Electrical Estimator's Manual

How to Estimate Electrical Construction Projects

Including Everyday Labor Installation Rates

William Penn

Houston, Texas

Gulf Publishing Company
2 Greenway Plaza, Suite 1020
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Contents

Preface

This guide of instructional and informative material has been developed for the individual who would like to add estimating of electrical construction projects to their skill set. Electrical workers, apprentices, contractors, draftspersons, engineers, architects, material handlers, salespeople, and instructors of electrical contracting courses who are involved in the electrical construction industry can benefit by studying and applying the information in this guide.

An explanation of bidding procedures, project specifications, and construction plans is laid out with step-by-step instructions using drawings, notations, detail sheets, and a ***complete sample estimate***. Blank estimating sheets for the estimator's use when estimating are included.

The guide begins by explaining the various sections and divisions of a sample project's bid specifications. We also review each trade's installation responsibilities (for example, general construction, plumbing, HVAC, and electrical). Partial floor plans and site plans have been developed for the electrical installation. These partial plans will lay out the services to the building, the site and interior lighting, various devices, voice/data communication, the fire alarm system, and mechanical equipment electrical requirements.

The sample estimate herein includes a recapitulation sheet of the sample estimate that depicts all of the job expenses, nonproductive labor, materials, and labor hours for a complete installation cost. Contractor overhead as well as profit is allowed for, and these percentages will be set by the contractor.

Electrical contractors are constantly searching for qualified, experienced estimators as well as junior estimators for their companies. By thoroughly studying this guide, you will enhance your job marketability to electrical contractors.

A section of this guide includes more than 2,500 easily accessed labor units on a wide array of electrical materials, along with charts, miscellaneous formulas, and rules of thumb. The labor units included herein have been developed by this author after more than 45 years in the electrical construction industry (see "About the Author").

Introduction

The electrical construction industry has evolved from the rudimentary adage "black is the hot leg and white is the neutral." Although this is still true and the theory is the same, much has been discovered and expanded on. When you visit or speak with an electrical contractor today about estimating, bidding, buying, etc., it is nearly the same as it was 50 years ago. Yes, the estimating hardware, so to speak, has evolved from handheld counters and individual wheel map measures to electronic probes that count and measure and at the same time keep a running total. New devices have come into the market to make the estimating task faster and more accurate, which, in theory, reduces the cost to produce an estimate. This is all true, yet there is one factor that has survived all these years and will continue to survive—the hands-on ESTIMATOR.

The ESTIMATOR has the ability to transform a set of electrical construction plans and documents into a total cost of labor, materials, and job expenses. All of the new probes, markers, and gadgets cannot attend a prebid site investigative walk-through or actually interpret bidding documents. This always has been, is now, and will be performed by a human being—an ESTIMATOR.

Estimators are constantly being sought out by electrical contractors and are in great demand. Many times a contractor will have an employee (an electrician or someone else) who shows responsibility, good work habits, dependability, and enjoys their work. The contractor might encourage that employee to begin to learn the estimating process; this was my personal experience with a contractor whom I worked for as an electrician and who led me to develop this knowledge.

The following text has been developed after my many years of experience in the electrical construction industry. The contents have been designed in such a way that electrical instructors, electricians, electrical engineers, architects, blueprint readers, etc. can draw some benefit from it, even if only for reference material. Those individuals who have some electrical experience and want to advance themselves into the electrical estimators' circle should study the material contained herein. The entire format has been designed with the beginner as well as the seasoned estimator and others in mind.

Included are step-by-step instructions on how to interpret construction plans and specifications, what to look for, and why you should read *all* of the specifications, even those for the roofing, woodwork, wall construction materials, plumbing, etc. Many times there will be items in these categories of the specifications that impact an electrical contractor's bidding price.

Partial plans of a typical office building are included to show the utilities coming into the building,

the site lighting, interior lighting, panels and power-distribution devices, safety and communication devices, mechanical equipment, and electrical services to properly depict the various electrical materials in place.

Rough takeoff sheets have been developed for all of the electrical materials shown on the partial plans and associated materials required for a complete installation. This book will show you how to transfer all of the materials shown on the rough takeoff sheets to estimating sheets for inserting prices and labor hours. The next step shown is to total all of the labor (material is not priced here due to each contractor's specific pricing structure) and transfer the hours to a final recapitulation sheet. This final recapitulation sheet will include all pricing, labor hours, nonproductive labor, job expenses, hourly labor rates, overhead, and profit.

Following the job estimate, there is a section on actual labor rates for thousands of items of materials and installations. These have been time-tested in the field and applied by many contractors whom I consulted for in the past (see "About the Author").

A complete sample estimate has been included here to show exactly how a professional estimate is formulated. Although the prices of the individual materials are not shown on the estimate pricing sheets, there have been allowances inserted on the final recapitulation sheet so that you can go through this sheet from beginning to final bidding price.

At the end of this book there is a miscellaneous section of formulas, charts, schematics, conversions, lighting levels for most common places, and blank estimating and related business forms.

There are many aspects to the electrical construction industry and the feeling here is that estimating is the heart and soul of a successful company.

CHAPTER 1

How to Estimate Electrical Construction Projects

This information and instructional material is designed for those who have experience as an electrical contractor, electrician, electrical draftsperson, or electrical engineer in the construction industry, and also for those who want to increase their knowledge of the estimating field. If you have some knowledge of blueprint reading, electrical materials, and field installations on construction projects, this material will be easier to learn and then apply. After you complete this book, you will need to have access to the essential reference materials and tools that are listed below, whether you are a beginning or a seasoned estimator.

Contractor's Library: Reference Material for the Estimator

- Latest edition of the National Electrical Code
- Latest edition of the National Fire Prevention Code
- Latest edition of the BOCA Code and local codes in the area of construction
- Catalogs and digests of electrical materials
- Material pricing references
- Labor unit manual for electrical materials (enclosed within Chapter 3 preferred)
- Reference material on installations of other trades
- Pads of rough takeoff, estimate, feeder, recapitulation, and change-order sheets

Estimator's Tools Required

- Triangular architect's rule
- Triangular engineer's rule
- Miscellaneous drafting tools (angles, protractor, templates)
- Manual hand counter
- Map measuring wheels (1 inch, ¼ inch, and ⅛ inch to the foot)
- Electronic probe counter and measurer in lieu of manual counter and wheels
- Walking measuring wheel
- A 100-foot tape measure
- Highlighter markers
- Access to a computer is recommended

Estimating is the art of translating blueprints, scopes of work, prebid field inspections, and verbal requests for proposals into costs of materials and labor required to produce a complete electrical installation with an adequate profit margin. Although there are various types of

estimating, such as the square-foot method or the assembly method, this course will use the labor-unit approach. There may be instances where the estimator uses methods other than the labor-unit approach to produce a budget or ballpark price. This often occurs when time does not allow for a labor unit estimate, but the contractor feels compelled to submit a proposal to the requesting party. These proposals are often costly to the contractor and have a negative effect on the relationship between both parties and perhaps others who have an interest in the project.

SECTION 1: Preparing Estimates from Plans, Specifications, and Related Documents

For this exercise, let us assume that a shell of a 5,000-square-foot (50' × 100') building has been erected for future office space. The floor has been poured with 4 inches of reinforced concrete, the exterior walls are constructed with cement blocks, and the roofing material is supported by steel bar joists on 4-foot centers. There is a main front entrance and side and rear exit doors. The building will be heated by natural gas and will be fully air-conditioned by four roof-mounted, prepackaged HVAC units. The men's and women's restrooms will have a roof-mounted exhaust fan and their walls will be constructed of cement blocks. The entire building will have an automatic wet fire-sprinkler system. The finished ceiling will be constructed with suspended tee bars and acoustical ceiling tiles sized at 2' × 4' and 2' × 2' as required. The interior walls will be steel studs with sheet rock. A utility room with exposed ceiling construction has been provided for the electrical equipment, building maintenance items, and communication space for voice and data distribution.

There are electrical floor plans that show the electrical panels, lighting fixtures, switches, receptacles, exhaust fans, HVAC units, exit and emergency light units, time clocks, fire alarm panel, fire bells, fire pull stations, smoke detectors, telephone and data outlets, and detailed riser diagrams for power, fire alarm, and communications systems. **Most estimators will review the electrical plans immediately and notify the various major material suppliers of the need for pricing and the date their prices are required.**

A site plan and partial site services plan show the site lighting poles and fixtures, the wall and floor openings for the electrical service, and communications and site lighting that the builder installed in the concrete bearing walls below grade. Also shown are details on the site lighting pole bases and conduits for the service, including wire size, conduit size for the communications, and conduit size with wire sizes for the site lighting. The location of the temporary electric service for the project's construction and staging area is also shown.

Included in the bid package are the plans, contract specifications including a scope of work, and a form of proposal to be used by the bidder when submitting his or her price. The scope of work defines what is to be included in each contractor's proposal. There is also a bulletin #1 (sometimes referred to as an addendum) that is to be acknowledged as received, and any cost impact must be included with the contractor's proposal. Bulletins and addenda often arise in response to questions of clarification asked by the contractors. This method keeps all of the bidders aware of any changes in their scope of work, which may affect their proposal. Bulletin #1 is issued to change the bid due date only.

STEP 1: What Documents to Look for and Examine

Invitation to Bid

The invitation may come to the bidder in the form of a letter, postcard, newspaper advertisement, facsimile, email, or by telephone. Let us assume it was delivered to the bidder by letter, requesting a proposal for his or her portion of the work. In this case, it is for the electrical installation of the proposed office space. The invitation usually provides a project description along with, but not limited to, other related information such as the physical size of the building, its present condition, location, owner, a time and date for a prebid meeting at the site for all the bidders (sometimes attendance is mandatory), and a time and place to receive the bids. This invitation may be sufficient for the contractor to either submit or decline to submit a proposal. In this case, we will review the invitation along with the form of proposal (bid form) prior to proceeding with the decision to submit a proposal.

Form of Proposal or Bid Form

This will give the contractor information on bonding requirements, among other things. Is there a bid bond, letter of surety, or performance and payment bond required, and to what percentage are the performance and the payment bonds rated? This is important for the contractor to know prior to investing time and dollars in an estimate. The contractor may or may not be able to acquire additional bonding for this project for various reasons. Perhaps the contractor has a limit on the dollar amount of volume the bonding company (also referred to as the surety) has predetermined to be the limit of liability.

There are many different ways a total estimated price might be requested. Instead of asking for just one total price for the contractor's entire scope of work, the bid request might require a breakdown of the total price by tasks within the scope of work. Thus, there will be many different forms of proposal that the contractor will be exposed to. **The estimator *must* prepare the estimate according to the requirements as described in the proposal form.**

Note: It is the estimator's responsibility to inform the contractor of bidding and bonding requirements as soon as possible, to give the contractor ample time to make an intelligent decision as to whether to bid on the project or decline. This also gives everyone concerned ample time to complete their tasks prior to the date fixed for submitting proposals.

Now that we have examined the invitation to bid and the form of proposal, the contractor has made the decision to submit a proposal on the project.

Project Specifications

Contained within the specifications are the general conditions, the supplementary conditions, and the special conditions for the mechanical and the electrical trades. Next we will follow the various trade divisions of the work. Let us look at each division for the items that may impact the estimator's price structure.

General Conditions. These apply to all the prospective contractors who may be contracted to install a portion of the construction project. A scope of work, which is part of the general conditions, will provide each contractor with specific requirements for the completion of their work. Here the contractor will review information on all of the contractor's obligations for their work. A scope of work is outlined, and also information on insurance requirements, time of completion, payments to contractors (including a schedule of values), damages, conflicts, disputes, arbitration, progress scheduling (either by a bar chart or a more complex critical path method), temporary facilities required, inspection reports, cooperation with other trades, cleanup, storage facilities, shop drawings, etc.

Supplementary Conditions. Not all projects will require this type of supplement. These are used primarily when a generic set of general conditions is used for a project. This reduces the cost of designing a whole new set of general conditions. As each project stands on its own as to conditions, it is more cost effective to use supplements along with a generic set of general conditions.

Special Conditions for the Mechanical and Electrical Trades. These trades require specific instructions because each trade either supplies electrical materials for installation by others, or is obligated to supply and install certain items requiring electrical power supply in one form or another. It is very important that the electrical estimator read the requirements of all the mechanical trades to ascertain the responsibility of the electrical contractor. Examples of items that would need to be clarified are motor controls, disconnect switches, duct heaters, automatic temperature control systems, handling of motors, fire-pump controls, and the like.

General Construction Division. Although we will be assuming that a shell of a building is in place and the scope of work will govern, it is necessary to become familiar with all building specifications that follow. This section will discuss who is responsible for the following: site clearing and preparation, civil work, drainage, roadways and **parking areas**, surveying, **excavation**, forms, reinforced concrete work, **masonry units**, roofing materials, miscellaneous metal, insulation, weatherproofing, **partitions and interior wall finishes**, windows, glazing, interior and exterior doors, **magnetic**

door holders for the fire alarm system, hardware, floor covering, painting, **suspended ceilings**, **acoustical treatment**, carpentry, **openings for other trades**, and other miscellaneous items.

Structural Steel Division. This section will not be as detailed as the general construction division. The estimator should review this and look for such items as openings in the roof material and bar joist construction. There may be specific loading and or hanging requirements allowed from these joists, in addition to other agencies having jurisdiction.

Plumbing Division. Do not overlook this division by assuming that plumbing has no significant impact on the electrical work. There are items that may require electrical power such as, but not limited to, **sewage ejector pumps, sump pumps, water pumps, boilers, certain gas-fired units, water connections to emergency power generators, motor controls, fire pumps and related flow switches, and tamper switches and controllers.** So, be sure to review this division as well as the supplementary conditions for the mechanical and electrical trades to learn who is responsible for furnishing, installing, and connecting such items.

Heating, Ventilating, and Air-Conditioning Division. In this division, there will be many items that will require coordination with the electrical contractor. Therefore, it is absolutely necessary for the estimator to review each section of this division where there are items that require electrical power and perhaps control wiring. These specifications will define who furnishes, installs, and connects the materials necessary for this division. **Review in detail the sections on roof fans and blowers, prepackaged gas-fired rooftop heating and air-conditioning units, automatic temperature control systems, connections to heat-supplying light fixtures, duct-mounted fire detectors with probes, motorized louvers, electric heat units, motor controls, and the like.**

Electrical Division. You should read these sections in their entirety; along with all the other divisions and sections, these form the written requirements for the electrical contractor. The specifications will define all of the electrical components as to type, installations, sizes, manufacturers, shop drawing requirements, etc. **When the specifications and plans conflict, a general rule of thumb would be that the plans take precedence over the specifications.** The thought behind this is that the plans are drawn for a particular project, while the specifications are used by many electrical engineers for many different projects.

If a major conflict is detected and a cost impact is apparent, the electrical estimator should write to the electrical engineer, with a copy to the architect, asking for a clarification. Beware of seeking answers in phone conversations. Too often, phone calls are forgotten and in the general conditions this type of communication will not be honored if challenged. Always put all of your job-related concerns, questions, and statements in writing to all the interested parties. Send copies to the owner's representative, inspectors, the architect, engineers, the general contractor, subcontractors, and any other persons who would be directly involved with your concern, question, or statement.

STEP 2: The Bid Drawings and Estimate

Let us begin with a set of bid drawings issued along with the previous bid documents. The drawings include a title sheet, which will list the project name and address, the owner's name and address, the designer architect, engineers, the date, and a list of drawings included. By having a complete set of drawings, the bidders on the various sections will have all of the building information necessary to submit a sound proposal. Unfortunately, there will be times when you will only receive the electrical floor plans and perhaps a site plan. This creates a list of exclusions you will need to submit along with your proposal. But let us continue with the premise you have all of the bid drawings.

Title Sheet

This sheet offers important information such as a list of the drawings for each main section of the work, the number of drawings, revisions with their dates, and the contact information for the architects and engineers.

The estimator must compare each drawing number, date, and revision to the title sheet list of drawings. This will assure the estimator that the drawings bound in the bid set are the appropriate bidding documents. If the estimator discovers any discrepancies in the bid drawings, he or she should immediately ask the architect for clarification, in writing, with copies to the owner's representative and the engineer. If the proposal is being made to a general contractor, the request for clarification would go to that contractor. **Remember, all communications by telephone must be followed up in writing to avoid under- or overbidding.**

Site Plan

Now that we have verified that all of the drawing numbers and dates bound in the bid documents are correct, we can proceed with a scan of all the drawings, beginning with the site plan. A typical site plan will show the building(s), roads, driveways, sidewalks, parking areas, utilities, landscaping, lighting, and various other details. Note the scale on the site plan for future reference and highlight it with a marker. **Consider repeating the scale in large numbers with a colored marker in an open area on all the plans so you can't miss it.** Take note of the compass heading in reference to the building for your information when placing photocells for exterior lighting, if specified.

The main road that provides access to the project will be the most likely area where all services will be accessed. Regarding the electric, telephone, and data services to the building, you will need to pay close attention to various elements such as the topography, landscaping, other utilities, paving, and curbs. All these factors have a direct impact on the electrical proposal. If the conduits that supply these services need to be buried at a depth of 42" minimum, then the topography will need to be examined closely for rises and declines of the rough graded area. You may have to excavate 60" of depth in some areas of the direction of the conduits to maintain 42" minimum depth of these conduits. **Locate any landscaping** that may affect the direction and depth of these conduits, and report any depth and direction conflicts to the architect. I have seen many auger bits chew up conduits because of the oversight by the affected trades. Landscaping contractors generally investigate their planting areas as they relate to utilities that may be buried there. Keep this in mind when preparing your estimate.

Look for the water meter, which may be located in a pit on the exterior of the building or in the building. This water meter may require a continuous bonding jumper around the meter to prevent loss of continuity of the metal water service conduit if the meter is removed. The local inspecting agency will be able to answer any questions regarding grounding and/or bonding that they require. Remember that the National Electric Code (NEC) provides the minimum requirements for electrical installations, but the local electrical inspecting agency may enforce a higher level of requirements. Question the local electrical inspector. Locate the sleeves that the general contractor built into the walls below grade for the electric service, telephone, data communications, and site lighting. You will need to connect to these and list this work in the estimate. Review the site lighting fixtures and bases. Look for any details on the site lighting fixtures, bases, and their description schedule that may be on this sheet. If there are no details here, they will be located on the electrical plans. This plan may also show where temporary services are to be located, such as electric, water, telephone, and staging and storage areas for the contractors.

Foundation Plans

Not all bid sets will contain separate foundation plans. The architect may decide to incorporate this information on the architectural plans. If you encounter foundation plans, you should scan them for possible utility sleeves or windows below grade in the foundation walls. Here you will find the depth and sizes of the footings, and the width of the foundation walls and grade beams. Take note of the elevation of the top of the footings. This will determine whether you need to stay above or below the footings with your conduits entering the building from the exterior. This plan might also include a list of test borings showing the earth composition at different levels made in various areas of the site. This will help you and/or your subcontractor in estimating your excavation costs for trenches, manholes,

handholes, site lighting pole bases, etc. that may be required.

Finish Schedule Sheet

This sheet will list every floor, wall, and ceiling finish within the building. This will guide you in selecting the proper floor outlets, wall outlet boxes, ceiling outlet boxes, recessed or flush-mounted ceiling fixture frames or rings. The architect may specify special colored devices and plates to match wall finishes. You will not know what colors may be special without reviewing the finish schedule, so the finish schedule has a direct impact on the electrical estimate. This sheet may also incorporate the door finish schedule. This will need to be reviewed for any electrically operated overhead-type doors, entry doors, roll-up windows, etc. for their electric requirements.

Architectural Plans

The total number of plans that are numbered A-1, A-2, A-3, A-4, etc. will be determined by the architect and the complexity of the project. These plans will be used to construct the project. All of the information needed by the general contractor will be incorporated therein. The electrical estimator should review all of these drawings to become familiar with all the different rooms, halls, multistory stairways, exits, entrances, details of wall sections, and ceiling details. A reflected ceiling plan will be included in these "A-drawings." This plan may show the ceiling lighting fixtures. The electrical engineer will use the reflected ceiling plan to design the fixtures and circuiting. Note the details on the suspension system of all the suspended ceilings.

Structural Plans

Again, the total number of plans that are numbered S-1, S-2, S-3, etc. will be determined by the structural engineer in coordination with the architect. It is important to review all of these plans and the associated details for slab thickness, foundation and footing design, structural steel layout, bar joist placement, roof steel, and decking. Do not overlook these plans, as many questions can be answered here.

Mechanical and Electrical Site Plans

Some engineers will prefer to add this plan rather than try to incorporate all of their designs onto the architect's site plan. This plan will lay out such items as the electrical and communications services, site lighting with their details, temporary services locations, cooling towers, condensers for air conditioning, motor-driven pumps, emergency power units, fuel tanks, etc. Coordinate this plan with other site plans in the bid package.

Plumbing Plans

Here again, the total number of plans that are numbered P-1, P-2, P-3, etc. will be determined by the mechanical engineer. Although you may think that reviewing the plumbing plans are not so important, you do need to review these plans just as you would review the other plans. Where is the water meter if not shown somewhere else? The fire pump and associated equipment will be shown here, as well as any sprinkler flow and tamper switches. Sump pumps, condensate pumps, hot water pumps, chilled water pumps, cooling towers, etc., and all of their associated electrical equipment will be shown here as well. Some engineers will include a schedule of all the mechanical equipment, the nameplate data, and the contractor's responsibilities.

Other engineers will list all of these requirements in the specifications rather than on the plans. The plumbing specifications may indicate that all control wiring is to be furnished and installed by others. Seldom will the plumbing specifications require that the control wiring be furnished and installed by the plumbing contractor. Most times it would be the responsibility of the electrical contractor.

Heating, Ventilating, and Air-Conditioning Plans

The total number of plans that are numbered HVAC-1, HVAC-2, HVAC-3, etc. will be determined by the mechanical engineer. The HVAC plans may be the most important plans that the electrical contractor reviews, other than the architectural and electrical plans. These plans will show where all of the heating, ventilating, and air-conditioning equipment are located. You should review

the sheet-metal duct drawing to know the various sizes of the supply and, if any, the return ducts. This will also lay out the rooftop multizone or single-zone HVAC units, roof fans, cooling tower, duct-mounted reheat units, thermostats, ATC zone valves, lighting unit boot attachments for air-handling fixtures, etc. The floor plans will locate the motorized dampers as required for the ventilation design, piping details, unit heaters, unit ventilators, sill-line heat units, etc. Some engineers may include a schedule of all equipment with the electrical requirements, along with who is responsible for furnishing, installing, and wiring it all. Other engineers will spell it all out in their specifications. The plumbing and the HVAC design engineering are generally performed by the same engineering company. In some instances, the plumbing, heating/ventilating/air conditioning, and electrical will be designed by the same engineering company.

Electrical Plans

The total number of plans that are numbered E-1, E-2, E-3, etc. will be determined by the electrical engineer. Now that we have reviewed all of the bid plans, we will review the electrical plans and prepare to do a systematic estimate. Keep in mind that we have previously asked the various material suppliers and subcontractors for their quotations on such items as interior and exterior light fixtures, electrical distribution panels, fire alarm equipment, communication equipment, precast concrete bases, and excavation on this project. Many suppliers will meet with the electrical estimator and review all of the equipment that will need pricing. Some electrical supply houses, if asked, will supply the estimator with prices on the total amount of power and communication cable, raceways, and devices. Look over each plan and become familiar with the layouts of all the devices and equipment. We will begin an electrical material takeoff in Chapter 2 by turning to the "Typical Electrical Symbol List," which has three pages of common electrical symbols. (Note: There are symbol lists on the other contract plans that the estimator can refer to when there is equipment furnished by other trades that require electrical connections.)

CHAPTER 2

Electrical Material and Labor Takeoff

Typical Electrical Symbol List

The symbols shown below are generic in nature, but they give the estimator a guide while doing a takeoff. Review this list and become familiar with the symbols. Some estimators will photocopy the symbols and keep them handy rather than keep fumbling through plans. Each engineer has symbol lists they use that may vary with others, but basic symbols are the same throughout the industry and will be on all symbol lists.

S	Single-pole switch, amp, and volt rating in specs
S_2	Two-pole switch, amp, and volt rating in specs
S_3	Three-way switch, amp, and volt rating in specs
S_4	Four-way switch, amp, and volt rating in specs
S_p	Single-pole switch with lighted handle, amp, and volt rating in specs
wp	Weather proof (nema rating as shown on plans and in specs)
dim	Dimmer switch rating, voltage, type, and incandescent or fluorescent in specs
explo	Explosion proof (class and division ratings in specs)
	Duplex receptacle, amp, and volt rating in specs
	Single (simplex) receptacle, amp, and volt rating in specs
	Special receptacle, amp, and volt rating in specs
	Duplex receptacle in a floor box, amp, volt, and type in specs
	Duplex receptacle-2 gang floor box with combo cover for receptacle and communication jack, in specs
	Enclosed circuit breaker as shown on plans and in specs
	Disconnect switch; 1-, 2- or 3-pole amp and volt as shown on plans and in specs
	Combination disconnect and starter as shown on plans and in specs
	Starter as shown on plans and in specs
S_m	Single-pole manual motor starter as shown on plans and in specs
S_{mp}	Single-pole manual motor starter with pilot light as shown on plans and in specs
	Control station with buttons, switches, and/or lights as shown on plans and in specs


Contactor as shown on plans and in specs


Time clock as shown on plans and in specs


Photocell as shown on plans and in specs


Relay as shown on plans and in specs


Motor control center as shown on plans and in specs


Single-phase electric motor as shown on plans and in specs


Three-phase electric motor as shown on plans and in specs

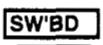

Unit heater as shown on plans and in specs

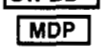

Cabinet heater as shown on plans and in specs


Heating, ventilating, and air-conditioning unit as shown on plans and in specs


Ground connection as shown on plans and in specs


Transformer as shown on plans and in specs


Switchboard as shown on plans and in specs


Main distribution panel as shown on plans and in specs


Power panel as shown on plans and in specs


Lighting panel as shown on plans and in specs


Receptacle panel as shown on plans and in specs


Manhole as shown on plans and in specs


Handhole as shown on plans and in specs

Raceway exposed as shown on plans and in specs

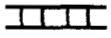
Raceway concealed in slab or below grade as shown on plans and in specs

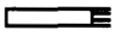

Raceway or cable concealed above finished floor as shown on plans and in specs


Surface raceway as shown on plans and in specs (metal or nonmetal)


Mineral insulated cable as shown on plans and in specs


Tray cable as shown on plans and in specs


Cable tray as shown on plans and in specs (include bends, hangers, drops, grounds, couplings, etc.)


Feeder bus duct as shown on plans and in specs (include all associated components)


Plug-in bus duct as shown on plans and in specs (include all associated components)


Bus plug-in disconnect/circuit breaker as shown on plans and in specs


Patch panel floor stand as shown on plans and in specs


64-port patch panel as shown on plans and in specs

Shelf for patch panel and wire manager as shown on plans and in specs


Floor box with data outlet as shown on plans and in specs


Wall box with data outlet as shown on plans and in specs


Floor box with voice outlet as shown on plans and in specs


Wall box with voice outlet as shown on plans and in specs


Two-gang floor box with data and voice outlet as shown on plans and in specs


100 pair #110-voice block for voice communications as shown on plans and in specs

Communication backboard, size as shown on plans and in specs


Wall box for public telephone connection as shown on plans and in specs


Incandescent light fixture recessed "TYPE" as shown on plans and in specs


Incandescent light fixture wall-mounted "TYPE" as shown on plans and in specs


Exit light fixture ceiling-mounted "TYPE" as shown on plans and in specs


Exit light fixture wall-mounted "TYPE" as shown on plans and in specs


Incandescent light fixture recessed "TYPE" as shown on plans and in specs


Fluorescent light fixture 12" to 24" long surface-mounted "TYPE" as shown on plans and in specs

Fluorescent fixture 48" long surface / recessed / lay-in / suspended "TYPE" as shown on plans and in specs

Fluorescent fixture 24" x 24" surface / recessed / lay-in / suspended "TYPE" as shown on plans and in specs

Fluorescent fixture 24" x 48" surface / recessed / lay-in / suspended "TYPE" as shown on plans and in specs

Fluorescent fixture 48" x 48" surface / recessed / lay-in / suspended "TYPE" as shown on plans and in specs

Fluorescent fixture 8' long surface / recessed / suspended "TYPE" as shown on plans and in specs

LT---LT Light-track surface-mounted "TYPE" and length as shown on plans and in specs

LT Light-track fixture "TYPE" as shown on plans and in specs

C Chandelier suspended "TYPE" as shown on plans and in specs

EM Emergency battery unit "TYPE" as shown on plans and in specs

RH Emergency remote light "TYPE" as shown on plans and in specs

HID HID lighting fixture "TYPE" as shown on plans and in specs

HID HID lighting fixture "TYPE" as shown on plans and in specs

BOL Bollard for walkway "TYPE" as shown on plans and in specs

SL Site lighting pole and one fixture "TYPE" as shown on plans and in specs

SL Site lighting pole and two fixtures "TYPE" as shown on plans and in specs

SL Site lighting pole and four fixtures "TYPE" as shown on plans and in specs

In ground flagpole light as shown on plans and in specs

FA/B Fire alarm panel with battery backup

R/ANN Fire alarm remote annunciator

F FA manual pull station

F FA combination horn and light

F WP FA outdoor combination horn and light

SD FA smoke detector

HD FA heat detector

DD FA duct detector with sampling tube

RIL FA remote indicating light

DGP FA data gathering panel

RM FA remote module

FS FA flow switch

TS FA tamper switch

DH FA electro/magnetic door holder

Ceiling Finishes

As suggested previously, a good procedure for the estimator to follow is to review the architectural plan for the ceiling finishes. Let us look at the ceiling finishes partial floor plan (Fig. 2-1, p. 13).

You will see that all ceiling finishes are type "A" unless noted otherwise. A type "A" ceiling finish is to be a 2' × 4' suspended grid with 2' × 4' acoustical ceiling tiles. A type "B" ceiling finish is to be a 2' × 2' suspended grid with 2' × 2' acoustical ceiling tiles. A type "C" ceiling finish is to be a suspended framework for a sheetrock finish. Finally, a type "D" ceiling finish is to be exposed construction.

Reviewing the ceiling finishes prior to counting the light fixtures will save many headaches when purchasing the light fixtures and fixture frames for recessed light fixtures, pendants for suspended light fixtures, hold-down clips for lay-in light fixtures, shade aligners for light fixtures with RLM-type shades (reflectors), and airplane-type steel cable for suspended light fixtures.

The estimator should transfer the ceiling finishes information to the electrical plans. Here is where colored highlighters will help the estimator—you can color code the various ceiling types on the electrical plans. Perhaps the ceiling finish with the greatest percentage of the

ceiling construction would not be color coded; just color code the smaller ceiling areas. This will make the light fixture takeoff easier and more accurate than hurrying the takeoff and omitting some of the associated light fixture accessories. This color-coding method will avoid serious and costly mistakes.

Text Introduction to Fixtures Takeoff

Before beginning to count the light fixtures, the estimator should have pencils, blank rough takeoff sheets, a few different colored highlighters, and a manual or electronic counter. These are essential for the estimator to keep handy at all times. As you begin to count the items, make a small colored slash mark on each item and record each item with the counter. It is a good idea to select a color for each division of the takeoff, such as fixtures, devices, and their wiring in orange, fire alarm systems in red, communications voice in green, data in yellow, etc. This method will ensure that each item will be counted only once (Figs. 2-2A, B, pp. 15, 16). Note that there are many products on the market that can color and count at the same time. Use whatever you find most comfortable.

All of the fixtures are listed on the top section of the fixtures rough takeoff sheets (Figs. 2-3A, B, pp. 18, 19). By listing the fixture type, size, mounting, lamps, voltage, etc., the estimator has a snapshot of the most important facts about the fixtures. Beginning with type "A" fixtures, count all of them on the floor plan and enter the total in the block under the description. Note that in the left-most column the estimator will list which plan the fixtures were counted from. There is a reason we takeoff the electrical items and list them according to which plan they were counted from. For example, if after the contracts are awarded, the owner requests that all of the type "B" light fixtures on the first floor be changed to another style or deleted, the estimator can turn to the rough takeoff sheets and very quickly respond to the request. This saves overhead time and money. The estimator does not have to open the plans and do another count on that type of fixture. This method applies to all of the takeoffs.

Text Recap of Fixtures Takeoff

This concludes the light fixture counting and completes the takeoff of all the building light fixtures. After all the light fixtures have been counted, we total them and list all of the associated items needed to have a complete working lighting system for the building. Each fixture will have lamps, outlet boxes, junction boxes, flexible whips, etc. Other necessary items may be hold-down clips, suspension materials (pendants, chains, cables, etc.), splicing materials, fixture wire, and labor for testing and tagging. A flexible whip is allowed for each lay-in and recessed fixture. Wall-mounted fixtures will require a wall outlet box, as will some ceiling-mounted fixtures. The estimator should investigate which fixtures may be furnished with an outlet box and check all notes and the specifications for possible spare lamps and fixtures. There are occasions when the engineer will specify that a percentage of all types of lamps be turned over to the owner as spares at the completion of the project. The estimator must allow a sum of money for this requirement in the estimate.

The estimate sheets (Figs. 2-4A, B, pp. 20, 21) will show how all of the fixtures and associated materials are to be listed for pricing and the hours required for each material. The prices are not included due to each contractor's price structure with the material suppliers and actual price fluctuation in the markets. A few of the items such as hold-down clips, supports, splicing, tags, testing, etc. are allowance items of money and hours. These amounts will vary according to the size of each project.

Text Introduction to Devices Takeoff

In order to count all the devices, we need to turn again to the lighting fixtures partial floor plan (see Fig. 2-2B, p. 16) to count the switches. This plan will show you that some of the switches are ganged together as required (meaning more than one is utilized). When you count these switch locations, count them as you see them; for example, SSS is a three-gang box and plate with three switches. Counting the switches this way will not only give you the switch count, but will give you the count of the boxes (single or ganged) and the matching plate(s). These switch totals are listed on the devices rough takeoff sheet (Fig. 2-6, p. 24). Also on this sheet is a count of the receptacles shown on the partial device floor plan (Fig. 2-5, p. 22). You should check the specifications to see if any special covers or

EST. NO: 10/01/03-1 Room names & finishes
JOB: Office bldg #100 Utown, USA

CEILING FINISHES

SHEET NO: 1 OF 1
DATE: 10/01/03

PARTIAL FLOOR PLAN

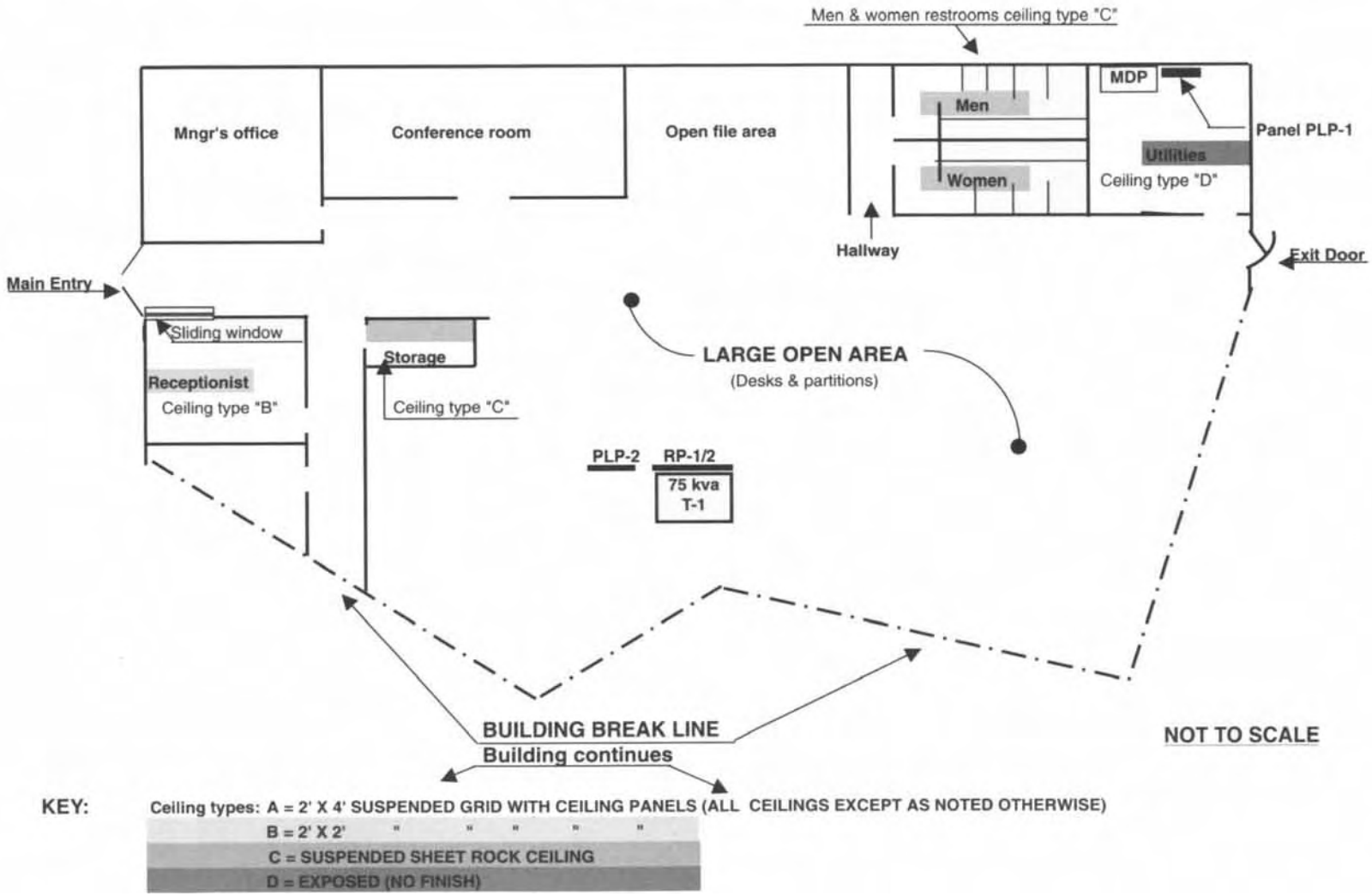


Figure 2-1

NOTES

FIXTURE LEGEND

SYMBOL	TYPE	DESCRIPTION
	A	FLUORESCENT 277V LAY-IN 2' X 4' 3/32W CWRS LAMPS
	A-1	" " " 2' X 4' 2/32W CWRS LAMPS
	B	" " " 2' X 2' 2/32W U CWRS LAMPS
	C	" " " 4' X 4' 6/32W CWRS LAMPS
	D	" " RECESSED 1' X 4' 2/32W CWRS LAMPS & FRAME
⊗	E	EXIT LIGHT UNIVERSAL MOUNT 277V W/ LAMPS AND BATTERY
●	F	FLUORESCENT 277V RECESSED HIGH HAT W/ 1 PL LAMP
	G	" " WALL MOUNTED W/1 PL LAMP
	H	HI-PRESSURE SODIUM 277V W/P WALL MOUNTED W/ 1 70W LAMP
△	J	TRACK LIGHT FIXTURE 120V W/ 1 75W PAR LAMP
	J-1	4' LONG TEE BAR MOUNTED LIGHT TRACK 120V 1 CIRCUIT & HARDWARE
	K	FLUORESCENT 120V UNDER COUNTER PLUG IN FIXTURE 24" LONG
	L	" 277V SUSPENDED FIXTURE W/ 2 32W CWRS LAMPS
●	M	INCANDESCENT FIXTURE W/P W/ 1 100W IF 130V LAMP & BOX
	N	" " " W/ 1 150W PAR 38 FLOOD LAMP & PE
	EM	EMER' BATT' UNIT 277V 2 HEADS WALL MTD.
	EM	" " " " 1 HEAD " "
	RH	REMOTE EMER. BATT' HEAD

Figure 2-2A

colors for the devices are required. Normally the catalog numbers of the devices are listed in the electrical specifications or on the symbol list. The architect may note special colors for all wall devices on the architectural plans; they might not be found *elsewhere*. This is why we stress the need for reviewing all the bidding documents for possible items that will affect the electrical estimate. Be assured that this will come up in your estimating at some point, so do not overlook the review of *all* the bidding documents.

