Italy in particular. It will also become the ideal forum for activities aimed at enhancing the urban fabric of Multan and at the same time constitute a sort of commercial/business hub to promote the economy of the Walled City and its surrounding productive land. The Resource Centre can become the portal of the city of Multan and its territory in the next Expo, event that will take place in Milan in 2015. The project area is located within the Pilot Area, near the Darbar of Musa Pak Shaheed, between Sarafa Bazaar and Musa Pak Complex, in a strategic place to the enhancement of the inner city. The symbolic, historic and cultural importance of Musa Pak Complex makes it one of the most significant and representative areas of the historical core of Multan. This chapter illustrates the design project of the Resource Centre building at Abdali Road, in a outside of the Walled City area. The project includes the design of the new Resource Centre building (a *nearly zero-energy building*), the connected restoration of the historical Dar Bar building (Musafir Khana) and the redevelopment of the courtyard.

20.1 Introduction

The Pakistan-Italian Resource Centre is a documentation centre, research and training located in the Walled City, and it has to contribute, through its presence and its activities, to the enhancement of the inner city.

E. Bersani (✉) • E. Invernizzi • M. Locatelli
DAStU – POLITECNICO DI MILANO- Dipartimento di Architettura e Studi Urbani (Department of Architecture and Urban Studies of Politecnico di Milano), Via Bonardi 3, 20133 Milano, Italy
e-mail: eleonora.bersani@polimi.it

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It aims to support the development of the city of Multan within a broader interest of cooperation between the two countries, Italy and Pakistan. Between Italy and Pakistan (and in particular the region of Multan) there are significant common interests and synergies. The new Resource Centre can become also the portal of the city of Multan and its territory in event "Expo Milano 2015—*Feeding the planet, energy for life*."

The Resource Centre in the Walled City area will be located between the Sarafa Bazaar (Gold Market) and the Musa Pak Complex, in an area characterized by several Holy Sites including the Shrine of Musa Pak Shaheed, the mosque of Musa Pak Shaheed (also called Masjid Ghausia), the Tomb of Hamin Gillani, the Darbar of Musa Pak Shaheed and Khana Gillani. The symbolic, historic and cultural importance of Musa Pak Complex makes it one of the most significant and representative of the historical core of Multan.

The Musa Pak Complex has an intricate genesis. If in general it is true that historical events were the protagonists of the conformation of the places, then perhaps it is useful to try to reconstruct the events that led Musa Pak Complex to its present state and in particular to try to reconstruct the events of the period in which the greatest changes have occurred and the Shrine of Musa Pak Shaheed was built.[1] The basic elements of the original urban form are the Shrine of the Saint (connected with the Mosque), the empty space and the Darbar (gate). So, according to history, the beginning of the eleventh (AH)/seventeenth (AD) century, the Musa Pak Complex is reorganized in clear composition, set according to an east–west axis:

- To the east was the gateway to the sacred area, the building of Darbar Musa Pak, designed to accommodate the pilgrims. The door is a key element in the definition of place in general and especially for a holy place.
- The centre was an open space, the real pivot around which the whole complex of Musa Pak was organized. It allowed the direct visual relationship between the

[1] We know that the body of Hazrat Musa Pak Shaheed was initially buried in Uch Sharif. He was transported to Multan and buried in the current tomb in 1025/1616, a few years after his death, according to M. Aulad Ali Gilani in the year 1001/1592 or in 1010/1601 (Gilani 1963, p. 246). It was then that the established habit was to build mosques near shrines. In fact, the Mosque of Musa Pak Shaheed (also called Masjid Ghausia) is located adjacent to the tomb, to the north. Some sources believe that previously there was already another mosque, built at Khanqah Gilani. An engraving on stone in Persian, partly preserved and belonging to the temple complex, mentions the following: Ta'amir Shaikh Hamid bin Shaikh Jeelani Shanzdeh 1005/1596. Some believe that this inscription belonged to the ancient mosque. Others argue for the hypothesis that this inscription is connected with the construction of the new mosque and shrine (Masjid Ghausia) and this leads to suppose that the period of construction of the shrine and of the complex of Musa Pak is prior to the date of burial of the holy man in Multan. Regardless of the two hypotheses, however, it is confirmed by numerous texts (Haq 1972, p. 175) that the mausoleum and the construction of the new mosque are roughly contemporaries and they were placed in front of the Darbar, beyond the open space laid to the south of the Khana Gillani.

various monumental buildings; in particular it was organized around the longitudinal axis (east–west) that united the complex and the Darbar Shrine of Musa Pak Shaheed.

- To the west stood the shrine of Musa Pak Shaheed, in longitudinal position. An entrance was to open towards the court and the axis forming the Darbar and a second entrance facing north, towards the mosque.

This space system was completed to the north of the building curtain and in particular from the porch of Khanqah Gilani, also part of the sacred place.

The elements of the original structure are still visible in the urban fabric of the city even if the subsequent transformations of the city fabric have changed the relationships between the monuments of Musa Pak Complex. In particular, in the courtyard originally the Darbar and the Shrine of the Saint were connected by a clearly comprehensive axis that integrated the two parts in a single monumental building with the built curtain to the north, in completing the courtyard, further contributing to the holistic reading of the sacred complex.

The southern side of the courtyard over time has changed and expanded. Buildings and facilities progressively occupied the open space. In fact, this space occupation of the court does not make more legible the explicit relation between the Shrine and Darbar and contributes to the loss of unit value originally assigned to the monument. In particular, the Darbar building, separated from the evident link with the Tomb and the Mosque, is undergoing a gradual loss of the original religious and symbolic value and it is subject to erosion by the functions related to the neighbouring Sarafa Bazar, as evidenced by the presence of shops and business premises on the ground floor of the door.

We learned that a next demolition of the buildings placed between the door and the tomb is foreseen. It's a brave choice and to some extent necessary in order to permit the reading of the original relationship between the monuments.

To enhance the Musa Pak Complex the planned demolitions are not enough. It must be accompanied by a redevelopment project of the area that may trace relationships between the component parts, define the functions and give importance to the open space around which monuments articulate, a place where a community comes together and is recognized.

The design of the new Resource Centre is an opportunity to reorganize the central courtyard of Musa Pak Complex. Its shape, recognizing the importance of the complex and the court, aligns the axes of the main monuments and the court itself by helping to give a made figure to that portion of public space.

This solution would allow:

(a) To put a stop to private commercial functions related to the Bazaar, which have eroded over time the space and has changed the shape of Darbar itself and of that of Musa Pak Complex.
(b) To have a showcase of the Resource Centre on Sarafa Bazaar contributing to the perception of the Resource Centre building as an element belonging both to

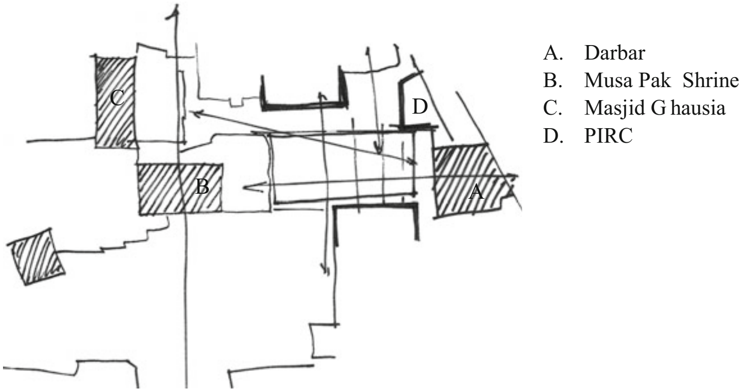

Fig. 20.1 The reorganization of Musa Pak Courtyard. (**a**) Darbar, (**b**) Musa Pak Shrine, (**c**) Masjid Ghausia, (**d**) PIRC

the complex of Musa Pak and to the rest of the Walled City. It is essential that the role of associated element to the economy of the city should be emphasized along with its belonging to the urban fabric.