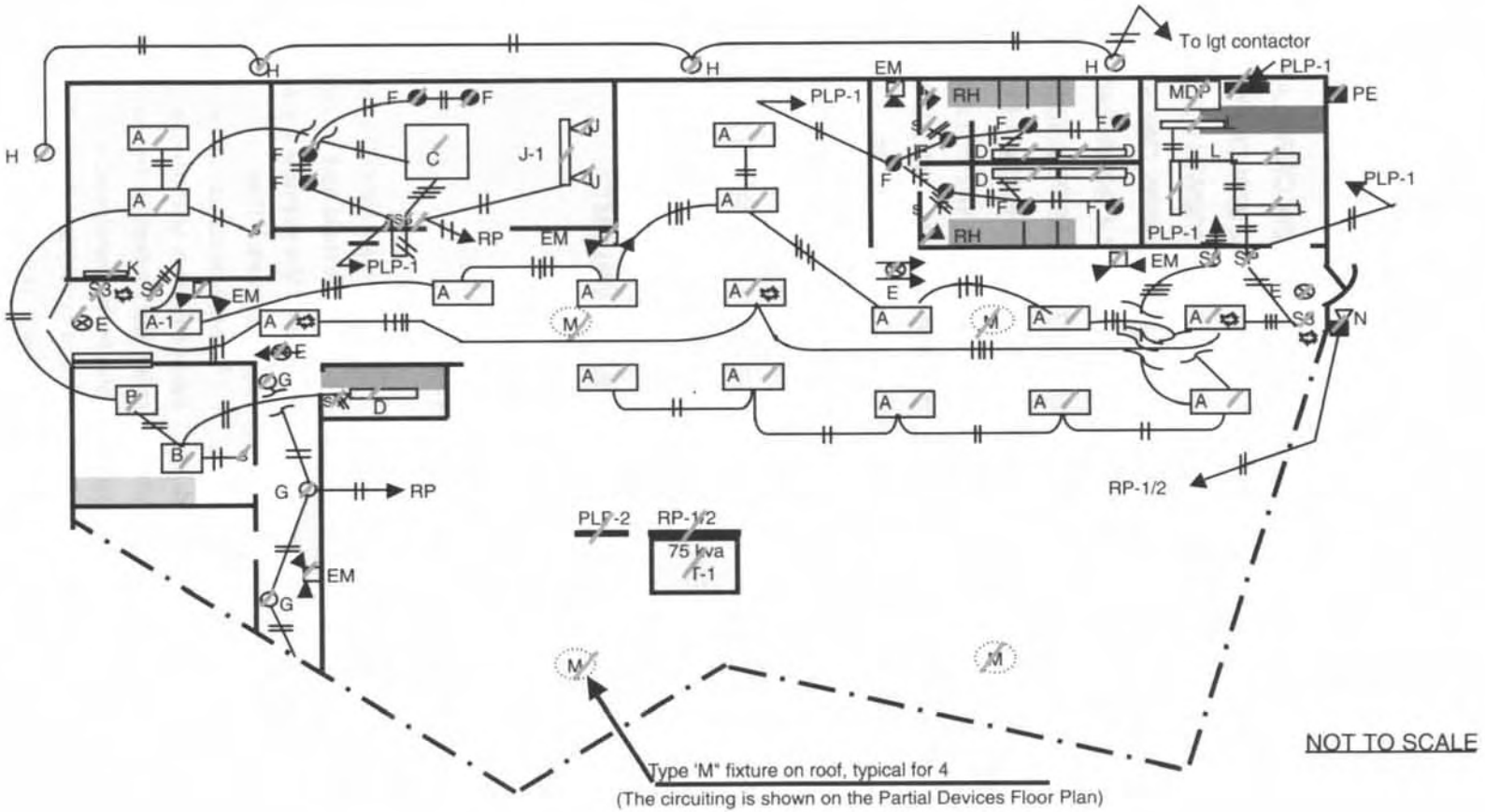
The estimate sheet (Fig. 2-7, p. 25) will show how all of the devices and associated materials are to be listed onto the estimate sheet for pricing and the hours required for each item.

The prices are not included due to each contractor's price structure with the material suppliers and actual price fluctuation in the markets. A few of the items such as the metal wall stud box supports are an allowance of money and hours. These amounts will vary according to the size and type of project.

EST. NO: 10/01/03-1 LIGHTING
JOB: Office bldg #100 Utown, USA

LIGHTING FIXTURES PARTIAL FLOOR PLAN

SHEET NO: 1 OF 1
DATE: 10/01/2003



NOTE: Connect the exit lights and emergency lights to panels PLP-1 or PLP-2 in their area.
Connect the remote emergency heads to the associated emergency light units.
Emergency lights should be connected to the same circuit as the lighting for that area.

Figure 2-2B

NOTES

EST. NO: 10/01/03-1 FIXTURES ROUGH TAKEOFF SHEET SHEET NO: 1 OF: 2

JOB: Office bldg #100 Utown, USA DATE: 10/1/03

Lighting Fixtures ITEMS & LOCATION	Type "A" 2'x4' lay-in 3-32w cw 277 volt	Type "A-1" 2'x4' lay-in 2-32w cw 277 volt	Type "B" 2'x2' lay-in 2-32wU cw 277 volt	Type "C" 4'x4' lay-in 6-32w cw 277 volt	Type "D" 4' rec'd 2-32w cw 277 volt (+4 frames)	Type "E" wall/ceiling w/em batt' 277 volt exit lt	Type "E-1" end wall/ceil' w/em batt' 277 volt d/f exit lt	Type "EM" wall batt unit 2 heads 277 volt emer unit	Type "EM-1" wall batt unit 1 heads 277 volt emer unit	Type "F" rec' hi-hat 1 pl lamps 277 volt	Type "G" fluor' wall 1 pl lamp 277 volt (sconce)	Type "H" w/p wall 1-70w hps 277 volt
Plan E-1 Lighting	16	1	2	1	5	4	0	3	1	8	3	4
Plan E-2 Power	0	0	0	0	0	0	0	0	0	0	0	0
Plan E-3 Tel/Data	0	0	0	0	0	0	0	0	0	0	0	0
Plan E-4 Panels & Feeders	0	0	0	0	0	0	0	0	0	0	0	0
Plan E-5 Systems Risers	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	16	1	2	1	5w/frm's	4	0	3	1	8	3	4
						"universal mounted"						
TOTALS												

Figure 2-3A

EST. NO: 10/01/03-1 FIXTURES ROUGH TAKEOFF SHEET SHEET NO: 2 OF: 2

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

Lighting Fixtures ITEMS & LOCATION	Type "J" 8' track surf 1 circuit 120 volt	Type "J-1" 4' track surf 1 circuit 120 volt	"J" fittings internal 90	"J" fittings live end feed in with outlet cover for "T" bar	"J" fittings couplings	"J" fittings "T" bar clips	"J" heads cylinders each with par20 75w lamps	Type "K" 2' surf under cab' 1-18w cw 120 volt	Type "L" 4' susp'd rlm reflect'r 2-32w cw 277 volt	Type "M" w/p globe w/ box 1-100 w if 130 volt	Type "N" w/p spot & motion sen'r 1-150w par 120 volt	RH Remote em' head
Plan E-1 Lighting	0	1	0	1	0	3	2	0	4	0	1	2
Plan E-2 Power	0	0	0	0	0	0	0	1	0	4	0	0
Plan E-3 Tel/Data	0	0	0	0	0	0	0	0	0	0	0	0
Plan E-4 Panels & Feeders	0	0	0	0	0	0	0	0	0	0	0	0
Plan E-5 Systems Risers	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS →	0	1	0	1	0	3	2	1	4	4	1	2

Fixture lamps Boxes Whips	32 WATT COOL WHT FLUO LAMP	32 WATT U COOL WHT FLUO LAMP	18 WATT DUAL PL LAMPS	100 WATT INCAND LAMPS 120 V	75 WATT PAR 20 LAMPS 120 V	18 WATT COOL WHT FLUOR LAMP	150 WATT PAR 38 FL LAMPS 120 V	70 WATT HPS BD CLEAR LAMP	FIXTURE OUTLET BOXES WALL	FIXTURE OUTLET BOXES IN CEIL'NG	FIXTURE JUNCTION BOXES 4"SQ&COV	FLEXIBLE FIXTURE WHIPS
TOTALS →	74	4	11	4	2	1	1	4	17	20	8	33

Allow materials for independently supporting all light fixtures mounted in or on suspended ceilings.

Allow for hold-down clips on lay-in fixtures, splicing materials tags, testing, etc.

TOTALS

Figure 2-3B

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 2

Estimate Sheet of Fixtures Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	TYPE "A" 2'X4' LAY-IN W/3-32W CW 277V	16	Q			1.3	EA	20.8	1
2	TYPE "A-1" 2'X4' LAY-IN W/2-32W CW 277V	1	Q			1.1	EA	1.1	2
3	TYPE "B" 2'X2' LAY-IN W/2-32WU CW 277V	2	Q			1	EA	2	3
4	TYPE "C" 4'X4' LAY-IN W/6-32W CW 277V	1	Q			2	EA	2	4
5	TYPE "D" 1'X4' REC'D W/2-32W CW 277V	5	Q			1	EA	5	5
6	TYPE "D" PLASTER FRAMES	5	Q			0.25	EA	1.25	6
7	TYPE "E" EXIT WALL/CEILING W/EM' BATT' 277V	4	Q			0.75	EA	3	7
8	TYPE "E-M" EMER BATT W/2 HEADS 277V	3	Q			1.5	EA	4.5	8
9	TYPE "EM-1" " " W/1 HEAD 277V	1	Q			1.5	EA	1.5	9
10	REMOTE HEADS FOR EM' BATT'	2	Q			0.75	EA	1.5	10
11	TYPE "F" REC' HI-HAT 1-PL LAMP 277V	8	Q			1	EA	8	11
12	TYPE "G" WALL SCONCE W/1 PL LAMP 277V	3	Q			0.75	EA	2.25	12
13	TYPE "H" HID WALL W/P 1/70 HPS 277V	4	Q			2	EA	8	13
14	TYPE "I" NOT USED	0							14
15	TYPE "J" 8' SUR TRACK 1 CIR 120V	0							15
16	TYPE "J-1" 4' SUR TRACK 1 CIR 120V	1	Q			0.65	EA	0.65	16
17	TYPE "J-1" END FEED-IN W/COVER FOR T BAR	1	Q			0.25	EA	0.25	17
18	TYPE "J-1" T-BAR CLIPS	3	Q			0.1	EA	0.3	18
19	TYPE "J-1" FIXT' HEADS W/PAR20 75W LAMPS	2	Q			0.65	EA	1.3	19
20	TYPE "K" 2' UNDER CABINET 1/18W 120V	1	Q			0.75	EA	0.75	20
21	TYPE "L" 4' SUSPND' FLUOR'W/2-32WCW 277V	4	Q			0.75	EA	3	21
22	TYPE "M" INC' W/P GLOBE W/1-100W IF 130V	4	Q			1.25	EA	5	22
23	TYPE "N" INC' W/P SPOT W/SENSOR 150W 120V	1	Q			1.5	EA	1.5	23
24	32 WATT CW LAMPS	74	Q			0.03	EA	2.2	24
25	32 WATT CW U LAMPS	4	Q			0.03	EA	0.1	25
26	18 WATT DUAL PL LAMPS	11	Q			0.03	EA	0.35	26
27	100 WATT IF LAMPS 130V LAMPS	4	Q			0.03	EA	0.1	27
28	75 WATT PAR 120V LAMPS	2	Q			0.03	EA	0.05	28
29	18 WATT CW FLUOR' LAMPS	1	Q			0.03	EA	0.05	29
30	150 WATT PAR 38FL LAMPS	1	Q			0.03	EA	0.05	30
31	70 WATT HID HPS BD LAMPS	4	Q			0.1	EA	0.4	31
32									32
	Q = Quotation EA = Each		TOTAL			TOTAL		76.95	

Figure 2-4A

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 2 OF 2

Estimate Sheet of Fixtures Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	FIXTURE OUTLET BOXES FOR WALL	17		EA		0.35	EA	5.95	1
2	FIXTURE OUTLET IN CEILING SPACE	20		EA		0.35	EA	7	2
3	4" SQ' BOXES W/ BLANK COVERS	8		EA		0.35	EA	2.8	3
4	FLEXIBLE FIXTURE WHIPS W/WIRE	33		EA		0.1	EA	3.3	4
5									5
6	HOLD-DOWN CLIPS FOR LAY-IN FIXTURES	ALLOW						0.5	6
7	INDEPENDENT SUPPORTS FOR LAY-IN FIXT'S	ALLOW						2	7
8									8
9	SPLICING MATERIALS	ALLOW						0	9
10									10
11	WIRE CONNECTORS, TAPE, TAGS, ETC.	ALLOW						0	11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each			TOTAL		TOTAL		21.55	

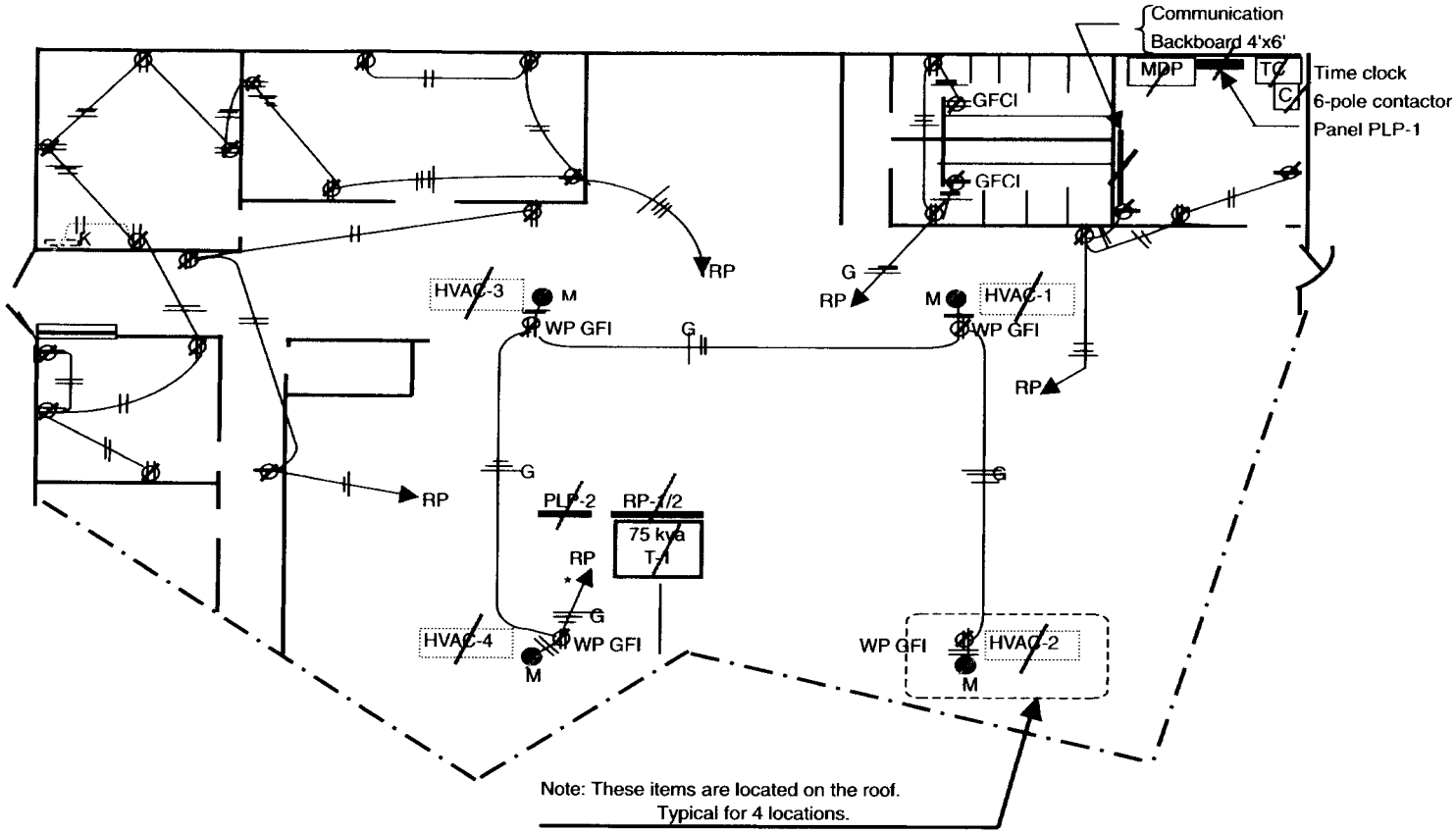
Take note that a line has been drawn thru space #10 on this *estimate sheet and all other empty spaces such as #5 also.* The reason is if every empty numbered line or part of the line is lined thru the chances of leaving out a price or hours are greatly reduced. Get in the habit of making a line from the quantity column to the labor hours amount column. Leave open only those spaces that require material prices and labor hours! This applies to all estimate sheets of the estimate from the recapitulation sheet to the last estimate sheet.

Figure 2-4B

EST. NO: 10/01/03-1 DEVICE LAYOUT
JOB: Office bldg #100 Utown, USA

DEVICES PARTIAL FLOOR PLAN

SHEET NO: 1 OF 1
DATE: 10/01/03



Notes: The type M fixture is a w/p globe complete with a photocell & box. Provide a suitable support for mounting the fixture to. Mount the w/p receptacle on the same support.
Branch circuiting to run beneath in the hung ceiling space.
Coordinate roof penetrations with the general contractor and architect.
*Provide a single pole switch at the roof hatch to control the lights and outlets.

NOT TO SCALE

Figure 2-5

NOTES

EST. NO: 10/01/03-1 **DEVICES ROUGH TAKEOFF SHEET** SHEET NO: 1 OF: 1

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

Device, box, plate ITEMS & LOCATION	S 1 sp sw 20a 277v wall box & plate	S S 2 sp sw 20a 277v wall box & plate	S S S 3 sp sw 20a 277v wall box & plate	S3 1-3way sw 20a 277v wall box & plate	S3 S3 2-3way sw 20a 277v wall box & plate	S4 1-4way sw 20a 277v wall box & plate	S dim 1-1000w wall dim'r 120v incand' box & plate	S dim S dim 2-1000w wall dim'rs 120v incand' box & plate	Sp sp sw & ligt 20a 277v wall box & plate	S wp sp sw 20a 277v wall box & wp plate	**** **** **** **** ****	**** **** **** **** ****
Plan E-1	6	0	1	4	0	0	0	0	1	0	****	****
Plan E-2	0	0	0	0	0	0	0	0	0	0	****	****
TOTALS →	6	0	1	4	0	0	0	0	1	0	****	****
Device, box, plate ITEMS & LOCATION	⊕ duplex recp 20a 120v box & plate (see below)	WP⊕ GFI duplex recp 20a 120 v wall box w/p cover	⊕FL 1 gang floor 20a 120v flush w/ carpet ring	⊕GFI duplex recp 20a 120v box & plate	⊕ WP single recp 20a 120 v w/p surf box w/p cover	30a single recp 30a 480v w/ box & cover						
Plan E-2 →	22	4	0	2	0	0						
TOTALS												

Figure 2-6

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 1

Estimate Sheet of Devices Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	S - 20 amp 277v single-pole switch	6		EA		0.7	EA	4.2	1
2	SS - 2-20 amp " " " "	0							2
3	SSS - 3-20 amp " " " "	1		EA		1.4	EA	1.4	3
4	S3 - 20 amp 277v 3-way switch	4		EA		0.75	EA	3	4
5	S3S3 - 2-20 amp " " "	0							5
6	S4 - 20 amp 277v 4-way switch	0							6
7	S dim - 1000 watt 120v wall dimmer inc.	0							7
8	S dim Sdim - 2 " " " " "	0							8
9	Sp - 20 amp 277v single-pole switch w/pilot light	1		EA		0.75	EA	0.75	9
10	Swp - 20 amp 277v single-pole switch (nema 3r)	0							10
11	⊕ - 20 amp 120v duplex receptacle	22		EA		0.7	EA	15.4	11
12	⊕wp gfi - 20 amp 120v duplex recpt' (nema 3R)	4		EA		1.1	EA	4.4	12
13	▣ - 20 amp 120v duplex recept' in a 1 gng' flr' box	0							13
14	⊕ - 20 amp 120v grnd' fault recpt'	2		EA		0.85	EA	1.7	14
15	⊕ - 20 amp 120v single recept'	0							15
16	⏢ - 30 amp 3 phase 4w 480v recept'	0							16
17									17
18	Price and labor the devices with a box and plate								18
19									19
20	Metal stud wall box supports	Allow						INC	20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each INC = Included		TOTAL			TOTAL		30.85	

Figure 2-7

Text Introduction to Site Lighting Takeoff

The site lighting partial plan (Fig. 2-8, p. 27) gives us a view of the building, site light fixtures, site lighting pole base detail, parking areas, sidewalks, driveways, road locations, utility pole, utility transformer, lighting contactor, time clock, and photo cell. Begin the takeoff by listing the site lighting pole types on the rough takeoff sheet (Fig. 2-9, p. 29). The poles have single or multiple fixtures on them and are laid out for driveway and parking area illumination. When we count the pole types, we will also be counting the fixture heads, lamps, and concrete bases at the same time. As listed on the sheet, there are many items that will be required for the fixtures, but not seen, such as fuses, splicing, direct burial warning tape, wire in the poles, and ground lugs. The concrete bases have a ½" PVC sleeve in the center to accommodate the installation of a ground rod after the base is set in place. The precast contractor will place the anchor bolts, sleeves for wiring, and the ground rod. They will not need a labor factor applied, just delivery charges to the precast company for their installation. The conduit system will be 1¼" schedule 40 PVC with copper wire sizes and types as shown. To determine the footages of the PVC, wire, trenching, and warning tape, you will need a scaled rule or map measurer. Measure each run of PVC and enter the totals as shown on the rough takeoff sheet (see Fig. 2-9, p. 29). List all of the PVC raceways, elbows, couplings, and PVC cement. The excavation and associated items required for the site lighting wiring are also listed. The estimator can request a quotation from excavators or do this work with in-house workers and in-house equipment. Coordinate the raceway installation with the site contractor to avoid problems with curbs, sidewalks, other utilities, and the like.

You can use the back of the sheet to list all of the individual footages of the PVC, wire, trench, warning tape, etc. and then transfer the totals (as shown on the sheet) to the face of the sheet. This will provide backup of the totals accumulated from the site plan as you measure all distances between poles and building.

Items not to overlook in the estimate:

1. Excavation, stone base, backfilling, and tamping for the precast concrete bases (allow for the removal or spreading of excess earth).
2. Delivery of bolt circles, anchor bolts, precut PVC ground rod sleeves, and preassembled PVC raceways to the precast manufacturer. Determine whether the precast manufucturer will set the bases in the holes or in one staging area upon delivery. If all the bases are delivered and unloaded in one place, the estimator must allow time and money to move the bases into place and set them.
3. Allow money for a boom truck to pick up the poles and set them on their bases. Preassemble the pole arms, fixtures, and wiring, and test the pole assembly on the ground prior to lifting it into place. Allow money for leveling material and allow for labor.
4. Allow money to lay out the pole locations with the site engineer. Request a quotation from other civil engineers, also.

The estimate sheets (Figs. 2-10A, B, pp. 30, 31) will show how all of the site lighting poles and all associated materials are to be listed for pricing and the required labor hours for all material. The prices are not included due to each contractor's price structure with the material suppliers and actual price fluctuation in the markets. A few items such as in-line fuse holders (with fuses), ground lugs, wirenuts, etc. will be allowance items of money and hours. Some of the material will be required in the specifications and not shown on the electrical plans. It is important for the estimator to review the specifications repeatedly to avoid missing specified materials.

EST. NO: 10/01/03-1 SITE LIGHTING
JOB: Office bldg #100 Utown, USA

SITE LIGHTING PARTIAL PLAN

SHEET NO: 1 OF 1
DATE: 10/01/03

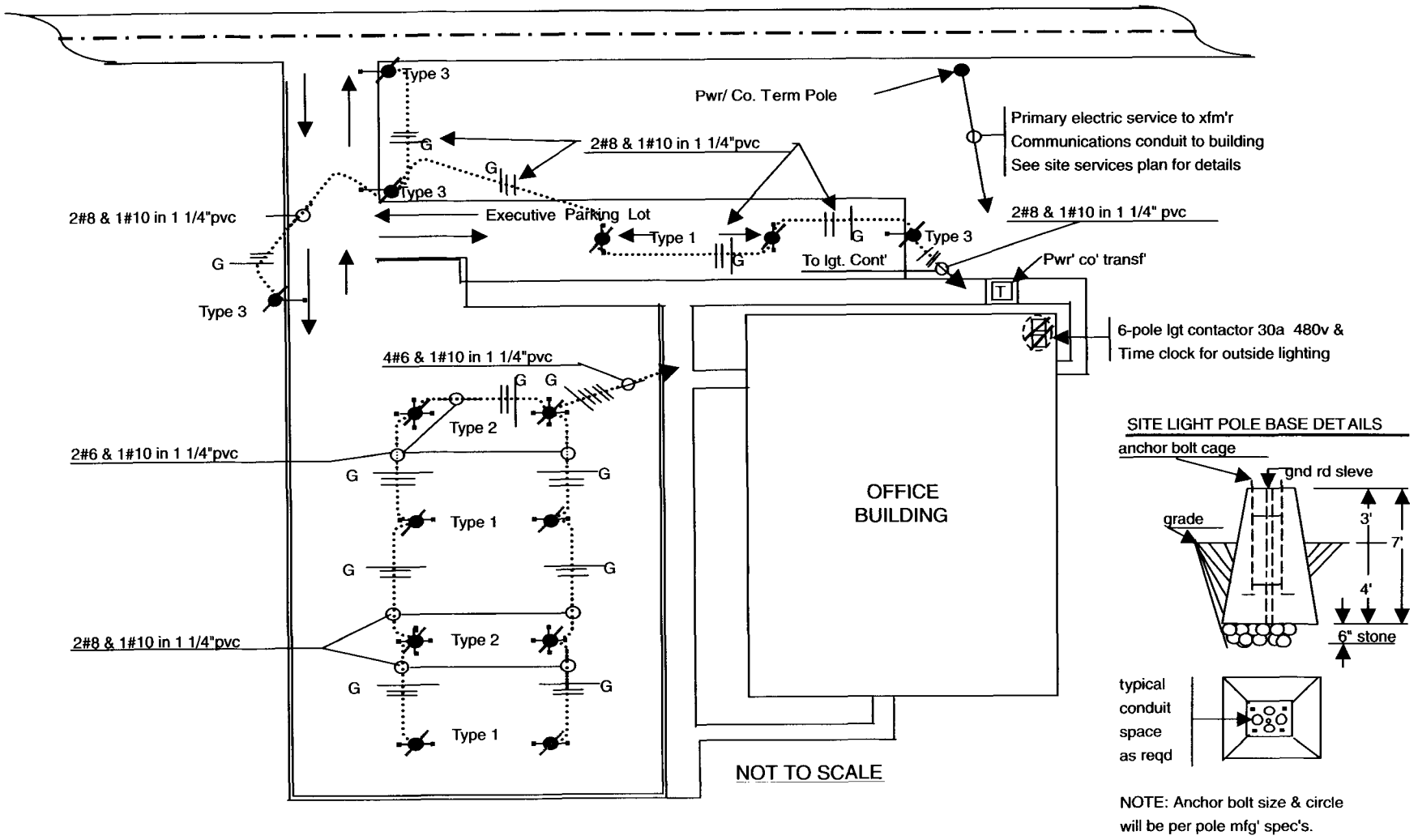


Figure 2-8

NOTES

EST. NO: 10/01/03-1 Site lighting Reg's

JOB: Office bldg #100 Utown, USA

SITE LGT' ROUGH TAKEOFF SHEET

SHEET NO: 1 OF: 1

DATE: 10/01/03

Site Lighting ITEMS & LOCATION	Type "1" 20' alum pole 2 400w fix 2 6' arms 480 volt hps	Type "2" 20' alum pole 4 400w fix 4 3' arms 480 volt hps	Type "3" 20' alum pole 1 400w fix 1 6' arm 480 volt hps	400 watt fixt heads w/ballasts 480 volt hps	400 watt hps lamps base horz.	in-line fuse holders w/ fuses 480 volt	#12 thhn cu in poles from feeder up to fixt.	wirenuts tape & etc. to splice to feeds in pole	ground lugs, attach to pole	7' precast conc' bases pyramid type 3' above grd' 4' below grd'	1/2"x10' copper clad gnd rods w/clamps	1/2"x7' pvc conduit for sleeves precasted into bases
Plan MEP-1	6	4	4	32	32	64	1,500'	allow $$$	14	14	14	*14

A good rule to follow when measuring the conduit and wire between the building panel and each pole light is as follows: Begin by numbering (1, 2, 3, 4, etc.) or lettering (A, B, C, etc.) each pole light. Then measure from the panel to the first pole and record that on the back of this sheet. Continue until you measure between each pole light and then transfer all that info to this side of the rough takeoff sheet as shown below. The estimator may want to use a separate rough takeoff sheet and not use the back of this sheet, whichever is more comfortable for the estimator ....

Site Lighting Wiring	1-1/4" pvc schld' 40 conduit in trench	1-1/4" pvc schld' 40 90 elbows	1-1/4" pvc schld' 40 couplings	pvc cement	#6 thhn cu wire stranded	#8 thhn cu wire stranded	#10 thhn cu wire stranded green	dig & backfill 6" w x 2' d tamp at 8" lifts	direct burial warning tape	astrodial time clock 2p 20a 277v n/1 enclo	ltg contactor 6p 30a 600v 277v coil n/1 enclo	photo cell 277v
Plan MEP-1	1,500'	33	70	allow $$$	1,500'	3,000'	1,800'	1,500'	1,500'	1	1	1
TOTALS												

Figure 2-9

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 2

Estimate Sheet of Site Lighting Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	Type "1" 20' aluminum poles (level w/shims)	6	Q	EA		4	EA	24	1
2	400 watt hps 480v fixtures	12	Q	EA		2.5	EA	18	2
3	Pole top yoke for 2 fixtures	6	Q	EA		1.5	EA	9	3
4	400 watt hps base horz' lamps	12	Q	EA		0.1	EA	1.2	4
5	Type "2" 20' aluminum poles (level w/shims)	4	Q	EA		4	EA	16	5
6	400 watt hps 480v fixtures	16	Q	EA		2.5	EA	40	6
7	Pole top yoke for 4 fixtures	4	Q	EA		2.5	EA	10	7
8	400 watt hps base horz' lamps	16	Q	EA		0.1	EA	1.6	8
9	Type "3" 20' aluminum poles (level w/shims)	4	Q	EA		4	EA	16	9
10	400 watt hps 480v fixtures	4	Q	EA		2.5	EA	10	10
11	6' aluminum fixture arms	4	Q	EA		3	EA	12	11
12	400 watt hps base horz' lamps	4	Q	EA		0.1	EA	0.4	12
13	Note: assemble all poles & test on the ground!								13
14	In-line fuse holders w/fuses 480 volt	64		E		0.1	EA	6.4	14
15	#12 thhn 600v copper wire in poles	1,500'		M		8	M	12	15
16	Wirenuts, tape, for splices in pole	Allow							16
17	Ground lugs in poles for grounding	14		E		0.15	EA	2.1	17
18	1/2" x 10' long copped clad ground rods w/acorn	14		E		1.6	EA	22.4	18
19	Time clock astro/dial 2pole 20 amp 277v N/1 enclo.	1		E		1.5	EA	1.5	19
20	Lighting contactor 6 pole 30 amp 277v coil " "	1		E		2	EA	2	20
21	Outdoor photo cell 277v	1		E		1	EA	1	21
22									22
23	7' precast concrete bases 3' "afg" and 4' "bfg"	14	Q			2	EA	28	23
24	"afg" = above & "bfg" = below the finish grade								24
25									25
26	Deliver the following to the precast co. all the	Allow						2	26
27	bolts, bolt circle, pvc sleeves for rods and wire								27
28	1-1/4" pvc x 5' long with a 90-degree coupling assembly	32		E				1.5	28
29	1/2" pvc x 7' long conduit for base sleeves, for rods	14		E				INC	29
30									30
31	Allow for boom truck to set 14 poles & relocate	Allow	Q						31
32	and set the 14 concrete bases into the holes.								32
	Q = Quotation M = Per thousand EA = Each C = Per hundred INC = Included			TOTAL			TOTAL	237.1	

Figure 2-10A

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 2 OF 2

Estimate Sheet of Site Lighting Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	1-1/4" schld' 40 PVC conduit in trench	1,500'		C		10	C	15	1
2	1-1/4" schld' 40 PVC 90's in trench	33		C		10	C	3.3	2
3	1-1/4" schld' 40 PVC couplings	70		C		—	—	INC	3
4	PVC cement	Allow				—	—	—	4
5									5
6	#6 thhn 600v copper wire stranded	1,500'		M		14	M	21	6
7	#8 thhn 600v copper wire stranded	3,000'		M		12	M	36	7
8	#10 thhn 600v copper wire stranded	1,800'		M		10	M	18	8
9									9
10	Direct buried electrical lines warning tape	1,500'		M		4	M	6	10
11									11
12	Excate and backfill trench 6" wide x 24" deep								12
13	(backfill & tamp in 8" lifts)								13
14	(if rocky conditions, provide a sand bed of	1.500'	Q			layout	—	8	14
15	4" on trench bottom prior to installing the								15
16	raceways)								16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand Q = Quotation C = Per Hundred							107.3	

Figure 2-10B

Text Introduction to Branch Wiring Takeoff

In order to takeoff the branch wiring, you need to refer to a few of the electrical plans. On the lighting plan (see Fig. 2-2B) you will find the circuiting for the lighting fixtures and for the associated switching of these fixtures. On the devices plan (see Fig. 2-5) you will find the circuiting for the receptacles and the 120 V feed to the fire alarm control panel from the RP panel. In our example here, MC cable is permitted on this project for all branch wiring within the building. There is no wiring in the floor, as it had been poured prior to the contracts being awarded. There may be a need to install a short amount on EMT in the utilities and restrooms (less than 50 feet), but we will make an allowance for this small amount of EMT and wire required. On the branch wiring rough *takeoff sheet* (Fig. 2-11, p. 33), the MC cable and associated fittings have been listed according to the plan number. As described above, we takeoff the material and list it according to the plan number, which serves as a check that a plan was not overlooked in the takeoff procedure.

The estimate sheet (Fig. 2-12, p. 34) will show how all of the branch circuit wiring and associated materials are to be listed for pricing and the hours required for each item. The prices are not included due to each contractor's price structure with the material suppliers and actual price fluctuation in the markets. A few items such as wall stud sleeves, splicing materials, tape, tags, junction boxes, etc. will not be shown on the plans, but will be required. It is important for the estimator to visualize the installation of the cable and listing the material and labor allowances in the estimate.

Text Introduction to Communications Takeoff

The partial communication floor plan (Fig. 2-13, p. 35) shows the communications equipment for the voice and data wiring required. The voice backboard and 110-punch-down block are located in the utilities room. The data patch panel floor stand with the patch panel are also located in the utilities room. There are three locations that have a combination voice and data outlet. These three outlet locations will require one category #3 plenum-rated cable for voice and one category #5 plenum-rated cable for data. Both cables will terminate in the utilities room on their respective voice block or data panel. The outlets at the wall will consist of one single-gang wall box, one voice connector, one data connector, and one single-gang combination wall plate to accommodate both voice and data connectors. The single-voice outlet in the utilities room will require an outlet box, a voice connector, and a single wall plate. As you can see on the floor plan, the cables run together through the suspended ceiling from the outlet to the utilities room. These cables will be supported by "J" hooks and through the wall sleeves as required at all penetrations. Patch cords are provided for both voice and data. All cables, plates, blocks, and panels will be tagged with the appropriate markings. Field testing must be performed on all cables and a record of the tests turned over to the proper authority. All penetrations of walls and partitions require sleeves to accommodate the voice and data cables. The estimator must count and list all the components required for the voice/data system on the rough takeoff sheet (Fig. 2-14, p. 37).

The estimate sheet (Fig. 2-15, p. 38) will show how all of the communication items and the associated materials are to be listed for pricing and the required labor hours. The prices are not included due to each contractor's price structure with the material suppliers and actual price fluctuation in the markets. As listed above, many materials for the communication system are not shown on the plans but will be necessary for a complete system. Some of these materials may be patch cables, grounding, a cable support system, labels, testing, etc. The specifications will also specify the various components required for a complete communication system.

EST. NO: 10/01/03-1 BRANCH WIRING ROUGH TAKEOFF SHEET SHEET NO: 1 OF: 1

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

ITEMS & LOCATION	2/C #12 MC CABLE	3/C #12 MC CABLE	4/C #12 MC CABLE	MC CONN'S.	2/C #10 MC CABLE	3/C #10 MC CABLE	4/C #10 MC CABLE	MC CONN'S.	MC HANGERS FASTNERS	SPLICING TAPE TAGS	WALL STUD SLEEVES	4" & 5" SQ' BOXES W/ BLANK COVERS
Plan E-1	125' 300'	175' 200'	150'	190	0	75'	0	4	700	ALLOW	40	25
	100' 250'	25'										
	400' 50'											
	75' 150'											
	50' 50'											
Plan E-2	350' 250'	300' 100'	250'	160	100'	225'	750'	20	1,000	ALLOW	50	25
	50' 200'	50' 50'										
	100' 75'	100'										
	425'											
TOTALS	3,000'	1,000'	400'	350	100'	300'	750'	24	1,700	ALLOW	90	50

Figure 2-11

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 1

Estimate Sheet of Branch Wiring Labor Hours

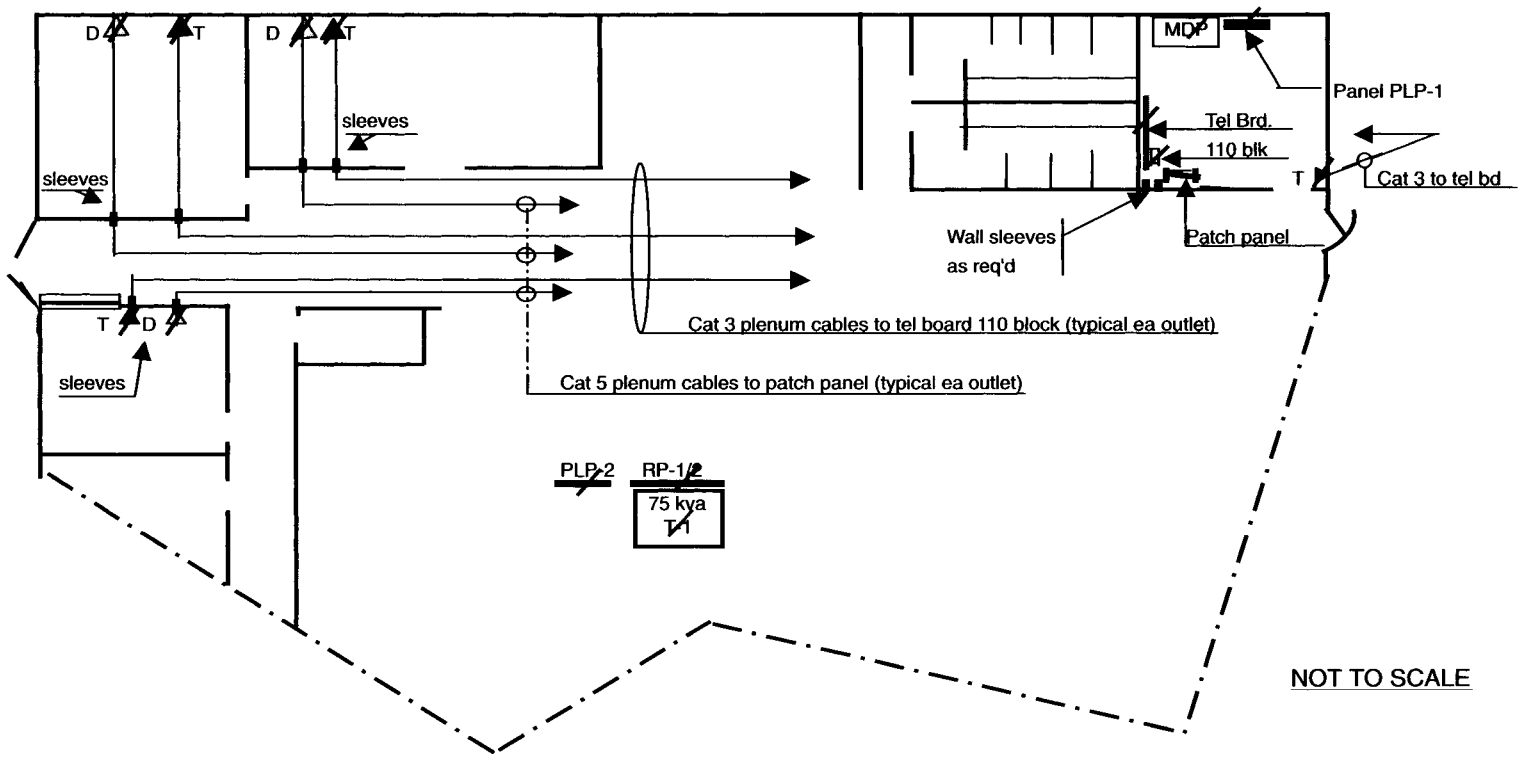
ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	2/c #12 MC cable	3,000'		M		30	M	90	1
2	3/c #12 MC cable	1,000'		M		35	M	35	2
3	4/c #12 MC cable	400'		M		40	M	16	3
4	2/c #10 MC cable	100'		M		36	M	3.6	4
5	3/c #10 MC cable	300'		M		50	M	15	5
6	4/c #10 MC cable	750'		M		55	M	41.25	6
7									7
8	MC cable connectors	374		C				INC	8
9	MC cable hangers and supports/fastners	Allow						80	9
10									10
11	Metal stud wall sleves	90		C				22	11
12									12
13	4" and 5" square boxes with blank covers	50		EA		0.35	EA	17.5	13
14									14
15	Misc. splicing, tags, tape, ty-raps, etc.	Allow							15
16									16
17	Allowance for misc' EMT and wire	Allow						4	17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each C = Per Hundred		TOTAL			TOTAL		324.35	

Figure 2-12

EST. NO: 10/01/03-1 VOICE/DATA LAYOUT COMM' PARTIAL FLOOR PLAN SHEET NO: 1 OF 1

JOB: Office bldg #100 Utown, USA DATE: 10/01/03



Note: Wall sleeves (▮) sizes and types per specs.