(c) To enhance the space of great architectural value of the inner courtyard of the Darbar (Fig. 20.1).

The project of the P.I.R.C. in Musa Pak Complex is organized into three parts:

1. The *restoration of the historic building of Darbar*, preserving its destination of Khanqah and Musafir Khana. The restoration of the Darbar is an integral part of the implementation of the P.I.R.C. not only because the historic building and the construction of new building are closely related but mostly because the restoration may be a visible and concrete example of the function of the role and mission of the Resource Centre.
2. The construction of the building to house the exhibition space, offices and training provided inside the *Resource Centre*.
3. The redevelopment of the open space of *Musa Pak Courtyard* to return identity and value to open space and monuments that make up the Musa Pak Complex.

20.2 The Musa Pak Complex Darbar Restoration

The restoration of historical building of Darbar is a necessary and urgent work in order to preserve the sacred and historical value of the compound and to allow the continuity of the destinations of Khanqah and Musafir Khana, particularly significant functions in terms of cultural, social and religious, both for the local community and for pilgrims coming from outside of the town. It is a building that, in

Fig. 20.2 Musa Pak Darbar survey: section

addition to being recognized as an integral part of the sacred place, has a significant historical and architectural value. Its upper floor is used as Khanqah and as Musafir Khana to accommodate pilgrims in spiritual retreat that come to visit the holy places of Musa Pak Complex especially during the Urs festivities. The current configuration of the building is the result of several layers that have occurred over time. In particular, the upper level comply in its current form due to a series of interventions towards the beginning of XX which are joint to an older artefact and adapted at the early seventeenth century, when the current urban system was configured. From the construction point of view, the building has brick bearing walls and floors with supporting parts in wood, with completion in terracotta tiles or timber elements (Fig. 20.2). The facade towards Sarafa Bazaar, with interventions from the turn of the last century, is greatly adorned: in addition to the rich decorations and to portions of Multani tile leads, the facade has an interesting *jharoka*, whose static conditions are particularly precarious.

From the point of view of functions, the building houses on the ground floor stores, shops and some rooms with beds, while the first floor is used almost entirely as Musafir Khana. The intervention has been designed in adherence to the international principles and conventions of restoration: reversibility (ability to roll back the changes made), compatibility between old and new, reduced operation and readability of new interventions; the intervention will not in any way alter the morpho-typological and historical character of the building, the modifications must be easily reversible without any damage to the existing and appropriate attention will be paid to new materials and innovative technologies for energy savings. The intervention consists mainly of the conservation works on the

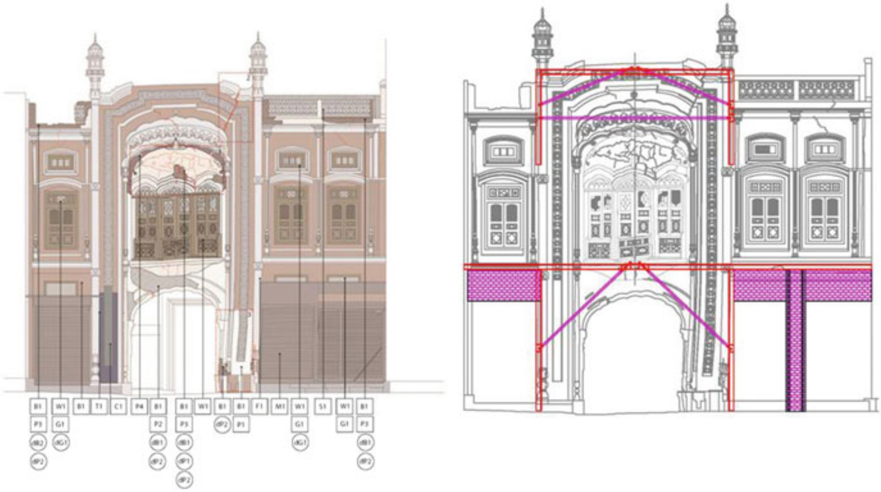

Fig. 20.3 Musa Pak Darbar building: Sarafa Bazar front survey and diagram of structural intervention

existing building to ensure the integrity of the historical construction, besides consolidation and reinforcement works to guarantee durability and integrity of the building. The project primarily aims to restore a state of structural safety of the building, conducted according to the principle "as close as possible to the original function so as to ensure a minimum intervention and minimum loss of cultural value" (Feilden and Jokilehto 1998, p. 90). The authenticity of monuments, buildings and structures is integrally linked to the temporal narrative embedded in their fabric. An understanding of the chronological development of a building, of its multiple and complex structural, spatial and decorative layers is an essential act to conserve its authenticity.

The model of the building structures showed that the main causes of functional-static instability of the fabric of Darbar (mainly the collapse of the structures of the bow window and a consequent profound injury of the bricks forming the hemi cupola coverage) are related to the lack of the lower portion of the far right column, probably removed during the formation of the shop on the ground floor (Fig. 20.3).

20.3 The Pakistan-Italian Resource Centre Building

The building of the P.I.R.C. is one of the most visible concrete expressions of project activities named "Italy for Multan" within the Walled City. The new building will house the project's activities more closely related to the development

Fig. 20.4 View of the P.I.R.C building from Musa Pak Courtyard

of the Walled City, constituting a point of contact with the population of the city centre. In particular, we provide the necessary offices to branches and activities to enhance the historic fabric of the centre of Multan (microcredit, capacity building, etc.) and a room to host training courses (Figs. 20.4–20.7).

The new project in the site of the Resource Centre, also for its specific function within the historic fabric of the city, is part of the building culture tradition to find contemporary design solutions and environmentally sustainable energy.

In the wise old buildings, water, wind and *jalis* were used and combined to ensure the residents a living quality. This is witnessed by some magnificent examples of historic architecture in Multan and in Pakistan. The new building is presented as a large three-dimensional *jali* that faces the public space of Musa Pak Complex. The building uses water, natural ventilation and shading/mechanics to ensure a well microclimate. In particular we are studying a system natural refreshment, very simple in principle, but which can be calculated very carefully to give efficient responses and may reduce energy consumption and easy operation/maintenance. It is based on the principle of water evaporation, resulting in reduced temperature, a principle used in ancient times in many homes in hot countries between India and Europe which is now carefully restored to bioclimatic architecture (evaporative cooling). The construction details of the refresh evaporative system in ceramic material is designed and developed in partnership with the Institute of Blue Pottery Development of Multan.

On the use of sun shields (jali)—traditionally made of wood (or stone) and known in the West as Mashrabiyas—the architectural culture between India and the

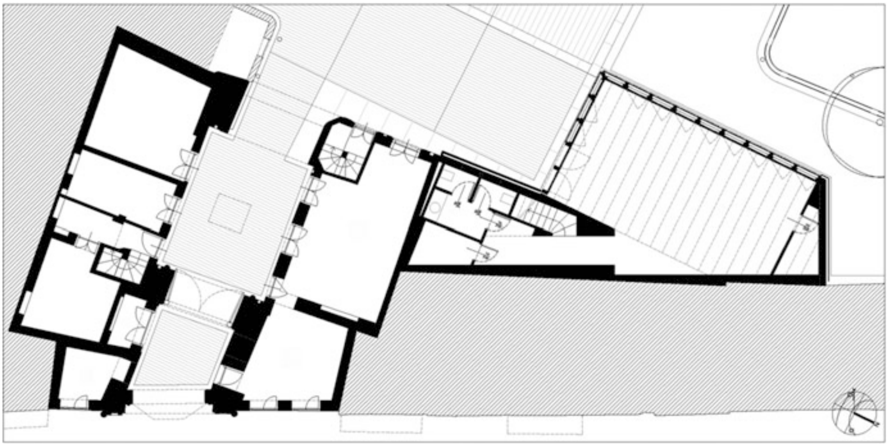

Fig. 20.5 Ground level: the Musa Pak Courtyard Darbar and P.I.R.C building planimetric drawing

Fig. 20.6 Front from the Musa Pak Courtyard

Mediterranean has produced a way of making architecture: the refinement of the light that passes through elements of the section and is thus diffused and softened, the ability to control ventilation, the formation of a particular relationship between interior and exterior and the elegance of the artefacts are elements of jalis that belong to a unique cultural–architectural heritage.

According to Hassan Fathy (1986) the jalis is not only the symbol and emblem of a tradition and a cultural identity but also a fantastic invention that performs many essential functions in climatic order. The coverage will be equipped with photovoltaic system able to make the building self-sufficient from the point of view of energy.

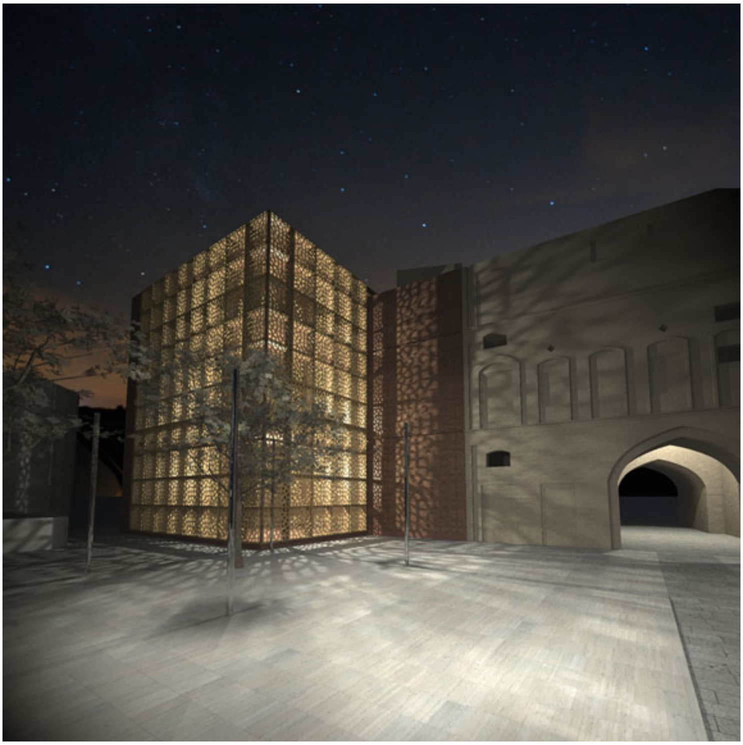

Fig. 20.7 View of the P.I.R.C building from Musa Pak Courtyard by night

The new building that will be formed has a pseudo-trapezoidal plan with dimensions of approximately 12 $\times$ 8 m^2 and a growth in height of 12 m. It is developed for three storeys starting from ground level and has an entire wooden structure; the exception is presented by the back wall already existing and in stone material.

The structure of the facade is made of a grid with wooden pillars, size cm.26 $\times$ cm.13, arranged along the whole front of the building. The vertical structures (pillars) are placed every cm. 110, while the horizontal structures (the beams size cm.13 $\times$ cm.13) have a variable pitch according to the windows.

20.4 Musa Pak Complex Courtyard Design

Musa Pak Courtyard is an urban area of aggregation of the most important part of the walled city. The municipality that has envisaged the demolition of buildings between the door and the tomb has indeed understood the need to structure the best

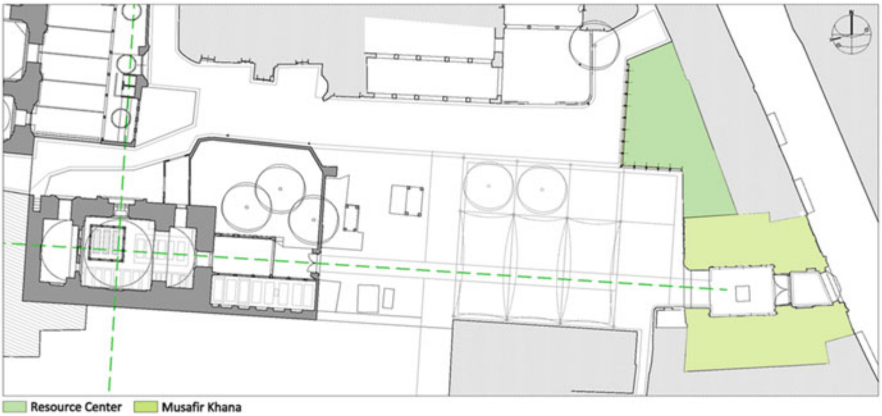

Fig. 20.8 Musa Pak Courtyard design: planimetric drawing

value that returns an empty space to monuments and at the same time is an urban space that can accommodate people visiting during events and religious events periodically held.

The design of the courtyard reconstructs the relationship between the buildings that make up the Musa Pak Complex and in particular shows the original relationship between the gate of the complex (now used as Musafir Khana) and the tomb of the saint.

The paving stone builds a geometric design based on the repetition of the shape of the square, which is used to give prominence to an urban space and to reconstruct the relationship between the entrance of the tomb of the saint and the function of the door. The presence of trees and of the supporting elements of the tents is used to improve the microclimate of open spaces which contribute significantly to reducing temperatures during hot weather (Figs. 20.8 and 20.9).

20.5 The P.I.R.C. in Abdali Road

Finally we were asked to design a "Resource Centre" in a different place, indicated by Pakistan authorities, on Abdali Road. The area is located outside the Walled City, with easy accessibility and proximity to an important structure connected to business. The project reconstructs the street frontage on Abdali Road, aligning the body of the building at the Ramada Hotel and forming an internal courtyard (Figs. 20.10 and 20.11). The building has an entrance area/showroom and a conference room that can be transformed into a unique area for exhibitions and events. Upstairs are the offices and meeting rooms. In the courtyard there is a small garden with trees and an area reserved for parking.