Figure 2-13

NOTES

EST. NO: 10/01/03-1 VOICE-DATA COMM' ROUGH TAKEOFF SHEET SHEET NO: 1 OF: 1

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

Voice/Data Comm' ITEMS & LOCATION	▼T public tele wall outlet box & plate	▼V voice wall outlet box & plate & connector	▽D data wall outlet box & plate & connector	V ▼▽D voice/data wall outlet box & plate & connectors	telephone voice/data backboard 4'x8'	patch panel floor stand & gnd conn	64 port data patch panel	shelf for patch panel & wire mng'r	6' long data patch cords	ground floor stand to bldg' steel	data conn' at patch panel	**** **** **** **** ****
Plan E-5	1	0	0	3	1	1	1	1	3	allowance	3	****
Voice/Data Comm' ITEMS & LOCATION	100 pr. 110 voice block	2' to 8' patch cords voice	voice cable punch down at 110 block	**** **** **** ****	cat' 5 data cable plenum 3x100'	cat' 3 voice cable plenum 4x100'	"J" hooks for cables	test all cables	misc hangers sleeves etc.	label all face plates 110 block ports	**** **** **** ****	**** **** **** ****
Plan E-5	1	4	4	****	300'	400'	30	7	allowance	allowance	****	****
TOTALS												

Figure 2-14

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 1

Estimate Sheet of Communications Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	▼ T Public tel. wall outlet box, & plate	1		EA		0.45	EA	0.45	1
2	▼ V Voice wall outlet box, plate, & conn'	0							2
3	▽ D Data wall outlet box, plate, & conn'	0							3
4	V ▼ ▽ D Voice/Data wall outlet box, plate, & conn'	3		EA		0.65	EA	1.95	4
5	Tele', voice, data backboard	1		EA		1.5	EA	1.5	5
6	Patch panel floor stand w/ gnd' conn'	1		EA		2	EA	2	6
7	64 port data patch panel	1		EA		0.5	EA	0.5	7
8	Shelf for patch panel & wire mngr'	1		EA		1	EA	1	8
9	100 pair 110 voice block	1		EA		0.5	EA	0.5	9
10	6' long data patch cords	3		EA		0.15	EA	0.45	10
11	Data conn at patch panel	3		EA		0.25	EA	0.75	11
12	2' to 8' voice patch cords	4		EA		0.05	EA	0.2	12
13	Voice cable punch downs at 110 block	4		EA		0.03	PR	0.1	13
14	Ground floor stand to bldg' steel	Allow						2	14
15									15
16	Cat #3 plenum cable	400'		M		5	M	2	16
17	Cat #5 plenum cable	300'		M		5	M	1.5	17
18	"J" hooks for cable supports thru ceiling space	30		C		25	C	7.5	18
19	Misc' hangers, sleeves, etc.	Allow						2	19
20	Label all face plates, ports & 110 block	Allow						2	20
21	Test all (7) cables and record	Allow						1.5	21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each C = Per Hundred PR = Per Pair		TOTAL			TOTAL		27.9	

Figure 2-15

Text Introduction to Fire Alarm Takeoff

The fire alarm partial floor plan (Fig. 2-16, p. 40) lays out the fire alarm devices required for this portion of the building. The typical fire alarm riser diagram (Fig. 2-17, p. 42) provides the estimator with the wiring and zones required. The main fire alarm panel is located in the utility room along with the sprinkler flow and tamper switches. The remote annunciator panel should be located near the entrance to give the first responders the immediate location that initiated the alarm. The duct detectors will be mounted on the HVAC duct work in accordance with the local authorities' codes. The length of the sampling tubes for the detector will need to be measured after a location has been determined. Coordinate the installation of the tube and detector with the HVAC duct installer. The estimator should verify the wiring requirements and device quantities for each zone with the fire alarm equipment supplier. The detector zones may incorporate manual stations as well as automatic detectors. The estimator should request a floor plan from the fire alarm equipment supplier showing the locations of the devices, wiring, and zones. Here again we list all of this material on the rough takeoff sheet (Fig. 2-18, p. 43).

The estimate sheet (Fig. 2-19, p. 44) will show all of the fire alarm system materials and associated items that are to be listed for pricing and the required labor hours for all the material. The prices are not included due to each contractor's price structure with the material suppliers and actual fluctuation in the markets. There are various items that are not shown on the plans but will be required for a complete fire alarm system; some of these may be junction boxes, hangers and supports, wall sleeves, splicing materials, and labels and tags. The estimator will find that the specifications will specify many of these items, but not all; the estimator must allow for these unseen items.

Text Introduction to Mechanical Equipment Takeoff Sheet

Allow for splicing, tagging, tape, testing, etc. Locate the ATC panel and furnish it with a 120 V circuit (Fig. 2-20, p. 45). All automatic temperature control wiring is to be furnished and installed by the HVAC contractor. All motor controllers and controls are to be furnished by the HVAC contractor. The electrical contractor shall receive, mount, and wire line the voltage wiring of starters. Coordinate all wiring and installations with the HVAC contractor. Here again we list all of this material on the rough takeoff sheet (Fig. 2-21, p. 47).

The estimate sheet (Fig. 2-22, p. 48) will show how all of the mechanical equipment requirements are listed for pricing and the required labor hours for the project. The electrical contractor will be responsible for certain items in accordance with the plans and specifications.

The estimator will need to go back through the HVAC specifications and read what that contractor is to furnish (e.g., fans, rooftop HVAC units, etc.). Coordinate this information with the electrical specifications. If there are any conflicts, seek clarifications prior to bid submission.

Text Introduction to Services to Building, Feeders, Panels, and Transformers

The following partial floor plans and estimate sheets (Figs. 2-23–2-27B, pp. 49–56) include the utility services to the building, the main service electrical equipment, the electrical panels, and the feeders to the electrical panels and HVAC equipment. The typical power riser diagram on this page depicts the feeders to the various panels, the transformer, and mechanical equipment. The estimator should review this riser and list the feeders shown on a feeder schedule (Fig. 2-26, p. 54), which is included herein. Take note that all of the interior feeders will be installed above the suspended ceiling and exposed in the utilities room. The raceways outside of the building walls are installed underground, as shown on the riser. The panels and transformer are shown here as well as the mechanical equipment.

EST. NO: 10/01/03-1 FIRE ALARM LAYOUT
JOB: Office bldg #100 Utown, USA

FIRE ALARM PARTIAL FLOOR PLAN

SHEET NO: 1 OF 1
DATE: 10/01/03

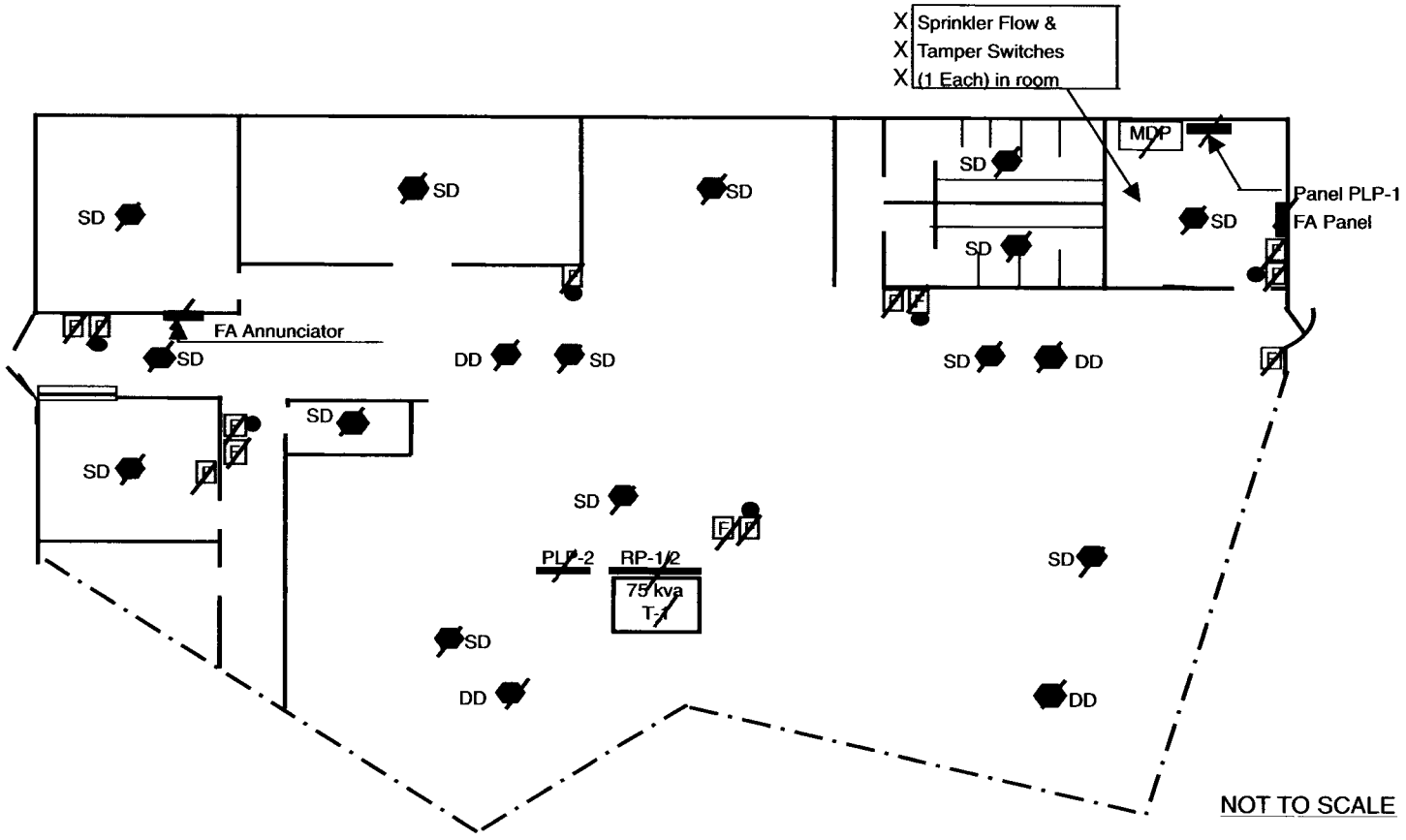


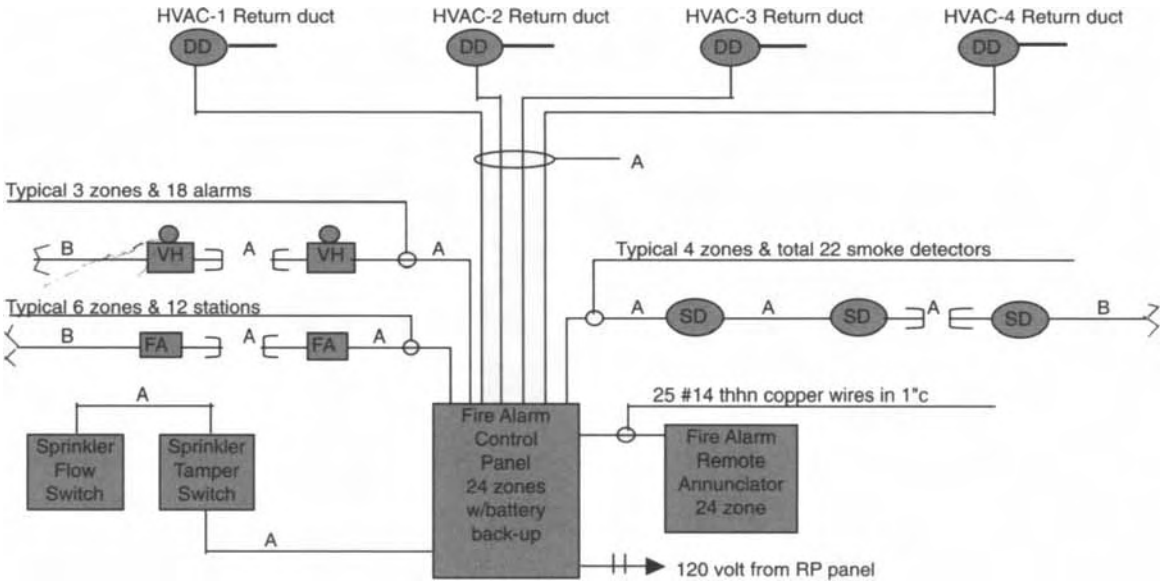
Figure 2-16

NOTES

EST. NO: 10/01/03-1 (FIRE ALARM)
JOB: Office bldg #100 Utown, USA

TYPICAL FIRE ALARM RISER DIAGRAM

SHEET NO: 1 OF: 1
DATE: 10/01/03



SYMBOLS: A= 4/c #16 plenum rated fire alarm cable
B= 2/c #16 plenum rated fire alarm cable
FA= manual pull station; mount on recessed wall box
VH= visual & audio alarm; mount on recessed wall box
SD= ceiling mounted smoke detector; mount on ceiling outlet box
DD= duct mounted detector w/ sample tube mounted in return duct (keep distance from all duct bends, see specs)

NOTE: The flow and tamper switches are furnished & installed by others.

Figure 2-17

EST. NO: 10/01/03-1 FIRE ALARM
JOB: Office bldg #100 Utown, USA

ROUGH TAKEOFF SHEET

SHEET NO: 1 OF: 1
DATE: 10/01/03

Fire Alarm System ITEMS & LOCATION	[redacted] fire alarm pnl' surf mtd 24 zones	[redacted] annunciator recessed 24 zones & rec'd box	[redacted] F manual pull station flush mtd.	[redacted] VH visual/horn surf plate	SD smoke detec	DD duct detec & sample tube	[redacted] SFS sprinkler flow sw. fbo	[redacted] STS sprinkler tamper sw. fbo	elr end of line resistors	4" sq box & blanks	**** **** **** **** ****	**** **** **** **** ****
Plan E-3	1	1	7	5	14	4	1	1	4	6	****	****
Fire Alarm System ITEMS & LOCATION	#16 4/c plenum rated fa cable	#16 2/c plenum rated fa cable	device outlet boxes	hangers, supports, ties, etc.	wall sleeves	testing	splicing, tagging, tape, etc.	1" emt in ceiling 2 conn's 12 coup's 14 clamps	#14 thhn cu wire 24 points 1 common (25x100')			
Plan E-3	1,500'	500'	42	allowance	allowance	allowance	allowance	90'	2,500'			
TOTALS												

Figure 2-18

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 1

Estimate Sheet of Fire Alarm Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

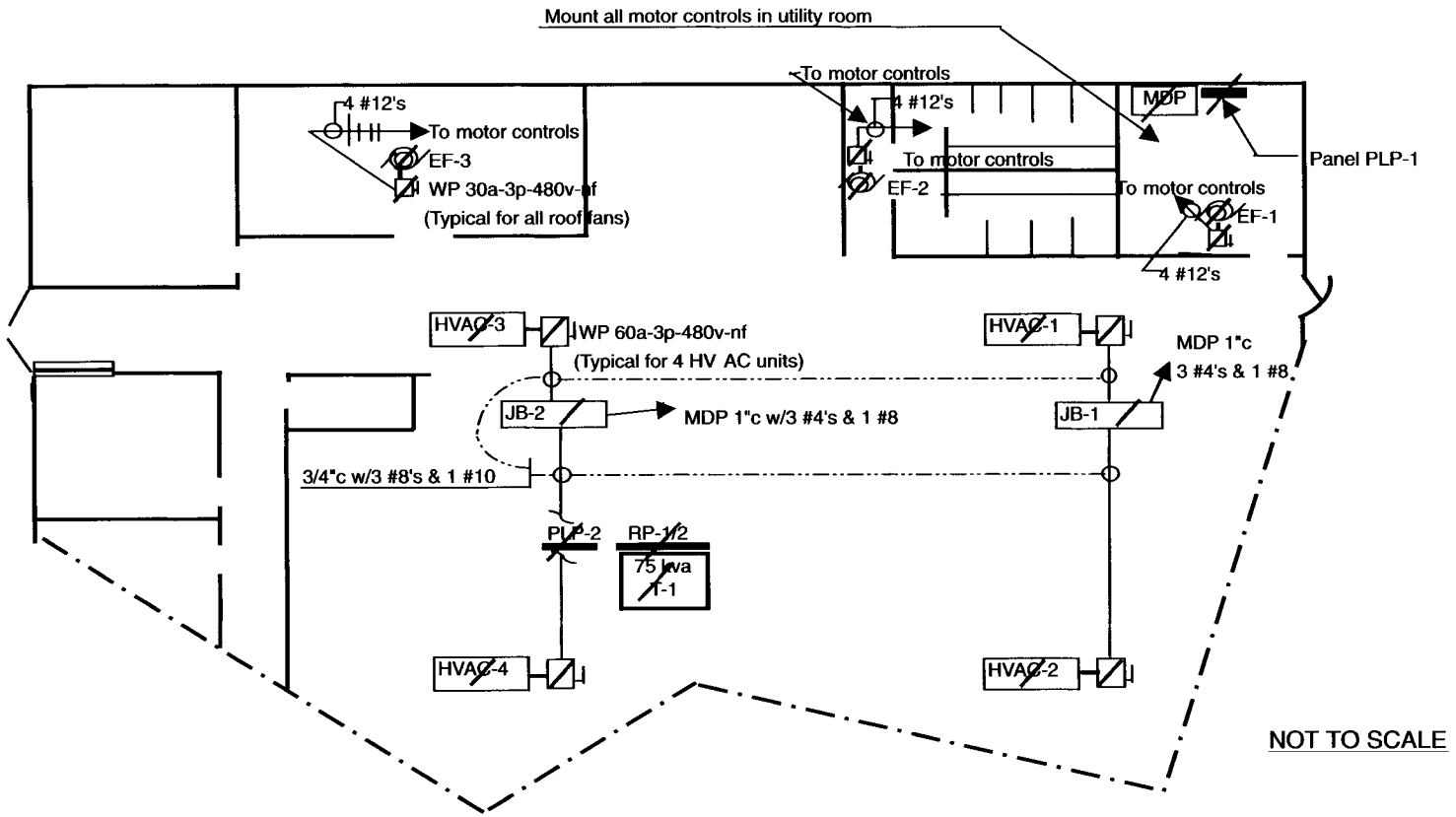
	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	Fire Alarm Panel 24 zones surf' mtd'	1	Q			24	EA	24	1
2	Annunciator panel 24 zones recessed	1	Q			24	EA	24	2
3	F Manual pull station flush mtd	7	Q			0.8	EA	5.6	3
4	AV Audio/visual alarm	5	Q			1	EA	5	4
5	SD Smoke detector	14	Q			1	EA	14	5
6	DD Duct detector & sample tube	4	Q			2	EA	8	6
7	SFS Sprinkler flow switch	1	Q			1.5	EA	1.5	7
8	STS Sprinkler tamper switch	1	Q			1	EA	1	8
9	"ELR" end of line resistors	4	Q			0.25	EA	1	9
10									10
11	1" emt in ceiling space	90'		C		6	C	5.4	11
12	1" emt connectors s/s	2		C		10	C	0.2	12
13	1" emt couplings s/s	12		C				INC	13
14	1" emt supports and fasteners	15		C		10	C	1.5	14
15	#14 thhn copper wire (24 points & common)	2,500'		M		6	M	15	15
16									16
17	#16/4 conductor plenum rated fire alarm coble	1,500'		M		16	M	24	17
18	#16/2 conductor plenum rated fire alarm cable	500'		M		15	M	7.5	18
19	Cable hangers, supports, ties, etc.	Allow						16	19
20	Device wall outlet boxes 1 gang	42		EA		0.35	EA	14.7	20
21	4" square boxes with blank covers	6		EA		0.35	EA	2.1	21
22	Wall sleves and sealant	Allow						8	22
23	Testing	Allow						8	23
24	Misc' splicing, tags, tape, etc.	Allow							24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each Q = Quotation C = Per Hundred INC = Included		TOTAL			TOTAL		186.5	

Figure 2-19

EST. NO: 10/01/03-1 MECH' EQUIP' LAYOUT
JOB: Office bldg #100 Utown, USA

MECH EQ PARTIAL FLOOR PLAN

SHEET NO: 1 OF 1
DATE: 10/01/03



NOTES:

All motor controls shall be furnished by the HVAC contractor and turned over to the electrical contractor for installation and power wiring. (All ATC wiring to be furnished and installed by the HVAC contractor.)

All exhaust fans are to be furnished with electric power safety disconnect devices.

All motor controllers shall be furnished with the proper-sized overload heaters.

The HVAC contractor shall furnish and install all equipment supplied, except as noted otherwise.

Figure 2-20

NOTES

EST. NO: 10/01/03-1 MECHANICAL EQUIP' ROUGH TAKEOFF SHEET SHEET NO: 1 OF: 1

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

Mechanical Eq' ITEMS & LOCATION	3ph 1 hp 480v roof top ex fan & wp flex whip	3ph 1.5 hp 480v roof top ex fan & wp flex whip	3ph 3 hp 480v roof top ex fan & wp flex whip	☐ 30a 480v nf wp disc sw (roof fans)	☒ size 0 mag starter nema 1 (roof fans)	☒ size 1 mag starter nema 1 (roof fans)	☐ hvac pack'd roof top 40a 480v 3 phase	☐ 60a 480v nf wp disc sw (hvac units)				
Plan E-2	1	1	1	3	2	1	4	4				
TOTALS												

Figure 2-21

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 1

Estimate Sheet of Mechanical Equipment Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	1 HP 3 phase 480 v roof top ex. fan	1			FIBO	1	EA	1	1
2	1.5 HP " " " " "	1			FIBO	1	EA	1	2
3	3 HP " " " " "	1			FIBO	1.5	EA	1.5	3
4	30 amp 480 v 3p 4w N/F W/P disc' sw	3		EA		1.7	EA	5.1	4
5	60 amp " " " " " " "	4		EA		2.8	EA	11.2	5
6	Size "O" mag' starter 3 pole 480 v n/1	2			FIBO	2	EA	4	6
7	Size "1" mag' starter 3 pole 480 v n/1	1			FIBO	2.35	EA	2.35	7
8	Pre-packaged HVAC roof top units	4			FIBO	4	EA	4	8
9	(3 phase 480V w/p pre-wired)								9
10									10
11	(Conduit and wire, flex connections, roof pockets								11
12	are included on the feeder estimate sheets.)								12
13	Misc splicing , tags, tape, testing	Allow						8	13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA= Each FIBO= Furnished & Installed by Others		TOTAL			TOTAL		38.15	

Figure 2-22

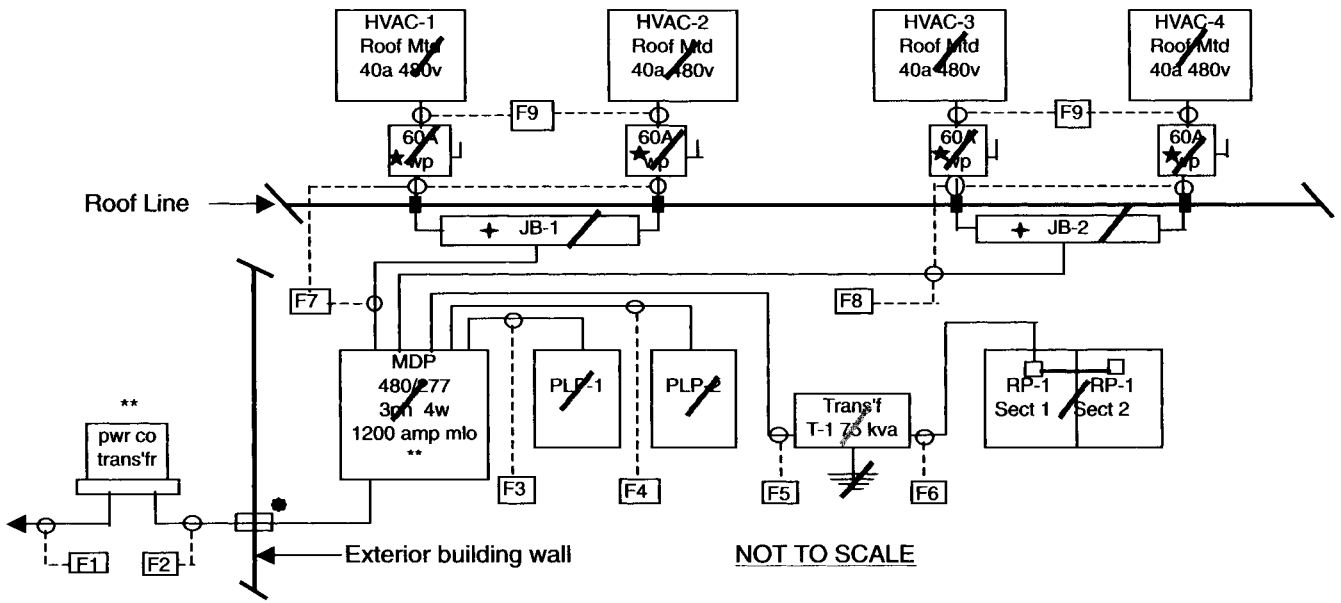
EST. NO: 10/01/03-1 (FEEDERS)

JOB: Office bldg #100 Utown, USA

TYPICAL POWER RISER DIAGRAM

SHEET NO: 1 OF: 1

DATE: 10/01/03



Feeder #

"F-1"= 2- 4" Schld 80 pvc conduits in trench for power co. feeder. Use galv' L/R sweep ells. Install drag lines. Min' bury @ 48" b.f.g.

"F-2"= 3- 4" Rigid galv' conduits in trench for secondary service to bldg' each with 4 #500 mcm thhn copper cables and 1 #3/0 bare copper

"F-3"= 1 1/4" c with 4 #2 awg thhn copper cables

"F-4"= 1 1/4" c with 4 #2 awg thhn copper cables

"F-5"= 1 1/4" c with 3 #1 awg thhn copper cables

"F-6"= 2" c with 4 #3/0 awg thhn copper cables

"F-7"= 1" c with 3 #4 & 1 #8 awg thhn copper cables

"F-8"= 1" c with 3 #4 & 1 #8 awg thhn copper cables

"F-9"= 3/4" c with 3 #8 & 1 #10 awg thhn copper cables

★ = 60 amp- 600 volt- no fuse- w/p disc. (w/gnd lug)

✦ = Jbox w/ term' block for feeders, taps & gnds.

= Ground to building steel

= Roof pitch pocket furnish and install

= Foundation wall seal sleeves for feeders

Note: See plans for all panel schedules, transformer, etc.

** Notes: Trenching, backfill, tamping, sand layers, burial warning tape, excess earth removal and layout by the EC.

Foundation wall sleeves/windows for all electrical penetrations to be furnished and installed by the GC. The EC to coordinate all locations.

EC to coordinate location and requirements with the utility company on their transformer, pad, and grounding.

EC to check with the local inspection authority on the grounding requirements for the electrical equipment.

Figure 2-23

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 2

Estimate Sheet of Panels & Transformers Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Main Distribution Panel 480/277v 3 phase 4 wire	1	Q					38	1
2	Includes a 1200 amp CT Section and Metering								2
3	1200 amp MCB 3 pole 12 #500 mcm & 3 #3/0's	connect		AL				6.9	3
4	Surface mounted at wall of utilities room	supports		AL				4	4
5	150 amp 3 pole circuit breaker active	1	Q			1.8	EA	1.8	5
6	125 amp " " " "	2	Q			1.7	EA	3.4	6
7	60 amp " " " "	2	Q			1.25	EA	2.5	7
8	200 amp " " " spare	1	Q						8
9	100 amp " " " "	1	Q						9
10									10
11									11
12	Lighting Panel "PLP-1" 480/277v 3 phase 4 wire	1	Q			4	EA	4	12
13	225 amp main lugs only 4 #2's	connect		AL		1	EA	1	13
14	Surface mounted at wall of utilities room	supports		AL		1	EA	1	14
15	20 amp 1 pole circuit breakers active	28	Q			0.3	EA	8.4	15
16	20 amp " " " spare	10	Q						16
17	1 " " " spaces	4	Q						17
18									18
19	Lighting Panel "PLP-2" 480/277v 3 phase 4 wire	1	Q			4	EA	4	19
20	225 amp main lugs only 4 #2's	connect		AL		1	EA	1	20
21	Surface mounted on wall near panel RP-1	supports		AL		1	EA	1	21
22	20 amp 1 pole circuit breakers active	36	Q			0.3	EA	10.8	22
23	20 amp 1 pole circuit breakers spare	6	Q						23
24									24
25									25
26	Receptacle Panel "RP-1" 120/208v 3 phase 4 wire	1	Q			4	EA	4	26
27	Section 1 of 2 with feed thru lugs 4 #3/0's	connect		AL		1.2	EA	1.2	27
28	225 amp 3 pole main cir' brkr' 4 #3/0's	connect		AL		1.2	EA	1.2	28
29	Surface mounted on wall near panel "PLP-1	supports	Q			1	EA	1	29
30	20 amp 1 pole circuit breakers active	42	Q			0.3	EA	12.6	30
31									31
32									32
	Q = Quotation EA = Each AL = Allowance		TOTAL			TOTAL		107.8	

Figure 2-24A

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 2 OF 2

Estimate Sheet of Panels & Transformers Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Receptacle Panel "RP-1" 120/208v 3 phase 4 wire	1	Q			4	EA	4	1
2	Section 2 of 2 w/main lugs only 4 #3/0's	connect		AL		1.2	EA	1.2	2
3	Surface mounted next to section #1 of RP-1	supports		AL		1	EA	1	3
4	20 amp 1 pole circuit breakers active	18	Q			0.3	EA	5.4	4
5	——— 1 pole " " spaces	24	Q						5
6									6
7	Dry transformer "T-1" 75 KVA	1	Q			21	EA	21	7
8	480v primary to 120/208v secondary 3 phase 4 wire	connect		AL		2.5	EA	2.5	8
9	Nema 1 indoor floor mounted	fastners		AL		1	EA	1	9
10	Ground to building steel	allow		AL		2	EA	2	10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each Q = Quotation AL = Allowance			TOTAL		TOTAL		38.1	

Figure 2-24B

EST. NO: 10/01/03-1 SERVICES LAYOUT
JOB: Office bldg #100 Utown, USA

SITE SERVICES PARTIAL PLAN

SHEET NO: 1 OF 1
DATE: 10/01/03

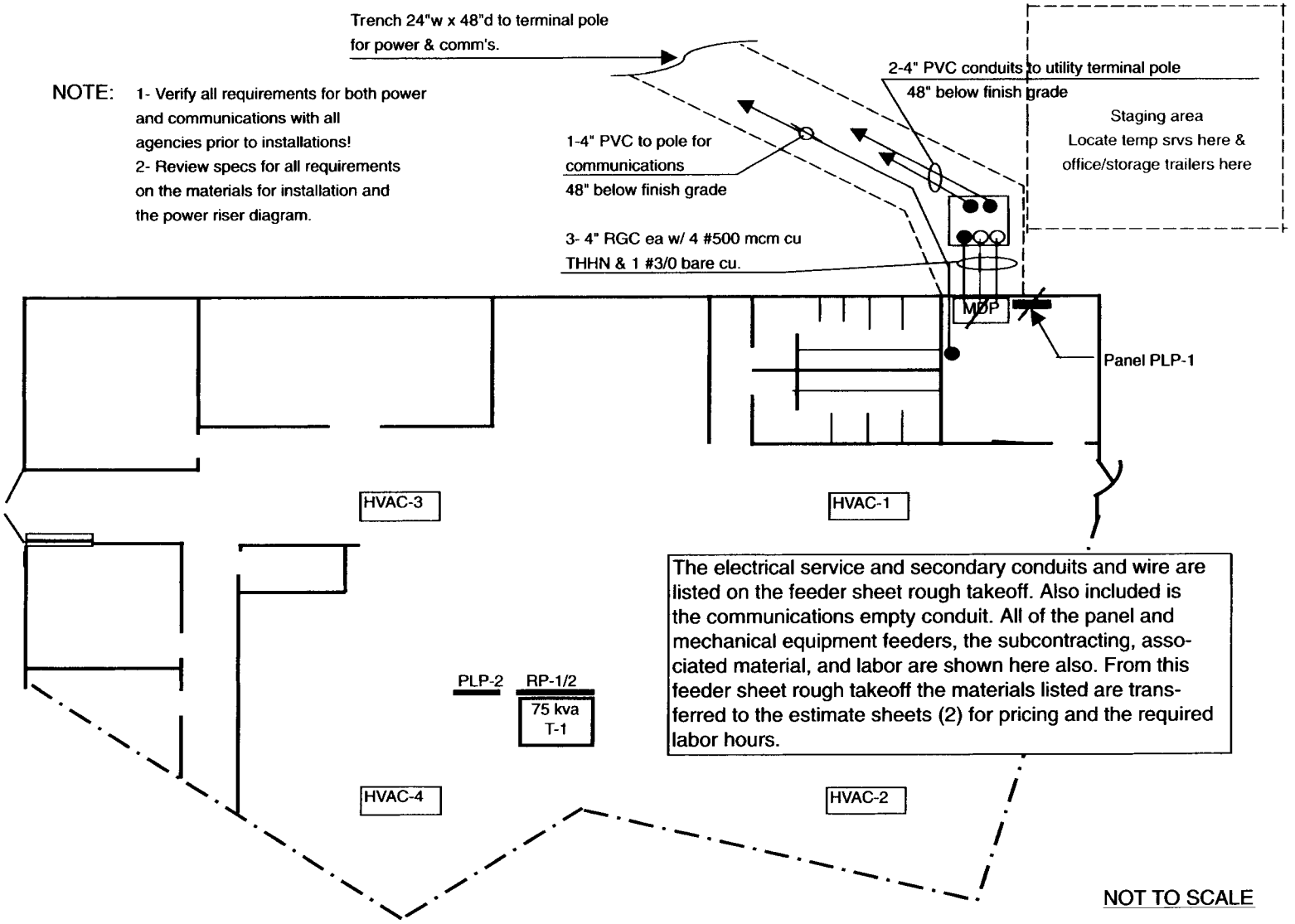


Figure 2-25

NOTES

EST. NO: 10/01/03-1 Feeders
JOB: Office bldg #100 Utown, USA

FEEDER SCHEDULE

SHEET NO: 1 OF 1
DATE: 10/01/03

FEEDER LOC	FROM	TO	CONDUIT					WIRE			MISC
			SIZE	LENGTH	ELS	TERMS	MISC	# WIRES	SIZE	LENGTH	
F1	Term' pole	Xfmr pad	4" p	100'	2 lr	2 p/r adp	sch 80 pvc	1	Drag	115'	Excavate 24"wide x 48"deep x 110'
F1	Term' pole	Xfmr pad	4" p	100'	2 lr	2 p/r adp	sch 80 pvc	1	Drag	115'	Provide 6" bottom & 6" sand cover
F1	Up pole	*****	4" r	10'	***	1 gb	r g c	1	Drag	10'	Back fill trench & tamp in 8" layers
F1	Up pole	*****	4"r	10'	***	1 gb	r g c	1	Drag	15'	Install 110' of buried warning tape
Comm	Term pole	Util rm	4"p	100'	2p	caps	pvc	1	Drag	115'	Remove/spread excess earth
F2	Xfmr pad	MDP	4" r	10'	2 r	2 gb		4	#500	160'	Wall windows/sleeves by GC
-----	----------	----------	----	---------	----	---------	---------	1	#3/0 br	40'	1- 3/4"x12' cu clad grnd rod & clamp
F2	Xfmr pad	MDP	4" r	10'	2 r	2 gb		4	#500	160'	Provide secondary tranf' lugs, 4- 3
-----	----------	----------	----	---------	----	---------	---------	1	#3/0 br	40'	barrel for #500mcm & 3 single #3/0
F2	Xfmr pad	MDP	4" r	10'	2 r	2 gb		4	#500	160'	Allow time to layout & coordinate
-----	----------	----------	----	---------	----	---------	---------	1	#3/0br	40'	Include communication conduit in the
F3	MDP	PLP-1	1 1/4"	20'	2	2		4	#2	140'	same trench as service.
											Verify above with all utilities.
F4	MDP	PLP-2	1 1/4"	80'	2	2		4	#2	400'	
F5	MDP	T-1	1 1/4"	30'	2	2		3	#1	210'	1-1 1/4" Flex connection nema 1
F6	T-1	RP-1 Sect 1	2"	10'	2 r	2		4	#3/0	10'	1-2" Flex connection nema 1
F6	RP-1 Sect 1	RP-1 Sect 2	----	---------	----	---------	---------	4	#3/0	20'	
F7	MDP	JB-1	1"	50'	3 r	2		3	#4	210'	Include 1 #8 ground
F7	JB-1	60A DISC	1"	5'	---	2 r		3	#4	15'	Include 1 #8 ground
F9	60A DISC	HVAC-1	3/4"	wp flex	----	------		3	#8	30'	Include 1 #10 ground
F7	JB-1	60A DISC	1"	25'	2 r	2		3	#4	165'	Include 1 #8 ground
F9	60A DISC	HVAC-2	3/"	wp flex	---	------		3	#8	30'	Include 1 #10 ground
F8	MDP	JB-2	1"	100'	2	2		3	#4	360'	Include 1 #8 ground
F8	JB-2	60A DISC	1"	5'	----	2 r		3	#4	15'	Include 1 #8 ground
F9	60A DISC	HVAC-3	3/4"	wp flex	----	------		3	#8	30'	Include 1 #10 ground
F8	JB-2	60A DISC	1"	25'	2 r	2 r		3	#4	165'	Include 1 #8 ground
F9	60A DISC	HVAC4	3/4"	wp flex	----	------		3	#8	30'	Include 1 #10 ground

Abbreviations

p/r= pvc to rigid adapter p=pvc
gb= ground bushing r=rigid
w/p flex=3' sealtight w/conn's
flex=3' greenfield w/conn's
br=bare copper lr=long radius
rgc=rigid galvanized conduit

JB-1&2 10"x10"x 6" D include terminal strip for feeders, taps, and grounds installed above ceiling material.
4- 1" pitch pockets to install and seal.

NOTE:

The following two estimate sheets will show how all of the feeders and associated materials are to be listed for pricing and required labor hours. Many of these are not on the plans but are necessary for a complete power system. Turn to the Estimate Sheet of Feeders Labor Hours for pricing and hours input.