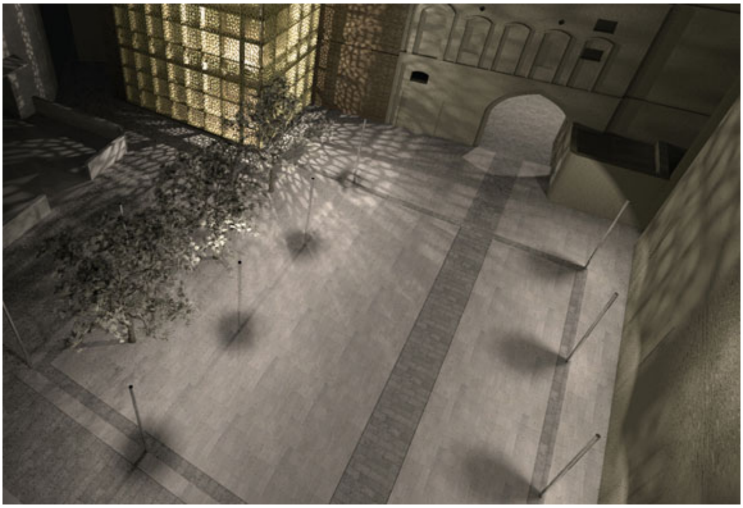

Fig. 20.9 Musa Pak Courtyard design: view

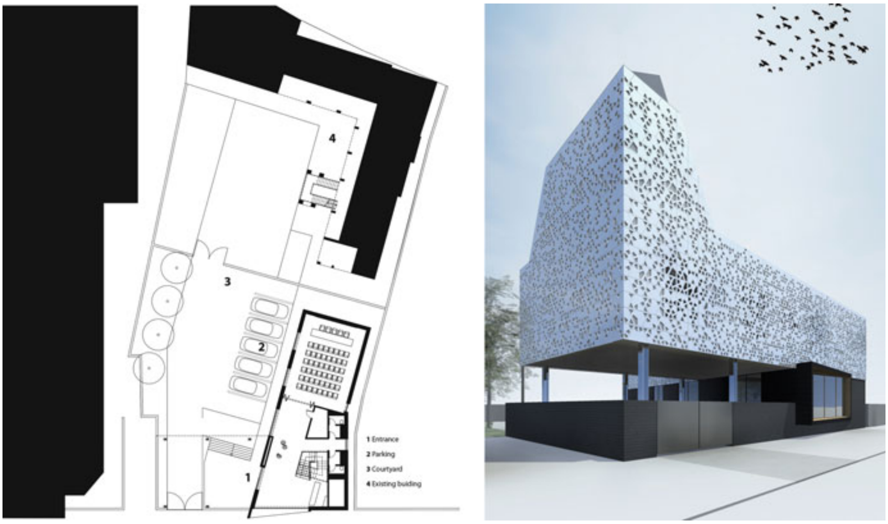

Fig. 20.10 P.I.R.C. at Abdali Road: planimetric drawing view from the street

The context is different from the Walled City. We choose to use architectural solutions and techniques totally different from the previous project. The tradition of Multan of ceramic tiles is declined to make a contemporary skin; the ventilation towers are used to facilitate the movement of internal air and also figuratively to recall the particulars of local building traditions.

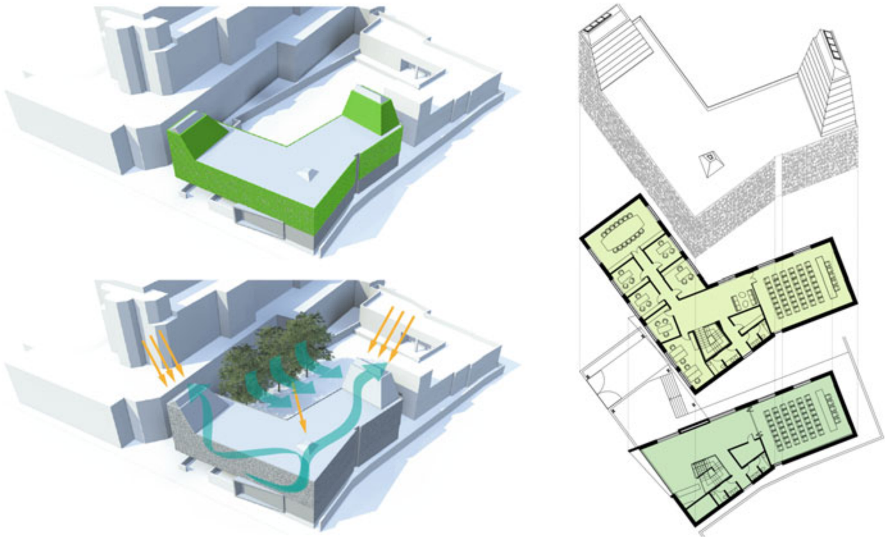

Fig. 20.11 P.I.R.C. at Abdali Road: iconic shape and climatic strategies and layout of the building

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Chapter 21
Italian Collaboration Programme for Training and Capacity Building

Lorenzo Maffioli, Paola Esena, and Emanuela Colombo

Abstract Fondazione Politecnico di Milano, through the Academic Social Responsibility Programme called Polisocial developed in cooperation with Politecnico di Milano, has been called to assist the enhancement of capacity building aspect as a part of the overall programme focused on the Italian Collaboration Programme for Training and Capacity Building.

The production of the final report, related to the capacity building programme that could be promoted between the Politecnico di Milano and the Bahauddin Zakariya University, underlines the empowerment that the programme will generate.

During the Pakistani Mission, made by Lorenzo Maffioli, Project Manager Polisocial Programme, in February 2012, the several meetings made, gave the impression of the potential by creating a strong network between the different stakeholders.

During the mission, many meetings were organized with the Multan Chamber of Commerce and Industry, its Cluster Development Centre for Light Engineering, the Punjab Small Industries Corporation and the principal departments of the BZU University. During the discussion with them, the opportunity to create a model to foster the local excellence and upgrading the youth's capability were recognised. Those results may be achieved by twinning the education of the University, upgraded with the support of Politecnico di Milano, to the experience of the opportunities created with the engagement of the Chamber of Commerce and his network.

The concept of the approach will be described briefly through the different actions proposed to the Pakistani Boarder of Evaluators after an intense survey

L. Maffioli (✉) • P. Esena
Fondazione Politecnico di Milano-Polisocial, Milan, Italy
e-mail: lorenzo.maffioli@fondazione.polimi.it; paola.esena@fondazione.polimi.it

E. Colombo
UNESCO Chair in Energy for Sustainable Development, Department of Energy, Politecnico di Milano, Milan, Italy

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made within the departments of the BZU University by submitting questionnaires to the professor, the students and the academic staffs.

21.1 Framework of the Action: Role of the Education and a Focus on the Target

Education plays a fundamental role in a country. The task developed by Fondazione Politecnico sustains this vision and faces aspects related to education, innovation and capacity building.

The necessary approach to tackle the difficulties of the country has to include a proper knowledge transfer, composed by a wide range of competences, addressed to the management of internal resources with creativity and proficiency.

Education and learning acquire high importance, and some aspects strictly connected to the several elements of education are promoted and valorised in Pakistan:

- Promotion of creativity and commitment
- Enhancing saving and investment
- Promotion of community membership
- Endorsing the approach of a wide human development
- Foster systems for supporting excellence
- Promoting education as strategy and changing agent

Concerning the last point of the list, it is evident that educational systems play a relevant role by transferring new emphasis and attitude to the next generation of professionals and citizens in terms of:

- Self-confidence and positive attitude
- Mind stimulated and prepared to creativity
- Innovation and hard work increase in the number of people trained in an innovative way and with a high capacity for analysis and resolution of societal problems

Consequently, the ability to assess the current situation of local programmes and services is an important step to prepare the way for the education system to respond to the challenge posed by the twenty-first century and, of course, to enhance capacity building in the context of the overall project in Multan.

There is a growing need to match economic, social and environmental sustainability with the development in local and global scale. This need is greatly enhanced by the principles of interdependence of the globalisation. The development of human capabilities, in this context, becomes a fundamental tool to regulate the relationship and balance between competitiveness and business needs, sustainable development and social equity.

Analysing the effectiveness of capacity building, it comes out the importance of an "ad hoc" set of competences, capabilities and attitudes, which need to be developed and taught within the BZU University. A clear role needs to be played by the university and their education programmes.

Pakistani institutions have mainly grown up not considering “networking” a means for effective enhancement of performance. Research, compared to the fast change and challenges that a globalised world impose, has received poor investments. The same lack of investments is related to the quality in academic staff. Another aspect is the weakness by the University and the system to develop labour-driven programmes and to enhance research activities. The involvement of stakeholders, especially representing the labour market, has been largely ineffective.

In this framework, there is a lack of equipment and technicians trained for laboratories and facilities.

The above considerations are also in line with the *“World Declaration on Higher Education for the Twenty-first Century: Vision and Action”* and the *“Framework for Priority Action for Change and Development of Higher Education”* which were adopted by the *World Conference on Higher Education* organised by UNESCO at the end of 1998.

Capacity building, promotion of research and technology transfer becomes, in this context, an important and innovative element that can be enhanced through the constant contact and collaboration with the industrial sectors concerned or with the local community, strengthening the participation of universities industry and institutions (EC CSTD 2006; Bologna Declaration 1999; Gu 1999).

21.2 Evaluation Methodology: Internal Questionnaires and Surveys to Relevant Stakeholders

In line with this vision on capacity building, the evaluation introduces a methodology and a set of tools that is informed by international best practice used for analysing academic curricula.

21.2.1 Range of Validity

Prepared for providing information at local level, the evaluation is specifically made up by the international experts and structured for interviewing the principals, students and the staffs met during the mission.

21.2.2 The 3D Approach to the Evaluation

The evaluation and therefore the questionnaires for evaluation are made around a methodological approach (Fig. 21.1) that has a three-dimensional matrix which takes into account three essential points of view:

Fig. 21.1 The 3D approach of the evaluation

1. *Relevancy of the Programmes*: This aspect depends strongly from internal situation.

   Didactics: scholarship and postgraduate courses' structures, the relevancy and scope of teachings, courses' efficiency, the educational offer and the influences of the sociocultural context

   Research: its organisation and the link with teachings, the level of commitment by professors and students and the analysis of applied research

   Technology Transfer: valorisations and promotion of results made from the research, relationship with industries related to patent, IP (intellectual property) strategy
2. *Availability and Qualification*: qualifications and skills of the human resources in teachings and administration, availability of prepared and qualified resources and staffs, opportunities created. This is not only depending on internal constraints and management.
3. *Feedback from Stakeholders*: not only depending on the attitude of higher education institution but also depending on the local socioeconomic conditions of the surrounding stakeholders' environment.

   Fundamental is the consultation with external stakeholders that is required in order to understand their perception of the quality of the education and the quality of the graduates introduced in the labour market by the university. Not secondary the consultation is useful to evaluate and understand its focus of teachings and research on specific stakeholders needs (UN Millennium Project 2005).

21.2.3 The First Dimension: The Programmes

The focus and the first dimension of the evaluation is related to the programmes. This system monitors *competences*, *capacities* and *attitudes* by evaluating the programmes' planning and quality and the reviewing system. Related to innovation, from a general point of view, there are some essential elements to be considered:

– Programmes need to be properly updated at the state of the art of the scientific and technological knowledge. There is a strong need to have and to use proper facilities as opportunity for applying the knowledge. This is a sort of predisposition to be innovators: to use brain in unconventional manner, to be able to change perspective and to find a solution. This attitude could be enhanced with a proper path of training and education.

– Programmes will be evaluated in terms of scientific contents and expectation for the future professionals. The evaluation seeks to identify the nature of the whole qualifications offering an interesting perspective for measuring the predisposition to innovation of these programmes and the coherence with external stakeholders' needs.

21.2.4 The Second Dimension: The Resources

Resources are essential because the evaluation is focused on three key elements:

1. *Human Resources*: Evaluation of teaching, administrative and technical staff in terms of quality and preparation.
2. *Available Facilities*: The facilities such as classroom, laboratories and libraries will be evaluated.
3. *Funding Resources*: The appropriateness of the funding represents an essential element to be known in order to proper make any current evaluation and future planning.

21.2.5 The Third Dimension: The Internal Stakeholders

A consultation with internal stakeholders (teachers and students) is required in order to understand their perception of the quality of the education and the quality of the graduates introduced in the labour market by the university.

21.3 Evaluation Activity

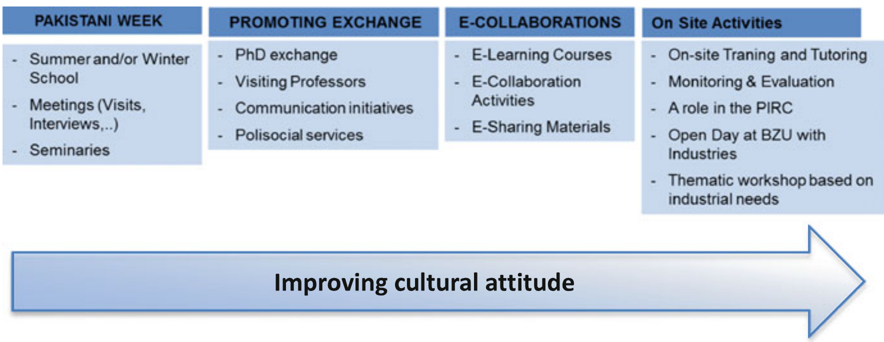
The evaluation activity, focused on the B.Sc. and M.Sc. Programmes, was organised in the following steps:

1. Questionnaires were prepared for the resource persons for collecting information required for the desk evaluators.
2. Fondazione Politecnico engaged local assistant to collect relevant data concerning, for example, the enrolment, the student's demographic profile, the gender issue, budget available and patents.
3. The resource persons were asked to prepare their in-depth responses to the questionnaires by interview sessions made.

4. Fondazione Politecnico made desk evaluation of the resource persons' responses and the data collected.
5. Classes were visited as well as facilities of the BZU University in the different departments.
6. The evaluators collected a series of interviews, concerning the real and practice needs, from external stakeholders in relation to the BZU activities and opportunities. Stakeholders were *PSIC—Punjab Small Industry Corporation*, the association of the community in the pilot area of the project, entrepreneurs in the sector of handicraft, Multan Pak Gate branch of the *Tameer Microfinance Bank Limited*, the Multan branch of the *Akhuwat Association*, the *Multan Chamber of Commerce* and the *Cluster Development Centre for Light Engineering Industries Multan*.
7. Finalisation of the evaluation report for analysing the strengths and weaknesses of the most relevant curricula offered by BZU University: *Faculty of Engineering* (the University College of Engineering and Technology, the University College of Textile Engineering and Technology, the Institute of Advance Materials), *Faculty of Science and Agriculture* (Department of Environmental Science), *Faculty of Arts and Social Sciences* (Department of Economics, Department of Sociology) and *Multan College of Arts*.

21.4 Proposal for the Action

In the face of consultations which took place in the various meetings both in Pakistan and in Milan, there were these possible proposals that could be developed in the future:



Pakistani Week. Organised at the Politecnico di Milano where a delegation of Pakistani representatives will attend a SUMMER SCHOOL organised to promote the empowerment of the teacher's and professor's level. The new design curricula upgraded would be the output of the action.