Figure 2-26

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 2

Estimate Sheet of Feeders Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	4" rigid galvanized conduit up terminal pole	20'		C		30	C	6	1
2	4" rigid galvanized conduit 3@ 15' each in trench	50'		C		15	C	7.5	2
3	4" ground bushings	10		EA		0.35	EA	3.5	3
4	4" galvanized 90-degree elbow 48-degree radius	4		EA		2.5	EA	10	4
5	4" galvanized 90-degree elbow standard radius	6		EA		2	EA	12	5
6	4" rigid to PVC coupling	4		EA		0.8	EA	3.2	6
7	4" schedule 80 PVC conduit in trench	300'		C		8.8	C	26.4	7
8	4" PVC 90-degree elbows	2		EA		0.8	EA	0.15	8
9	4" plastic capped bushings	2		EA		0.06	EA	0.1	9
10	Drag line	375'		M		6	M	2.25	10
11	Copper clad ground rod 3/4" x 12' w/clamp	1		EA		2.25	EA	2.25	11
12	Coordinate with power company on all their req's.	allow						2	12
13	regarding services to the building								13
14	#500 mcm thhn copper cable	480'		M		40	M	19.2	14
15	#3/0 thhn copper cable	120'		M		21	M	2.5	15
16	3 pulls of 4 #500's & 1 #3/0 @ 40' each pull								16
17	Provide 3 barrell #500 mcm copper lugs for the	4		EA		2	EA	8	17
18	secondary transformer connections	s/s hardware		AL					18
19	Provide grounding req's for the power company's	allow						4	19
20	transformer and the conduits	s/s hardware		AL					20
21									21
22	Layout and coordinate all excavation with all of the	allow						4	22
23	effected contractors and architect								23
24	Trench 48" deep x 24" wide	110'	Q					INC	24
25	Provide 6" layers of sand under & above conduits	allow	Q					2	25
26	Backfill trench and tamp in in 8" lifts	allow	Q					2	26
27	Install warning tape 12" below grade in trench	110'		M		4	M	0.45	27
28	Spread or remove excess excavated earth	allow	Q						28
29									29
30									30
31									31
32									32
	EA = Each M = Per Thousand Q = Quotation C = Per Hundred AL = Allowance		TOTAL			TOTAL		117.5	

Figure 2-27A

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 2 OF 2

Estimate Sheet of Feeders Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

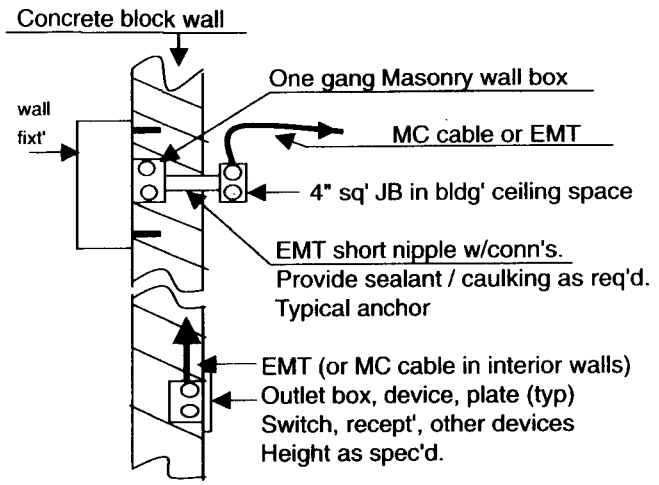
	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	2" EMT raceway	10'		C		12	C	1.2	1
2	1-1/4" " "	150'		C		8	C	12	2
3	1" " "	210'		C		6	C	12.6	3
4	2" EMT connectors s/s	2		EA		0.15	EA	0.3	4
5	1-1/4" " " "	6		EA		0.1	EA	0.6	5
6	1" " " "	12		EA		0.1	EA	1.2	6
7	2" EMT couplings s/s	5		EA					7
8	1-1/4" " " "	30		EA					8
9	1" " " "	50		EA					9
10	2" EMT supports & fastners	2		EA		0.15	EA	0.3	10
11	1-1/4" " " "	20		EA		0.1	EA	2	11
12	1" " " "	30		EA		0.1	EA	3	12
13	2" EMT 90-degree elbows	2		EA		0.2	EA	0.4	13
14	1-1/4" " " " "	9		EA		0.1	EA	0.9	14
15	1" " " " "	10		EA		0.05	EA	0.5	15
16	2" Greenfield whip & 2 connectors	1		EA		2	EA	2	16
17	1-1/4" " " " "	1		EA		1	EA	1	17
18	3/4" sealtight whip & 2 connectors	4		EA		0.75	EA	3	18
19	JB #1 & 2 10"x10"x6" deep nema 1 w/ term' strip	2		EA		2	EA	4	19
20	fer feeds, taps and grounds	supports						INC	20
21	Pitch pockets for 1"c install & seal	4		EA		1	EA	4	21
22	#3/0 thhn copper wire (short runs)	30'		M		33	M	1	22
23	#1 " " " (3 legs 70' ea)	210'		M		22	M	0.95	23
24	#2 " " " (4 legs 100' ea)	400'		M		20	M	8	24
25	#4 thhn copper wire (6 runs of 3 #4's +- 50' ea)	870'		M		17	M	14.8	25
26	#8 thhn copper green wire for grounding	300'		M		12	M	3.6	26
27	#10 thhn copper green wire for grounding	40'		M		10	M	0.4	27
28									28
29	Misc splicing, lugs, tags, tape, testing, etc.	allow						4	29
30									30
31									31
32									32
	EA = Each M = Per Thousand C = Per Hundred		TOTAL			TOTAL		81.75	

Figure 2-27B

EST. NO: 10/01/03-1 TYPICAL DETAILS ROUGH TAKEOFF SHEET SHEET NO: 1 OF 2

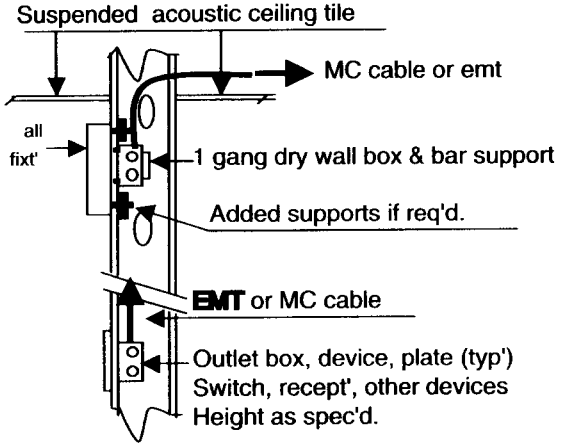
JOB: Office bldg #100 Utown, USA DATE: 10/01/03

TYPICAL WALL MOUNTED FIXTURE DETAIL (EXTERIOR)



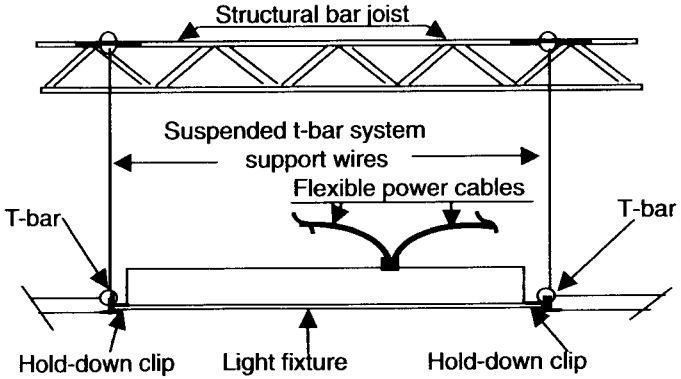
DETAIL 1

TYPICAL WALL MOUNTED FIXTURE DETAIL (INDOOR)
(Metal Stud w/sheetrock 2 sides)



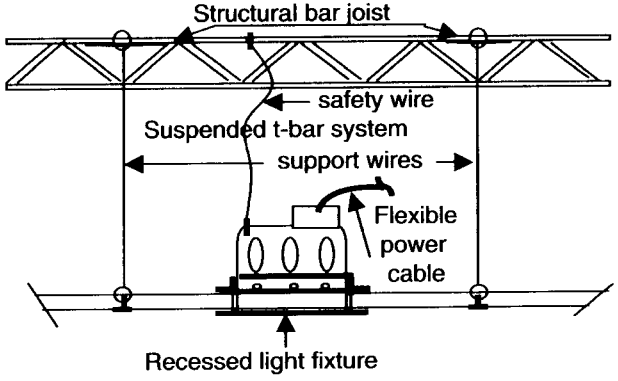
DETAIL 2

TYPICAL LAY-IN FIXTURE



DETAIL 3

TYPICAL RECESSED HI-HAT TYPE FIXTURE



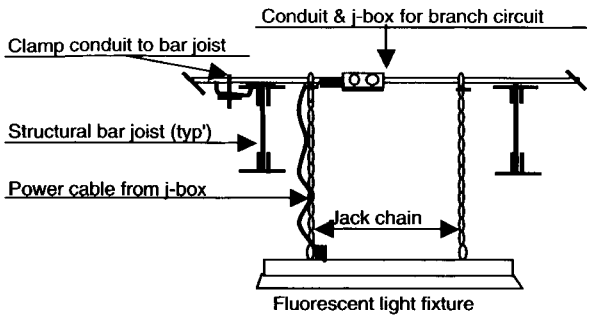
DETAIL 4

Figure 2-28A

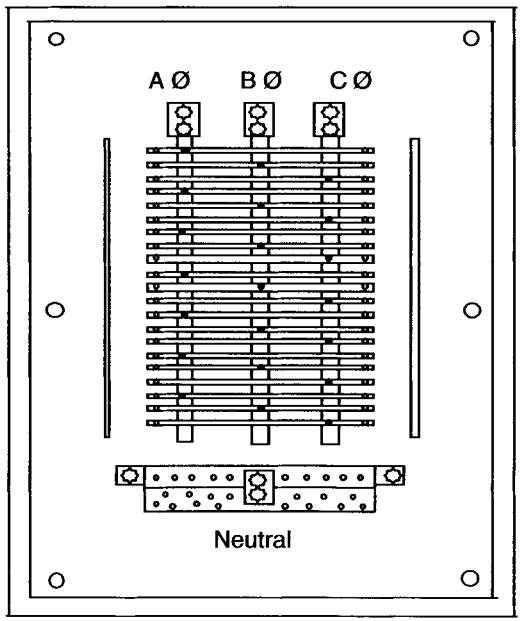
EST. NO: 10/01/03-1 TYPICAL DETAILS ROUGH TAKEOFF SHEET SHEET NO: 2 OF: 2

JOB: Office bldg #100 Utown, USA DATE: 10/01/03

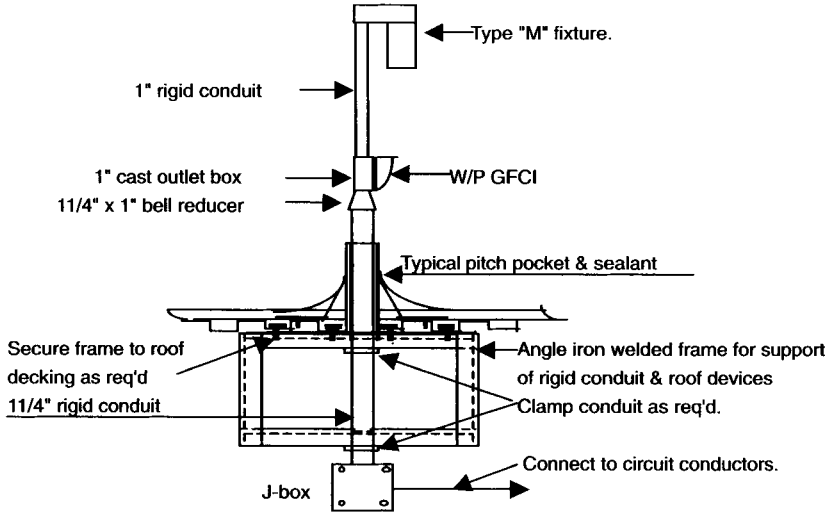
Typical suspended light fixture support



Typical lighting panel with main lugs only



Typical detail of recept' & "M" fixture on roof and typical roof pitch pocket for conduit penetrations



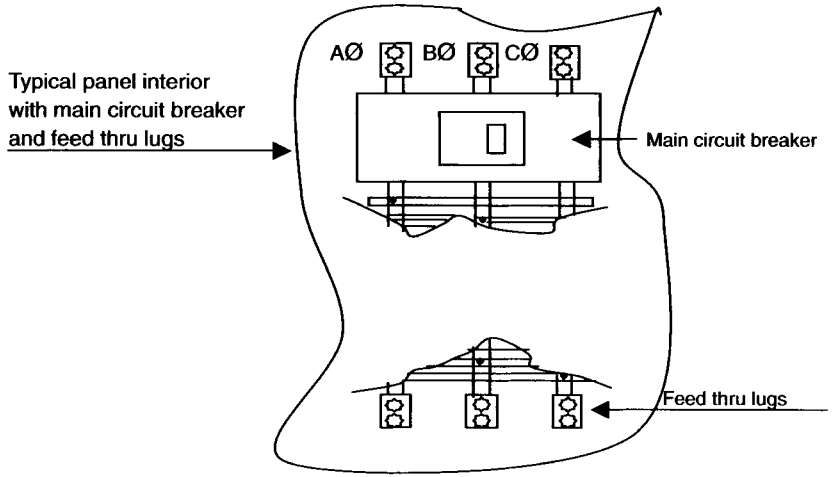


Figure 2-28B

Rough Takeoff Sheets to Estimate Sheets

Now that we have listed all electrical devices, light fixtures, service equipment, raceways, and wire on the rough takeoff sheets, we move all of the items from the rough takeoff sheets to the estimate sheets for material pricing and labor rates (Figs. 2-29A–P, pp. 61–77).

Figure 2-29D, p. 65, lists the materials and work required for the empty conduits for the utility company feeders and the communications for the project, transformer pad requirements, secondary feeders to the MDP in the building, excavation, grounding, etc. This information was gathered from the feeder schedule for the project (see Fig. 2-26, p. 54).

Here we see the PVC raceways, the excavation requirements, rigid conduits up the terminal pole, drag lines, grounding, direct burial warning tape, utility company transformer pad requirements, and all conduit fittings. On the feeder schedule (see Fig. 2-26, p. 54) we listed the material required. The estimate sheet allows the estimator to list all the items and apply pricing and labor hours necessary for their purchase and their installation. In order to apply the labor hours for all the materials the estimator will need a reliable labor unit reference manual such as the labor rates included in this book.

Figures 2-29E–F, pp. 66–67, list the service equipment, panels, transformers, grounding, etc. This information was gathered from the riser and plan of the project. On the feeder/riser and panel schedule (see Fig. 2-23, p. 49) we listed all of the materials onto another estimate sheet (or sheets). The format for the estimate sheets listing this equipment allows the estimator to apply labor to each item as needed. Project specifications will describe all of the equipment details.

Figure 2-29G, p. 68, lists feeders that service distribution equipment, transformers panels, and the mechanical equipment. This information was gathered from the riser and panel schedule of the estimate (see Fig. 2-23, p. 49). On the feeders one-line diagram (see Fig. 2-23, p. 49) we listed all the conduit, cable, junction boxes, flex, etc. onto another estimate sheet. There will be items required such as hardware, clamps, hangers, splicing materials, and lugs not seen on the plans but that must be accounted for in the estimate.

Figure 2-29H, p. 69, lists the materials and work required for the branch circuits. This information was gathered from rough takeoff sheets of the project. On the branch wiring rough takeoff sheet (see Fig. 2-11, p. 33) we listed all of the material onto another estimate sheet. As you can see on the estimate sheets of this estimate there are items of material not shown on the plans but necessary for a complete installation. The estimator must be aware of these types of materials and make all allowances of labor and material costs in the estimate.

Figures 2-29I–J, pp. 70–71, list the site lighting poles, fixtures, wiring, etc. This information was gathered from rough takeoff sheets of the estimate. On the site lighting rough takeoff sheet (see Fig. 2-9, p. 29) we listed all of the materials onto another estimate sheet. This rough takeoff sheet lists all of the site lighting as shown on the partial site plan and all of the unseen but necessary material and labor for a complete installation.

Figures 2-29K–L, pp. 72–73, list the light fixtures, lamps, whips, boxes, etc. This information was gathered from rough takeoff sheets of the estimate. On the fixtures rough takeoff sheets (see Figs. 2-3A, B, pp. 18, 19) we listed all of the materials onto another estimate sheet (or sheets). There are a few allowances that must be included here again. The estimator should be aware of the unseen material and any associated labor hours necessary for a complete installation and include them in the estimate.

Figure 2-29M, p. 74, lists the devices, boxes, and plates. This information was gathered from rough takeoff sheets of the estimate. On the devices rough takeoff sheet (see Fig. 2-6, p. 24) we listed all of the materials onto another estimate sheet (or sheets).

Figure 2-29N, p. 75, lists all of the materials for a voice and data communications system. This information was gathered from rough takeoff sheets of the estimate. On the communications rough takeoff sheet (see Fig. 2-14, p. 37) we listed all of the voice and data outlets, backboard, patch panel and stand, cables, patch cords, punch-down block, connectors, etc. onto another estimate sheet (or sheets).

Figure 2-29O, p. 76, lists all of the materials for a fire alarm system. This information was gathered from rough takeoff sheets of the estimate. On the fire alarm rough

takeoff sheet (see Fig. 2-18, p. 43) we listed the fire alarm panel, annunciator, stations, signals, detectors, resistors, flow and tamper switches, cable, boxes, raceways, wire, etc. onto another estimate sheet (or sheets).

Figure 2-29P, p. 77, lists all of the materials required for the mechanical equipment. This information was gathered from rough takeoff sheets of the estimate. On the mechanical equipment takeoff sheet (see Fig. 2-21, p. 47) we listed the various items furnished by the electrical contractor and the mechanical equipment that requires electrical connections onto another estimate sheet (or sheets).

NOTE: As the estimate sheets are developed a page number should be placed on them. This will help the estimator to keep track of how many pages there are and will reduce the loss of a sheet. If they are numbered sequentially, a missing estimate sheet will be avoided. The sequence of the pages can be adjusted and when doing so the number should also be changed to match the sequence (some use the A, B, C, etc. method then change to numerals).

The next step is to assemble all of the estimate sheets in numerical order and begin to apply the prices and labor hours to all of the materials and necessary allowances where they are needed. In order to apply the labor rates, the estimator will need a labor rate reference guide to refer to. This book contains a section devoted to material labor rates used herein (see Chapter 3). Refer to the sample estimate to see how the labor rate units are applied to the materials listed on the estimate sheets. Upon completion of the individual labor units and their mathematical extensions, the sheets should be totaled.

Pricing the material and allowances on each estimate sheet is delegated to different persons in contracting companies. Some will have the estimator do it, some will have a purchasing agent do it, and some contractors will perform the task themselves. No matter who does the pricing of the material, the estimator should be the one responsible for assembling the estimate sheets after all of the labor hours and prices are completed and totaled. All major material suppliers' quotations should be reviewed for any exclusions, quantities, delivery dates, shop drawings submittal dates, etc. The supplier with the lowest quotation in accordance with all of the plans and specifications should be entered into the estimate where required.

During this time frame the estimator should prepare the recapitulation of the estimate sheets. The recapitulation sheet (or sheets) will list all of the estimate sheets and their totals of labor hours and material (Fig. 2-29C, p. 64). Upon completion of the recapitulation sheet (or sheets) the total of the material cost (less quotations) and the total of hours will be transferred forward to the final recapitulation cover sheet (Fig. 2-29A, p. 61). Now that the material prices and the labor hours for the entire estimate have been entered onto the final recapitulation sheet, the estimator prepares the equipment prices needed recapitulation sheet (Fig. 2-29B, p. 63). On this recapitulation sheet (or sheets) the estimator enters all the quotations of the major items for the project. Such material may be the light fixtures in the building as well the site lighting, power distribution equipment, life-safety equipment, communications equipment, civil work subcontractor, precast concrete items, etc.

Once all of the quotations have been entered onto the equipment prices needed recapitulation sheet (or sheets) and totaled, the estimator will transfer this total onto the final recapitulation sheet. On the final recapitulation sheet we now have all of the material prices entered and the total of the labor hours required to complete the project installation (see Fig. 2-29A, p. 61).

The final estimate in a completed form follows (see Fig. 2-29A–P, pp. 61–77). The cover recapitulation sheet includes all anticipated costs of material, labor, job expenses, nonproductive labor, overhead, and profit.

NOTE: You will see spaces on the estimate sheets with a "Q" and a space in the material column highlighted (any color highlight will work here). The highlight is a reminder to the estimator that a price quote is needed. If one lump sum is received for multiple items, the estimator will enter the lump sum on that estimate sheet and write "inc." (included) in each space that is included in the lump sum.

RECAPITULATION SHEET

ESTIMATE NO: 10/01/03-1

JOB OFFICE BLDG' #100 UTOWN, USA SHEET NO: 1 OF 1

ESTIMATED BY MR. E.S.T. CHECKED BY Sr. DATE: 10/01/03

SHEET NO	ESTIMATE SHEETS DESCRIPTION	$ MATERIAL	HOURS
RE-1 OF 1	RECAPITULATION OF 13 ESTIMATE SHEETS	$100,000.00	1,398.00
PN-1 OF 1	PRICE QUOTATIONS NEEDED	$50,000.00	0

NONPRODUCTIVE LABOR	HOURS
HANDLING MATERIAL	40.00
SUPERVISION	120.00
TRAVEL TIME	16.00
OVERTIME	0
NONWORKING PERSONNEL	0
TOTAL (A)	176.00

JOB EXPENSE	
SCAFFOLDS, LIFTS COSTS	$750.00
STORAGE	$225.00
INSPECTION, PERMIT FEES	$275.00
LICENSE FEE	$0.00
FREIGHT CHARGES	$1,000.00
AS-BUILT DRAWINGS	$875.00
INSURANCE	FBO
WATCHMAN	FBO
PRO RATA CHARGES	$0.00
TRANSPORTATION, TOLLS, ETC.	$125.00
TELEPHONE AND OFFICE COSTS	$750.00
TOTAL (B)	$4,000.00

MISC. MATERIAL (C) AND LABOR (D)	$150,000.00	1,398.00
NONPRODUCTIVE LABOR (A)		176.00
TOTALS: MATERIAL (C) & LABOR (D)	$150,000.00	1,574.00
136 Hours Labor @ $ 50.00 PER HR		$6,800.00
40 Hours Labor @ $ 37.00 PER HR		$1,480.00
1,398 Hours Labor @ $ 45.00 PER HR		$62,910.00
Taxes: Soc. Sec. INC Unemp. INC		$0.00
Workmen's Compensation Insurance INC		$0.00
LABOR GROSS TOTAL		$71,190.00
JOB EXPENSE (B)		$4,000.00
MATERIAL (C) (EST. ONLY)		$150,000.00
TOTAL PRIME COST		$225,190.00
12% OVERHEAD		$27,023.00
TOTAL NET COST		$252,213.00
8% PROFIT		$20,177.00
SELLING PRICE (NO BOND)		$272,390.00
BOND COST		N/A
SELLING PRICE (W / BOND)		$272,390.00
FINAL QUOTED PRICE		$272,000.00

(*continues*)

Figure 2-29A

RECAPITULATION SHEET (BACK)

1. THE CONTRACTOR MUST INVESTIGATE THE REQUIREMENTS OF EACH GOVERNMENT AGENCY AS IT RELATES TO SALES TAXES ON BOTH MATERIALS AND LABOR AND INCLUDE ALL OF THESE COSTS IN EACH PROPOSAL!
2. Nonproductive labor section contains various areas of costs that are affected by noninstallation labor factors. These items may or may not apply to all proposals but remind the contractor that there may be labor costs beyond the actual labor cost associated with the project. This may also remind the contractor that there may be other items of nonproductive labor cost that should be addressed in the proposal.
3. Job expense section contains important direct project-related costs. These dollar costs may or may not be applicable to each proposal submitted by the contractor. This may also remind the contractor that there may be additional job-related expenses to be considered.
4. Labor hour section allows the contractor to apply different labor rates as they may apply to the level of grade of the workers who physically install or direct the installations.
5. Taxes section allows the contractor to include such taxable items of labor as they may apply to the project.
6. Overhead section is a cost of doing business for the contractor. This cost may include insurances, office supplies, postage, contractor's building facility, utilities, office personnel payroll, telephone, association fees, periodicals, facility maintenance, rolling stock upkeep and fuel, rental of office equipment, support programs costs, etc. Include any other costs that are fixed as they relate to the business inside the contractor's facilities.
7. Profit is relative to the size of the proposal and the amount the contractor anticipates.
8. Bond section gives the contractor the ability to include the cost of a bid bond, performance bond, and/or payment bonds.

Figure 2-29A *continued*

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: PN-1 OF 1

EQUIPMENT PRICES NEEDED

ESTIMATED BY: MR. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS		MATERIALS				LABOR HOURS			
			QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Civil work	EST. PAGE #67	QUOTE	→	Q					1
2	MDP, panels, transformer	EST. PAGE #63 & 64	QUOTE	→	Q					2
3	Site lighting fixtures	EST. PAGE #43	QUOTE	→	Q					3
4	Boom truck allowance	EST. PAGE #43	QUOTE	→	Q					4
5	Civil work	EST. PAGE #43 & 44	QUOTE	→	Q					5
6	Light fixtures	EST. PAGE #33	QUOTE	→	Q					6
7	Fire alarm	EST. PAGE #56	QUOTE	→	Q					7
8										8
9										9
10										10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30
31										31
32										32
				TOTAL		est' only $50,000.00	TOTAL			

Figure 2-29B

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: RE-1 OF 1

RECAP OF ESTIMATE SHEETS

ESTIMATED BY: MR. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Electric, communication services to building				Prices			117.5	1
2	MDP, panels, transformer				By			107.8	2
3	" " "				Contractor			38.1	3
4	Feeders							81.75	4
5	Branch circuits							324.35	5
6	Site lighting							237.1	6
7	" "							109.4	7
8	Light fixtures							76.95	8
9	Light fixtures							21.55	9
10	Devices							30.85	10
11	Communications							27.9	11
12	Fire alarm							186.5	12
13	Mechanical equipment requirements							38.15	13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL		est' only $100,000.00	TOTAL		1,397.90	

Figure 2-29C

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 1 OF 13

Estimate Sheet of Feeders Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	4" rigid galvanized conduit up terminal pole	20'		C		30	C	6	1
2	4" rigid galvanized conduit 3 @ 15' each in trench	50'		C		15	C	7.5	2
3	4" ground bushings	10		EA		0.35	EA	3.5	3
4	4" galvanized 90-degree elbow 48-degree radius	4		EA		2.5	EA	10	4
5	4" galvanized 90-degree elbow standard radius	6		EA		2	EA	12	5
6	4" rigid to PVC coupling	4		EA		0.8	EA	3.2	6
7	4" schedule 80 PVC conduit in trench	300'		C		8.8	C	26.4	7
8	4" PVC 90-degree elbows	2		EA		0.8	EA	0.15	8
9	4" plastic capped bushings	2		EA		0.06	EA	0.1	9
10	Drag line	375'		M		6	M	2.25	10
11	Copper clad ground rod 3/4" x 12' w/clamp	1		EA		2.25	EA	2.25	11
12	Coordinate with power company on all their req's	allow						2	12
13	regarding services to the building								13
14	#500 mcm thhn copper cable	480'		M		40	M	19.2	14
15	#3/0 thhn copper cable	120'		M		21	M	2.5	15
16	3 pulls of 4 #500's & 1 #3/0 @ 40' each pull								16
17	Provide 3 barrell #500 mcm copper lugs for the	4		EA		2	EA	8	17
18	secondary transformer connections	s/s hardware		AL					18
19	Provide grounding req's for the power company's	allow						4	19
20	transformer and the conduits	s/s hardware		AL					20
21									21
22	Layout and coordinate all excavation with all of the	allow						4	22
23	affected contractors and architect								23
24	Trench 48" deep x 24" wide	110'	Q					INC	24
25	Provide 6" layers of sand under & above conduits	allow	Q					2	25
26	Backfill trench and tamp in 8" lifts	allow	Q					2	26
27	Install warning tape 12" below grade in trench	110'		M		4	M	0.45	27
28	Spread or remove excess excavated earth	allow	Q						28
29									29
30									30
31									31
32									32
	EA = Each M = Per Thousand Q = Quotation C = Per Hundred AL = Allowance		TOTAL			TOTAL		117.5	

Figure 2-29D

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 2 OF 13

Estimate Sheet of Panels & Transformers Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Main Distribution Panel 480/277v 3 phase 4 wire	1	Q					38	1
2	Includes a 1200 amp CT section and metering								2
3	1200 amp MCB 3-pole 12 #500 mcm & 3 #3/0's	connect		AL				6.9	3
4	Surface mounted at wall of utilities room	supports		AL				4	4
5	150 amp 3-pole circuit breaker active	1	Q			1.8	EA	1.8	5
6	125 amp " " " "	2	Q			1.7	EA	3.4	6
7	60 amp " " " "	2	Q			1.25	EA	2.5	7
8	200 amp " " " spare	1	Q						8
9	100 amp " " " "	1	Q						9
10									10
11									11
12	Lighting Panel "PLP-1" 480/277v 3 phase 4 wire	1	Q			4	EA	4	12
13	225 amp main lugs only 4 #2's	connect		AL		1	EA	1	13
14	Surface mounted at wall of utilities room	supports		AL		1	EA	1	14
15	20 amp 1-pole circuit breakers active	28	Q			0.3	EA	8.4	15
16	20 amp " " " spare	10	Q						16
17	1 " " " spaces	4	Q						17
18									18
19	Lighting Panel "PLP-2" 480/277v 3 phase 4 wire	1	Q			4	EA	4	19
20	225 amp main lugs only 4 #2's	connect		AL		1	EA	1	20
21	Surface mounted on wall near panel RP-1	supports		AL		1	EA	1	21
22	20 amp 1-pole circuit breakers active	36	Q			0.3	EA	10.8	22
23	20 amp 1-pole circuit breakers spare	6	Q						23
24									24
25									25
26	Receptacle Panel "RP-1" 120/208v 3 phase 4 wire	1	Q			4	EA	4	26
27	Section 1 of 2 with feed thru lugs 4 #3/0's	connect		AL		1.2	EA	1.2	27
28	225 amp 3-pole main cir' brkr' 4 #3/0's	connect		AL		1.2	EA	1.2	28
29	Surface mounted on wall near panel "PLP-1"	supports	Q			1	EA	1	29
30	20 amp 1-pole circuit breakers active	42	Q			0.3	EA	12.6	30
31									31
32									32
	Q = Quotation EA = Each AL = Allowance		TOTAL			TOTAL		107.8	

Figure 2-29E

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 3 OF 13

Estimate Sheet of Panels & Transformers Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Receptacle Panel "RP-1" 120/208v 3 phase 4 wire	1	Q			4	EA	4	1
2	Section 2 of 2 w/main lugs only 4 #3/0's	connect		AL		1.2	EA	1.2	2
3	Surface mounted next to section #1 of RP-1	supports		AL		1	EA	1	3
4	20 amp 1 pole circuit breakers active	18	Q			0.3	EA	5.4	4
5	——— 1 pole " " spaces	24	Q						5
6									6
7	Dry transformer "T-1" 75 KVA	1	Q			21	EA	21	7
8	480v primary to 120/208v secondary 3 phase 4 wire	connect		AL		2.5	EA	2.5	8
9	Nema 1 indoor floor mounted	fastners		AL		1	EA	1	9
10	Ground to building steel	allow		AL		2	EA	2	10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each Q = Quotation AL = Allowance			TOTAL		TOTAL		38.1	

Figure 2-29F

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 4 OF 13

Estimate Sheet of Indoor Feeders Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	2" EMT raceway	10'		C		12	C	1.2	1
2	1-1/4" " "	150'		C		8	C	12	2
3	1" " "	210'		C		6	C	12.6	3
4	2" EMT connectors s/s	2		EA		0.15	EA	0.3	4
5	1-1/4" " " "	6		EA		0.1	EA	0.6	5
6	1" " " "	12		EA		0.1	EA	1.2	6
7	2" EMT couplings s/s	5		EA		—	—	—	7
8	1-1/4" " " "	30		EA		—	—	—	8
9	1" " " "	50		EA		—	—	—	9
10	2" EMT supports & fastners	2		EA		0.15	EA	0.3	10
11	1-1/4" " " "	20		EA		0.1	EA	2	11
12	1" " " "	30		EA		0.1	EA	3	12
13	2" EMT 90-degree elbows	2		EA		0.2	EA	0.4	13
14	1-1/4" " " " "	9		EA		0.1	EA	0.9	14
15	1" " " " "	10		EA		0.05	EA	0.5	15
16	2" Greenfield whip & 2 connectors	1		EA		2	EA	2	16
17	1-1/4" " " " "	1		EA		1	EA	1	17
18	3/4" sealtight whip & 2 connectors	4		EA		0.75	EA	3	18
19	JB #1 & 2 10"x10"x6" deep nema 1 w/ term' strip	2		EA		2	EA	4	19
20	for feeds, taps, and grounds	supports				—	—	INC	20
21	Pitch pockets for 1"c install & seal	4		EA		1	EA	4	21
22	#3/0 thhn copper wire (short runs)	30'		M		33	M	1	22
23	#1 " " " (3 legs 70' ea)	210'		M		22	M	0.95	23
24	#2 " " " (4 legs 100' ea)	400'		M		20	M	8	24
25	#4 thhn copper wire (6 runs of 3 #4's ± 50' ea)	870'		M		17	M	14.8	25
26	#8 thhn copper green wire for grounding	300'		M		12	M	3.6	26
27	#10 thhn copper green wire for grounding	40'		M		10	M	0.4	27
28		—						—	28
29	Misc' splicing, lugs, tags, tape, testing, etc.	allow				—	—	4	29
30		—						—	30
31		—						—	31
32									32
	EA = Each M = Per Thousand C = Per Hundred		TOTAL			TOTAL		81.75	

Figure 2-29G

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 5 OF 13

Estimate Sheet of Branch Wiring Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	2/c #12 MC cable	3,000'		M		30	M	90	1
2	3/c #12 MC cable	1,000'		M		35	M	35	2
3	4/c #12 MC cable	400'		M		40	M	16	3
4	2/c #10 MC cable	100'		M		36	M	3.6	4
5	3/c #10 MC cable	300'		M		50	M	15	5
6	4/c #10 MC cable	750'		M		55	M	41.25	6
7									7
8	MC cable connectors	374		C				INC	8
9	MC cable hangers and supports/fastners	Allow						80	9
10									10
11	Metal stud wall sleves	90		C				22	11
12									12
13	4" and 5" square boxes with blank covers	50		EA		0.35	EA	17.5	13
14									14
15	Misc. splicing, tags, tape, ty-raps, etc.	Allow							15
16									16
17	Allowance for misc' EMT and wire	Allow						4	17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each C = Per Hundred		TOTAL			TOTAL		324.35	

Figure 2-29H

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 6 OF 13

Estimate Sheet of Site Lighting Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	Type "1" 20' aluminum poles (level w/shims)	6	Q	EA		4	EA	24	1
2	400 watt hps 480v fixtures	12	Q	EA		2.5	EA	18	2
3	Pole top yoke for 2 fixtures	6	Q	EA		1.5	EA	9	3
4	400 watt hps base horz' lamps	12	Q	EA		0.1	EA	1.2	4
5	Type "2" 20' aluminum poles (level w/shims)	4	Q	EA		4	EA	16	5
6	400 watt hps 480v fixtures	16	Q	EA		2.5	EA	40	6
7	Pole top yoke for 4 fixtures	4	Q	EA		2.5	EA	10	7
8	400 watt hps base horz' lamps	16	Q	EA		0.1	EA	1.6	8
9	Type "3" 20' aluminum poles (level w/shims)	4	Q	EA		4	EA	16	9
10	400 watt hps 480v fixtures	4	Q	EA		2.5	EA	10	10
11	6' aluminum fixture arms	4	Q	EA		3	EA	12	11
12	400 watt hps base horz' lamps	4	Q	EA		0.1	EA	0.4	12
13	Note: Assemble all poles & test on the ground!								13
14	In-line fuse holders w/fuses 480 volt	64		E		0.1	EA	6.4	14
15	#12 thhn 600v copper wire in poles	1,500'		M		8	M	12	15
16	Wirenuts, tape, for splices in pole	Allow							16
17	Ground lugs in poles for grounding	14		E		0.15	EA	2.1	17
18	1/2" x 10' long copped clad ground rods w/acorn	14		E		1.6	EA	22.4	18
19	Time clock astro/dial 2-pole 20 amp 277v N/1 enclo.	1		E		1.5	EA	1.5	19
20	Lighting contactor 6-pole 30 amp 277v coil " "	1		E		2	EA	2	20
21	Outdoor photo cell 277v.	1		E		1	EA	1	21
22									22
23	7' precast concrete bases 3' "afg" and 4' "bfg"	14	Q			2	EA	28	23
24	"afg" = above & "bfg" = below the finish grade								24
25									25
26	Deliver the following to the precast co. all the	Allow						2	26
27	bolts, bolt circle, pvc sleves for rods and wire								27
28	1-1/4" pvc x 5' long with a 90-degree & coupling assembly	32		E				1.5	28
29	1/2" pvc x 7' long conduit for base sleves, for rods	14		E				INC	29
30									30
31	Allow for boom truck to set 14 poles & relocate	Allow	Q						31
32	and set the 14 concrete bases into the holes								32
	Q = Quotation M = Per Thousand EA = Each C = Per Hundred INC = Included		TOTAL			TOTAL		237.1	

Figure 2-29I

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 7 OF 13

Estimate Sheet of Site Lighting Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	1-1/4" schld' 40 PVC conduit in trench	1,500'		C		10	C	15	1
2	1-1/4" schld' 40 PVC 90's in trench	33		C		10	C	3.3	2
3	1-1/4" schld' 40 PVC couplings	70		C		—	—	INC	3
4	PVC cement	Allow				—	—	—	4
5		—							5
6	#6 thhn 600v copper wire stranded	1,500'		M		14	M	21	6
7	#8 thhn 600v copper wire stranded	3,000'		M		12	M	36	7
8	#10 thhn 600v copper wire stranded	1,800'		M		10	M	18	8
9		—							9
10	Direct buried electrical lines warning tape	1,500'		M		4	M	6	10
11		—							11
12	Excavate and backfill trench 6"w x 24" deep	—							12
13	(backfill & tamp in 8" lifts)	—							13
14	(if rocky conditions, provide a sand bed of	1.500'	Q			layout	—	8	14
15	4" on trench bottom prior to installing the	—							15
16	raceways)	—							16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand Q = Quotation C = Per Hundred		TOTAL			TOTAL		107.3	

Figure 2-29J

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 8 OF 13

Estimate Sheet of Fixtures Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	TYPE "A" 2'X4' LAY-IN W/3-32W CW 277V	16	Q			1.3	EA	20.8	1
2	TYPE "A-1" 2'X4' LAY-IN W/2-32W CW 277V	1	Q			1.1	EA	1.1	2
3	TYPE "B" 2'X2' LAY-IN W/2-32WU CW 277V	2	Q			1	EA	2	3
4	TYPE "C" 4'X4' LAY-IN W/6-32W CW 277V	1	Q			2	EA	2	4
5	TYPE "D" 1'X4' REC'D W/2-32W CW 277V	5	Q			1	EA	5	5
6	TYPE "D" PLASTER FRAMES	5	Q			0.25	EA	1.25	6
7	TYPE "E" EXIT WALL/CEILING W/EM' BATT' 277V	4	Q			0.75	EA	3	7
8	TYPE "E-M" EMER BATT W/2 HEADS 277V	3	Q			1.5	EA	4.5	8
9	TYPE "EM-1" " " W/1 HEAD 277V	1	Q			1.5	EA	1.5	9
10	REMOTE HEADS FOR EM' BATT'	2	Q			0.75	EA	1.5	10
11	TYPE "F" REC' HI-HAT 1-PL LAMP 277V	8	Q			1	EA	8	11
12	TYPE "G" WALL SCONCE W/1 PL LAMP 277V	3	Q			0.75	EA	2.25	12
13	TYPE "H" HID WALL W/P 1/70 HPS 277V	4	Q			2	EA	8	13
14	TYPE "I" NOT USED	0							14
15	TYPE "J" 8' SUR TRACK 1 CIR 120V	0							15
16	TYPE "J-1" 4' SUR TRACK 1 CIR 120V	1	Q			0.65	EA	0.65	16
17	TYPE "J-1" END FEED-IN W/COVER FOR T BAR	1	Q			0.25	EA	0.25	17
18	TYPE "J-1" T-BAR CLIPS	3	Q			0.1	EA	0.3	18
19	TYPE "J-1" FIXT' HEADS W/PAR20 75W LAMPS	2	Q			0.65	EA	1.3	19
20	TYPE "K" 2' UNDER CABINET 1/18W 120V	1	Q			0.75	EA	0.75	20
21	TYPE "L" 4' SUSPND' FLUOR' W/2-32WCW 277V	4	Q			0.75	EA	3	21
22	TYPE "M" INC' W/P GLOBE W/1-100W IF 130V	4	Q			1.25	EA	5	22
23	TYPE "N" INC' W/P SPOT W/SENSOR 150W 120V	1	Q			1.5	EA	1.5	23
24	32 WATT CW LAMPS	74	Q			0.03	EA	2.2	24
25	32 WATT CW U LAMPS	4	Q			0.03	EA	0.1	25
26	18 WATT DUAL PL LAMPS	11	Q			0.03	EA	0.35	26
27	100 WATT IF LAMPS 130V LAMPS	4	Q			0.03	EA	0.1	27
28	75 WATT PAR 120V LAMPS	2	Q			0.03	EA	0.05	28
29	18 WATT CW FLUOR' LAMPS	1	Q			0.03	EA	0.05	29
30	150 WATT PAR 38FL LAMPS	1	Q			0.03	EA	0.05	30
31	70 WATT HID HPS BD LAMPS	4	Q			0.1	EA	0.4	31
32									32
	Q = Quotation EA = Each		TOTAL			TOTAL		76.95	

Figure 2-29K

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 9 OF 13

Estimate Sheet of Fixtures Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	FIXTURE OUTLET BOXES FOR WALL	17		EA		0.35	EA	5.95	1
2	FIXTURE OUTLET IN CEILING SPACE	20		EA		0.35	EA	7	2
3	4" SQ' BOXES W/ BLANK COVERS	8		EA		0.35	EA	2.8	3
4	FLEXIBLE FIXTURE WHIPS W/WIRE	33		EA		0.1	EA	3.3	4
5									5
6	HOLD-DOWN CLIPS FOR LAY-IN FIXTURES	ALLOW						0.5	6
7	INDEPENDENT SUPPORTS FOR LAY-IN FIXT'S	ALLOW						2	7
8									8
9	SPLICING MATERIALS	ALLOW						0	9
10									10
11	WIRE CONNECTORS, TAPE, TAGS, ETC.	ALLOW						0	11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each							21.55	

Figure 2-29L

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 10 OF 13

Estimate Sheet of Devices Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	S - 20 amp 277v single-pole switch	6		EA		0.7	EA	4.2	1
2	SS - 2-20 amp " " " "	0							2
3	SSS - 3-20 amp " " " "	1		EA		1.4	EA	1.4	3
4	S3 - 20 amp 277v 3-way switch	4		EA		0.75	EA	3	4
5	S3S3 - 2-20 amp " " "	0							5
6	S4 - 20 amp 277v 4-way switch	0							6
7	S dim - 1000 watt 120v wall dimmer inc.	0							7
8	S dim S dim - 2 " " " " "	0							8
9	Sp - 20 amp 277v single-pole switch w/pilot light	1		EA		0.75	EA	0.75	9
10	Swp - 20 amp 277v single-pole switch (nema 3r)	0							10
11	⊕ - 20 amp 120v duplex receptacle	22		EA		0.7	EA	15.4	11
12	⊕wp gfi - 20 amp 120v duplex recpt' (nema 3R)	4		EA		1.1	EA	4.4	12
13	▣ - 20 amp 120v duplex recept' in a 1 gng' flr' box	0							13
14	⊕ - 20 amp 120v grnd' fault recpt'	2		EA		0.85	EA	1.7	14
15	⊕ - 20 amp 120v single recept'	0							15
16	⏢ - 30 amp 3 phase 4w 480v recept'	0							16
17									17
18	Price and labor the devices with a box and plate								18
19									19
20	Metal stud wall box supports	Allow						INC	20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each INC = Included		TOTAL			TOTAL		30.85	

Figure 2-29M

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 11 OF 13

Estimate Sheet of Communications Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	▼ T Public tel. wall outlet box & plate	1		EA		0.45	EA	0.45	1
2	▼ V Voice wall outlet box, plate, & conn'	0							2
3	▽ D Data wall outlet box, plate, & conn'	0							3
4	V ▼ ▽ D Voice/Data wall outlet box, plate, & conn'	3		EA		0.65	EA	1.95	4
5	Tele', voice, data backboard	1		EA		1.5	EA	1.5	5
6	Patch panel floor stand w/ gnd' conn'	1		EA		2	EA	2	6
7	64-port data patch panel	1		EA		0.5	EA	0.5	7
8	Shelf for patch panel & wire mngr'	1		EA		1	EA	1	8
9	100 pair 110-voice block	1		EA		0.5	EA	0.5	9
10	6' long data patch cords	3		EA		0.15	EA	0.45	10
11	Data conn at patch panel	3		EA		0.25	EA	0.75	11
12	2' to 8' voice patch cords	4		EA		0.05	EA	0.2	12
13	Voice cable punch downs at 110 block	4		EA		0.03	PP	0.1	13
14	Ground floor stand to bldg' steel	Allow		EA				2	14
15									15
16	Cat #3 plenum cable	400'		M		5	M	2	16
17	Cat #5 plenum cable	300'		M		5	M	1.5	17
18	"J" hooks for cable supports thru ceiling space	30		C		25	C	7.5	18
19	Misc' hangers, sleeves, etc.	Allow						2	19
20	Label all face plates, ports, & 110 block	Allow						2	20
21	Test all (7) cables and record	Allow						1.5	21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each C = Per Hundred PP = Per Pair		TOTAL			TOTAL		27.9	

Figure 2-29N

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 12 OF 13

Estimate Sheet of Fire Alarm Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	Fire alarm panel 24 zones surf' mtd'	1	Q			24	EA	24	1
2	Annunciator panel 24 zones recessed	1	Q			24	EA	24	2
3	F Manual pull station flush mtd	7	Q			0.8	EA	5.6	3
4	AV Audio/visual alarm	5	Q			1	EA	5	4
5	SD Smoke detector	14	Q			1	EA	14	5
6	DD Duct detector & sample tube	4	Q			2	EA	8	6
7	SFS Sprinkler flow switch	1	Q			1.5	EA	1.5	7
8	STS Sprinkler tamper switch	1	Q			1	EA	1	8
9	"ELR" end of line resistors	4	Q			0.25	EA	1	9
10									10
11	1" emt in ceiling space	90'		C		6	C	5.4	11
12	1" emt connectors s/s	2		C		10	C	0.2	12
13	1" emt couplings s/s	12		C				INC	13
14	1" emt supports and fastners	15		C		10	C	1.5	14
15	#14 thhn copper wire (24 points & common)	2,500'		M		6	M	15	15
16									16
17	#16/ 4 conductor plenum rated fire alarm cable	1,500'		M		16	M	24	17
18	#16/ 2 conductor plenum rated fire alarm cable	500'		M		15	M	7.5	18
19	Cable hangers, supports, ties, etc.	Allow						16	19
20	Device wall outlet boxes 1 gang	42		EA		0.35	EA	14.7	20
21	4" square boxes with blank covers	6		EA		0.35	EA	2.1	21
22	Wall sleves and sealant	Allow						8	22
23	Testing	Allow						8	23
24	Misc' splicing, tags, tape, etc.	Allow							24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	M = Per Thousand EA = Each Q = Quotation C = Per Hundred INC = Included		TOTAL			TOTAL		186.5	

Figure 2-29O

ESTIMATE SHEET ESTIMATE NO: 10/01/03-1

JOB: Office bldg' #100 Utown, USA PAGE NO: 13 OF 13

Estimate Sheet of Mechanical Equipment Labor Hours

ESTIMATED BY: Mr. E.S.T. CHCK'D BY: Sr. DATE: 10/01/03

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	1 HP 3-phase 480 v roof top ex. fan	1			FIBO	1	EA	1	1
2	1.5 HP " " " " "	1			FIBO	1	EA	1	2
3	3 HP " " " " "	1			FIBO	1.5	EA	1.5	3
4	30 amp 480 v 3p 4w N/F W/P disc' sw	3		EA		1.7	EA	5.1	4
5	60 amp " " " " " " "	4		EA		2.8	EA	11.2	5
6	Size "O" mag' starter 3-pole 480 v n/1	2			FIBO	2	EA	4	6
7	Size "1" mag' starter 3-pole 480 v n/1	1			FIBO	2.35	EA	2.35	7
8	Prepackaged HV AC rooftop units	4			FIBO	4	EA	4	8
9	(3-phase 480 v w/p prewired)								9
10									10
11	(Conduit and wire, flex connections, roof pockets								11
12	are included on the feeder estimate sheets.)								12
13	Misc' splicing, tags, tape, testing	Allow						8	13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
	EA = Each FIBO = Furnished & Installed by Others		TOTAL			TOTAL		38.15	

Figure 2-29P

CHAPTER 3

Labor Rate Schedules and Forms, Charts, and Diagrams

This section contains electrical construction materials and associated installation labor units along with a sample estimate of a combination office and warehouse. The estimate lays out the project in orderly steps, such as the installation of the projects incoming electric service. You should understand that in order to have service delivered to the project, a variety of electrical materials will be necessary. A power company will require raceways, drag lines, and grounding among related items. To prepare a coherent itemized quantity of material, you will need to review the contract documents including plans, specifications and all addendums that may be included.