Promoting Exchange. Another core of the proposal is to focus the short-term activity through different actions related with the universities' collaboration for promoting student and teacher exchange.

E-Collaboration. E-learning courses for distance learning related on basic courses needed or other relevant subjects. A website design for making available useful material given.

On-Site Activities. Conducted to promote and enhance the follow-up, to support local partners and for planning the monitoring activities focused on handicrafts and microcredit. Other activities within the BZU will promote the role of the university at local level as a leverage for development. A plan of activities involving institutions and industries will enhance and empower the capacity building action of the project.

In order to increase the efficacy of capacity building and the effectiveness of its introduction in the BZU University and local system, high relevance will be given to an "ad hoc" identification of competences, capabilities and attitudes that need to be developed and taught within the university and the other stakeholders selected.

Promoting capacity building within the Multan system would be expected to improve competitiveness, to foster economic growth, to reduce the gap between universities and industrial enterprises and to foster their mutual cooperation for promoting industrial innovation. Brain drain process will be limited (Aubert 2004).

21.4.1 Pakistani Week

The organisation of a Pakistani week in Milan seems to be the most appropriate solution in order to group all the selected partners for focusing in a deep and intensive 10–15 days of hard work that will include different activities:

- Summer schools
- Meetings
- Seminaries

The delegation will be selected among professors, Ph.D., researchers, students, other representatives involved, institutions, corporations and all the stakeholders that are deemed necessary.

Summer School

It is focused on a deep understanding of the Politecnico di Milano methodology of teaching, research and technology transfer. A clear and comprehensive framework could be provided, in which local curricula could be improved and upgraded to international standards. The lectures will be divided in different subjects, accordingly selected, due to the different priorities that will be chosen from the partner.

The lessons could be divided in three areas of analysis: teaching, research and technology transfer, paying the attention on:

- Relevance of the programmes
- Structure of scholarships and postgraduate courses
- Methodology of teaching
- Efficiency of the courses
- Educational offers
- Organisations of research activity and the link with teaching
- Involvement of students and professors on research activities
- Applied research and networking with industries
- Valorisations research's results
- Relationships with industries related to patent
- IP (intellectual property strategy) (European Commission 2006)

Meetings

In order to furnish a complete frame of the situation, meetings will be held with the scope of networking the Pakistani Representatives from different areas to other specific stakeholders such as entrepreneurs, the Chamber of Commerce in Milan, and Assolombarda (Association of the Lombardia Region Entrepreneurs).

The BZU Professors, Ph.D. and all the partners could furnish a preference or a list of interesting subject that they would like to meet in a constructive optic, focused on the improvement and the effectiveness of the action targeted on the final beneficiaries.

Visits and interviews could be organised to those district, areas, facilities, industry, clusters and other relevant structures that could be interesting for an overall comprehension.

Seminaries

Besides being important events of dissemination, seminaries will be organised in order to present the best practice and results of the Politecnico di Milano and vice versa regarding the specific subjects and areas of the selected partners.

The importance of the seminaries is to show results and explain the methodology used to reach them in order to acquire a complete understanding of the various activities that could be replicated.

21.4.2 Promoting Exchange

- Ph.D. exchange
- Visiting professors

- Communication initiatives
- Polisocial services

Another core of the proposal is to focus the short-term activity through different actions focused on universities' collaboration for promoting student and teacher exchange after correct and efficient upgrading curricula.

PHD Exchange and Visiting Professors

It is an important and challenging aspect. Accordingly with our standards should be done an evaluation of the level of students and teachers. Also a dialogue has to start between the administrative staffs from both universities, in order to understand the real feasibility and next steps. After the Pakistani week, a second kind of this week could be proposed at BZU, and a plan of visiting professors could be set up for these lessons on site.

Communication Initiatives

Opportunity at Politecnico di Milano has to be shown at the BZU students and teachers through both websites for promoting exchanges and opportunity both sides: a bilateral relation has to be started between the communication and Web offices of both universities.

Polisocial Services

A service could be offered to those students, admitted at Politecnico di Milano, for hosting and staying, accommodations and facility services.

21.4.3 E-Collaborations

- E-learning courses
- E-collaboration activities
- E-sharing materials

E-Learning and E-Collaboration

The organisation of e-learning courses for distance learning to make available the material used during the summer school and to assure proper follow-up. Courses and other important matter would be available on-line through a website dedicated.

METID[1] Politecnico could offers services on the whole process of design and development of e-learning and e-collaboration related to the teachings and to other relevant aspects.

E-Learning Courses

Design and development of an e-learning course; definition of the characteristics of an e-learning course from all points of view: educational, technological, organisational and communicative.

E-Collaboration Activities

Platforms and technological tools development; implementation or customisation of software platforms according to users' needs. This could be done in partnership with the BZU Dept. of Computer Engineering.

E-Sharing Materials

Multimedia editing, creation of multimedia materials in different formats usable on different devices (Web, mobile devices, etc.), for sharing knowledge and scientific papers, for example.

21.4.4 On-Site Activities

- On-site training and tutoring
- Monitoring and evaluation
- Open day at BZU with industries
- Thematic workshop based on industrial needs

On-site activities are fundamental for supporting local partners and to empower the capacity building action of the project.

[1] Since 1996 METID (Methods and Innovative Technologies for Educations) is the Politecnico di Milano Centre dealing with design, development and delivery of e-learning and e-collaboration services, at both national and international level.

On-Site Training and Tutoring

Innovating Teaching and Learning Experience. The issue may be divided into two aspects:

1. *Contents*: The specific content of a course may be updated by delivering the knowledge and the lesson learned during the summer school. In this case local teaching staff would need to be prepared and international experts need to be called and deliver seminars/summer school or intensive semesters.
2. *Teaching methodology*: It may be updated, for instance, by introducing the facilities coming from the e-learning, e-sharing approach. Also the participatory lessons (in small groups but also in plenary sessions with the teachers) have proven to be more efficient, since students are directly involved in the process.

Open Day at the BZU University with Industries

Organisation of a dedicated day where the industries enter the universities and present themselves is one of the major suggestions that come out from discussions with stakeholders. That could be the first action for keeping in line with industry needs the various curricula within the BZU University, and it could represent the first occasion for upgrading curricula by themselves.

Three are the essential elements of the open day:

- A sort of exhibition with panels and stands
- Some sessions to introduce the companies and their activities to the students
- Some key note speaker lectures (based on their experience and from the needs of the industrial world)

Thematic Workshop Based on Stakeholders Needs

Thematic workshop on industrial needs DRIVEN by INDUSTRIES

Thematic workshop on strategic topics DRIVEN by INSTITUTIONS

Thematic workshop on valorisation of the research DRIVEN by UNIVERSITIES

We strongly believe these are low-cost and low-effort activities compared to others but can really contribute to change the interaction of industries and universities. Such events could be organised on a semester or an annual base. The presence of international experts bringing comparable lessons and experiences may be useful but not mandatory especially in the early stage (UNIDO 2005; UNESCO and the OECD 2004).

21.5 Final Considerations

Within the framework of Politecnico di Milano's vision, technology and innovation, properly driven by human factors and coupled with the principles of social responsibility and ethics, may represent an adequate set of values and necessary instruments to be used. In this contest university has a key role to play and the link (real and effective) with industry and institutions need to be enforced and maintained.

The on-site mission contributed to make a focus on the general situation existing in Multan City, specifically in the relation between institutions, universities and industries.

In this vision, the human capital becomes central. Technology is a mean for solving a new problem and it is appropriate when it is able to solve the problem, regardless from its true originality. Innovation stands in the idea of the solution itself.

Within this vision, the first effort that needs to be done at the local level is the investment in human capital in order to create a new culture of research and to promote a new attitude on innovation and a major propulsion to networking.

About the academic staff and institution, the general impression is positive, in terms of their background, skills and ability to manage the teaching actions in a situation which is partly constrained by underfunding (buildings, laboratories where a limited number of experiences can be carried out) and some structural problems (e.g. electricity supply, computer resources for both science and administration). Moreover, the general preparation of the graduates seems quite satisfying. Most of the staffs in BZU are very well aware of the needs of the country and of the necessity of upgrading and opportunities in their fields through capacity building. Their contribution in finding the proper implementation of the concepts here exposed will be essential and must be supported at the governmental/institutional levels.

Without the triple helix including university, industry and government, it would be very difficult to set up long-term and sustainable programme. Therefore, we would like to recall the essential element of involving the governmental institutions as the key players, together with the cooperation between Politecnico di Milano and BZU University for fostering and designing a more proactive link among the universities, the industry, the institutions and their needs and the opportunities that could be offered by proper capacity building action.

Finally we would like to close with a positive feeling coming from the young people we met in the university, who seem to be highly motivated. They need to be supported by the university with proper training courses and by institutions, with scholarship, exposure and financial support.

As a final note of our contribution, we strongly believe that this new attitude, working together for development, may indeed in the short run enforce the local commitment and sense of ownership in any project of development promoted at the local level, thus effectively contributing to create a wider framework of opportunities for socioeconomic growth and sustainable and autonomous development.

A cooperation with BZU University and Pakistan is considered strategic by the Politecnico di Milano and Fondazione Politecnico di Milano due to the importance of strengthen relations between countries in terms of human capital, opportunities and knowledge exchange.

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Chapter 22
An Architectural Analysis of the Walled City: A "Pilot Experiment" of Collaboration with the Building and Architectural Engineering Department of Bahauddin Zakariya University

Daniele Beacco

Abstract Sixteen students and one professor from the Faculty of Architecture and Engineering of the Bahauddin Zakariya University were involved in an on-the-ground preliminary survey of the Walled City of Multan. The purposed of this work was to understand the structure of the city and to develop a cartographic analysis designed to create the basis of metric-type morphology studies of the historical city buildings.

This experiment proved to be helpful in recognizing the historical and architectural heritage of the Walled City of Multan through an urban study that revealed the character of the city as well as its heritage. That task was not easy to implement in a country considered strong in development, where increasing economic pressure is causing numerous replacement operations of ancient artifacts.

The redrawing of urban spaces as a mapping operation was helpful in determining the shapes of the city, a study that had never been carried out previously. The study of the city, not just of its function but also of its morphological qualities, in the absence of reliable documentation, was for the students a path of initiation, observation, and discovery of elements useful to the understanding of the city structure through freehand drawings interpolated with satellite images.

The educational activity prefigured the desire to encourage students, administrators, and civil society in general to protect the unique historical and architectural heritage of this part of the Punjab region.

D. Beacco (✉)
Fondazione Politecnico di Milano, Milan, Italy
e-mail: daniele.beacco@polimi.it

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22.1 The Educational Survey Across the Walled City

One of the core project activities was the harvest of data for a preliminary cartographic development of the pilot area in collaboration with students of the Bahauddin Zakariya University in Multan. This type of activity, which had never happened before, involved the participation of 16 students in their last university year and their professor in the Department of Architecture and Engineering (Fig. 22.1). A series of preliminary meetings before the operational phase provided the students with the knowledge background on the data collection strategy in order to understand the city, its morphology, and its functions for the final establishment of a GIS.

During the various campaigns, the student team was kept constantly informed and attended weekly meetings throughout the course of the surveys on the objectives of the analysis research. This extraordinary experience in Multan immediately garnered the interest of the students, who participated in the encounters with enthusiasm, involving themselves in the re-drawing of city structure (Fig. 22.2).

The first step was to convey the reason for a study and analysis across the Walled City. General knowledge of Multan, as one of the oldest cities in Asia, was not supported by any archaeological and urban studies able to define its historical and urban evolution. Additionally, the absence of urban studies in Multan forced us to work on a "clean slate." Only the city of Lahore, which is the most analyzed and near to Multan, is one of the few urban sites that has had, during the past decades, scientific data collection studies of its structure and its developments over time. After collecting the initial fundamental urban data, an adversarial analysis is possible.

One element that contributed to misinformation about the actual character of the Walled City is the fact that the center had never been visited before the project by many of the young students who worked on the studies and direct surveys. With them, we defined the city as a complex artifact described by the few research materials available, and we set the qualitative analysis defining primary elements and residential areas and, after that, the preliminary measurements between Haram Gate and Pak Gate. The analysis started from the two main axes recognized by the presence of the bazaars, considered the urban element that creates the fundamental city structure.

The city mapping action was established by focusing the analysis on the actual geometry and functionality of each building without, this first time, the total stations but giving priority to action that aims "to educate seeing through the design," allowing students to discover and "look intently" and, through the freehand drawings, to understand the shape. It is an approach to comprehension of the city through the senses, stimulating sensory cognition and observation. The idea of this kind of survey has a central importance because it is the privileged path of educational practice focused on active understanding rather than passive explanation (Fig. 22.3). With this method it was easier to highlight our attention on the

Fig. 22.1 The16 students from Bahauddin Zakariya University, Multan, Pakistan, with their professor

Fig. 22.2 The preliminary explanation of how to recognize the city's structures

Fig. 22.3 Freehand drawings done during the direct survey

system that considers the city as a structural space instead of the mere results of different functional systems responsible of the city architecture.

This approach underlines the characteristics of morphological permanence that constitute the peculiar city urban qualities, as Aldo Rossi said that "whenever we describe a city we are dealing with its shape and this shape is a tangible data referred to a real experience." The first harvesting of empiric data could be accomplished through observation in order to describe the architectural forms as an instrument, an action by which we can know the structure of the city as one of its urban facts.

This is the aim that has characterized the approach to the survey, with a desire to know not only the metric characteristics but oriented to a real understanding of the structural, compositional logic and typological qualities. This allows us to deduce, via the measurements and observations, useful criteria for the design problem solutions that underlie the objective of conservation and promotion of the city center.

It was important to stress the differences between an analysis based on the study of the architectural shape and the study of its functions. The first type of study reflects the quality of the architecture; the second type, the function analysis, does not always show the real identity of the urban artifacts because the functions have a dynamic development and transformation compared to the architectural shape characteristics. Shifting our survey attention to the different architectural shapes, we were able to determine a more complex descriptive scenario and comprehension of the urban identity. This theoretical construct was envisaged as an analytic tool for the understanding of the physical reality in an educational context, where the analysis of old and existing urban areas is less developed compared to the experience with new urban and building development.

To study the old city map, we focused our attention on a defined part of the city that offers more pragmatic criteria for better knowledge and planning. Choosing a study area could be considered a sort of abstraction compared to the entire urban area; it is a useful study method for defining a certain urban phenomena. For an initial tracking of the morphology of the city, numerous urban blocks were identified and delimited as macro areas containing single urban artifacts, following the intention to create, with good accuracy, many sketches that at the conclusion of the campaign proved to be a reference to a more accurate geometrical survey with a theodolite.