TAKEOFF: The estimator should begin the takeoff of all electrical materials required by examining all the plans including building, steel, plumbing, HVAC, electrical, and communications plans. Review the specifications that help to describe the makeup of all the materials. After the estimator has reviewed the documents, a plan should be developed and the takeoff should begin. It is recommended that each section of the project should be listed on rough takeoff sheets and be assembled by sections (see sample estimate in Chapter 4). Consider counting and listing all of the items that would require a specific quotation price (e.g., sw. gear, panels, transformers, disconnect switches, lighting fixtures, civil work, life-safety systems, voice and data systems, etc.). This facilitates returns of quotations prior to the bid date.

STEP 1: Review the fixture schedule, count the fixtures, and list them on a takeoff sheet along with the lamps, flexible whips, hangers, hold-down clips, fixture outlet boxes, and miscellaneous items. This allows the estimator to visit areas of the project and it familiarizes the estimator with the project, which will assist in the takeoff. After this section of the takeoff is on the estimate sheet, refer to the sections of the manual where the labor units are listed. Apply labor units as they relate to the fixtures listed on the estimate sheet.

STEP 2: Follow STEP 1 for the remaining sections of the project, as the sample estimate would show (see Chapter 4). NOTE: The sample estimate does not include pricing, as each contractor will have their own pricing structure arrangements with their suppliers and market fluctuations.

After the estimator has compiled all of the estimate sheets they will need to be listed on a separate estimate sheet referred to as a recap of estimate sheets. Next, the estimator will need to prepare a price quotations needed sheet. This should list all of the quotations that have been received from the various manufacturers of required equipment.

The final sheet will be the recapitulation sheet. Refer to the sample sheet for the final assembly of all the associated sheets (see Fig. 4-1A). Along with all of the sheets, the estimator should alert his superiors of all associated costs that will be required in the complete installation of the work required. The estimator should review the completion schedule and calculate the amount of workers whom will be required to complete the work contracted for and any nonproductive labor required.

The actual costs of materials, labor, overhead, and profit will be determined by the estimator's superiors. But, the estimator should be prepared to provide the necessary information to those who will have the final responsibility in developing the final selling price.

Included here are blank forms for the estimator to use in preparing estimates.

Section 1

Raceways and Fittings

- Rigid galvanized conduit (Figs. 3-1 and 3-2)
- Rigid conduit associated fittings (Figs. 3-3 and 3-4)
- Rigid conduit associated fittings, explosion proof (Figs. 3-5 and 3-6)
- Wireways and fittings (Fig. 3-7)
- Cable tray and fittings (Fig. 3-8 and 3-9)
- Flexible conduit and fittings (Figs. 3-10 and 3-11)
- Flexible motor whips (Fig. 3-12)
- EMT raceways and fittings (Fig. 3-13)
- PVC raceways and fittings (Figs. 3-14 and 3-15)
- Under floor ducts and fittings (Fig. 3-16)
- Trench duct and fittings (Figs. 3-17 and 3-18)
- Wiremold and fittings (Fig. 3-19)
- Mineral insulated (MI) cable 600 volt (Figs. 3-20 and 3-21)

Section 2

Devices, Boxes, Plates, and Flat Wiring

- Devices and plates (Fig. 3-22)
- Poke-through fittings (Fig. 3-23)
- Outlet and junction boxes (Figs. 3-24 and 3-25)
- Under carpet flat-wiring system (Fig. 3-26)

Section 3

Light Fixtures

- Hid, incandescent, exit, and emergency lights (Figs. 3-27 and 3-28)
- Fluorescent fixtures (Fig. 3-29)
- Track lighting and associated components (Fig. 3-30)
- Preassembled quick wiring system (Figs. 3-31 and 3-32)
- Area lighting (Fig. 3-33)
- Wood pole installation (Fig. 3-34)

Section 4

Emergency Generators

- Emergency generator sets (Figs. 3-35 and 3-36)

Section 5

Grounding

- Grounding, cadwelding, and associated fittings (Fig. 3-37)

Section 6

Bus Ducts

- Copper/aluminum ducts and associated devices (Figs. 3-38 and 3-39)

Section 7

Distribution Equipment

- Fused and nonfused disconnect switches (Fig. 3-40)
- Motor control centers (Fig. 3-41)
- Starters, contactors, and controls (Figs. 3-42 and 3-43)
- High-voltage transformers (Figs. 3-44 and 3-45)
- Low-voltage transformers (Figs. 3-46 and 3-47)
- Incoming service and distribution sections (Fig. 3-48)
- Meter stacks (Figs. 3-49 and 3-50)
- Indoor surface panels (Figs. 3-51 and 3-52)
- Circuit breakers and terminations (Figs. 3-53, 3-54, and 3-55)
- Enclosures and circuit breakers (Fig. 3-56)

Section 8

Fire Alarm and Miscellaneous Systems

- Fire alarm devices and cables (Fig. 3-57)
- Clock, sound, doorbell, nurse call, and cctv/ public systems (Fig. 3-58)

Section 9

Electric Heating

- Baseboard, wall, radiant, panels, and explosion proof units (Figs. 3-59 and 3-60)
- Snow melting mats and roof gutter cables (Figs. 3-61 and 3-62)

Section 10

High- and Low-Voltage Cables

- High-voltage cables installed in raceways (Fig. 3-63)
- 600-volt cables installed in raceways (and reel setup) (Figs. 3-64 and 3-65)
- Multiconductor tray cables (Fig. 3-66)
- Multiconductor copper cables (Figs. 3-67 and 3-68)
- Low-voltage and multiconductor cables (Fig. 3-69)

Section 11

Voice and Data Wiring

- Category 3 and 5 cables, devices, and terminations (Fig. 3-70)

Section 12

Miscellaneous HVAC Devices

- ATC controls and fan units (Fig. 3-71)

Section 13

Light Bases

- Concrete light bases built in place (Fig. 3-72)

Section 14

Voltage Drop Tables

- 6- and 12-volt voltage drop tables (Fig. 3-73)

Section 15

Miscellaneous

- Formulas, tables, conversion factors, etc. (Fig. 3-74)
- AC motor connections
- Single-phase motor HP and ampere ratings (Fig. 3-75)
- Three-phase motor HP and ampere ratings (Fig. 3-76)
- Typical motor control circuits (Figs. 3-77, 3-78, 3-79, and 3-80)
- Conversion factors (Fig. 3-81)
- Ampere ratings of single- and three-phase resistance loads (Figs. 3-82 and 3-83)
- Diagrams of three-phase transformer connections (Figs. 3-84 and 3-85)
- Transformer KVA and single- and three-phase ampere ratings (Figs. 3-86 and 3-87)
- Lighting design/footcandle recommendations (Fig. 3-88)

Section 1: Raceways and Fittings

FIELD INSTALLATION OF RACEWAYS
AND ASSOCIATED FITTINGS FOR RGC

RGC CONDUIT SIZES	LABOR HRS TO INSTALL PER "C"				
	RGC COND (EXP)	RGC COND (SLAB)	RGC COND TRENCH	RGC COND PAINT	RGC MFG BENDS 90, 45, ETC.
1/2"	5	3	2.5	1	10
3/4"	6	4	3	1	15
1"	7	5	3.5	1.2	20
1-1/4"	8	6	4	1.2	30
1-1/2"	10	N/A	5	1.5	40
2"	12	N/A	6	2	60
2-1/2"	17	N/A	8.5	2.5	80
3"	20	N/A	10	3	100
3-1/2"	25	N/A	12.5	3.3	125
4"	30	N/A	15	4	200
5"	40	N/A	20	4.5	2.5
6"	50	N/A	25	5	3

NOTES:

Add 25% to labor hours to install above 15' up to 25'.

Parallel runs: 2nd run × 75%; 3rd run × 70%; 4th run × 65%; above 4th × 50%.

Coupling labor is included with conduit labor.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Deduct 15% if installing aluminum raceways and fittings.

Add for assembly and removal of scaffolding if required (+/– 8 hrs total for 3/6' sections).

Add 25% to exposed RGC hours if using PVC-coated conduit.

Allow 2–4 hrs per 1,000' for direct burial marker tape (hr rate per M depends on job conditions).

Figure 3-1

FIELD INSTALLATION OF RACEWAYS AND ASSOCIATED FITTINGS FOR RGC

RGC CONDUIT SIZES	LABOR HRS TO INSTALL PER "C"				
	RGC MFG 90 ELLS 48" RADIUS	RGC MFG 90 ELLS 60" RADIUS	RGC CLAMPS & SUPPORTS	RGC TERMS LOCK/BUSH	RGC MFG NIPPLES
1/2"	*****	*****	10	10	10
3/4"	*****	*****	10	10	10
1"	*****	*****	15	10	15
1-1/4"	*****	*****	15	10	20
1-1/2"	*****	*****	15	15	25
2"	*****	*****	20	15	25
2-1/2"	*****	*****	20	15	35
3	125	150	25	25	50
3-1/2"	150	175	25	25	50
4"	250	300	50	25	75
5"	300	400	75	35	75
6"	350	500	75	45	75

NOTES:

Add 25% to labor hours to install above 15' up to 25'.

Parallel runs: 2nd run × 75%; 3rd run × 70%; 4th run × 65%; above 4th × 50%.

Coupling labor is included with conduit labor.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Deduct 15% if installing aluminum raceways and fittings.

Add for assembly and removal of scaffolding if required (+/– 8 hrs total for 3/6' sections).

Add 25% to exposed RGC hours if using PVC-coated conduit.

Allow 2–4 hrs per 1,000' for direct burial marker tape (hr rate per M depends on job conditions).

Figure 3-2

FIELD INSTALLATION OF RIGID CONDUIT ASSOCIATED FITTINGS

RGC CONDUIT SIZES	LABOR HRS TO INSTALL PER "C"						
	RGC GROUND BUSHING	RGC SERVICE HEAD	RGC THREADED HUB	RGC CONDULET 1 HUB	RGC CONDULET "LB" & COV	RGC CONDULET "T" & COV	RGC CONDULET "X" & COV
1/2"	10	20	20	20	30	60	80
3/4"	10	25	20	20	40	60	80
1"	10	35	25	25	50	75	100
1-1/4"	10	40	35	35	70	100	140
1-1/2"	15	45	45	45	90	130	180
2"	15	50	60	60	120	180	240
2-1/2"	20	60	85	85	170	250	340
3"	25	75	125	125	250	375	500
3-1/2"	25	85	175	175	300	400	*****
4"	35	100	250	250	375	500	*****
5"	40	125	375	*****	*****	*****	*****
6"	50	150	450	*****	*****	*****	*****

NOTES:

Deduct 15% if using aluminum fittings.

Ground bushings include lug termination of ground wire.

Threaded hub includes KO hole.

Add 25% to labor hours to install above 15' up to 25'.

Add 15% to hours if using PVC-coated conduit.

Figure 3-3

FIELD INSTALLATION OF RIGID CONDUIT ASSOCIATED FITTINGS

RGC CONDUIT SIZES	LABOR TO INSTALL PER "C"					
	RGC REDUCING BUSHING	RGC 3-PIECE COUPLING	RGC RISER CLAMPS	RGC FLOOR FLANGE	RGC SPLIT COUPLING	RGC FLOOR SLEEVE
1/2"	*****	30	15	25	30	*****
3/4"	7.5	35	15	25	35	*****
1"	10	45	15	25	45	*****
1-1/4"	12	60	20	35	60	50
1-1/2"	15	70	20	35	70	50
2"	20	95	25	40	95	50
2-1/2"	25	125	25	40	125	50
3"	30	150	35	50	150	100
3-1/2"	50	175	50	50	175	100
4"	80	200	50	75	200	100
5"	100	250	75	100	250	100
6"	150	300	100	100	300	100

NOTES:

Labor on reducing bushings is size to be reduced (e.g., 3/4" labor is to reduce to 1/2", etc.).

Floor flange labor includes anchors.

Floor sleeve labor includes layout.

Core bore concrete floor 4" thick up to 4" diameter allow 1.5 hrs each (this includes layout, setup, and removal). Add extra labor to catch core material if required on floor below.

Figure 3-4

FIELD INSTALLATION OF RIGID CONDUIT AND ASSOCIATED EXPLOSION-PROOF FITTINGS

RGC COND SIZES	LABOR TO INSTALL PER "C"					
	RGC UNY/UNF EX/PF	RGC LBY EX/PF	RGC EYS/EYZ EX/PF	RGC EYD EX/PF	RGC ECLK EX/PF	RGC LBH EX/PF
1/2"	30	30	35	40	50	45
3/4"	35	35	40	45	55	45
1"	45	40	50	55	70	55
1-1/4"	60	50	65	75	85	80
1-1/2"	70	60	80	90	95	100
2"	95	*****	110	120	125	130
2-1/2"	130	*****	145	155	160	185
3"	160	*****	175	185	190	265
3-1/2"	175	*****	200	210	*****	320
4"	200	*****	225	235	*****	400
5"	250	*****	*****	*****	*****	*****
6"	300	*****	*****	*****	*****	*****

NOTES:

Above units include layout, fitting to conduit, and covers (guj-type also).

Sealing of seal fittings is included.

Installation of drain is included on drain fittings.

Add for any "special" supports of fittings.

Average labor based on lengths up to 24" for eclk-type flex.

"Exp prf" = explosion proof/hazardous locations.

Add 15% to hours if using PVC-coated conduit.

Figure 3-5

FIELD INSTALLATION OF RIGID CONDUIT AND ASSOCIATED EXPLOSION-PROOF FITTINGS

RGC COND SIZES	LABOR HRS TO INSTALL PER "C"					
	RGC GUAE EX/PF	RGC GUAC EX/PF	RGC GUAL/B EX/PF	RGC GUAT EX/PF	RGC GUAX EX/PF	RGC GUASC EX/PF
1/2"	20	40	40	60	80	10
3/4"	20	40	40	60	80	10
1"	25	50	50	75	100	10
1-1/4"	*****	70	70	100	140	*****
1-1/2"	*****	90	90	130	180	*****
2"	*****	120	120	180	240	*****

NOTES:

Above units include layout, fitting to conduit, and covers (guj-type also).

Installation of drain is included on drain fittings.

Add for any "special" supports of fittings.

"Exp prf" = explosion proof/hazardous locations.

Add 15% to hours if using PVC-coated conduit.

Figure 3-6

FIELD INSTALLATION OF WIREWAYS AND FITTINGS

WIREWAY INDOOR SIZES	HRS PER EACH FOOT	LABOR HRS TO INSTALL EACH			
		W/W COUP' CONN'	W/W FACTORY BEND	W/W TEE FITTING	W/W CROSS FITTING
2.5" x 2.5"	0.2	0.05	0.1	0.12	0.15
4" x 4"	0.25	0.08	0.12	0.15	0.18
6" x 6"	0.35	0.08	0.12	0.18	0.2
8" x 8"	0.4	0.1	0.15	0.2	0.25
12" x 12"	0.5	0.15	0.2	0.25	0.35

WIREWAY INDOOR SIZES	LABOR HRS TO INSTALL EACH			
	W/W BLANK END	W/W PANEL ADAPTER	W/W FACTORY REDUCER	W/W UNIVERSAL HANGER
2.5" x 2.5"	0.05	0.45	0.1	0.1
4" x 4"	0.08	0.45	0.12	0.1
6" x 6"	0.08	0.5	0.12	0.15
8" x 8"	0.1	0.6	0.15	0.15
12" x 12"	0.15	0.75	0.2	0.2

NOTES:

Add 25% to hrs to install above 15' up to 25'.

Add 25% to hrs to install Nema 12- and 3R-types wireway and fittings.

Add .35 hrs per hanging rod and clamp.

Add 1.25 hrs per trapeze hanger (add 15% each foot if longer than 3').

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Figure 3-7

FIELD INSTALLATION OF CABLE TRAY AND FITTINGS

ALUMINUM TRAY SIZES	LABOR HRS TO INSTALL EACH			
	ALUM TRAY LENGTH 12' LONG	ALUM 90 DEG ELL 12" RAD	ALUM 90 DEG ELL 24" RAD	ALUM TEE FTNG 12" RAD
3" D X 12" W	1.55	1.65	1.75	3.55
3" D X 24" W	1.75	2.95	3.15	3.95
4" D X 6" W	1.45	1.55	1.65	3.55
4" D X 12" W	1.55	1.65	1.85	3.75
4" D X 18" W	1.75	2.45	2.65	4.15
4" D X 24" W	1.85	2.95	3.25	4.75
6" D X 12" W	2.25	1.85	2.05	3.95
6" D X 24" W	2.75	3.15	3.35	5.15

NOTES:

Add 75% to the above labor rates if tray is steel.

Trapeze hangers add 1.25 hrs each as required (add 15% each foot if longer than 3').

Drill and set anchors overhead at 20 minutes each.

Pairs of splice plates included in tray labor.

Hold-down clips included in tray labor.

Add 5 hrs per hundred feet for divider strip.

Add .50 hrs each for divider strips in fittings.

Add .25 hrs each for tray ground clamp.

Figure 3-8

FIELD INSTALLATION OF CABLE TRAY AND FITTINGS

ALUMINUM TRAY SIZES	LABOR HRS TO INSTALL EACH				
	ALUM TEE FTNG 24" RAD	ALUM CROSS FTNG	ALUM END FTNG	ALUM DROP OUT FTNG	ALUM TRAY BOX CONN
3" D X 12" W	3.95	4.45	0.55	0.55	0.35
3" D X 24" W	4.35	5.55	0.75	0.75	0.45
4" D X 6" W	3.95	4.45	0.45	0.45	0.35
4" D X 12" W	4.25	4.85	0.55	0.55	0.45
4" D X 18" W	4.45	5.15	0.75	0.75	0.55
4" D X 24" W	5.15	5.65	0.85	0.85	0.65
6" D X 12" W	4.45	5.15	0.75	0.75	0.55
6" D X 24" W	5.65	6.15	1.15	1.15	0.75

NOTES:

Add 75% to the above labor rates if tray is steel.

Trapeze hangers add 1.25 hrs each as required (add 15% each foot if longer than 3').

Drill and set anchors overhead at 20 minutes each.

Pairs of splice plates included in tray labor.

Hold-down clips included in tray labor.

Add 5 hrs per hundred feet for divider strip.

Add .50 hrs each for divider strip.

Add .25 hrs each for tray ground clamp.

Figure 3-9

FIELD INSTALLATION OF FLEXIBLE CONDUIT AND FITTINGS

DESCRIPTION	LABOR HRS TO INSTALL PER "C"					
METAL FLEX SIZES	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
FLEX COND	3.5	3.5	4	7.5	10	12
STR CONN	5	5	6	8.5	14	18
ANGL CONN	5.5	5.5	7	10	16	20
FLEX TO RGC	5	5	6	8.5	14	18
STRAP/CLAMP	5	5	5	10	10	15

DESCRIPTION	LABOR HRS TO INSTALL PER "C"					
SEALTITE SIZES	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
SEALTITE	5.5	5.5	7.5	11	15.25	18.75
STR CONN	10	10	14	18.5	25	31
ANGL CONN	10	10	14	18.5	25	31
SEALTITE/RGS	35	35	40	50	60	70
STRAP/CLAMP	6	6	6	11	11	16

NOTES:

Drill and set anchors at 10 minutes each (add 100% if overhead).

For short whips 3' to 6' long, add 15% to above flex-conduit labor units.

Figure 3-10

FIELD INSTALLATION OF FLEXIBLE CONDUIT AND FITTINGS

DESCRIPTION	LABOR HRS TO INSTALL PER "C"				
METAL FLEX SIZES	2"	2-1/2"	3"	3-1/2"	4"
FLEX COND	15	20	28	34	40
STR CONN	25	30	40	50	75
ANGL CONN	30	40	50	60	85
FLEX TO RGC	25	30	40	50	75
STRAP/CLAMP	15	20	25	25	50

DESCRIPTION	LABOR HRS TO INSTALL PER "C"				
SEALTITE SIZES	2"	2-1/2"	3"	3-1/2"	4"
SEALTITE	28	30	34	44	50
STR CONN	43	55	70	94	120
ANGL CONN	43	55	70	94	120
SEALTITE/RGS	82	88	95	110	130
STRAP/CLAMP	16	22	30	30	65

NOTES:

Drill and set anchors at 10 minutes each (add 100% if overhead).

For short whips 3' to 6' long, add 15% to above flex-conduit labor units.

Figure 3-11

FIELD INSTALLATION OF MOTOR WHIP CONNECTIONS

MOTOR SIZE HP	LABOR HRS TO INSTALL EACH	
	1 Ø PHASE MOTOR	3 Ø PHASE MOTOR
1 HP	0.75	1
2 HP	0.75	1.5
3 HP	1	1.5
5 HP	1.25	1.75
7.5 HP	1.5	2
10 HP	1.75	2.5
15 HP	2	3
20 HP	2.25	3.25
25/30 HP	2.75	3.5
40 HP	3	3.75
50/60 HP	3.25	4
75 HP	*****	4.5
100 HP	*****	5
125 HP	*****	5.25
150 HP	*****	5.5
200 HP	*****	6

NOTES:

Labor units include the makeup of flexible whips that include:

a. flexible whip with connectors.

b. appropriate wire size and connections of each end.

Handling and/or setting of motors is not included.

Figure 3-12

FIELD INSTALLATION OF RACEWAYS AND ASSOCIATED FITTINGS FOR EMT

EMT CONDUIT SIZES	LABOR HRS TO INSTALL PER "C"						
	EMT CONDUIT	EMT CONN'.	EMT MFG BENDS	EMT CLAMPS STRAPS	EMT SERVICE HEADS	EMT LB' & COVER	EMT T' & COVER
1/2"	4	5	3	5	16	5	7
3/4"	5	5	3	5	16	5	7
1"	6	10	5	10	20	10	12
1-1/4"	8	10	10	10	25	10	12
1-1/2"	9	10	10	15	25	10	15
2"	12	15	20	15	35	15	18
2-1/2"	14	15	20	20	40	15	18
3"	16	20	25	25	50	20	25
3-1/2"	18	25	40	25	75	25	35
4"	18	25	50	50	75	25	35

NOTES:

Add 25% to labor hours to install above 15' up to 25'.

Parallel runs: 2nd one × 75%; 3rd one × 70%; 4th one × 75%; above 4th × 50.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Coupling labor is included with all raceways.

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Add for assembly and removal of scaffolding if required (+/– 8 hrs total for 3/6' sections).

Figure 3-13

FIELD INSTALLATION OF RACEWAYS AND ASSOCIATED PVC FITTINGS

PVC CONDUIT SIZES	LABOR HRS TO INSTALL "C"			
	PVC 40 CONDUIT EXPOSED	PVC 80 CONDUIT EXPOSED	ADAPTERS PVC 40/80 MALE / FEMALE	MFG BEND PVC 40/80 (REG 45/90)
1/2"	4	4.4	10	10
3/4"	4	4.4	10	10
1"	5	5.5	10	10
1-1/4"	6	6.6	20	20
1-1/2"	6	6.6	20	20
2"	7	7.7	30	30
2-1/2"	8	8.8	35	35
3"	10	11	35	35
3-1/2"	10	11	40	40
4"	12	13.2	80	80
5"	16	17.6	90	90
6"	20	22	100	100

NOTES:

For PVC in trench reduce hourly rate by 50%.

Chair labor rate at 5 hrs per "C."

Add for field bending as required (hot box or blanket).

Add for special stakes and tie downs to avoid floating when encased with concrete.

Raceway labor is based upon 10' lengths.

End-bell labor (bell ends) same as adapter labor.

Coupling labor included with raceway labor.

Allow 2–4 hrs per 1,000' for direct burial marker tape (hr rate per M depends on job conditions).

Figure 3-14

FIELD INSTALLATION OF RACEWAYS AND ASSOCIATED PVC FITTINGS

PVC CONDUIT SIZES	LABOR HRS TO INSTALL "C"		
	MFG BEND PVC 40/80 (48" RAD.)	MFG BEND PVC 40/80 (60" RAD.)	PLUGS PVC (& CAPS)
1/2"	11	12.1	3
3/4"	11	12.1	3
1"	11	12.1	3
1-1/4"	22	24.2	4
1-1/2"	22	24.2	4
2"	33	36.3	5
2-1/2"	38.5	42.35	5
3"	38.5	42.35	5
3-1/2"	44	48.4	5
4"	88	96.8	6
5"	99	108.9	6
6"	110	121	6

NOTE:
Coupling labor included with raceway labor.

Figure 3-15

FIELD INSTALLATION OF UNDER FLOOR DUCTS AND FITTINGS

1 POWER FLOOR DUCT: 10' LONG	.80 HRS EA. LENGTH
1 COMMUNICATION FLOOR DUCT: 10' LONG	.85 HRS EA. LENGTH
2 POWER FLOOR DUCTS: 10' LONG	.85 HRS EA. LENGTH
3 POWER FLOOR DUCTS: 10' LONG	.90 HRS EA. LENGTH
1 POWER & 2 COMMUNICATION FLOOR DUCTS: 10' LONG	1.00 HR EA. LENGTH
1 POWER & 2 SUPER COMMUNICATION FLOOR DUCTS: 10' LONG	1.2 HRS EA. LENGTH
COMBINATION SUPPORT / COUPLING	.50 HRS EACH
SINGLE-LEVEL FLOOR DUCT JUNCTION BOX	1.5 HRS EACH
TWO-LEVEL FLOOR DUCT JUNCTION BOX	2.5 HRS EACH
VERTICAL 90-DEG' ELL FOR POWER DUCT	.75 HRS EACH
VERTICAL 90-DEG' ELL FOR COMMUNICATION DUCT (STND & SUPER)	1.00 HR EACH
HORZ' 90-DEG' ELL FOR POWER DUCT	.75 HRS EACH
HORZ' 90-DEG' ELL FOR COMMUNICATION DUCT (STND & SUPER)	1.00 HR EACH
SINGLE CONDUIT ADAPTER	.25 HRS EACH
MULTICONDUIT ADAPTER	.50 HRS EACH
RED' COUP'/ELL ENTER PULL BX/"Y" FITTING/CAB' CONN'	1.00 HR EACH
CLOSURE PLATES	.10 HRS EACH
AFTER INSERT	1.3 HRS EACH

NOTES:

Fasten ducts, supports, and boxes to concrete subfloor.

If no concrete to fasten to, allow added time to secure to subfloor to avoid floating.

Allow additional labor to level ducts if there is no concrete subfloor.

Allow additional labor to install markers.

Allow additional labor to distribute duct to multistory buildings (also lift charges).

Figure 3-16

FIELD INSTALLATION OF TRENCH DUCT AND FITTINGS

TRENCH DUCT SIZES	LABOR HRS TO INSTALL EACH				
	DUCT 10' LONG	COVER 24" LONG	DUCT DIVIDER 5' LONG	DUCT SUPPORT CHANNEL	DUCT END BLANK
6"	4	0.35	0.15	0.5	1
9"	4	0.35	0.15	0.5	1
12"	5.25	0.5	0.15	0.5	1.25
18"	7	0.75	0.15	0.75	1.75
24"	8	1	0.15	0.75	2
30"	8.75	1.3	0.15	1	2.5
36"	9	1.5	0.15	1	2.85

NOTE:

Allow additional labor to cut hole for cabinet connector.

Figure 3-17

FIELD INSTALLATION OF TRENCH DUCT AND FITTINGS

TRENCH DUCT SIZES	LABOR HRS TO INSTALL EACH			
	DUCT VERT' ELL	RISER + CABINET CONN	REDUCER: SIZE TO BE REDUCED	GROMMETS PLASTIC & METAL
6"	2.75	3	*****	0.25
9"	3	3	*****	0.25
12"	3.5	3.5	0.5	0.4
18"	4	4.15	1	0.5
24"	4.75	4.9	1.5	0.65
30"	6	6	2	0.75
36"	6.5	7.75	2.75	0.75

NOTES:

See notes on page 97, under floor duct (Fig. 3-16).

Allow additional labor to cut hole for cabinet connector.

Figure 3-18

FIELD INSTALLATION OF METAL WIREMOLD AND FITTINGS

W/M SIZES	LABOR HRS TO INSTALL PER "C"								
	FEET	STRAPS	90-DEG ELLS	TEE & CROSS	CEIL'G BOX	DEVICE BOX 1G	COMBO' FIT'NG	DEVICE BRCK'T	BOX CONN'
200	4.5	10	10	15	25	25	25	*****	*****
500	5	10	10	15	25	25	25	*****	*****
700	6	10	15	18	25	25	25	*****	*****
1,000	7	12	15	18	*****	*****	*****	*****	*****
2,100	8	15	15	20	*****	*****	*****	*****	*****
2,600	8.5	15	18	22	*****	*****	*****	*****	*****
3,000	10	18	25	35	*****	*****	*****	25	25
4,000	12	20	25	40	*****	*****	*****	25	25

NOTE:

Deduct 50% of using nonmetallic surface raceways and fittings.

Figure 3-19

FIELD INSTALLATION OF MINERAL INSULATED CABLE 600V

"MI" CABLE COND' SIZES	LABOR HRS TO INSTALL PER "C"				
	"MI" CABLE 1 COND'	"MI" CABLE 2 COND'	"MI" CABLE 3 COND'	"MI" CABLE 4 COND'	"MI" CABLE 7 COND'
#12	4.8	5.5	6.25	7	7.5
#10	5	5.75	7	7.85	8.5
#8	5.5	7	8	8.55	*****
#6	6	7.75	9	9.75	*****
#4	7.25	8	9.25	*****	*****
#2	8	*****	*****	*****	*****
#1	8.5	*****	*****	*****	*****
#1/0	9	*****	*****	*****	*****
#2/0	9.5	*****	*****	*****	*****
#3/0	10	*****	*****	*****	*****
#4/0	12	*****	*****	*****	*****

NOTES:

Add 25% to labor to install above 15' up to 25'.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Allow for assembly and removal of scaffolding if required (+/– 8 hrs total for 3/6' sections).

Figure 3-20

FIELD INSTALLATION OF MINERAL INSULATED CABLE 600V

"MI" CABLE COND' SIZES	LABOR HRS TO INSTALL EACH TERMINATION				
	"MI" CABLE 1/COND' TERM	"MI" CABLE 2/COND' TERM	"MI" CABLE 3/COND' TERM	"MI" CABLE 4/COND' TERM	"MI" CABLE 7/COND' TERM
#12	1	1.25	1.55	1.75	2.5
#10	1	1.35	1.65	1.9	3
#8	1.15	1.45	1.75	2.15	*****
#6	1.25	1.65	1.9	2.25	*****
#4	1.35	1.75	2	*****	*****
#2	1.5	*****	*****	*****	*****
#1	1.7	*****	*****	*****	*****
#1/0	1.9	*****	*****	*****	*****
#2/0	2.1	*****	*****	*****	*****
#3/0	2.25	*****	*****	*****	*****
#4/0	2.5	*****	*****	*****	*****

NOTES:

Add 25% to labor to install above 15' up to 25'.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Drill and set concrete anchors at 10 minutes each (add 100% if in overhead).

Allow for assembly and removal of scaffolding if required (+/– 8 hrs total for 3/6' sections).

Figure 3-21

Section 2: Devices, Boxes, Plates, and Flat Wiring

FIELD INSTALLATION OF DEVICES AND PLATES

SINGLE-POLE SWITCH W/ PLATE (15 & 20 AMP)	35 HRS PER "C"
SINGLE-POLE SWITCH & PILOT LIGHT W/ PLATE (15 & 20 AMP)	40 HRS PER "C"
PILOT LIGHT W/ PLATE (120 VOL T)	25 HRS PER "C"
2-POLE SWITCH W/ PLATE (15 & 20 AMP)	45 HRS PER "C"
3-WAY SWITCH W/ PLATE (15 & 20 AMP)	40 HRS PER "C"
4-WAY SWITCH W/ PLATE (15 & 20 AMP)	45 HRS PER "C"
SINGLE RECEPTACLE W/ PLATE (15 & 20 AMP)	35 HRS PER "C"
DUPLEX RECEPTACLE W/ PLATE (15 & 20 AMP)	35 HRS PER "C"
GFCI RECEPTACLE W/ PLATE (15 & 20 AMP)	40 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (15 & 20 AMP)	35 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (15 & 20 AMP)	45 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (30 AMP)	40 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (30 AMP)	45 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (40 AMP)	50 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (40 AMP)	50 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (50 AMP)[a]	70 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (50 AMP)[a]	75 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (60 AMP)[a]	70 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (60 AMP)[a]	75 HRS PER "C"
2-POLE 3-WIRE RECEPTACLE W/ PLATE (100 AMP)[a]	100 HRS PER "C"
3-POLE 4-WIRE RECEPTACLE W/ PLATE (100 AMP)[a]	100 HRS PER "C"

NOTES:

[a]Add 50 hrs per "C" for manufacturer's back box.

All labor rates apply to commercial and residential use.

Figure 3-22

FIELD INSTALLATION OF POKE-THROUGH FITTINGS / DEVICES / COVERS

POKE-THROUGH FITTING W/ A SIMPLEX OR DUPLEX RECEPTACLE	150 HRS PER "C"
POKE-THROUGH FITTING W/ TWO SIMPLEX OR DUPLEX RECEPTACLE	175 HRS PER "C"
POKE-THROUGH FITTING W/ HOLE FOR FLEX' CONDUIT	125 HRS PER "C"
POKE-THROUGH FITTING W/ RECEPTACLE AND HOLE FOR FLEX' CONDUIT	150 HRS PER "C"
POKE-THROUGH POWER OR COMMUNICATIONS DIVIDER KIT	25 HRS PER "C"
SERVICE FITTING W/ 1 SIMPLEX OR DUPLEX RECEPTACLE	75 HRS PER "C"
SERVICE FITTING W/ 2 RECEPTACLES	105 HRS PER "C"
SERVICE FITTING FOR VOICE / DATA	50 HRS PER "C"

NOTES:

Labor includes complete installation of receptacles and covers/plates.
Allow additional time to layout and core drill floor holes.
Allow additional time for flexible conduit as required.
Allow additional time for voice or data connections.

Figure 3-23

FIELD INSTALLATION OF SHEET METAL OUTLET AND JUNCTION BOXES

ONE GANG METAL WALL BOX / NEW OR EXIST' WORK[a]	35 HRS PER "C"
ONE GANG METAL MASONRY WALL BOX[b]	35 HRS PER "C"
ONE GANG METAL THROUGH 4" WALL BOX FOR NEW WORK	45 HRS PER "C"
ONE GANG METAL THROUGH 8" WALL BOX FOR NEW WORK	45 HRS PER "C"
METAL HANDY BOX[d]	30 HRS PER "C"
4" SQUARE METAL BOX 1-1/2" DEEP[c,d]	25 HRS PER "C"
4" SQUARE METAL BOX 2-1/8" DEEP[c,d]	40 HRS PER "C"
4-11/16" SQUARE METAL BOX 1-1/2" DEEP[c,d]	35 HRS PER "C"
4-11/16" SQUARE METAL BOX 2-1/8" DEEP[c,d]	50 HRS PER "C"
4" ROUND METAL BOX OR EXTENSION BOX[d]	25 HRS PER "C"
METAL HUNG CEILING BOX WITH 24" BAR SUPPORT	50 HRS PER "C"
ONE GANG METAL FLOOR BOX W/ COVER (ADJUSTABLE)	125 HRS PER "C"
METAL JUNCTION BOX W/COVER 6"x6"x4" DEEP (144/256 cu. in.)	100 HRS PER "C"
METAL JUNCTION BOX W/COVER 12"x12"x4" DEEP (556 cu. in.)	150 HRS PER "C"
METAL JUNCTION BOX W/COVER 18"x18"x6" DEEP (1,944 cu. in.)	200 HRS PER "C"
METAL JUNCTION BOXES 2,000 cu. in. to 4,000 cu. in.[e]	300 HRS PER "C"

NOTES:

[a]Gangable type add 15 hrs per "C" for additional gang in sheetrock.

[b]Add 10 hrs per "C" for each added gang and 10 hrs per "C" for box partitions.

[c]Add 10 hrs per "C" for blank cover and 10 hrs per "C" for 1 and 2 gang tile covers.

[d]Add 10 hrs per "C" for blank covers.

[e]Add .75 hrs for each additional 1,000 cu. in. up to 12,000 cu. in.

Add for cutting into existing masonry and 15 hrs per "C" for box supports.

Add 1.25 hrs for each 1,000 cu. in. above 12,000 cu. in.

Figure 3-24

FIELD INSTALLATION OF CAST OUTLET AND JUNCTION BOXES

ONE GANG, ONE HUB OUTLET BOX[a]	50 HRS PER "C"
TWO GANG, ONE HUB OUTLET BOX[a]	65 HRS PER "C"
ONE GANG FLOOR OUTLET BOX	100 HRS PER "C"
TWO GANG FLOOR OUTLET BOX	135 HRS PER "C"
THREE GANG FLOOR OUTLET BOX	175 HRS PER "C"
JUNCTION BOX W/COVER 6" x 6" x 4" DEEP (144 CU IN)	200 HRS PER "C"
JUNCTION BOX W/COVER 8" x 8" x 4" DEEP (256 CU IN)	200 HRS PER "C"
JUNCTION BOX W/COVER 12" x 12" x 4" DEEP (576 CU IN)[b]	300 HRS PER "C"

NOTES:

[a]Add 15 hrs per "C" for each additional hub.

[b]Add 1.5 hrs per "M" cu. in. for boxes 600 cu. in. up to 10,000 cu. in.

Add 10 hrs per "C" for cover plate and 15 hrs per "C" for w/p cover.

Add 50 hrs per "C" for w/p bubble cover.

Deduct 15% if using aluminum.

Add 15% if using 2 gang box made in tandem.

Add 2 hrs per "M" cu. in. for boxes above 10,000 cu. in.

Figure 3-25

FIELD INSTALLATION OF UNDER CARPET FLAT-WIRING SYSTEM

FLAT CABLE SIZES	LABOR HRS TO INSTALL PER "C"					
	CABLE W/SHLD'S	CABLE SPLICE	CABLE TEE	CABLE TO POWER TRANS'	SINGLE FLOOR RECEP	DUAL FLOOR RECEP
3/C #12	4	24	40	12	65	75
4/C #12	5	24	40	12	65	75
5/C #12	6	24	40	12	65	75
3/C #10	6	26	42	12	65	75
4/C #10	7	26	42	12	65	75
5/C #10	8	26	42	12	65	75

LABOR HRS TO INSTALL PER "C"					
FLAT TELEPH CABLE 25 PR.	FLAT DATA CABLE 25/C	SHLD'S BOTTOM & TOP	WALL TRANS' BOX	FLOOR TELE FTNG'	FLOOR DATA FTNG'
16	16	4	200	100	100

NOTES:

Layout labor for runs of flat wire is included.

Removal of floor covering and any adhesive is not included.

Installation of floor covering is not included.

Figure 3-26

Section 3: Light Fixtures

FIELD INSTALLATION OF HID LIGHTING FIXTURES

FLUSH-MOUNTED HID LIGHT FIXTURE 100 WATT	2.50 HRS EACH
FLUSH-MOUNTED HID LIGHT FIXTURE 250 WATT	2.50 HRS EACH
FLUSH-MOUNTED HID LIGHT FIXTURE 400 WATT	2.80 HRS EACH
FLUSH-MOUNTED HID LIGHT FIXTURE 1000 WATT	4.00 HRS EACH
FLUSH-MOUNTED HID LIGHT FIXTURE 1500 WATT	**********

*SURFACE-MOUNTED HID LIGHT FIXTURE 100 WATT	3.00 HRS EACH
*SURFACE-MOUNTED HID LIGHT FIXTURE 250 WATT	3.00 HRS EACH
*SURFACE-MOUNTED HID LIGHT FIXTURE 400 WATT	3.30 HRS EACH
SURFACE-MOUNTED HID LIGHT FIXTURE 1000 WATT	4.30 HRS EACH
SURFACE-MOUNTED HID LIGHT FIXTURE 1500 WATT	4.75 HRS EACH

HIGH OR LOW BAY HID LIGHT FIXTURE 100 WATT	2.00 HRS EACH
HIGH OR LOW BAY HID LIGHT FIXTURE 250 WATT	2.00 HRS EACH
HIGH OR LOW BAY HID LIGHT FIXTURE 400 WATT	2.00 HRS EACH
HIGH OR LOW BAY HID LIGHT FIXTURE 1000 WATT	2.25 HRS EACH
HIGH OR LOW BAY HID LIGHT FIXTURE 1500 WATT	2.25 HRS EACH

NOTES:

*Add 100% to labor for explosion proof.
All labor units are based upon ceiling height of 12' or less.
Add 25% to labor for each 5' increase in ceiling height.
Add 1 hr for each remote-mounted HID ballast.
Allow for added hangers for fixtures if required for independent suspension.
Add .50 hrs each for pendants (max 24") and .10 hrs for each foot over 24".
Add flex fixture whips at 10 hrs per "C."
High/low bay HID prewired with cord and male cap and furnished with loop and hook.

Figure 3-27

FIELD INSTALLATION OF LIGHTING FIXTURES (INCANDESCENT, EXIT, EMERGENCY)

SURFACE-MOUNTED PORCELAIN LAMP HOLDER	.035 HRS EACH
*SURFACE-MOUNTED INCAND. FIXTURE 100 WATT MAXIMUM	.075 HRS EACH
*SURFACE-MOUNTED INCAND. FIXTURE 300 WATT MAXIMUM	1.25 HRS EACH
*WALL-MOUNTED INCAND. FIXTURE 200 WATT MAXIMUM	1.00 HRS EACH
INCAND. LAMP HOLDER FOR "PAR" OR "R" TYPE LAMPS	0.50 HRS EACH
*PENDANT-MOUNTED INCAND. RLM FIXTURE 300 WATT MAXIMUM	1.50 HRS EACH
LOW VOLTAGE AND LINE VOLTAGE HI-HATS	1.00 HRS EACH

EXIT LIGHT CEILING / WALL MTD 1 FACE	.75 HRS EACH
EXIT LIGHT CEILING / WALL MTD 2 FACE	1.00 HRS EACH
COMBO EXIT/EMERG LIGHT CEILING/WALL MTD 1 FACE	1.50 HRS EACH
COMBO EXIT/EMERG LIGHT CEILING/WALL MTD 2 FACE	1.50 HRS EACH
EXIT LIGHT EXPLOSION PROOF	2.25 HRS EACH
EMERG BATTERY LIGHT UNIT EXPLOSION PROOF	3.00 HRS EACH
REMOTE EMERG LIGHT EXPLOSION PROOF	2.25 HRS EACH

NOTES:

*Add 100% to labor for explosion proof.

All labor units are based upon ceiling height of 12' or less.

Add 25% to labor for each 5' increase in ceiling height.

Allow for added hangers for fixtures if required for independent suspension.

Add .50 hrs each for pendants (max 24") and .10 hrs for each foot over 24".

Add flex fixture whips at 10 hrs per "C."

Add .75 hrs for a remote emergency light head for battery pack.

Figure 3-28

FIELD INSTALLATION OF FLUORESCENT FIXTURES

FLUSH-MOUNTED FIXTURE	LABOR HRS TO INSTALL EACH					
	2' LONG	2' X 2'	4'	2' X 4'	8'	4' X 4'
1 LAMP	0.75	1	1	*****	1.25	*****
2 LAMP	0.75	1	1	1.1	1.25	1.5
3 LAMP	*****	1.25	1.25	1.3	1.5	1.75
4 LAMP	*****	1.25	1.25	1.3	1.5	1.75

SURFACE-MOUNTED FIXTURE	LABOR HRS TO INSTALL EACH					
	2' LONG	2' X 2'	4'	2' X 4'	8'	4' X 4'
1 LAMP	0.35	0.5	0.65	*****	1	*****
2 LAMP	0.35	0.5	0.65	0.8	1	1.25
3 LAMP	*****	0.65	0.8	1	1.25	1.5
4 LAMP	*****	0.65	0.8	1	1.25	1.5

PENDANT-MOUNTED FIXTURE	LABOR HRS TO INSTALL EACH					
	2' LONG	2' X 2'	4'	2' X 4'	8'	4' X 4'
1 LAMP	0.5	0.75	0.75	*****	1.25	*****
2 LAMP	0.5	0.75	0.75	1	1.25	1.75
3 LAMP	*****	1	1	1.25	1.5	2
4 LAMP	*****	1	1	1.25	1.5	2

NOTES:

All labor units are based upon ceiling height of 12' or less.

Add 25% to labor for each 5' increase in ceiling height.

Add 1 hr for each remote-mounted emergency battery for fluorescent fixtures.

Allow for additional fixture support if required for independent suspension.

Figure 3-29

FIELD INSTALLATION OF TRACK LIGHTING SYSTEM

TRACK LIGHT LENGTH	LABOR HRS TO INSTALL EACH									
	1 CKT TRACK	2 CKT TRACK	1 CKT END FEED	2 CKT END FEED	1 CKT CENTER FEED	2 CKT CENTER FEED	1 CKT THRU COUP	2 CKT THRU COUP	1 CKT FLEX COUP	2 CKT FLEX COUP
2'	0.5	0.6	0.25	0.4	0.35	0.5	0.15	0.2	0.2	0.25
4'	0.65	0.75								
8'	1	1.25								
12'	1.5	0.175								

LABOR HRS TO INSTALL EACH									
1 CKT 4-WAY FITTING	2 CKT 4-WAY FITTING	1 CKT TEE FITTING	2 CKT TEE FITTING	1 CKT 90-DEG FITTING	2 CKT 90-DEG FITTING	TRACK MTG CLIP	LOW VOLT FIXT	LINE VOLT FIXT	LINE HID FIXT
0.35	0.5	0.25	0.4	0.2	0.35	0.1	0.5	0.65	1

NOTES:

Fixture labor hours are an average for the various types.

Add additional labor for mounting above 12'.

Tracks are rated at 20 amps.

Figure 3-30

FIELD INSTALLATION OF PREASSEMBLED QUICK WIRING SYSTEMS

QUICK WIRING COMPONENTS	HRS TO INSTALL EACH
FIXTURE CONVERTER: HARD WIRE TO CABLE SYSTEM	0.25
HARDWIRE TO CABLE CONVERTER: 3 WIRE	0.25
HARDWIRE TO CABLE CONVERTER: 4 WIRE	0.3
HARDWIRE TO CABLE CONVERTER: 5 WIRE	0.35
CABLE SPLITTER: CABLE IN AND 2 CABLES OUT	0.2
PREASS'LD CABLE COMBO' HARDWIRE END & FIXT' CONVERTER END 9'	0.35
PREASS'LD CABLE COMBO' HARDWIRE END & FIXT' CONVERTER END 15'	0.5
PREASS'LD CABLE SWITCH DROP HARDWIRE END & 3-WAY CABLE RECEPT' 7'	0.35
PREASS'LD CABLE SWITCH DROP HARDWIRE END & 3-WAY CABLE RECEPT' 9'	0.35
PREASS'LD CABLE DROP: HARDWIRE TO CABLE SYSTEM	0.25
PREASS'LD CABLE #12 AWG CONVERTER END TO FIXTURE END 9'	0.25
PREASS'LD CABLE #10 AWG CONVERTER END TO FIXTURE END 9'	0.3
PREASS'LD CABLE #12 AWG CONVERTER END TO FIXTURE END 15'	0.25
PREASS'LD CABLE #10 AWG CONVERTER END TO FIXTURE END 15'	0.3
PREASS'LD CABLE #12 AWG CONVERTER END TO FIXTURE END 21'	0.35
PREASS'LD CABLE #10 AWG CONVERTER END TO FIXTURE END 21'	0.4

NOTES:

The items referenced above are similar to RELOC® by Lithonia.

Add 25% to labor hours to install above 15' up to 25'.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Figure 3-31

FIELD INSTALLATION OF PREASSEMBLED QUICK WIRING SYSTEMS

QUICK WIRING COMPONENTS	HRS TO INSTALL EACH
PREASS'LD CABLE #12 AWG CONVERTER END TO FIXTURE END 25'	0.35
PREASS'LD CABLE #10 AWG CONVERTER END TO FIXTURE END 25'	0.4
PREASS'LD CABLE #12 AWG CONVERTER END TO FIXTURE END 31'	0.35
PREASS'LD CABLE #10 AWG CONVERTER END TO FIXTURE END 31'	0.4
PREASS'LD CABLE FIXTURE TO FIXTURE 5'	0.2
PREASS'LD CABLE FIXTURE TO FIXTURE 7'	0.2
PREASS'LD CABLE FIXTURE TO FIXTURE 9'	0.25
PREASS'LD CABLE FIXTURE TO FIXTURE 11'	0.25
PREASS'LD CABLE FIXTURE TO FIXTURE 13'	0.3
PREASS'LD CABLE FIXTURE TO FIXTURE 15'	0.3
PREASS'LD CABLE EXTENDER 5'	0.2
PREASS'LD CABLE EXTENDER 9'	0.2
PREASS'LD CABLE EXTENDER 11'	0.25
PREASS'LD CABLE EXTENDER 15'	0.3
PREASS'LD CABLE EXTENDER 21'	0.35

NOTES:

The items referenced above are similar to RELOC® by Lithonia.

Add 25% to labor hrs to install above 15' up to 25'.

Trapeze hangers add 1.25 hrs each (add 15% each foot if longer than 3').

Figure 3-32

FIELD INSTALLATION OF AREA LIGHTING

* SITE LIGHTING POLES	HOURS EACH 12'	HOURS EACH 18'	HOURS EACH 25'	HOURS EACH 30'	HOURS EACH 50'
STEEL	3	4	5	6	8
ALUMINUM	2	3	4	5	6
WOOD	2	2.5	3	4	5

TRANS'FRM.	BASE FOR METAL POLE ----------2.0 HRS EACH

**100 WATT HID FIXTURE ON POLE	1.5 HRS EACH
**250 WATT HID FIXTURE ON POLE	2.0 HRS EACH
**400 WATT HID FIXTURE ON POLE	2.5 HRS EACH
**1000 WATT HID FIXTURE ON POLE	3.0 HRS EACH
**1500 WATT HID FIXTURE ON POLE	4.0 HRS EACH

**POLE TOP TO FIXTURE ADAPTER	1.0 HRS EACH
**POLE TOP YOKE FITTING FOR 2 FIXTURES	1.5 HRS EACH
**POLE TOP YOKE FITTING FOR 3 FIXTURES	2.0 HRS EACH
**POLE TOP YOKE FITTING FOR 4 FIXTURES	2.5 HRS EACH
**POLE ARM UP TO 3' LONG	2.0 HRS EACH
**POLE ARM UP TO 6' LONG	3.0 HRS EACH

WALKWAY BOLLARD (42" high) set on concrete base	2.5 HRS EACH

NOTES:

*Allow for use of bucket truck, or the like, to set and connect.

**Labor rates are intended for dressing up pole prior to setting.

Allow for in-line fuse holders with fuses and shims for leveling poles as required.

Allow extra labor for remote ballast (average at 1.5 hrs each).

Figure 3-33

FIELD INSTALLATION OF WOOD POLES

LABOR HRS TO INSTALL EACH								
WOOD POLE 20' SET IN SOIL 4' DEEP	WOOD POLE 25' SET IN SOIL 5' DEEP	WOOD POLE 30' SET IN SOIL 5.5' DEEP	WOOD POLE 35' SET IN SOIL 6' DEEP	WOOD POLE 40' SET IN SOIL 6' DEEP	WOOD POLE 45' SET IN SOIL 6.5' DEEP	WOOD POLE 50' SET IN SOIL 7' DEEP	WOOD POLE 55' SET IN SOIL 7.5' DEEP	WOOD POLE 60' SET IN SOIL 8' DEEP
7	7	8	8	9	10	12	14	16

LABOR HRS TO INSTALL EACH								
WOOD POLE 20' SET IN ROCK 3' DEEP	WOOD POLE 25' SET IN ROCK 3.5' DEEP	WOOD POLE 30' SET IN ROCK 3.5' DEEP	WOOD POLE 35' SET IN ROCK 4' DEEP	WOOD POLE 40' SET IN ROCK 4' DEEP	WOOD POLE 45' SET IN ROCK 4.5' DEEP	WOOD POLE 50' SET IN ROCK 4.5' DEEP	WOOD POLE 55' SET IN ROCK 5' DEEP	WOOD POLE 60' SET IN ROCK 5' DEEP
7	7	8	8	9	10	12	14	16

LABOR HRS TO INSTALL EACH				
CROSS ARM & HRD'WR 48"	CROSS ARM & HRD'WR 60"	CROSS ARM & HRD'WR 72"	ANCHOR & GUY HRD'WR IN SOIL	ANCHOR & GUY HRD'WR IN ROCK
4	4	5	8	16

NOTES:

Allow for the rental of auger and bucket trucks as needed.

Add 6" deeper at corners, dead ends, etc.

Dig hole with 4" clearance (e.g., 30" pole butt should have 38" diameter hole).

Backfill and tamping is included.

Figure 3-34

Section 4: Emergency Generators

FIELD INSTALLATION OF EMERGENCY GENERATOR SETS

GENERATOR SETS KW SIZES	LABOR HRS TO INSTALL EACH	
	GAS / GASOLINE 277V / 480V / 3Ø	DIESEL 277V / 480V / 3Ø
10	50	*****
15	55	55
30	62	62
50	*****	88
70	88	*****
75	*****	102
85	102	*****
100	*****	124
115	124	*****
125	*****	132
150	*****	142
170	148	*****
175	*****	152

NOTES:

Installation includes receiving, handling, setting, and leveling generator (lifting equipment charges not included).

Installation includes automatic transfer switch, battery, charger, and critical silencer (muffler).

Sheet metal and damper requirements are not included.

Concrete work, water, fuel, and exhaust piping are not included.

Day tank and remote control wiring are not included.

Main fuel tank and installation are not included.

Figure 3-35

FIELD INSTALLATION OF EMERGENCY GENERATOR SETS

GENERATOR SETS KW SIZES	LABOR HRS TO INSTALL EACH	
	GAS / GASOLINE 277V / 480V	DIESEL 277V / 480V
200	*****	160
250	*****	172
300	*****	188
350	*****	196
400	*****	216
500	*****	240

NOTES:

Installation includes receiving, handling, setting, and leveling generator (lifting equipment charges are not included).

Installation includes automatic transfer switch, battery, charger, critical silencer (muffler).

Sheet metal and damper requirements are not included.

Concrete work, water, fuel, and exhaust piping are not included.

Day tank and remote control wiring are not included.

Main fuel tank and installation are not included.

Figure 3-36

Section 5: Grounding

FIELD INSTALLATION OF GROUNDING

COPPER CLAD GROUND RODS	LABOR HRS TO INSTALL EACH						
	GND RD 8' LONG IN EARTH	GND RD 10' LONG IN EARTH	GND RD 12' LONG IN EARTH	GND RD 15' LONG IN EARTH	GND RD COUP	GND RD CLAMP (acorn)	GND RD DRIVE STUDS
1/2"	1.4	1.6	1.8	2	0.1	0.25	0.1
5/8"	1.6	1.8	2	2.25	0.1	0.25	0.1
3/4"	1.8	2	2.25	2.5	0.1	0.25	0.1

GROUND CLAMP FOR PIPES: 1/2" TO 1"	.75 HR EA
GROUND CLAMP FOR PIPES: 1-1/4" TO 2"	1.00 HR EA
GROUND CLAMP FOR PIPES: 2-1/2" TO 4"	1.25 HR EA
GROUND CLAMP FOR PIPES: 5" TO 8"	1.65 HR EA
GROUND CLAMP FOR PIPES: 10" TO 12"	2.00 HR EA

#8 - ARMORED BARE COPPER GROUND WIRE	4 HRS PER "C" FEET
#6 - ARMORED BARE COPPER GROUND WIRE	5 HRS PER "C" FEET
#4 - ARMORED BARE COPPER GROUND WIRE	6 HRS PER "C" FEET

CADWELD GROUND WIRE (#2/0 TO #4/0) TO GROUND ROD	1.50 HR EA
CADWELD GROUND WIRE (#2/0 TO #4/0) TO BUILDING STEEL	1.75 HR EA
CADWELD GROUND WIRE (#2/0 TO #4/0) TEE OR THRU JOINT	1.75 HR EA

NOTES:

Add 75% to ground rod hours for rock or shale conditions.

Add 25% to armored ground wire labor if drilling wood beams are required.

Figure 3-37

Section 6: Bus Ducts

FIELD INSTALLATION OF COPPER BUS DUCTS

BUS DUCTS COPPER NEMA 1	HRS TO INSTALL EA FT'		HRS TO INSTALL EACH					
	PLUG IN 3P/4W STRAIGHT	FEEDER 3P/4W STRAIGHT	90-DEG' ELBOW 3P/4W	TEE FITTING 3P/4W	CABLE TAP BOX 3P/4W	SW'BD TO PNL' STUB 3P/4W	END BOX 3P/4W	WALL FLANGE 3P/4W
225 AMP	0.48	*****	3.25	5	4	4	0.5	2
400 AMP	0.56	*****	3.75	6.5	5.5	4.5	0.5	2.25
600 AMP	0.64	0.56	4.75	8	7	5.25	0.75	2.5
800 AMP	0.8	0.72	5.5	10	8	6.75	0.75	3
1,000 AMP	0.88	0.8	6	12	10	7.25	0.75	4
1,200 AMP	0.96	0.88	7	14	12	7.75	1	4
1,600 AMP	1.28	1.12	8	16	16	8.5	1	5
2,000 AMP	1.76	1.52	10	18	18	9.5	1	6
2,500 AMP	1.92	1.92	12	24	24	12	1	7
3,000 AMP	2.64	2.64	14	30	30	16	1	8

NOTES:

Add 20% to above for weatherproof installation if required.

Add 35% to labor hours to install above 15' up to 25'.

Trapeze hangers add 1.75 hrs each (add 15% each foot if longer than 5').

Single-rod hanger labor at 65% of trapeze labor.

Drill and set concrete anchors at 20 minutes each.

Deduct 15% for using aluminum ducts.

Labor rates for plug-in switch and circuit breaker include terminations of wire.

Figure 3-38

FIELD INSTALLATION OF COPPER BUS DUCTS AND PLUG-IN UNITS

BUS DUCT AMPERE COPPER	HRS PER FT ADD MFG' GND BUS	HRS TO INSTALL EACH		
		HANGER CLAMP	SPRING SUPPORT	SERVICE HEAD
225	0.035	0.5	1	4
400	0.055	0.5	1.5	5
600	0.055	0.5	1.5	6.5
800	0.085	0.5	1.75	7
1,000	0.085	0.75	1.75	8
1,200	0.01	1	2	10
1,600	0.12	1	2	12
2,000	0.16	1.25	3	16
2,500	0.185	1.5	3	18
3,000	0.2	2	4	24

PLUG-IN SWITCH & CIR. BRKR.	HRS TO INSTALL EA	
	3 POLE 3 WIRE	3 POLE 4 WIRE
30 AMP	1	1.25
60 AMP	1.25	1.5
100 AMP	1.5	1.75
200 AMP	2.5	3.25
400 AMP	5	5.5
600 AMP	7	9
800 AMP	10	12
1,200 AMP	16	20
1,600 AMP	24	28

NOTES:

Add 20% to above for weatherproof installation if required.

Add 35% to labor hours to install above 15' up to 25'.

Trapeze hangers add 1.75 hrs each (add 15% each foot if longer than 5').

Single-rod hanger labor at 65% of trapeze labor.

Drill and set concrete anchors at 20 minutes each.

Deduct 15% for using aluminum ducts.

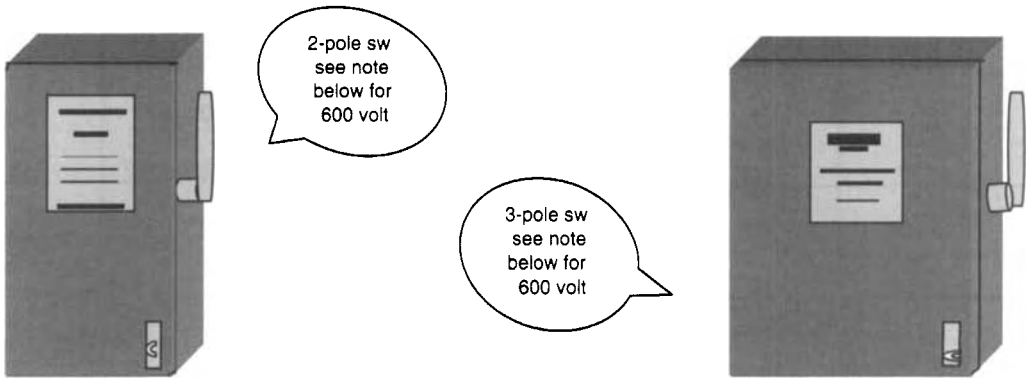
Labor rates for plug-in switch and circuit breaker includes terminations of wire.

Figure 3-39

Section 7: Distribution Equipment

FIELD INSTALLATION OF NONFUSED DISCONNECT SWITCHES: 250 VOLTS

LABOR HRS TO INSTALL EACH							
30 AMP 2 P 3W NEMA 1 DISC. SW.	60 AMP 2 P 3W NEMA 1 DISC. SW.	100 AMP 2 P 3W NEMA 1 DISC. SW.	200 AMP 2 P 3W NEMA 1 DISC. SW.	400 AMP 2 P 3W NEMA 1 DISC. SW.	0 to 200 AMP FUSE *****	200 to 600 AMP FUSE *****	600 to 1,200 AMP FUSE *****
0.8	1.6	2.8	4.5	7.5	0.03	0.05	0.1



LABOR HRS TO INSTALL EACH							
30 AMP 3 P 4W NEMA 1 DISC. SW.	60 AMP 3 P 4W NEMA 1 DISC. SW.	100 AMP 3 P 4W NEMA 1 DISC. SW.	200 AMP 3 P 4W NEMA 1 DISC. SW.	400 AMP 3 P 4W NEMA 1 DISC. SW.	600 AMP 3 P 4W NEMA 1 DISC. SW.	800 AMP 3 P 4W NEMA 1 DISC. SW.	1,200 AMP 3 P 4W NEMA 1 DISC. SW.
1.2	2	3.3	5	8	12	16	20

NOTES:

Add 25% for Nema 3R enclosures.

Add 15% for 600-volt enclosures.

Add 10% for fusible enclosures.

Figure 3-40

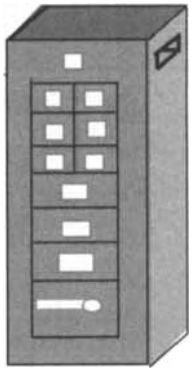
FIELD INSTALLATION OF NEMA 1 MOTOR CONTROL CENTERS

Motor Control Center Section, Class B Wiring 600 V

Approx. size: 72"H x 20"W x 20"D

Receive, unload, unwrap, set, and connect together units

8 hours each section



NOTES:

Allow for lifting equipment costs as required.
Allow for raised pad and leveling channels.
Allow for grounding as required.

Starter unit up to size 1 factory installed FVNR	.75 HR EA
" " " " size 2 " " "	1.0 " "
" " " " size 3 " " "	1.3 " "
" " " " size 4 " " "	1.6 " "
" " " " size 5 " " "	1.8 " "
" " " " size 6 " " "	2.0 " "

NOTES:

Add 100% to starter units for FVR.
Add .25 each to connect PBs, HOAs, PLs, and INTLKs.

Disconnect/circuit breaker unit up to 30 amps factory installed	.75 HR EA
" " " " " " 60 " " "	1.0 " "
" " " " " " 100 " " "	1.3 " "
" " " " " " 200 " " "	1.6 " "
" " " " " " 400 " " "	1.8 " "
" " " " " " 600 " " "	2.0 " "
" " " " " " 800 " " "	3.0 " "

NOTE:

Add 100% to starter and cb/disc units if not factory installed.

Figure 3-41

FIELD INSTALLATION OF STARTERS, CONTACTORS, AND CONTROLS

STARTER SIZES	HRS TO INSTALL			
	N/1 600V ENCLOSED NO PB'S	STR/STP BUTTON IN COV'R	HOA SW IN COV'R	PILOT LGT IN COV'R
0-0	2	0.5	0.75	0.5
0	2	0.5	0.75	0.5
1	2.35	0.5	0.75	0.5
2	2.75	0.5	0.75	0.5
3	3.25	0.5	0.75	0.5
4	4	0.5	0.75	0.5
5	6	0.5	0.75	0.5
6	10	0.5	0.75	0.5
7	16	0.5	0.75	0.5
8	24	0.5	0.75	0.5

CONTACTOR AMP RATING	HRS TO INSTALL	
	N/1 600V ENCLOSED ELECT. HELD	N/1 600V ENCLOSED MECH. HELD
30	1.75	1.75
60	2.25	2.25
100	3	3
200	4.5	4.5
300	6	6
400	8	8
600	10	10

DEVICES	HRS TO INSTALL
STOP BUTTON	0.5
START BUTTON	0.5
HOA SWITCH	0.75
ON-OFF SWITCH	0.5
PILOT LIGHT	0.5

NOTES:

Add 25% for Nema 3R enclosures.

Add 100% for explosion-proof enclosures.

Figure 3-42

FIELD INSTALLATION OF STARTERS, CONTACTORS, AND CONTROLS

ENCLOSURES ONLY	HRS TO INSTALL
1 PUSH BUTTON NEMA 1 ENCLOSURE	0.5
2 PUSH BUTTON NEMA 1 ENCLOSURE	0.5
3 PUSH BUTTON NEMA 1 ENCLOSURE	0.65
4 PUSH BUTTON NEMA 1 ENCLOSURE	0.65
6 PUSH BUTTON NEMA 1 ENCLOSURE	1
12 PUSH BUTTON NEMA 1 ENCLOSURE	1.5
16 PUSH BUTTON NEMA 1 ENCLOSURE	1.75
20 PUSH BUTTON NEMA 1 ENCLOSURE	2
24 PUSH BUTTON NEMA 1 ENCLOSURE	2.5

NOTES:

Add 25% for Nema 3R enclosures.

Add 100% for explosion-proof enclosures.

Figure 3-43

FIELD INSTALLATION OF HIGH-VOLTAGE TRANSFORMERS

KVA SIZE OF XFORMR'S	LABOR HRS TO INSTALL EACH		
	DRY TYPE 3 Ø PAD MTD 5 & 15 KV PRI 277/480V SEC	LIQUID FILLED 3 Ø PAD MTD 5 & 15 KV PRI 277/480V SEC	LIQUID FILLED 1 Ø POLE MTD 5 TO 25 KVA PRI 120 TO 480V SEC
10	*****	*****	12
15	*****	*****	16
25	*****	*****	18
37.5	*****	*****	19
50	*****	*****	22
75	*****	*****	32
100	*****	*****	40
167	*****	*****	56
250	*****	*****	76
333	*****	*****	108
112	21	*****	*****
150	28	32	*****

NOTES:

The above labor includes primary, secondary, and ground terminations. (Cable end preparation is not included. See high-voltage cable section.)

Mounting of the transformers is relative to each installation.

Allow for rigging, lifting if conditions require.

Allow for grounding, bonding as required.

Allow for leveling channels for pad-mounted transformers.

Allow for line/bucket truck as required.

Figure 3-44

FIELD INSTALLATION OF HIGH-VOLTAGE TRANSFORMERS

KVA SIZE OF XFORMR'S	LABOR HRS TO INSTALL EACH		
	DRY TYPE 3 Ø PAD MTD 5 & 15 KV PRI 277/480V SEC	LIQUID FILLED 3 Ø PAD MTD 5 & 15 KV PRI 277/480V SEC	LIQUID FILLED 1 Ø POLE MTD 5 TO 25 KVA PRI 120 TO 480V SEC
225	35	38	*****
300	41	46	*****
500	58	52	*****
750	65	55	*****
1,000	70	80	*****
1,500	77	86	*****
2,000	88	103	*****
2,500	112	112	*****
3,000	120	124	*****
3,750	*****	132	*****

NOTES:

The above labor includes primary, secondary, and ground terminations. (Cable end preparation is not included. See high-voltage cable section.)

Mounting of the transformers is relative to each installation.

Allow for rigging, lifting if conditions require.

Allow for grounding, bonding as required.

Allow for leveling channels for pad-mounted transformers.

Allow for line/bucket truck as required.

Figure 3-45

Next Page

FIELD INSTALLATION OF LOW-VOLTAGE TRANSFORMERS

KVA SIZE OF XFORMR'S	LABOR HRS TO INSTALL EACH					
	BUCK/BOOST 1 Ø 120/240V PRI 12/24V SEC	BUCK/BOOST 3 Ø 240/208V	"ISOLATING" 1 Ø 120/240 V PRI 120/240V SEC	"ISOLATING" 3 Ø 120/240V PRI 120/208V SEC	1 Ø 240/480V PRI 120/240V SEC	3 Ø 240/480V PRI 120/208V SEC
0.1	1	*****	*****	*****	1	*****
0.25	1	*****	*****	*****	1	*****
0.5	1.5	*****	1.75	*****	1.5	*****
0.75	2	*****	*****	*****	1.5	*****
1	3.75	*****	3.75	*****	2	*****
2	4.5	*****	6	*****	2	*****
3	6	*****	6.5	*****	3	4
5	8	*****	7.5	*****	4	*****
6	*****	*****	*****	*****	*****	7
7.5	*****	*****	8	*****	6	*****
9	*****	*****	*****	*****	*****	8
10	*****	*****	9	*****	7	*****
15	*****	8	14	*****	8	10
25	*****	*****	16	*****	9	*****
30	*****	12	*****	*****	*****	12
37.5	*****	*****	21	*****	11	*****

NOTES:

Primary, secondary, and ground connections labor are included.

Allow for grounding, bonding as required.

Labor hours are based upon floor or wall mounting. Allow for rigging, lifting if required.

Allow for special supports, trapeze hangers, framing, etc.

Figure 3-46

FIELD INSTALLATION OF LOW-VOLTAGE TRANSFORMERS

KVA SIZE OF XFORMR'S	LABOR HRS TO INSTALL EACH					
	BUCK/BOOST 1 Ø 120/240V PRI 12/24V SEC	BUCK/BOOST 3 Ø 240/208V	ISOLATING 1 Ø 120/240V PRI 120/240V SEC	ISOLATING 3 Ø 120/240V PRI 120/208V SEC	1 Ø 240/480V PRI 120/240V SEC	3 Ø 240/480V PRI 120/208V SEC
45	*****	14	*****	*****	*****	18
50	*****	*****	*****	*****	14	*****
75	*****	16	24	*****	16	21
100	*****	*****	*****	*****	18	*****
112.5	*****	18	*****	24	*****	24
150	*****	20	*****	26	*****	30
167	*****	*****	*****	*****	24	*****
200	*****	*****	*****	*****	26	*****
225	*****	24	*****	32	*****	36
250	*****	*****	*****	*****	32	*****
300	*****	28	*****	35	*****	40
500	*****	*****	*****	42	*****	46
750	*****	*****	*****	56	*****	54
1,000	*****	*****	*****	*****	*****	70

NOTES:

Primary, secondary, and ground connections labor are included.

Allow for grounding, bonding as required.

Labor hours are based upon floor or wall mounting. Allow for rigging, lifting if required.

Allow for special supports, trapeze hangers, framing, etc.

Figure 3-47

FIELD INSTALLATION OF INCOMING SERVICE AND DISTRIBUTION SECTIONS

MAIN SERVICE SECTION AMPS	LABOR HRS TO INSTALL EACH W/ CT SECT' 120/208V 3Ø 4W MLO 6 CB SPACES	W/ CT SECT' 277/480V 3Ø 4W MLO 6 CB SPACES	W/ CT SECT' 120/208V 3Ø 4W MAIN FU SW	W/ CT SECT' 277/480V 3Ø 4W MAIN CB	DIST' SECTION 120/208V 3Ø 4W CB/SW NOT INC	DIST' SECTION 277/480V 3Ø 4W CB/SW NOT INC
400	16	16	18	20	16	16
600	20	20	22	24	20	20
800	24	24	28	30	24	24
1,000	26	26	30	32	26	26
1,200	30	30	34	38	30	30
1,600	48	48	56	60	48	48
2,000	52	52	62	65	52	52
3,000	64	64	76	80	64	64
4,000	80	80	96	100	80	80

NOTES:

Labor includes receiving, handling, setting, and leveling (allow for lifting equipment as required).

Connections of service conductors are included.

Branch breakers and connections are not included.

Grounding as required is not included.

Figure 3-48

FIELD INSTALLATION OF METER SOCKETS AND STACKS

METER SOCKETS	LABOR	NOTES
SINGLE-METER SOCKET 1 Ø PHASE 100 AMPS	2 HRS EA	Labor is included to connect the bonds and grounding.
SINGLE-METER SOCKET 1 Ø PHASE 150 AMPS	3 HRS EA	
SINGLE-METER SOCKET 1 Ø PHASE 200 AMPS	4 HRS EA	
TWIN-METER SOCKET 1 Ø PHASE 100 AMPS	4 HRS EA	
TWIN-METER SOCKET 1 Ø PHASE 150 AMPS	6 HRS EA	
TWIN-METER SOCKET 1 Ø PHASE 200 AMPS	8 HRS EA	

METER STACKS 1 Ø PHASE 120/240V MAIN CB OR FUSED SW							
AMP RATING	MAIN CB	MAIN SW FUSED	3 METER STACK	4 METER STACK	5 METER STACK	6 METER STACK	------NOTES------
400	12	12	16	18	22	24	Labor is included to connect the bonds and grounding. Allow for special lifting if required.
600	16	16	"	"	"	"	
800	18	18	"	"	"	"	
1,000	22	22	"	"	"	"	
1,200	24	24	"	"	"	"	
1,600	28	28	"	"	"	"	

NOTES:

Connections of service conductors are included.

Allow for housekeeping pads as required.

Figure 3-49

FIELD INSTALLATION OF METER STACKS

METER STACKS 3 Ø PHASE 120/208V MAIN CB OR FUSED SW							
AMP RATING	MAIN CB	MAIN SW FUSED	3 METER STACK	4 METER STACK	5 METER STACK	6 METER STACK	------NOTES------
400	13	13	16	18	22	24	Labor is included to connect the bonds and grounding. Allow for special lifting if required.
600	17	17	"	"	"	"	
800	20	20	"	"	"	"	
1,000	26	26	"	"	"	"	
1,200	28	28	"	"	"	"	
1,600	32	32	"	"	"	"	

NOTES:

Connections of service conductors are included.

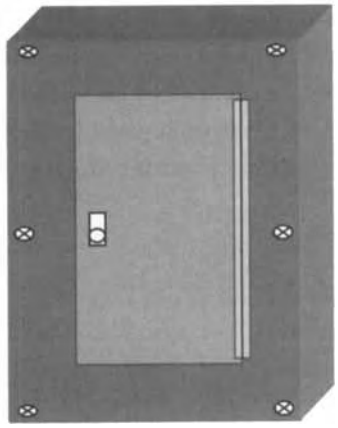
Allow for housekeeping pads as required.

Figure 3-50

FIELD INSTALLATION OF INDOOR SURFACE PANEL BOARDS

3 Ø 3 WIRE 240V MLO	LABOR HRS TO INSTALL EACH	
	30 CIR BRK SPACES	42 CIR BRK SPACES
100 AMP	5	5.5
125 AMP	5	5.5
250 AMP	6	6.5
400 AMP	7	7.5

3 Ø 4 WIRE 277/480V MLO	LABOR HRS TO INSTALL EACH	
	30 CIR BRK SPACES	42 CIR BRK SPACES
125 AMP	5.5	6
250 AMP	5.5	6
400AMP	6.5	7
600 AMP	7.5	8
800 AMP	9	9.5



NOTES:

Above labor includes installing the back box and cover, and connecting the main lugs.

Installing and connecting the branch breakers is not included.

Add .5 hrs to install a ground bar kit.

Add 1.0 hrs to each panel for flush mounting.

Manufacturer's specifications may vary slightly from those listed above.

Figure 3-51

FIELD INSTALLATION OF INDOOR SURFACE-MOUNTED PANELS

1 Ø 3 WIRE 120/240V MLO	LABOR HRS TO INSTALL EACH					
	6 CIR' BRK'R SPACES	8 CIR' BRK'R SPACES	16 CIR' BRK'R SPACES	24 CIR' BRK'R SPACES	30 CIR' BRK'R SPACES	42 CIR' BRK'R SPACES
100 AMP	2	2	*****	*****	*****	*****
125 AMP	*****	2	2.5	3	3.5	*****
150 AMP	*****	*****	*****	4	4	*****
200 AMP	*****	*****	4	4	4.5	*
225 AMP	*****	*****	*****	*****	*****	5

NOTES:

*40 circuit breaker branch spaces labor = 5.0 hrs.

Above labor includes installing the panel and cover, and connecting the main lugs.

Installing and connecting the branch breakers is not included (see Fig. 3-53).

Add .5 hrs to install a ground bar kit.

Add .75 hrs to each panel for flush mounting.

Manufacturer's specifications may vary slightly from those listed above.

Figure 3-52

FIELD INSTALLATION OF CIRCUIT BREAKERS

BRANCH CIRCUIT BREAKERS
INSTALLED AND CONNECTED

CIR' BRK'R AMPERES	LABOR HRS TO INSTALL EACH	
	ONE POLE CIR' BRK'R	TWO POLE CIR' BRK'R
15	0.3	0.5
20	0.3	0.5
25	0.3	0.5
30	0.4	0.5
35	*****	0.5
40	0.45	0.6
45	*****	0.6
50	0.45	0.8
60	*****	0.8
70	*****	0.8
80	*****	0.9
90	*****	0.9
100	*****	1
110	*****	1.05
125	*****	1.15

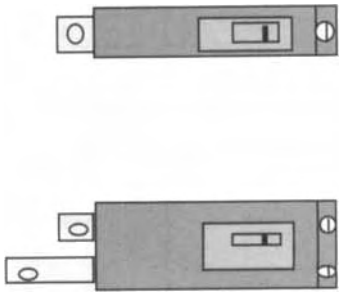


Figure 3-53

FIELD CONNECTION OF PREINSTALLED CIRCUIT BREAKERS/PRESSURE SWITCHES AND SINGLE-WIRE TERMINATIONS

CIRCUIT BREAKER AMPERE RATINGS	LABOR HRS TO CONNECT EACH				
	1 POLE CIRCUIT BREAKER	2 POLE CIRCUIT BREAKER	3 POLE CIRCUIT BREAKER/ PRESS' SW'	AWG SIZE COPPER WIRE	SHAPE CUT STRIP TERMINATE CABLE
15	0.3	0.5	0.75	#14	0.1
20	0.3	0.5	0.75	#12	0.1
25	0.3	0.5	*****	#10	0.1
30	0.4	0.5	0.75	#8	0.15
35	*****	*****	*****	#6	0.15
40	0.45	0.6	0.85	#4	0.15
45	*****	*****	0.95	#3	0.2
50	0.45	0.8	1.25	#2	0.2
60	*****	0.8	1.25	#1	0.25
70	*****	0.8	1.25	#1/0	0.25
80	*****	0.9	1.35	#2/0	0.3
90	*****	0.9	1.35	#3/0	0.3
100	*****	1	1.5	#4/0	0.35
110	*****	1.05	1.6	#250	0.35
125	*****	1.15	1.7	#300	0.4
200	*****	1.2	1.8	#350	0.4
225	*****	1.35	1.9	#400	0.45
250	*****	1.35	1.9	#500	0.5
275	*****	1.5	2	#600	0.6
300	*****	1.5	2	#750	0.75
325	*****	1.6	2.25	#1000	1

Figure 3-54

FIELD CONNECTION OF PREINSTALLED CIRCUIT BREAKERS/PRESSURE SWITCHES AND SINGLE-WIRE TERMINATIONS

CIRCUIT BREAKER AMPERE RATINGS	LABOR HRS TO CONNECT		
	1 POLE CIRCUIT BREAKER	2 POLE CIRCUIT BREAKER	3 POLE CIRCUIT BREAKER
350	*****	1.6	2.25
375	*****	1.7	2.5
400	*****	1.7	2.5
450	*****	1.9	2.6
500	*****	2	2.8
600	*****	2.1	3.15
800	*****	3	4.5
1,000	*****	4.2	5.25
1,200	*****	5.6	7.1
1,600	*****	*****	8.25
2,000	*****	*****	9.5
2,500	*****	*****	11
3,000	*****	*****	16
4,000	*****	*****	24

Figure 3-55

FIELD INSTALLATION OF CIRCUIT BREAKER ENCLOSURES AND CIRCUIT BREAKERS

ENCLOSURES

CIR' BRK'R ENCLOSURE SIZES	# OF POLES	NEMA 1 FLUSH MTD. ENCLO.	NEMA 1 SURF. MTD. ENCLO.	NEMA 3R SURF. MTD. ENCLO.
15 TO 100 AMPS	1,2,3	20"h x 10"w x 4"d * 2.0 HRS EA *	18"h x 9"w x 4"d * 1.0 HRS EA *	18"h x 9"w x 5"d * 1.0 HRS EA *
100 TO 225 AMPS	2,3	30"h x 14"w x 6"d * 2.25 HRS EA *	30"h x 14"w x 6"d * 1.5 HRS EA *	30"h x 14"w x 6"d * 1.5 HRS EA *
225 TO 400 AMPS	2,3	46"h x 17"w x 7"d * 3.75 HRS EA *	45"h x 16"w x 7"d * 3.0 HRS EA *	44"h x 16"w x 8"d * 3.75 HRS EA *
400 TO 1,000 AMPS	3	***** *****	62"h x 23"w x 15"d * 5.0 HRS EA *	62"h x 23"w x 15"d * 6.0 HRS EA *

CIRCUIT BREAKERS

AMPERE RANGES	SIMILAR TO	LABOR HRS TO INSTALL EACH		
		1 POLE CIR. BRK.	2 POLE CIR. BRK.	3 POLE CIR. BRK.
15 TO 30 AMP	FAL,FHL	0.5	0.75	1
35 TO 60 AMP	FAL,FHL	0.75	1.05	1.5
60 TO 100 AMP	FAL,FHL	*****	1.25	2
100 TO 150 AMP	Q2L,Q2LH	*****	1.4	2.3
150 TO 200 AMP	Q2L,Q2LH	*****	1.45	2.3
200 TO 300 AMP	LAL,KAL	*****	1.75	2.5
300 TO 400 AMP	LAL,KAL	*****	1.95	3
400 TO 600 AMP	MEL	*****	2.35	3.65
600 TO 800 AMP	MEL	*****	3.25	5
800 TO 1,000 AMP	MAL,LAL	*****	4.5	5.75
1,000 TO 1,200 AMP	NAL,NCL	*****	6	7.6

NOTES:

Enclosure labor does not include installation and connection of circuit breaker.