The comprehension of some urban blocks and the influence on a plot's development on certain building types required the extension of the analysis to adjacent blocks that constitute the surroundings. This helped to determine whether or not the shape is related to the general and common urban characteristics.

Drawings were therefore spotlighted as a fundamental tools for reflective analysis of the city space. We prohibited use of high-tech electronic devices, which do not allow, at this primary stage, an active and accurate direct analysis. Pushed aside by the extensive use of computers, freehand drawing skill, well known in the past, has now been rediscovered and put into operation because it can create a faster and easier connection between the brain and paper. It is an instrument of dialogue in real time that is useful on the worksite. With its lack of precision, it can suggest the impact of a detail in an intuitive way,—and hand drawing allows for virtual three-dimensional rendering. As times passed, however, it became clear that there is no conflict between the use of digital technologies and freehand drawing; rather, they are complementary because all sketches collected were then assembled to create a first mapping for the development of the GIS (Fig. 22.4).

The assembled model appears, therefore, as a first element (inevitably only partial and without specific measurements but still providing a graphic-oriented analysis) required for future projects inside the historical city. Its value is not merely documentary; this way of representing the territory correlates heterogeneous data affecting the scale from the detail up to the wider one. Consider the cartographic base as a necessary spatial matrix, a core able to connect results of different moments of research computing with overlapping levels dictated by the GIS but also with more qualitative content.

From the architect's point of view, to "detect an object" means to know first of all how to make a "morphological analysis," understanding how certain urban contexts are made. In the urban fabric, we need to understand how the elements and their syntax are organized in a dynamic system, governed by precise relationships between sets of "culture" and settlement arrangements defined as "natural" that refer to the morphology of the soil.

In increasingly complex and detailed field analyses, the studies went beyond the mere design of building shapes. We introduced to students the observation of the

Fig. 22.4 Drawing map stages: the three main steps, starting from the satellite image, through the drawing activities, to the digitalization of the entire pilot area map

building type and the recognition of those forms that are invariable and give meaning to the definition of building type that was not clearly intelligible at the first stage of our encounters. The city analysis was enriched by the type definition that resulted from the field work through a process in which "the reality of architecture reveals itself with its essential content and at the same time as an operating method which forms the basis of the same design act" (Marti'aris 1993). In order to identify typological elements, the students collected material characteristics and the estimated age of the artifacts. We expanded the scope of analysis and reduce the boundaries of each survey field to create a synthesis that could describe the architectural quality and, in a second phase, the identity of the city.

The experience of compiling the GIS forms could be considered the result of these discriminating urban studies, a period of enrichment when new analysis elements were discovered daily, and knowledge of new building classifications and traditional construction techniques were obtained through the survey process (Fig. 22.5).

With this kind of direct study, we gradually discovered that the building type summarizes in its complexity a permanent feature and manifests itself with a character of necessity; but even though it is predetermined, it reacts dielecticelly with technique, function, and style, as well as with both the collective character and the individual moment of the architectural artifacts (Rossi 1982).

Analysis and communication of objectives for the documentation and preservation of the city go hand in hand. It was essential to shift the research focus from the attention to monuments (deeply studied in the past) to all city structures like public space and the residential and commercial city that is undergoing the most dynamic transformations. Urban geographers such as Raul Blanchard view the city as an "*organisme vivant*," a living being, always changing and subjected to influences. In

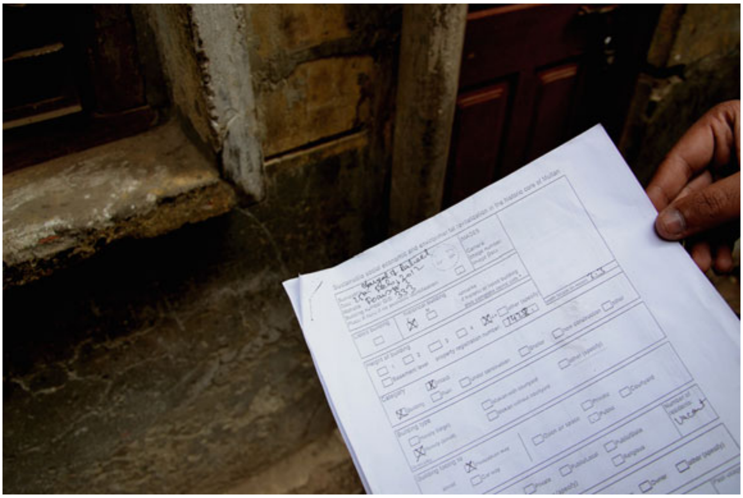

Fig. 22.5 Compiling the GIS forms

Multan, the dynamic changes are a common conditions that required monthly updates of the map details because of demolitions.

Some old city areas are in constant threat of disappearance, as they are increasingly subjected to commercial pressures with new activities that require more space and do not match the existing houses. This lead the desire to communicate to the students the recognition of heritage. The transmission of these concepts during field observations was accomplished through the definition of culture that characterizes "what we are" *as repository of knowledge, meanings and values that permeated all aspects of our lives, cultures and human beings also defines the way we live and interact, both at local and international levels* (Badarin and Al Hassan 2013). This takes into account the definition of heritage, released by UNESCO, as a result of culture and civilization, referring to the historical areas, cultural and natural environmental, that provide evidence of a durable past.

Following this paradigm, it is deduced that the shape of the house, the location of the architectural, structural, and ornamental elements, and the construction process directed by traditional rules and theories are themselves evidence of a cultural architectural heritage to be preserved. Documentation in the field should involve building workers, custodians of traditional construction knowledge not mentioned in any document, who are themselves an essential resource for a conservation project.

To better instill the design work, it was helpful to review similar experiences, during weekly meetings, which included other examples of urban analysis and building conservation projects, such as some early experiences of UNESCO in the Islamic world, especially in the historic cities in Morocco and Yemen, recent conservation activities in Lahore, and the actual guidelines for the building and protection in an ancient city in Italy.

In addition to technical methodology and the process of preservation strategies, the studies and projects in old city may increase the awareness of historical heritage. Something that is at risk of disappearance requires an accurate analysis and the sensibility to transform studies into conservation projects.

Promotion, especially through education, of the value of heritage to students and to wider audience including the local population, make people, professionals, and governments aware of the potential of heritage as a tool for development. This should include in its explanations research solutions adapted to enhance heritage through procedures already used in other similar experiences, fostering the establishment or development of national or regional centres for training in the protection, conservation and presentation of the cultural and natural heritage and to encourage scientific research in this field (United Nations Educational, Scientific and Cultural 1972).

It is, therefore, crucial to mainstream the cultural dimension, including education, gender, and experiences, into all development project activities. As a repository of knowledge, meaning, and value, culture is also central to shaping the relationship between people and their environment. The mission was to know the complexities of local context and societies, to create an environment conducive to sustainable development, able to promote a plurality of knowledge systems, and to suggest how a powerful socioeconomic resource could thrive in an old urban area.

Such activities have opened a new cognitive scenario in Pakistan and have been supported by active interest, curiosity, and participation by students involved in the critical analysis through studies of different completed experiences in other cities across developing countries. They perceived the projects' potentialities, objectives, and outcomes. The numerous exchanges between the local knowledge system and new knowledge have provided fruitful insights and tools for tackling human, professional, and educational challenges.

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