Circuit breaker labor includes installation in enclosures and connections, line and load.

Manufacturer's specifications may vary slightly from those listed above.

Figure 3-56

Section 8: Fire Alarm and Miscellaneous Systems

FIELD INSTALLATION OF FIRE ALARM SYSTEM EQUIPMENT

FIRE ALARM PANEL # ZONES	LABOR HRS TO INSTALL EACH							
	FA PNL W/BATT BACKUP	MANUAL STATION	ALARM BELL	BELL & LIGHT	F/T&R/R DETECT'	SMOKE DETECT'	DUCT DETECT' W/TUBE	ELR
1 TO 6	8	0.8	0.8	1	0.75	1	2	0.25
7 TO 12	12	0.8	0.8	1	0.75	1	2	0.25
13 TO 16	18	0.8	0.8	1	0.75	1	2	0.25
17 TO 24	24	0.8	0.8	1	0.75	1	2	0.25

FA REMOTE ANNUN' PNL'	LABOR HRS TO INSTALL EACH					
	BACK BOX	ANNUN' PANEL	ELECT' DOOR HOLD'R	MAG'NT FOR HOLD'R	SPRNK'R *FLOW SW	SPRNK'R *ALARM SIGNAL
1 TO 6	2	6	1.5	0.5	1.5	1
7 TO 12	3	9	1.5	0.5	1.5	1
13 TO 16	4	12	1.5	0.5	1.5	1
17 TO 24	4	20	1.5	0.5	1.5	1

FA CABLE PLENUM-RATED 150 VOLT	LABOR HRS TO INSTALL PER "M"					
	2/C	4/C	6/C	8/C	10/C	12/C
#16	11	13	15	17	19	21
#18	10	12	14	16	18	20
#20	8	10	12	14	16	18

NOTES:

*These items are installed by others.

Plenum-cable labor is installed open above ceilings.

Cable hangers up to 36" long included in labor (add additional labor for longer hangers).

Add for wall penetrations and sleeves as required.

Cable terminations are not included in cable labor.

Figure 3-57

FIELD INSTALLATION OF MISCELLANEOUS SYSTEMS

MASTER CLOCK SYSTEM EQUIPMENT LABOR HRS TO INSTALL EACH					
MASTER CLOCK	CLOCK BOX	CLOCK	CLOCK & SPEAKER BOX	PROG SIGNAL	WALL PHONE
8	0.5	1	1	0.75	1.25

MAIN SOUND SYSTEM EQUIPMENT LABOR TO INSTALL EACH					
MAIN COUNSEL	REMOTE AMP	SPEAKER BOX	SPEAKER	MIC OUTLET	PROJ OUTLET
40	8	0.5	0.8	1	1

DOORBELL SYSTEM EQUIPMENT LABOR HRS TO INSTALL EACH					
BELL & BOX	BUZZER & BOX	CHIME	TRANSF'	PUSH BUTTON	WP P/B
1	1	2	1	1	1.5

NURSE CALL SYSTEM EQUIPMENT LABOR HRS TO INSTALL EACH					
40 STATION MASTER CONTROL	DOME LIGHT	DUTY STATION	EM PULL CORD	SINGLE BED STA	DUAL BED STA
40	1	2.5	1.5	1.5	2.5

PUBLIC TV & CCTV SYSTEM EQUIPMENT LABOR HRS TO INSTALL EACH							
MAIN HEAD END EQUIPMENT	ANTENNA AND SUPPORT	TV MONITOR	TV CAMERA	TV CAM' WP ENCLO	TV OUTLET	TV SPLITTER	TV PREAMP
16	8	1	4	4	1	1	4

NOTES:

Systems are generic and for guidance purposes.

Manufacturer's products will vary in design, but functions will be very similar.

These labor units will assist the estimator and may need to be adjusted to fit the project.

Figure 3-58

Section 9: Electric Heating

FIELD INSTALLATION OF ELECTRIC HEATING

BASEBOARD HEAT UNITS 120/208/277V	HRS TO INSTALL EACH
2' LONG	1
3'	1
4'	1.25
5'	1.5
6'	1.75
7'	2
8'	2
9'	2.25
10'	2.5

WALL HEATER WITH FAN 120/208/240V TOTAL WATTS	HRS TO INSTALL EACH
500	1.25
750	1.25
1,000	1.5
1,250	1.75
1,500	1.75
2,000	2
2,500	2.25
3,000	2.75
4,000	3

UNIT HEATER 3 Ø 208/240/480V TOTAL WATTS	HRS TO INSTALL EACH
5,000	3.25
7,500	5
10,000	6.5
15,000	8
20,000	8.75
30,000	10
40,000	12
50,000	14

RADIANT PNL'S 120/208/277V TOTAL WATTS LENGTH	HRS TO INSTALL EACH
24 " 310 W	1
36" 470 W	1.25
48" 625 W	1.5
60" 785 W	2
72" 940 W	2.5
84" 1,095 W	3
96" 1,250 W	3.5

NOTES:

Allow 1.25 hrs each for trapeze hangers (add 15% each foot if longer than 3').

Add additional labor if installed above 15'.

Figure 3-59

FIELD INSTALLATION OF ELECTRIC HEATING

EXPLOSION PRF' UNIT HEATER 208/240/480V 3 Ø PHASE WATTS	HRS TO INSTALL EACH
3,000	4
5,000	6
7,500	10
10,000	12
15,000	16
20,000	18
25,000	19
30,000	20

EXPLOSION PRF' UNIT HEATER 120/208/277V SINGLE PHASE WATTS	HRS TO INSTALL EACH
3,000	5
5,000	6
7,500	9
10,000	12
15,000	18
20,000	*****
25,000	*****
30,000	*****

UNIT HEATER 1 Ø PHASE 120/208/240V TOTAL WATTS	HRS TO INSTALL EACH
3,000	2.5
5,000	3
7,500	4.5
10,000	6
15,000	9
20,000	*****
25,000	*****
30,000	*****
40,000	*****
50,000	*****

NOTES:

Allow 1.25 hrs each for trapeze hangers (add 15% each foot if longer than 3').
Add additional labor if installed above 15'.

Figure 3-60

FIELD INSTALLATION OF SNOW MELTING MATS, SNOW MELTING CABLE, AND HEAT TRACING CABLE

SNOW MATS	LABOR	NOTES
8" WIDE X 5' LONG	.50 HRS EACH	Add .15 hrs for each additional 5' in length on all mats. Connection of power leads to mat leads are included. Installation of power source, automatic controllers, or sensors not included. Allow for extra labor to witness the installation of permanent cover material. Sub-base material leveling not included.
12" WIDE X 5' LONG	.50 HRS EACH	
18" WIDE X 5' LONG	.60 HRS EACH	
24" WIDE X 5' LONG	.70 HRS EACH	
30" WIDE X 5' LONG	.80 HRS EACH	
36" WIDE X 5' LONG	.90 HRS EACH	
48" WIDE X 5' LONG	1.00 HRS EACH	
60" WIDE X 5' LONG	1.10 HRS EACH	
72" WIDE X 5' LONG	1.20 HRS EACH	

HEAT TRACE CABLE	LABOR	NOTES
120/240/480V AWG#12	8 HRS PER "C"	Labor includes tape, pipe straps, labels, etc. Add 25% if installing from 15' to 25'. Allow for scaffold or lift as required.
" " " #10	10 HRS PER "C"	
CABLE / PWR CONN'	1 HR EA	
SPLICE & TEE	1.5 HRS EA	
END SEAL	1 HR EA	
THERMOST T	1.5 HRS EA	

NOTES:

Manufacturer's equipment may vary from each other.

Estimator may need to adjust the labor rates to fit the designed project.

Figure 3-61

FIELD INSTALLATION OF SNOW MELTING MATS, SNOW MELTING CABLE, AND HEAT TRACING CABLE

ROOF & GUTTER DE-ICING CABLE	
DE-ICING CABLE	LABOR
120V CABLE	12 HRS PER "C"
208/277V CABLE	14 HRS PER "C"
PWR CONN KIT	1 HR EA
SPLICE KIT	1 HR EA
END SEAL KIT	1 HR EA
ROOF CLIPS	*****
DOWNSPOUT HNGR	*****
* ALUM TAPE	*****

NOTES:

*Included with cable installation.

Manufacturer's equipment may vary from each other.

Estimator may need to adjust the labor rates to fit the designed project.

Figure 3-62

Section 10: High- and Low-Voltage Cables

FIELD INSTALLATION OF HIGH-VOLTAGE CABLE IN CONDUIT

5 & 15KV CABLE SIZES	HRS TO INSTALL PER "M" FEET				HRS TO INSTALL EACH	
	COPPER 5KV SHLD' CABLE	COPPER 15KV SHLD' CABLE	ALUM' 5KV SHLD' CABLE	ALUM' 15KV SHLD' CABLE	INDOOR CABLE TERM'	OUTDOOR CABLE TERM'
#4	36.4	*****	*****	*****	1	1.25
#2	40	*****	32	*****	1	1.25
#1	40	40	36.4	36.4	1	1.25
#1/0	42.1	42.1	40	40	1.5	1.75
#2/0	44.4	44.4	42.1	42.1	1.5	1.75
#4/0	50	50	44.4	44.4	1.5	1.75
#250	53.3	53.3	50	50	1.75	2
#350	61.5	61.5	53.3	53.3	1.75	2
#500	66.7	66.7	61.5	61.5	2	2.5
#750	*****	*****	66.7	66.7	2	2.5

NOTES:

Allow for HV cable testing in accordance with cable manufacturer's recommendations.

Allow for reel setup time (see Figs. 3-64 and 3-65).

Figure 3-63

FIELD INSTALLATION OF "COPPER" WIRE AND CABLE

AWG WIRE CABLE SIZES	LABOR HRS TO INSTALL PER "M"		LABOR HOURS TO ADD FOR SETUP OF REELS
	CABLE INSTALLED IN CONDUIT	CABLE INSTALLED (SHORT RUNS) IN CONDUIT	
#14 & (drag line)	6 BR	*****	*****
#12	8 BR	*****	*****
#10	10 BR	*****	*****
#8	12 BR	*****	*****
#6	14 BR	*****	*****
#4	10 FDR	17 FDR	1
#3	11 FDR	18 FDR	1
#2	12 FDR	20 FDR	1.5
#1	14 FDR	22 FDR	1.5
#1/0	16 FDR	25 FDR	1.5
#2/0	20 FDR	30 FDR	2
#3/0	21 FDR	33 FDR	2
#4/0	24 FDR	35 FDR	3

NOTES:

Direct burial cable × 50% of above hours (warning tape labor at 2–4 hrs per "M").

BR = branch; FDR = feeder.

Duplicate pulls #14 through #1 deduct 10%.

Duplicate pulls #1/0 through #750 mcm deduct 12%.

Aluminum cable × 80% of above hours.

Figure 3-64

FIELD INSTALLATION OF "COPPER" WIRE AND CABLE

AWG WIRE CABLE SIZES	LABOR HRS TO INSTALL PER "M"		LABOR TO ADD FOR SETUP OF REELS
	CABLE INSTALLED IN CONDUIT	CABLE INSTALLED (SHORT RUNS) IN CONDUIT	
#250	27 FDR	37 FDR	3
#300	31 FDR	40 FDR	3.5
#350	33 FDR	48 FDR	4
#400	36 FDR	54 FDR	5
#500	40 FDR	64 FDR	6
#600	50 FDR	74 FDR	7
#750	70 FDR	100 FDR	8

NOTES:

Direct burial cable × 50% of above hours (warning tape labor at 2–4 hrs per "M").

FDR = feeder.

Duplicate pulls #14 through #1 deduct 10%.

Duplicate pulls #1/0 through #750 mcm deduct 12%.

Aluminum cable × 80% of above hours.

Figure 3-65

FIELD INSTALLATION OF MULTICONDUCTOR TRAY CABLES

MULTI-COND' CABLE SIZES	LABOR TO INSTALL PER "M"					
	600V T/C 3 / COND' PVC JCKT'	600V T/C 4 / COND' PVC JCKT'	5KV T/C 3 / COND' UNGND' NEUT' PVC JCKT'	5KV T/C 3 / COND' GND' NEUT' PVC JCKT'	15KV T/C 3 / COND' UNGND' NEUT' PVC JCKT'	15KV T/C 3 / COND' GND' NEUT' PVC JCKT'
#6	24	28	*****	*****	*****	*****
#4	28	32	44	*****	*****	*****
#2	32	37	50	56	52	64
#1	36	40	54	60	56	68
#1/0	40	44	58	65	62	76
#2/0	44	48	65	68	70	82
#3/0	48	53	68	72	76	90
#4/0	53	65	71	76	82	96
#250	65	70	75	80	88	104
#350	70	80	82	98	98	112
#500	80	90	96	108	112	124

NOTES:

Allow additional labor for pulleys, wheels, and rollers as required.

Labor is considered at normal work conditions and heights.

Add for scaffolding and lifts as required.

Allow for HV cable testing in accordance with cable manufacturer's recommendations.

Figure 3-66

FIELD INSTALLATION OF MULTICONDUCTOR COPPER CABLES

MULTI-COND' CABLE SIZES	LABOR HRS TO INSTALL PER "M"					
	"AC / "MC" CABLE 2 COND'	"AC / MC" CABLE 3 COND'	"AC / MC" CABLE 4 COND'	"NM" CABLE 2 COND'	"NM" CABLE 3 COND'	"NM" CABLE 4 COND'
#14	25	30	35	30	35	40
#12	30	35	40	32	37	43
#10	36	50	55	42	55	70
#8	50	65	75	55	65	*****
#6	70	80	90	65	75	*****
#4	80	96	102	75	90	*****
#3	*****	100	108	*****	*****	*****
#2	*****	110	120	*****	*****	*****

NOTES:

Above labor does not include drilling wood beams (add 25% for drilling if required).

Cable connectors are included in above labor.

Cable hangers up to 36" are included in above labor.

Wall penetrations and sleeves are not included in above labor.

Figure 3-67

FIELD INSTALLATION OF MULTICONDUCTOR COPPER CABLES

MULTI-COND' CABLE SIZES	LABOR HRS TO INSTALL PER "M"				
	"UF" CABLE 2 COND'	"UF" CABLE 3 COND'	"UF" CABLE 4 COND'	"SE-R" CABLE 3 COND'	"SE-U" CABLE 3 COND'
#14	22	24	*****	*****	*****
#12	25	28	*****	*****	*****
#10	28	35	*****	*****	*****
#8	32	40	*****	65	50
#6	40	48	*****	75	60
#4	*****	*****	*****	90	72
#3	*****	*****	*****	112	90
#2	*****	*****	*****	118	104
#1	*****	*****	****	130	118
#1/0	*****	*****	*****	145	132
#2/0	*****	*****	*****	160	148

SERVICE HEAD FOR SEU CABLE 100 AMP	1.00 HR
SERVICE HEAD FOR SEU CABLE 150 AMP	1.25 HR
SERVICE HEAD FOR SEU CABLE 200 AMP	1.50 HR

NOTES:

Above labor does not include drilling wood beams (add 25% for drilling if required).

Cable connectors are included in above labor.

Cable hangers up to 36" are included in above labor.

Wall penetrations and sleeves are not included in above labor.

Figure 3-68

FIELD INSTALLATION OF LOW-VOLTAGE AND MULTICONDUCTOR CABLES

MULTI-COND' CABLE PLENUM 300V	LABOR HRS TO INSTALL PER "M"									
	2/C UN SHL'D	2/C SHL'D	4/C UN SHL'D	4/C SHL'D	6/C UN SHL'D	6/C SHL'D	8/C UN SHL'D	8/C SHL'D	12/C UN SHL'D	12/C SHL'D
#16 CU	15	15	16	16	18	18	19	19	22	22
#18 CU	10	10	11	11	15	15	16	16	20	20
#22 CU	8	8	9	9	12	12	13	13	18	18
#24 CU	8	8	9	9	10	10	11	11	16	16

THERMOSTAT CABLE UNJACKETED TWISTED	LABOR HRS TO INSTALL PER "M"						
	2/C	3/C	4/C	5/C	6/C	7/C	8/C
#18	10	11	11	12	14	14	16

TV CABLE PLENUM	LABOR HRS TO INSTALL PER "M"			
	59 OHM	62 OHM	75 OHM	BNC JACK
RG/COAX	12	12	12	250

NOTES:

Plenum cable labor is installed open above ceilings.

Cable hangers up to 36" long are included in above labor (add additional labor for longer hangers).

Add for wall penetrations, sleeves, and patching as required.

Cable terminations are not included in cable labor.

Figure 3-69

Section 11: Voice and Data Wiring

FIELD INSTALLATION OF VOICE/DATA SYSTEMS

CATEGORY 5 PLENUM DATA CABLE	PATCH PANEL FLOOR STAND	32 PORT DATA PATCH PANEL	64 PORT DATA PATCH PANEL	6' LONG PATCH CORD	SURFACE COMMUN' BOX	COMMUN' BOX PLATE	COMBO PLATE VOICE & DATA	DATA CONN'S
5 HOURS PER "M"	2 HOURS EACH	.50 HOURS EACH	.50 HOURS EACH	.15 HOURS EACH	.25 HOURS EACH	.10 HOURS EACH	.10 HOURS EACH	.25 HOURS EACH

SHELF FOR PATCH PANEL	GROUND CLAMP FOR STAND	WIRE MANAGER	CABLE & PLATE LABELS	J-HOOK SUPPORTS	CABLES TO TEST
1 HOUR EACH	.25 HOURS EACH	.50 HOURS EACH	.04 HOURS EACH	.25 HOURS EACH	.20 HOURS EACH

CATEGORY 3 PLENUM VOICE CABLE	100 PAIR 110 TERM BLOCK	300 PAIR 110 TERM BLOCK	2' TO 8' PATCH CABLES	SURFACE VOICE BOX	NO BOX WALL RING	VOICE BOX PLATE	VOICE CONN'S	PUNCH DOWN 110 TERM BLOCK
5 HOURS PER "M"	.50 HOURS EACH	.75 HOURS EACH	.05 HOURS EACH	.25 HOURS EACH	.15 HOURS EACH	.10 HOURS EACH	.15 HOURS EACH	.03 HOURS PER PAIR

NOTES:

Allow additional labor for abnormal working conditions in existing occupied areas.

In existing office-type facilities allow for ceiling tile replacement for damages.

Allow for wall and floor penetrations including sleeves and patching.

Allow for lifts as required.

100 and 300 pair 110-terminal block labor is to mount only.

4' × 8' plywood backboard labor at 1.5 hrs each.

4' × 4' plywood backboard labor at 1 hr each.

Figure 3-70

Section 12: Miscellaneous HVAC Devices

FIELD INSTALLATION OF WIRING FOR MISCELLANEOUS HVAC DEVICES

DESCRIPTION OF DEVICES	LABOR HRS EACH
EP SWITCH TO CONNECT	0.5
PE SWITCH TO CONNECT	0.5
MOTORIZED DAMPERS TO CONNECT	0.5
MOTORIZED ZONE VALVE TO CONNECT	0.5
FREEZESTAT TO CONNECT	0.5
FIRESTAT TO CONNECT	0.5
WALL HUMIDISTAT TO CONNECT	0.75
WALL THERMOSTATS TO CONNECT	0.75
PROVIDE POWER CONNECTIONS TO ATC PANEL (120V)	0.75
ELECTRIC DUCT HEATER 3 Ø, 1 KW TO CONNECT	1
" " " " " 5 KW " "	1.5
" " " " " 10 KW " "	2
" " " " " 15 KW " "	2.5
" " " " " 20 KW " "	3
" " " " " 40 KW " "	4
FAN COIL UNIT 1Ø, TO CONNECT	1
CABINET HEATER 1Ø TO CONNECT	1
UNIT VENTILATOR 1Ø TO CONNECT	1

NOTES:

Labor does not include installation but does include connections.

Estimator to review HVAC specifications on installation responsibilities.

Figure 3-71

Section 13: Light Bases

FIELD INSTALLATION OF CONCRETE BASES

SIZE OF CONCRETE BASES	BASES FLUSH W/GRADE		BASES 36" ABOVE GRADE	
	CUBIC YARDS	HOURS TO INSTALL	CUBIC YARDS	HOURS TO INSTALL
BOLLARDS	0.044	1	*****	*****
8' TO 12' POLE	0.196	2.75	0.392	3.5
14' TO 20' POLE	0.465	3.5	0.816	4.5
22' TO 30' POLE	0.582	4	0.932	5.15
32' TO 40' POLE	1.092	4.75	1.638	6
42' TO 60' POLE	1.454	5.5	2	6.75

NOTES:

Digging, backfill, and tamping for the base are not included.

Bases are estimated to be round in shape (similar to sonotube).

Anchor bolt placement is included.

Placing reinforcing steel is included.

Placing conduits is included.

FORMULA: 3.1416 Rsq × length ÷ 1728 = cubic feet (1728 cu. in. = 1 cu. ft.).

Example: 30" diameter × 60" long

3.1416 × radius squared (15" sq.) × length (60") ÷ 1728 = 706.86 × 60 ÷ 1728 = 42,411.6 cu. in.

42,411.6 cu. in. ÷ 1728 (or 1 cu. ft.) = 24.54 cu. ft. (a little less than 1 cu. yard)

Rule of thumb: concrete base depth below grade is = to 1/5 of pole height;

allow 2" of concrete outside of anchor bolt circle.

Figure 3-72

Section 14: Voltage Drop Tables

VOLTAGE DROP TABLES FOR LOW-VOLTAGE CIRCUITS

TOTAL OF WATTS ON WIRE RUN	6-VOLT SYSTEM WIRE GAUGE LENGTH OF WIRE RUN IN FEET				12-VOLT SYSTEM WIRE GAUGE LENGTH OF WIRE RUN IN FEET			
	#12	#10	#8	#6	#12	#10	#8	#6
10	56	90	143	227	226	360	570	910
14	40	64	102	162	162	257	409	650
18	30	47	75	119	119	189	300	477
21	27	43	68	108	108	171	273	434
25	21	34	54	86	86	136	216	344
30	19	30	48	76	75	120	190	303
35	15	25	39	63	65	103	164	260
40	13	21	33	53	53	85	135	214
50	11	17	27	43	43	68	108	172
75	7	11	18	29	28	45	72	115
100	5	8	14	21	21	34	54	86
125	4	7	11	17	17	27	43	69
150	3	5	9	14	14	23	36	57
175	3	5	8	12	12	19	31	49
200	2	4	6	10	10	16	27	42
225	2	4	6	10	10	16	25	40
250	2	3	5	9	9	14	22	36

NOTE:
These values are used for sizing the wire based on the loads on the run.

Figure 3-73

Section 15: Miscellaneous

MISCELLANEOUS INFORMATION, FORMULAS

A yard of sand weighs approximately 2,700 pounds, which is 1.35 times one ton (2,000 lbs).

Conversion Factors: B.T.U./HOUR × .000393022 = HP

B.T.U./HOUR × .000293018 = KW

HP × 2544.39 = B.T.U./HOUR

HP × .745702 = KW

KW × 3412.08 = B.T.U./HOUR

KW × 1.34102 = HP

WATTS × 3.413 = B.T.U./HOUR

WATTS × .0001341 = HP

AMPS = KW × 1,000 ÷ 1.732 × VOLTS × POWER FACTOR (80%).

AMPS = KV × 1,000 ÷ 1.732 × VOLTS × POWER FACTOR (100%).

Rule of thumb is that electrical demolition labor = 1/2 of the installation labor.

Basic rule of thumb is 1 square inch of copper bus (1/2" × 2") is = to 1,000 amps.

One horsepower = 746 watts

One kilowatt = 1,000 watts

Power factors = lighting at 100%; motors at 80 to 90%

Conversion formulas for illumination as follows:

Footcandles = LUX × .0929; LUX = Footcandles × 10.76 (e.g., 50 footcandles = 538 LUX).

Figure 3-74

AC Motor Connections

Most AC motors will come from the manufacturer with the leads numbering 10, 11, and 12, internally pre-spliced together and not brought out into the connection box, or "nosebag" or "pecker head" as commonly referred to in the field. Below are the common everyday connections you will see and need to follow when you are connecting the power feeds to the respective motor.

- AC 3-phase low-voltage motor connection at nosebag (208, 230, and 240 volts)
- Line 1 connects to motor leads #1 and #7
- Line 2 connects to motor leads #2 and #8
- Line 3 connects to motor leads #3 and #9
- Motor leads #4, #5, and #6 splice together and tuck in nosebag
- AC 3-phase high-voltage motor connection at nosebag (440, 460, and 480 volts)
- Line 1 connects to motor lead #1
- Line 2 connects to motor lead #2
- Line 3 connects to motor lead #3
- Motor leads #4 and #7 splice together and tuck in nosebag
- Motor leads #5 and #8 splice together and tuck in nosebag
- Motor leads #6 and #9 splice together and tuck in nosebag

There may be times when the motor will have all 12 leads in the nosebag #1 to #12. If you see this condition, just connect the #10, #11, and #12 together and fold into the nosebag.

Some larger motors will just have the #1, #2, and #3 exposed for the power connections. The manufacturer will have made the other connections inside the frame of the motor.

Use Fig. 3-75 for squirrel-cage induction motors at 1,800 RPM. Check the nameplate of the motor and see the service factor, voltage, and class. Another consideration may be the temperature of the motor surroundings. Check all these factors with the motor manufacturer if in doubt.

To change the rotation direction of most standard single-phase motors, interchange the lead connections of the starting winding.

MOTOR HP AND AMPERE RATINGS

SINGLE PHASE

HORSE-POWER	115V AMPS	208V AMPS	230V AMPS	460V AMPS	575V AMPS
1/6 hp	4.4	2.4	2.2	1.1	0.9
1/4 hp	5.8	3.2	2.9	1.4	1.2
1/3 hp	7.2	4	3.6	1.8	1.4
1/2 hp	9.8	5.4	4.9	2.5	2
3/4 hp	13.8	7.6	6.9	3.5	2.8
1	16	8.8	8	4	3.2
1-1/2	20	11	10	5	4
2	24	13.2	12	6	4.8
3	34	18.7	17	8.5	6.8
5	56	30.8	28	14	11.2
7-1/2	80	44	40	21	16
10	100	55	50	26	20

Figure 3-75

Use Fig. 3-76 for squirrel-cage induction motors at 1,800 RPM. Check the nameplate of the motor and see the service factor, voltage, and class. Another consideration may be the temperature of the motor surroundings. Check all these factors with the motor manufacturer if in doubt.

MOTOR HP AND AMPERE RATINGS

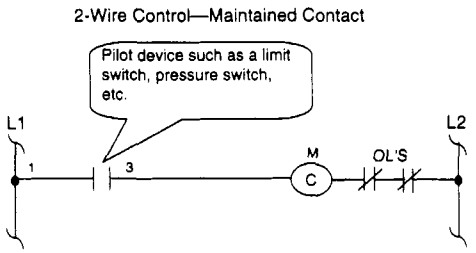
THREE PHASE

HORSE-POWER	208V AMPS	230V AMPS	460V AMPS	575V AMPS
1/2 hp	2.4	2.2	1.1	0.9
3/4 hp	3.5	3.2	1.6	1.3
1	4.6	4.2	2.1	1.7
1-1/2	6.6	6	3	2.4
2	7.5	6.8	3.4	2.7
3	10.6	9.6	4.8	3.9
5	16.7	15.2	7.6	6.1
7-1/2	24.2	22	11	9
10	30.8	28	14	11
15	46.2	42	21	17
20	59.4	54	27	22
25	74.8	68	34	27
30	88	80	40	32
40	114	104	52	41
50	143	130	65	52
60	169	154	77	62
75	211	192	96	77
100	273	248	124	99
125	343	312	156	125
150	396	360	180	144
200	528	480	240	192
250	*****	*****	302	241
300	*****	*****	361	289
350	*****	*****	414	336
400	*****	*****	477	382
450	*****	*****	514	411
500	*****	*****	592	474

Figure 3-76

TYPICAL MOTOR CONTROL CIRCUIT

EXAMPLE:

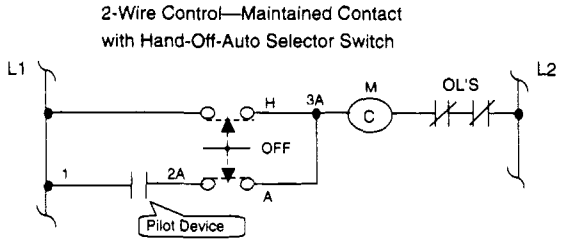


Low-voltage release is a "two-wire" control scheme using a maintained contact pilot device in series with the starter coil. This scheme is used when a starter is required to function automatically without the attention of an operator. If a power failure occurs while the contacts of the pilot device are closed, the starter will drop out. When the power is restored, the starter will pickup automatically through the closed contacts of the pilot device. The term "two-wire" control arises from the fact that in the basic circuit only two wires are required to connect the pilot device to the starter.

Figure 3-77

TYPICAL MOTOR CONTROL CIRCUIT

EXAMPLE:

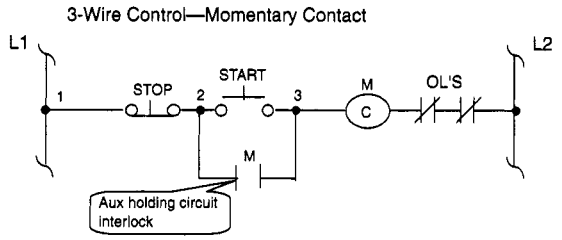


A "hand-off-auto" selector switch is used on two-wire control applications where it is desirable to operate the starter manually as well as automatically. The starter coil is energized manually when the switch is turned to the "hand" position, and is energized automatically by the pilot device when the switch is in the "auto" position.

Figure 3-78

TYPICAL MOTOR CONTROL CIRCUIT

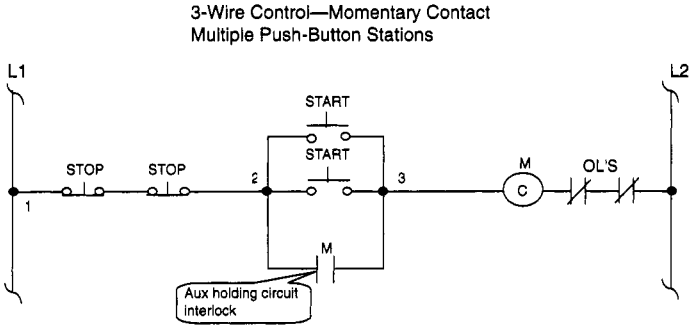
EXAMPLE:



Using the wiring scheme above we use momentary hold devices such as push buttons for the control of the starter. The starter is energized by pressing the start button. An auxiliary "holding circuit" interlock on the starter forms a parallel circuit around the start button's contacts holding the starter in after the button is released. If a power failure does occur, the starter will drop out and will open the holding circuit interlock. Upon the return of power, the start button must be operated again before the motor will restart. The term "3-wire" control arises from the fact that in the basic circuit at least three wires are required to connect the pilot devices to the starter.

Figure 3-79

TYPICAL MOTOR CONTROL CIRCUIT



When a motor needs to be controlled from various places, any number of the "start" and "stop" push buttons may be wired together as needed. It is also possible to use only one "start–stop" station and have several "stop" buttons at different locations to serve as emergency stop locations.

Figure 3-80

CONVERSION FACTORS: METRIC EQUIVALENTS

	UNIT	MULTIPLY BY	TO GET
LINEAR:	centimeter	0.3937	inches
	inch	2.54	centimeters
	foot	30.48	centimeters
	meter	39.37	inches
	yard	0.9144	meters
	meter	1.0936	yards
	kilometer	0.62137	miles
	mile	1.6093	kilometers
AREA:	square centimeter	0.155	square inches
	square inch	6.452	square centimeters
	square meter	1.196	square yards
	square yard	0.8361	square meters
	acre	160	square rods
	acre	0.4047	hectares
	square kilometer	0.386	square miles
	square mile	2.59	square kilometers
VOLUME:	cubic centimeter	0.061	cubic inches
	cubic inch	16.39	cubic centimeters
	cubic meter	1.308	cubic yards
	cubic yard	0.7646	cubic meters
	liter	1.0567	quarts-liquid
	quart-liquid	0.9453	liters
WEIGHT:	gram	0.03527	ounces
	ounce	28.35	grams
	kilogram	2.2046	pounds
	pound	0.4536	kilograms

(*continues*)

Figure 3-81

CONVERSION FACTORS

UNIT	MULTIPLY BY	TO GET
Ampere-hours	3,600	Coulombs
Ampere-hours	0.037307	Faradays
Atmospheres	76	Cm. of Hg (0° C)
Atmospheres	14.696	Pounds/square inch
B.T.U.	252	Calories, gram
B.T.U.	1.05508×10^{10}	Ergs
B.T.U.	778.184	Foot-pounds
B.T.U.	1,055	Joules
B.T.U./hour	0.000393022	Horsepower
B.T.U./hour	0.000293018	Kilowatts (int.)
Calories, gram	0.00396832	B.T.U.
Calories, gram	4.18689×10^{7}	Ergs
Calories, gram	3.08808	Foot-pounds
Calories, gram	4.18689	Joules
Calories, gram/hour	1.55964×10^{-6}	Horsepower
Calories, gram/hour	1.16279×10^{-6}	Kilowatts
Cm. of Hg (0° C)	0.0131579	Atmospheres
Coulombs	0.000277778	Ampere-hours
Coulombs	1.0365×10^{-5}	Faradays
Dynes	2.248089×10^{-6}	Pounds
Dynes/square cm.	1×10^{-6}	Bars
Ergs	9.47798×10^{-11}	B.T.U.
Ergs	2.38841×10^{-8}	Calories, gram
Ergs	7.3756×10^{-8}	Foot-pounds
Ergs	1×10^{-7}	Joules

(*continues*)

Figure 3-81 *continued*

CONVERSION FACTORS

UNIT	MULTIPLY BY	TO GET
Ergs/sec.	1.34102×10^{-10}	Horsepower
Faradays	26.8	Ampere-hours
Faradays	96.48	Coulombs
Feet of H_2O (60° F)	0.029469	Atmospheres
Feet of H_2O (60° F)	62.364	Pounds/square foot
Feet/hour	1.64468×10^{-5}	Knots
Feet/second	0.681818	Miles/hour
Foot-pounds	0.00128504	B.T.U.
Foot-pounds	0.323826	Calories, gram
Foot-pounds	1.35582×10^{7}	Ergs
Foot-pounds	1.35582	Joules
Foot-pounds	3.76617×10^{-7}	Kilowatt-hour
Foot-pounds/minute	3.0303×10^{-5}	Horsepower
Gram-cm.	9.29472×10^{-8}	B.T.U.
Gram-cm.	2.34223×10^{-5}	Calories, gram
Gram-cm.	980.665	Ergs
Gram-cm.	7.2330×10^{-5}	Foot-pounds
Horsepower	2544.39	B.T.U./hour
Horsepower	10686.3	Calories, gram/min.
Horsepower	7.45702×10^{9}	Ergs/sec.
Horsepower	550	Foot-pounds/sec.
Horsepower	0.745702	Kilowatts
Inches of Hg (32° F)	0.033421	Atmospheres
Inches of Hg (32° F)	33864	Dynes/square cm.
Inches of Hg (32° F)	70.726	Pounds/square foot

(*continues*)

Figure 3-81 *continued*

CONVERSION FACTORS

UNIT	MULTIPLY BY	TO GET
Joules	0.000947798	B.T.U.
Joules	0.238841	Calories, gram
Joules	1×10^7	Dynes-cm.
Joules	1×10^7	Ergs
Joules	0.073756	Foot-pounds
Joules	10197.16	Gram-cm.
Kilowatts	3412.08	B.T.U./hour
Kilowatts	859,828	Calories, gram/hour
Kilowatts	1×10^{10}	Ergs/second
Kilowatts	2.65522×10^6	Foot-pounds/hour
Kilowatts	1.34102	Horsepower
Kilowatts	3.67098×10^5	Kg.-meters/hour
Kilowatts-hours	3.6×10^6	Joules
Knots	1.8532486	Kilometers/hour
Knots	1	Miles (Naut.)/hour
Knots	1.15155	Miles/hour
Lamberts	295.719	Candles/square foot
Lamberts	929.034	Lumens/square foot
Light years	9.45994×10^{12}	Kilometers
Light years	5.87812×10^{12}	Miles
Meters of Hg (0° C)	1.31579	Atmospheres
Meters of Hg (0° C)	44.65	Feet of H_2O (60° F)
Meters of Hg (0° C)	19.3368	Pounds/square inch
Miles/hours	1.46667	Feet/sec.
Million gal./day	1.54723	Cu. feet/sec.

(*continues*)

Figure 3-81 *continued*

CONVERSION FACTORS

UNIT	MULTIPLY	TO GET
Ounces/square inch	0.0106042	Feet of Hg (32° F)
Ounces/square inch	0.144314	Feet of H_2O (60° F)
Pounds/square foot	0.000472543	Atmospheres
Pounds/square foot	0.000478803	Bars
Pounds/square foot	0.0359131	Cm. of Hg (0° C)
Pounds/square foot	478.803	Dynes/sq. cm.
Pounds/square foot	0.00117825	Ft. of Hg (32° F)
Pounds/square foot	0.016035	Ft. of H_2O (60° F)
Pounds/square foot	0.488241	Gram/square inch
Pounds/square foot	0.0359131	Cm. of Hg (0° C)
Watts	3.413	B.T.U./hour
Watts	860	Calories, gram/hour
Watts	1×10^7	Ergs/second
Watts	44.25	Foot-pounds/minute
Watts	0.0001341	Horsepower
Watt-hours	2655.75	Foot-pounds

(*continues*)

Figure 3-81 *continued*

CONVERSION FACTORS

WEIGHTS AND MEASURES

LENGTH

1 Nautical Mile =	1.115151 miles
1 Mile =	1,760 yards = 5,280 feet
1 Yard =	3 feet = 36 inches
1 Foot =	12 inches

AREA

1 Square Mile =	640 acres
1 Acre =	4,840 sq. yards = 43,560 sq. feet
1 Square Yard =	9 sq. feet
1 Square Foot =	144 sq. inches

VOLUME

1 Cubic Yard =	27 cubic feet
1 Cubic Foot =	1,728 cubic inches
1 Quart =	2 pints
1 U.S. Gallon =	8 U.S. pints
1 U.S. Bushel =	64 U.S. pints

WEIGHT

1 Long Ton =	2,240 pounds
1 Short Ton =	2,000 pounds
1 Pound =	16 ounces
1 Ounce =	437.5 grams

Figure 3-81 *continued*

AMPERE RATINGS OF RESISTANCE LOADS

SINGLE PHASE

KW	120V	208V	240V	277V
0.5	4.2	2.5	2.1	1.9
0.75	6.3	3.7	3.2	2.8
1	8.4	4.9	4.2	3.7
2	16.7	9.7	8.4	7.3
3	25	14.5	12.5	10.9
4	33.4	19.3	16.7	14.5
5	41.7	24.1	21	18.1
6	50	28.9	25.2	21.7
7.5	62.5	36.1	31.3	27.1
10	83.4	48.1	41.7	36.2
12	100	57.7	50	43.4
15	125	72.2	62.5	54.2
20	166.7	96.2	83.4	72.3
25	208.4	120.2	104.2	90.3
30	250	144.3	125	108.4
50	416.7	240.4	208.4	180.6
75	625	360.6	312.5	270.8
100	833.4	480.8	416.7	361.1

NOTE:

To find kw for loads not listed, just combine the total of kw needed. For example, to find amps for 18 kw at 277V, find amps for 15 kw = 54.2 amps. Next find amps for 3 kw = 10.9 amps and add this to 54.2 amps = 65.1 amps total.

Figure 3-82

AMPERE RATINGS ON RESISTANCE LOADS

THREE PHASE

KW	208V	240V	480V
1	2.8	2.5	1.3
2	5.6	4.9	2.5
3	8.4	7.3	3.7
4	11.2	9.7	4.9
5	13.9	12.1	6.1
6	16.8	14.5	7.3
8	22.4	19.4	9.8
10	27.8	24.1	12.1
12	33.4	29	14.5
15	41.7	36.2	18.1
20	55.6	48.2	24.1
25	69.5	60.3	30.2
30	83.4	72.3	36.2
50	139	120.5	60.3
75	208.5	180.7	90.4
100	278	240.9	120.5

NOTE:

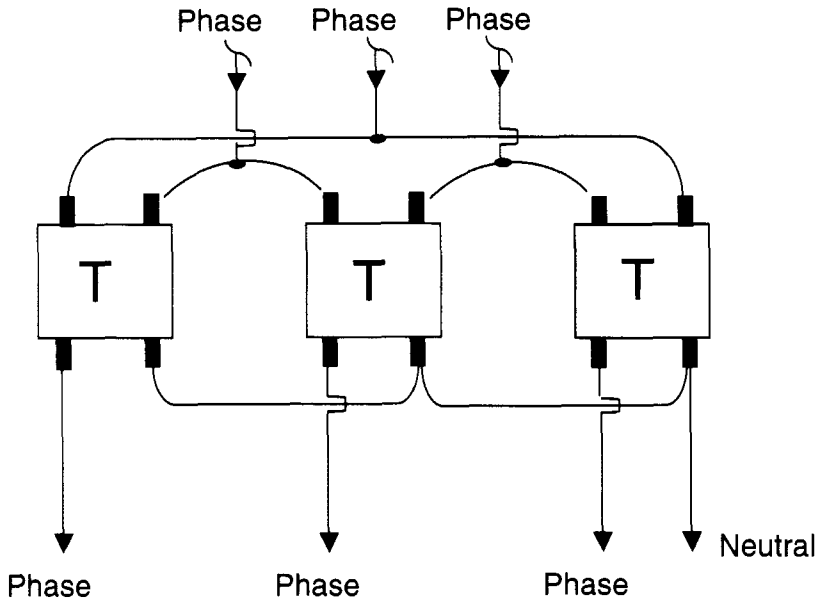
To find kw for loads not listed, just combine the total of kw needed. For example, to find amps for 18 kw at 480V, find amps for 15 kw = 18.1 amps. Next find amps for 3 kw = 3.7 amps and add this to 18.1 amps = 21.8 amps total.

Figure 3-83

TRANSFORMER CONNECTIONS

DELTA TO WYE

HIGH-VOLTAGE PRIMARY CONNECTION
3-PHASE 3-WIRE INPUT VOLTAGE
Also referred to as a DELTA connection



LOW-VOLTAGE SECONDARY CONNECTION
3-PHASE 4-WIRE OUTPUT VOLTAGE
Also referred to as a WYE connection

NOTE:

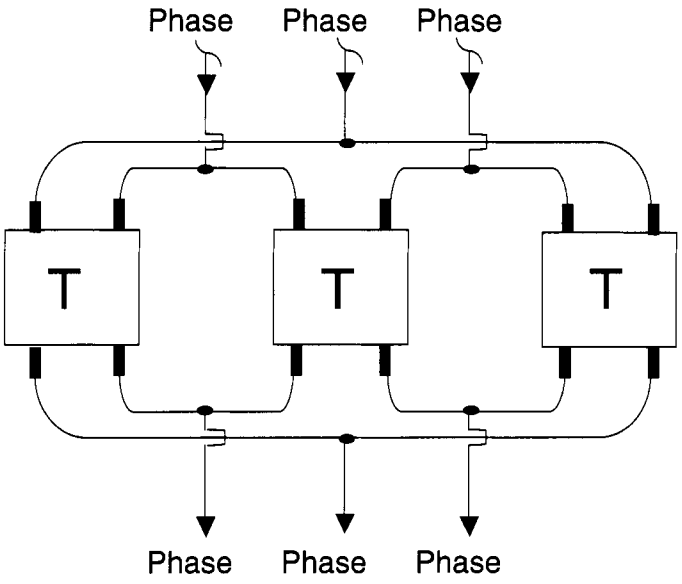
This is a typical transformer connection that we see all the time with three single-phase transformers connected together to provide 3-phase service.

Figure 3-84

TRANSFORMER CONNECTIONS

DELTA TO DELTA

HIGH-VOLTAGE PRIMARY CONNECTION
3-PHASE 3-WIRE INPUT VOLTAGE
Also referred to as a DELTA connection



LOW-VOLTAGE SECONDARY CONNECTION
3-PHASE 3-WIRE OUTPUT VOLTAGE
Also referred to as a DELTA connection

NOTES:

This transformer connection that we see sometimes is not as common as the typical 3-phase primary to 3-phase 4-wire secondary transformer setup using the three single-phase transformers.

This configuration allows the enduser to determine whether to ground one phase of the three phases. This must be coordinated with the utility company that supplies the electricity. The purpose of grounding one phase is for safety.

Figure 3-85

TRANSFORMER KVA AND AMPERE RATINGS

SINGLE PHASE

KVA RATINGS	120V AMPS	208V AMPS	240V AMPS	277V AMPS	480V AMPS
0.25	2.1	1.2	1	0.9	0.52
0.5	4.2	2.4	2.1	1.8	1.4
0.75	6.3	3.6	3.1	2.7	1.6
1	8.3	4.8	4.2	3.6	2.1
1.5	12.5	7.2	6.3	5.4	3.1
2	16.7	9.6	8.3	7.2	4.2
3	25	14.4	12.5	10.8	6.3
5	41.7	24	20.8	18.1	10.4
7.5	62.5	36.1	31.3	27.1	15.6
10	83.3	48.1	41.7	36.1	20.8
15	125	72.1	62.5	54.2	31.3
25	208.3	120.2	104.2	90.3	52.1
37.5	312.5	180.3	156.3	135.4	78.1
50	416.7	240.4	208.3	180.5	104.2
75	625	361	313	271	156
100	833	481	417	361	208
167	1392	803	696	603	348
200	1667	962	833	722	417
250	2083	1202	1042	903	521

AMPS = KVA x 1000/VOLTAGE (e.g., 50 x 1000 = 50,000/277V = 180.51 AMPS)

NOTES:

To choose the correct size of a transformer, the load amperes must be known. When the amperes are known, select the next higher KVA size transformer (e.g., load amperes are 28 at 277V, so select 10 KVA [7.5 KVA is too small]).

All calculations are rounded off to the nearest tenth or whole number.

Check with the transformer manufacturer for recommendations based on the application. Location, distribution equipment, and loads to be serviced may have a direct impact on the type and size of transformer needed.

Figure 3-86

TRANSFORMER KVA AND AMPERE RATING

	THREE PHASE			
KVA RATING	208V AMPS	240V AMPS	460V AMPS	480V AMPS
3	8.3	7.2	3.8	3.6
6	16.7	14.4	7.5	7.2
9	25	21.7	11.3	10.8
15	41.6	36.1	18.8	18
30	83.3	72.2	37.7	36.1
45	125	108.3	56.5	54.1
75	208.2	180.4	94.1	90.2
112.5	312	271	141.2	135
150	416	361	188.3	180
225	625	541	282.4	271
300	833	722	376.6	361
500	1,388	1,203	627.6	601

NOTES:

To choose the correct size of a transformer, the load amperes must be known. When the amperes are known, select the next higher KVA size transformer from the chart (e.g., load amperes are 40 at 460V, so select 45 KVA [30 KVA is too small]).

AMPS = KVA × 1,000 / VOLTAGE × 1.732 (e.g., 75 × 1,000 = 75,000/460 × 1.732 (796.7) = 94.14 AMPS).

All calculations are rounded off to the nearest tenth or whole number.

Check with the transformer manufacturer for recommendations based on the application. Location, distribution equipment, and loads to be serviced may have a direct impact on the type and size of transformer.

Figure 3-87

LIGHTING DESIGN / FOOTCANDLE RECOMMENDATIONS

THIS TABLE REPRESENTS THE "IES" ILLUMINANCE CATEGORIES AND VALUES FOR GENERIC TYPE OF INDOOR ACTIVITIES. ALL TASKS FALL INTO 1 OF 9 ILLUMINANCE CATEGORIES, COVERING FROM 20 TO 20,000 LUX (2 TO 2,000 FOOTCANDLES). THE CATEGORIES ARE KNOWN AS "A TO I" AND EACH PROVIDE A RANGE OF 3 ILLUMINANCES VALUES (LOW-MEDIUM-HIGH).

ACTIVITY	CATEGORY	LUX LOW-MEDIUM-HIGH	FOOTCANDLES LOW-MEDIUM-HIGH
PUBLIC SPACES WITH DARK SURROUNDINGS	A	20-30-50	2-3-5
SIMPLE ORIENTATION FOR SHORT TEMPORARY VISITS	B	50-75-100	5-7.5-10
WORKING SPACES WHERE VISUAL TASKS ARE ONLY OCCASIONALLY PERFORMED	C	100-150-200	10-15-20
PERFORMANCE OF VISUAL TASKS OF HIGH CONTRAST OR LARGE SIZE	D	200-300-500	20-30-50
PERFORMANCE OF VISUAL TASKS OF MEDIUM CONTRAST OR SMALL SIZE	E	500-750-1,000	50-75-100
PERFORMANCE OF VISUAL TASKS OF LOW CONTRAST OR VERY SMALL SIZE	F	1,000-1,500-2,000	100-150-200
PERFORMANCE OF VISUAL TASKS OF LOW CONTRAST AND VERY SMALL SIZE OVER A PROLONGED PERIOD	G	2,000-3,000-5,000	200-300-500
PERFORMANCE OF VERY PROLONGED AND EXACTING VISUAL TASKS	H	5,000-7,500-10,000	500-750-1,000
PERFORMANCE OF VERY SPECIAL VISUAL TASKS OF EXTREMELY LOW CONTRAST AND SMALL SIZE	I	10,000-15,000-20,000	1,000-1,500-2,000

(*continues*)

Figure 3-88

COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL LIGHTING LEVELS

AREA OF THE ACTIVITY	ILLUMINANCE CATEGORY
AUDITORIUMS:	
ASSEMBLY	C
SOCIAL ACTIVITIES	B
BANKS:	
GENERAL	C
WRITING AREA	D
TELLER STATIONS	E
CONFERENCE ROOMS	D
EDUCATIONAL FACILITIES:	
CLASSROOMS GENERAL	E
DRAFTING	E
SCIENCE	E
LECTURE HALLS	F
SHOP ROUGH WORK	D
SHOP MEDIUM BENCH WORK	E
SHOP FINE BENCH WORK	G
SHOP EXTRA-FINE BENCH WORK	H
EXHIBITION HALLS	C
FOOD SERVICES:	
DINING	B
KITCHEN	E
FOOD DISPLAYS	E
GASOLINE STATIONS:	
W/ DARK SURROUNDINGS	*****
APPROACH	A
DRIVEWAY	A
PUMP ISLAND AREA	D
SERVICE AREA	A
LANDSCAPE HIGHLIGHTS	A
W/ LIGHT SURROUNDINGS	*****
APPROACH	A
DRIVEWAY	B
PUMP ISLAND AREA	D
SERVICE AREAS	B
LANDSCAPE HIGHLIGHTS	B
HEALTH CARE FACILITIES:	
CORRIDORS	C
NURSING AREAS—DAY	C
NURSING AREAS—NIGHT	B
OPERATING AREAS	E
DELIVERY	E
RECOVERY	E
LAB SUITES/SERVICES	E
LOBBY AREA	C
MEDICAL RECORDS	E
PATIENTS' ROOMS GENERAL	B
SOLARIUM GENERAL	C
STAIRWAYS	C
WAITING AREAS GENERAL	C

(*continues*)

Figure 3-88 *continued*

COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL LIGHTING LEVELS (*continued*)

AREA OF THE ACTIVITY	ILLUMINANCE CATEGORY
LIBRARIES:	
READING AREAS GENERAL	E
MUNICIPAL BUILDINGS:	
FIRE AND POLICE RECORDS	F
INTERROGATION—CELLS	D
FIRE HALL	D
OFFICES:	
GENERAL LEVELS	C
MAIL SORTING	E
PRINTING AND COPING	D
STORAGE YARDS:	
ACTIVE	D
INACTIVE	A
TRANSPORTATION TERMINALS:	
WAITING ROOM AND LOUNGE	C
TICKET COUNTERS	E
BAGGAGE CHECKING	D
RESTROOMS	C
CONCOURSE	B
BOARDING AREA	C
INDUSTRIAL ASSEMBLY:	
SIMPLE	D
MODERATELY DIFFICULT	E
DIFFICULT	F
VERY DIFFICULT	G
EXACTING	H
GARAGES—SERVICE:	
REPAIRS	E
ACTIVE TRAFFIC AREAS	C
WRITE-UP	D
GENERAL PARKING AREAS:	
MAIN LOTS	A
SECONDARY LOTS	A

Figure 3-88 *continued*

CHAPTER 4

Sample Estimate and Forms

The following sample estimate (Figs. 4-1A–S) shows the contractor and/or estimator how a professional estimate is formatted and assembled into a logical easy-to-read estimate.

The first sheet of the estimate is referred to as the "Recapitulation Sheet" (Fig. 4-1A). On this sheet the front is designed to enter all costs associated with the particular project. The back of the sheet alerts the contractor and/or estimator to various cost items not shown on the plans but that may be required in the project bid documents.

The second sheet of the estimate, referred to as "PN-1" (prices needed) (Fig. 4-1B), is the recapitulation of all the costs sometimes referred to as **major** materials, equipment, or subcontractors required for the project that are listed in detail on the estimate sheets. The estimated material should be listed along with quotations of costs for these materials. When all of the quotations are totaled, transfer this total to the first sheet of the estimate as shown on the sample estimate.

The third sheet of the estimate, referred to as "RE-1" (recapitulation of the estimate) (Fig. 4-1C), is a list of all of the estimate sheets for the project. Each estimate sheet will have a total of labor hours and the materials listed. (NOTE: This sample does not include material prices due to their fluctuation.) These totals are placed accordingly on the RE-1 sheet to be totaled and brought forward to the Recapitulation Sheet of the estimate. (The quotations entered on the PN-1 sheet will not be included on the RE-1 sheet.)

The remaining 16 pages of the sample estimate (Figs. 4-1D–S) list the materials, labor hours, and subcontractor requirements.

As shown, the material pricing is left out purposely due to their fluctuations and each contractors' buying power with their respective suppliers. The labor hours, however, are included and are based on years of estimating experience and applications. Some items of the estimate need allowances in dollars and/or hours as a project requires. Therefore, each contractor must use their experience and know-how as to the allowance of dollars and hours that need to be addressed.

This sample estimate was prepared using a method developed over 30 years ago and used very successfully. Follow these few simple rules when preparing your estimates:

1. Review the scope of your work completely and highlight all items of possible cost.
2. Read all the specifications for the project. Not only the electrical but all of the other trades involved in the project. There may be a hint of cost that may affect your estimate.

3. Open the plans and confirm that they include all the electrical layouts, a site plan, a utility plan, mechanical plans, architectural plans, riser diagrams, and all addendums and other bulletins that may have been issued.
4. There will be certain projects that will not have a complete set of plans, specifications, or a scope of work. In these cases the contractor should include in the bid a complete scope of the work that lists all of the work included and excluded prior to contract acceptance.
5. In seeking answers from a builder, engineer, architect, or owner always **document** the question and answer. Follow up with a speedy message confirming the conversation and keep a copy for the job file.

These simple rules may help a contractor avoid common pitfalls such as being held responsible for work specified in the contract documents that otherwise may be missed in the estimate. NOTE: In rule #2 it is recommended that all specifications be read to determine if there may be costs that reflect on the estimate. A seasoned estimator will know exactly what sections of the specifications may have a direct impact on the estimated cost of the project. An example of what can be skimmed over may be fabrication of the stairs, doors, windows, bricks, etc. You may uncover a cost-saving item such as cutting, patching, and painting that may be included in the general contractor's specifications, reinforcement of the suspended ceiling to support the superimposed load of the lighting fixtures, roof openings and placement of portals and/or pitch pockets for the mechanical trades, automatic temperature control wiring, and more. So until you read over **all** of the specifications for a project for bid, the estimator is the only one who can effectively ensure that all hidden costs are included in the estimate.

Take the time to review the following sample estimate —each estimate sheet, the recapitulation of the estimate sheets, the price quotations needed sheet, and finally the main cover recapitulation sheet.

The estimator should complete the main cover recapitulation sheet with the assistance of either the contractor or the estimator's immediate superior. This finalization of the estimate will produce the bid amount including all of the items on the main cover recapitulation sheet. This final tally may be adjusted up or down at the discretion of the contractor.

Estimator's Check Sheet

The following check list will help an estimator in preparing an estimate and avoid leaving some of the important items out of the estimate.

- ☐ Review the bidding documents and confirm that all were received.
- ☐ Forward the insurance and bonding requirements to the proper department in the company.
- ☐ Notify all suppliers that you have a set of bid documents and are requesting their quotations.
- ☐ Contact outside subcontractors for their estimates on the project as needed.
- ☐ Organize the estimate takeoff and in-house pricing with the material purchasing department.
- ☐ Meet with the shop foreman in regards to the tools that may need to be rented or purchased.
- ☐ Estimators will generally begin the takeoff by listing all of the materials as shown on the electrical plans including items such as lighting fixtures, lamps, switches, receptacles, electrical panels, site lighting poles and fixtures, life-safety systems, communications systems, feeders, branch wiring raceways/cables/wire, power distribution ducts, under floor ducts, and many other visible items.

A lot of the mistakes that are made in the materials takeoff are materials that are not shown on the plans and oftentimes overlooked. And if material is overlooked, the associated labor hours that are necessary are not entered into the estimate.

Listed below are some of the job-expense items that are often overlooked.

- Permit and inspection fees
- Utility company charges for their services
- Insurance and bonding charges

- Temporary electric meter charges
- Clean up
- As-built drawings
- Rentals
- Job site drinking water and sanitation facilities
- Storage
- Freight and shipping charges
- Travel and room-and-board allowances

Listed below are some of the materials needed that are often overlooked.

- Grounding
  - Transformers
  - Manholes
  - Site light poles and bases
  - Distribution panels
  - Wood-pole installations
  - Communications stands and racks
- Excavation and backfill
  - Machine excavation for trenches
  - Machine backfill
  - Removal and/or spreading of excess earth
  - Hand excavation as needed
  - Sand fill if necessary
  - Stone base for precast items
- Raceways under ground
  - Chairs and spacers
  - Tie-downs to prevent floating in encased concrete (PVC conduits)
  - Warning tape—"buried utilities"
- Raceways above ground
  - Clamps, straps, anchors, fasteners, and hangers
  - Cutting and patching for floor and wall penetrations
- Wire and cable
  - Wire splicing materials
  - Wire labeling
  - Cable wedges and insulators
  - Wire/cable testing (high and low voltage)
  - Allow stud sleeves for multiconductor cables (armored and plastic covered)
  - Allow for cable supports and fasteners
- Site lighting poles and fixtures
  - Receiving, handling, and storing until installation (allow for lift to unload)
  - Moving poles to place of installation (allow for boom truck)
  - Preassemble fixtures on poles on ground and test for illumination
  - Allow for boom truck to set poles
  - Allow shims for leveling
  - Inline fuse holders and fuses
- Building light fixtures
  - Receiving, handling, and storing until installation (if on pallets, allow forklift)
  - Check documents for spare lamp requirements
  - Fixture hangers, supports, and hold-down clips on lay-ins
  - Inspect for lamps installed at the factory
  - Devices, boxes, and plates
  - Check architects plans for special colors of devices and plates
  - Include box supports in stud walls (metal and wood studs)
- Mechanical equipment
  - Flexible connections
  - Safety disconnect devices and fuses
  - Overload heaters for motor protection
  - Roof-mounted equipment conduit supports and portal responsibility
  - Allow testing for and adjusting motor direction if required
- Expendable material allowances
  - Wood-cutting blades
  - Metal-cutting blades
  - Threading oil
  - Duct sealant
  - Bits for drilling concrete
  - Drill bits for metal
  - Metal files
  - Jet line or similar conduit snaking cords and air cartridges
  - Wire-pulling compound
  - Rags
  - Hydraulic fluid
  - Silicone sealant for outdoor use

Although this is not 100% of all unseen items of material and labor, it will give an estimator a relatively good idea of the materials that will be required but are unseen. The other bidding documents besides the plans will also specify certain materials and labor required for the project.

For the estimator: It is your responsibility to provide the best interpretation of all of the project bidding documents to the contractor in the form of an estimate.

Following the sample estimate, blank forms are provided in duplicate so that you may tear one each from the book for use.

RECAPITULATION SHEET

ESTIMATE NO: 234-11/02

JOB XYZ TECH OFFICE AND WAREHOUSE #J-16 SHEET NO: 1 OF 1

COMPTON COMPLEX AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

ESTIMATED BY DENIS SMITH CHECKED BY MKR DATE: 11-29-02

SHEET NO	ESTIMATE SHEETS DESCRIPTION	$ MATERIAL	HOURS
RE-1 OF 1	RECAPITULATION OF 16 ESTIMATE SHEETS MATERIAL COST EST. ONLY	$175,000.00	5,309.00
PN-1 OF 1	PRICE QUOTATIONS NEEDED	$50,450.00	0

NONPRODUCTIVE LABOR	HOURS
HANDLING MATERIAL	40.00
SUPERVISION	280.00
TRAVEL TIME	35.00
OVERTIME	0
NONWORKING PERSONNEL	0
TOTAL (A)	355.00

JOB EXPENSE	
SCAFFOLDS, LIFTS COSTS	$2,500.00
STORAGE	$600.00
INSPECTION, PERMIT FEES	$500.00
LICENSE FEE	$0.00
FREIGHT CHARGES	$1,800.00
AS-BUILT DRAWINGS	$2,500.00
INSURANCE	FBO
WATCHMAN	FBO
PRO RATA CHARGES	$0.00
TRANSPORTATION, TOLLS, ETC.	$450.00
TELEPHONE AND OFFICE COSTS	$1,500.00
TOTAL (B)	$9,850.00

MISC MATERIAL (C) AND LABOR (D)		$225,450.00	5,309.00
NONPRODUCTIVE LABOR (A)			355.00
TOTALS: MATERIAL (C) & LABOR (D)		$225,450.00	5,664.00
(D)	280 Hours Labor @ $ 50.00 PER HR		$14,000.00
	75 Hours Labor @ $ 35.00 PER HR		$2,625.00
	5,309 Hours Labor @ $ 45.00 PER HR		$238,905.00
Taxes: Soc. Sec. INC Unemp. INC			$0.00
Workmen's Compensation Insurance INC			$0.00
LABOR GROSS TOTAL			$255,530.00
JOB EXPENSE (B)			$9,850.00
MATERIAL (C)	(EST. ONLY)		$225,450.00
TOTAL PRIME COST			$490,830.00
12% OVERHEAD			$58,900.00
TOTAL NET COST			$549,730.00
8% PROFIT			$43,978.00
SELLING PRICE (NO BOND)			$593,708.00
BOND COST			N/A
SELLING PRICE (W / BOND)			$593,708.00
FINAL QUOTED PRICE			$593,500.00

(*continues*)

Figure 4-1A

RECAPITULATION SHEET (BACK)

1. THE CONTRACTOR MUST INVESTIGATE THE REQUIREMENTS OF EACH GOVERNMENT AGENCY AS IT RELATES TO SALES TAXES ON BOTH MATERIALS AND LABOR, AND INCLUDE ALL OF THESE COSTS IN EACH PROPOSAL!
2. Nonproductive labor section contains various areas of costs that are affected by noninstallation labor factors. These items may or may not apply to all proposals, but remind the contractor that there may be labor costs beyond the actual labor cost associated with the project. This may also remind the contractor that there may be other items of nonproductive labor cost that should be addressed in the proposal.
3. Job expense section contains important direct project-related costs. These dollar costs may or may not be applicable to each proposal submitted by the contractor. This may also remind the contractor that there may be additional job-related expenses to be considered.
4. Labor hour section allows the contractor to apply different labor rates as they may apply to the level of grade of the workers who physically install or direct the installations.
5. Taxes section allows the contractor to include such taxable items of labor as they may apply to the project.
6. Overhead section is a cost of doing business for the contractor. This cost may include insurances, office supplies, postage, contractor's building facility, utilities, office personnel payroll, telephone, association fees, periodicals, facility maintenance, rolling stock upkeep and fuel, rental of office equipment, support programs costs, etc. Include any other costs that are fixed as they relate to the business inside the contractor's facilities.
7. Profit is relative to the size of the proposal and the amount the contractor anticipates.
8. Bond section gives the contractor the ability to include the cost of a bid bond, performance bond, and/or payment bonds.

Figure 4-1A *continued*

ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: PN-1 OF 1

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

PRICE QUOTATIONS NEEDED

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS		MATERIALS				LABOR HOURS			
			QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	EXCAVATION, BACKFILL, & SAND	EST PG 1, 2, 1	QUOTE	→	Q					1
2	MDP, PANELS, TRANSFORMERS	EST PG 3, 4, 8	QUOTE	→	Q					2
3	SITE LIGHT STANDARDS	EST PG 11	QUOTE	→	Q					3
4	BUILDING LIGHT FIXTURES	EST PG 12	QUOTE	→	Q					4
5	VOICE / DATA SYSTEM EQUIPMENT	EST PG 14	QUOTE	→	Q					5
6	FIRE ALARM SYSTEM EQUIPMENT	EST PG 15	QUOTE	→	Q	▼				6
7										7
8										8
9										9
10										10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30
31										31
32										32
				TOTAL		"EST ONLY" $50,450.00	TOTAL		0	

Figure 4-1B

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: RE-1 OF 1

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

RECAP OF ESTIMATE SHEETS

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	PRIMARY INCOMING SERVICE REQ'S							48.80	1
2	SECONDARY SERVICE REQ'S							83.4	2
3	MDP, PANELS							165.95	3
4	PANELS, TRANSFORMERS							117.7	4
5	FEEDERS							396.6	5
6	FEEDERS							351.2	6
7	TELEPHONE SERVICE REQ'S							17.55	7
8	BUS DUCT							154.7	8
9	BRANCH WIRING							962.95	9
10	BRANCH WIRING							872.5	10
11	SITE LIGHTING REQ'S							465.8	11
12	LIGHTING FIXTURES							1,050.90	12
13	DEVICES, BOXES, & PLATES							142.7	13
14	VOICE & DATA REQ'S							134.5	14
15	FIRE ALARM REQ'S							208.8	15
16	MECHANICAL EQUIPMENT REQ'S							135.15	16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL		"EST ONLY" $175,000.00	TOTAL		5,309.20	

Figure 4-1C

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 1 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

INCOMING SERVICE REQUIREMENTS: DRWG # E-1 RISER & SPEC. SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Primary: 2-4" empty pvc schld' 80 w/drag from the Pwr. Co. terminal pole to their distribution transformer								1
2	4" PVC SCHLD' 80 T/R	300'		C		6.6	C	19.8	2
3	4" RIGID GALV. 48" RADIUS 90-DEG. ELBOWS	4		C		250	C	10	3
4	4" PVC SCHLD' 80 COUPLINGS	2		C		INC	0	0	4
5	4" PVC SCHLD' 80 FEMALE ADAPTER	4		C		80	C	3.2	5
6	4" RGC COUPLINGS	1		C		INC	0	0	6
7	4" RIGID GALV. CONDUIT (RGC) UP/POLE	10'		C		30	C	3	7
8	4" RGC 2 HOLE STRAPS AND LAGS	2		C		50	C	1	8
9	4" RGC CAPPED BUSHING	4		C		25	C	1	9
10	DRAG LINE (USE SAME LABOR AS #14 WIRE)	400'		M		6	M	2.4	10
11	INSTALL GROUND # 3/0 COPPER IN TRENCH W/ PVC'S	200'		M		8	M	1.6	11
12	TRENCH 48" D X 24" W (Q: SUB CONTRACT QUOTATION)	150'		Q		layout	0	4	12
13	SAND BED 6" BELOW & 6" ABOVE	12 YDS		Q		0	0	0	13
14	REMOVAL OF EXCAVATED MATERIAL	12 YDS		Q		0	0	0	14
15	ALLOW FOR XFORMER PAD PER PWR' CO' REQ'S	1		Q		0	0	0	15
16	ALLOW FOR DIRECT BURIAL WARNING TAPE	150'		M		2	M	0.3	16
17	3/4" X 10' COPPER GROUND ROD (FOR XFORM GRND)	1		EA		2	EA	2	17
18	3/4" GROUND ROD CLAMP	1		EA		0.25	EA	0.25	18
19	ATTACH #3/0 TO XFORM GND PAD (AL: ALLOWANCE)	ALLOW		AL		0	AL	0.25	19
20	MISC. GLUE, TAPE, RAGS, ETC.	ALLOW		AL		0	0	0	20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL		48.8	

Figure 4-1D

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 2 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

INCOMING SERVICE REQUIREMENTS: DRWG # E-1 RISER & SPEC. SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Secondary electric service from pwr. co. xformer to MDP, 4-4" rgc w/4-#600mcm copper cables								1
2	4" RIGID GALV. CONDUIT T/R	40'		C		15	C	6	2
3	4" RIGID GALV. 90-DEG ELBOWS W/COUP	8		C		200	C	16	3
4	4" RIGID GALV. COUPLINGS	8		C		INC	0	0	4
5	4" GROUND BUSHINGS	8		C		35	C	2.8	5
6	4" RIGID GALV. NIPPLES 12" LONG	8		C		75	C	6	6
7	#600 MCM THHN COPPER CABLE	640'		M		50	M	32	7
8	(4 PULLS OF 4 600'S @ 40' EACH PULL) SETUP REELS	ALLOW		AL		0	0	7	8
9	XFORMER SECONDARY #600 MCM TERMS TO MAKE	16		EA		0.6	EA	9.6	9
10	COORDINATE CONDUIT ENTRY THRU FOUNDATION WALL	ALLOW		AL		0	0	2	10
11	TRENCH 48" D X 24" W (Q: SUBCONTRACT QUOTATION)	18'		Q		layout	0	2	11
12	MISC. STAKES, TIES, ETC.	ALLOW		AL		0	0	0	12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		83.4	

Figure 4-1E

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 3 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

MDP AND DISTRIBUTION EQUIPMENT, PANELS, TRANSFORMERS: DRWG. # E-1 RISER & SPEC SECT.16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	"MDP" 3 Ø 4W 480/277 VOLT W/ CT SECTION & M.C.B.	SET & CONNECT		Q		60	EA	60	1
2	DISTRIBUTION SECTION W / 7- 3 POLE SPACES FOR CB'S	SET & CONNECT		Q		48	EA	48	2
3	FREE STANDING BACK ACCESS	LEVEL/FASTEN		AL		0	0	INC	3
4	800 AMP 3 POLE CIRCUIT BREAKER ACTIVE	1		Q		4.5	EA	4.5	4
5	400 AMP 3 POLE	1		Q		2.5	EA	2.5	5
6	200 AMP 3 POLE	1		Q		1.8	EA	1.8	6
7	100 AMP 3 POLE	2		Q		1.5	EA	3	7
8	200 AMP 3 POLE SPACES	2		Q		0	0	0	8
9									9
10	"PP-1" 3 Ø 3W 480 VOLT POWER PANEL	1		Q		9	EA	9	10
11	800 AMP MLO 6 #500MCM CABLES	CONNECT		Q		0.5	EA	3	11
12	SURFACE MOUNTED	SUPPORTS		AL		0	AL	1	12
13	200 AMP 3 POLE CIRCUIT BREAKER ACTIVE	2		Q		1.8	EA	3.6	13
14	100 AMP 3 POLE	2		Q		1.5	EA	3	14
15	60 AMP 3 POLE	2		Q		1.25	EA	2.5	15
16	40 AMP 3 POLE	2		Q		0.85	EA	1.7	16
17	XX XX XX 1 POLE SPACES	2		Q		0	0	0	17
18									18
19	"PP-2" 3 Ø 4W 480/277 VOLT POWER PANEL	1		Q		7	EA	7	19
20	400 AMP MLO 4 #500MCM CABLES	CONNECT		Q		0.5	EA	2	20
21	SURFACE MOUNTED	SUPPORTS		AL		0	AL	2	21
22	100 AMP 3 POLE CIRCUIT BREAKER ACTIVE	1		Q		1.5	EA	1.5	22
23	40 AMP 3 POLE	2		Q		0.85	EA	1.7	23
24	30 AMP 3 POLE	2		Q		0.75	EA	1.5	24
25	20 AMP 3 POLE	3		Q		0.75	EA	2.25	25
26	20 AMP 2 POLE	4		Q		0.5	EA	2	26
27	20 AMP 1 POLE	8		Q		0.3	EA	2.4	27
28	XX XX XX 1 POLE SPACES	2		Q		O	O	O	28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		165.95	

Figure 4-1F

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 4 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

PANELS & TRANSFORMERS: DRWG.# E-1 & E-2 & SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	"LP-1" 3 Ø 4W 480/277 VOLT LIGHTING PANEL	1		Q		6	EA	6	1
2	225 AMP MLO 4 #4/0 CABLES	CONNECT		Q		0.35	EA	1.4	2
3	SURFACE MOUNTED	SUPPORTS		AL		0	AL	1	3
4	30 AMP 2 POLE CIRCUIT BREAKERS ACTIVE	12		Q		0.5	EA	6	4
5	20 AMP 1 POLE " " "	12		Q		0.3	EA	3.6	5
6	20 AMP 1 POLE " SPARES	6		Q		0	0	0	6
7									7
8	"LP-2" 3 Ø 4W 480/277 VOLT LIGHTING PANEL	1		Q		6	EA	6	8
9	125 AMP MLO 4 #1 CABLES	CONNECT		Q		0.25	EA	1	9
10	FLUSH MOUNTED	SUPPORTS		AL		0	AL	1	10
11	20 AMP 1 POLE CIRCUIT BREAKERS ACTIVE	24		Q		0.3	EA	7.2	11
12	20 AMP 1 POLE " SPARES	6		Q		0	0	0	12
13									13
14	"RP-1" 3 Ø 4W 208/120 VOLT RECEPT. PANEL	1		Q		6	EA	6	14
15	225 AMP MLO 4 #4/0 CABLES	CONNECT		Q		0.35	EA	1.4	15
16	SURFACE MOUNTED	SUPPORTS		AL		0	AL	1	16
17	20 AMP 1 POLE CIRCUIT BREAKERS ACTIVE	34		Q		0.3	EA	10.2	17
18	20 AMP 1 POLE " SPARES	8		Q		0	0	0	18
19									19
20	"RP-2" 3 Ø 4W 208/120 VOLT LIGHTING PANEL	1		Q		6	EA	6	20
21	125 AMP MLO 4 #1 CABLES	CONNECT		Q		0.25	EA	1	21
22	FLUSH MOUNTED	SUPPORTS		AL		0	AL	1	22
23	20 AMP 1 POLE CIRCUIT BREAKERS ACTIVE	23		Q		0.3	EA	6.9	23
24	20 AMP 1 POLE " SPARES	7		Q		0	0	0	24
25									25
26	X'FORMER T-1 75 KVA 480V 3 Ø 3W 480 TO 208/120V	1		Q		21	EA	21	26
27	" T-2 45 KVA " "	1		Q		18	EA	18	27
28	ALLOW FOR GROUNDING OF XFORMERS TO BLDG STEEL	ALLOW		AL		0	AL	4	28
29	ALLOW FOR SUPPORTS, HANGERS, ETC.	ALLOW		AL		0	AL	8	29
30									30
31									31
32									32
	TOTAL					TOTAL		117.7	

Figure 4-1G

ESTIMATE SHEET

ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 5 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

FEEDERS PER ONE LINE DIAGRAM ON DRWG # E-1 & E-2 & SPEC SECT.16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	4" EMT INSTALL EXPOSED 20' ABOVE FIN. FLOOR	500'		C		22.5	C	112.5	1
2	3" EMT	350'		C		20	C	70	2
3	2" EMT	450'		C		15	C	67.5	3
4	1-1/2" EMT	300'		C		11.25	C	33.75	4
5	1-1/4" EMT	250'		C		10	C	25	5
6									6
7	4" EMT SET SCREW STEEL CONNECTORS	6		C		25	C	1.5	7
8	3" EMT	4		C		20	C	0.8	8
9	2" EMT	8		C		15	C	1.2	9
10	1-1/2" EMT	4		C		10	C	0.4	10
11	1-1/4" EMT	4		C		10	C	0.4	11
12									12
13	4" EMT SET SCREW STEEL COUPLINGS	65		C		0	0	0	13
14	3" EMT	45		C		0	0	0	14
15	2" EMT	65		C		0	0	0	15
16	1-1/2" EMT	50		C		0	0	0	16
17	1-1/4" EMT	32		C		0	0	0	17
18									18
19	4" EMT 90 DEG ELBOWS	9		C		62.5	C	5.65	19
20	3" EMT	6		C		31.25	C	1.9	20
21	2" EMT	9		C		25	C	2.25	21
22	1-1/2" EMT	6		C		12.5	C	0.75	22
23	1-1/4" EMT	6		C		12.5	C	0.75	23
24									24
25	4' EMT SUPPORTS & FASTNERS	60		C		62.5	C	37.5	25
26	3" EMT	40		C		31.25	C	12.5	26
27	2" EMT	50		C		18.75	C	9.4	27
28	1-1/2" EMT	45		C		18.75	C	8.45	28
29	1-1/4" EMT	35		C		12.5	C	4.4	29
30									30
31									31
32									32
				TOTAL		TOTAL		396.6	

Figure 4-1H

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 6 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

FEEDERS PER ONE LINE DIAGRAM ON DRWG # E-1 & E-2 & SPEC SECT.16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	8" X 8" X 48" WIREWAY NEMA 1 SCREW COVER	2		EA		1.6	EA	3.2	1
2	8" X 8" BLANK END FITTING	4		EA		0.1	EA	0.4	2
3	4' X 4' X 1/2" INDOOR PLYWOOD & SUPPORTS	2		EA		1	EA	2	3
4									4
5	36"W X 24"H X 12"D N/1 S/C JB (10,368 CU. IN.)	2		EA		7.8	EA	15.6	5
6	18"W X 18"H X 10"D N/I S/C JB	2		EA		3	EA	6	6
7	12"W X 12"H X 6"D	2		EA		1	EA	2	7
8									8
9	#600 MCM COPPER THHN CABLE	2,500'		M		50	M	125	9
10	#500	1,600'		M		40	M	64	10
11	#4/0	1,500'		M		24	M	36	11
12	#1	2,000'		M		14	M	28	12
13	#4	2,500'		M		10	M	25	13
14	ALLOW FOR REEL SETUP TIME FOR EACH PULL	8		AL		0	AL	28	14
15									15
16	MISC. TAPE, TAGS, TESTING, ETC.	ALLOW		AL		0	AL	16	16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		351.2	

Figure 4-1l

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 7 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

TELEPHONE SERVICE CONDUIT TO BUILDING PER DRWG # E-1 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	Install 1- 4" empty pvc conduit from pole to telephone backboard in building. Install in same trench as electric service conduits.								1
2	4" PVC SCHLD' 40 T/R	170'		C		6.6	C	11.2	2
3	4" PVC 90-DEGREE ELBOWS	2		C		80	C	1.6	3
4	4" PVC PLUGS	2		C		6	C	0.1	4
5	DRAG LINE (USE SAME LABOR AS #14 WIRE)	190'		M		6	M	1.15	5
6	ALLOW FOR SOME HAND TRENCHING AS REQ'D	ALLOW		AL		0	AL	2	6
7									7
8	4' X 8' X 3/4" PLYWOOD BACKBOARD W/ SUPPORTS	1		AL		0	AL	1.5	8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		17.55	

Figure 4-1J

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 8 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

PLUG-IN COPPER BUS DUCT & PLUG-IN CIRCUIT BREAKERS PER DRWG # E-3 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	225 AMP 3 Ø 3W CU 480V PLUG-IN DUCT W/GND BUS	100'		Q		0.65	FT	65	1
2	(INSTALL DUCT AT 18' HGT. AFF)								2
3	END CABLE TAP BOX FOR FEED IN TO DUCT	1		Q		5.4	EA	5.4	3
4	60 AMP 3 POLE 3W 480V & GND PLUG-IN CB	1		Q		2.05	EA	2.05	4
5	40 AMP 3 POLE	1		Q		2.05	EA	2.05	5
6	30 AMP 3 POLE	2		Q		1.7	EA	3.4	6
7	20 AMP 3 POLE	2		Q		1.7	EA	3.4	7
8	DUCT HANGER CLAMPS @ 5' INTERVALS	21		Q		0.7	EA	10.5	8
9	DUCT SPRING SUPPORTS	21		Q		1.35	EA	28.35	9
10	SINGLE ROD AND FASTNER FOR DUCT HANGERS	21		AL		1.55	EA	32.55	10
11									11
12	ALLOW FOR USE OF LIFT TO INSTALL DUCT	1		AL		0	AL	2	12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		154.7	

Figure 4-1K

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 9 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

BRANCH CIRCUIT WIRING PER DRWG # E-2 THRU E-6 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS QUANTITY	UNIT COST	PER	AMOUNT	LABOR HOURS UNIT	PER	AMOUNT	
1	1-1/4" EMT INSTALL EXPOSED 18' ABOVE FIN FLOOR	640'		C		10	C	64	1
2	1"	550'		C		7.5	C	56.25	2
3	1"	250'		C		6	C	15	3
4	3/4" 18' ABOVE FIN FLOOR	3,500'		C		6.25	C	218.75	4
5	3/4"	600'		C		5	C	30	5
6	1/2" 18' ABOVE FIN FLOOR	4,000'		C		5	C	200	6
7	1/2"	2,800'		C		4	C	112	7
8									8
9	1-1/4" EMT SET SCREW STEEL CONNECTORS	18		C		10	C	1.8	9
10	1" EMT	30		C		10	C	3	10
11	3/4" EMT	180		C		5	C	9	11
12	1/2" EMT	290		C		5	C	14.5	12
13									13
14	1-1/4" EMT SET SCREW STEEL COUPLINGS	70		C		0	0	0	14
15	1" EMT	100		C		0	0	0	15
16	3/4" EMT	500		C		0	0	0	16
17	1/2" EMT	800		C		0	0	0	17
18									18
19	1-1/4" EMT 90 DEG ELBOWS	9		C		12.5	C	1.1	19
20									20
21	1-1/4" EMT SUPPORTS & FASTNERS	75		C		12.5	C	9.4	21
22	1" EMT	95		C		12.5	C	11.9	22
23	3/4" EMT	500		C		6.25	C	31.25	23
24	1/2" EMT	800		C		6.25	C	50	24
25									25
26	6"W X 6"H X 4"D N/1 S/C JB	4		EA		1.25	EA	5	26
27	4-11/16" SQ X 2-1/8" DEEP	100		C		50	C	50	27
28	4" SQ X 2-1/8" DEEP	200		C		40	C	80	28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL		962.95	

Figure 4-1L

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 10 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

BRANCH CIRCUIT WIRING PER DRWG # E-2 THRU E-6 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	3/4" PVC SCHLD 40 CONDUIT IN / SLAB	500'		C		4	C	20	1
2	3/4" PVC CONNECTORS	30		C		10	C	3	2
3	3/4" PVC COUPLINGS	12		C		0	0	0	3
4	3/4" PVC 90-DEGREE ELBOWS	30		C		10	C	3	4
5									5
6	#6 CU THHN STRANDED WIRE	2,000'		M		14	M	28	6
7	#8	1,000'		M		12	M	12	7
8	#10	9,000'		M		10	M	90	8
9	#12	25,000'		M		8	M	200	9
10									10
11	#10-3/C MC CABLE OFFICE AREA	1,500'		M		50	M	75	11
12	#12-4/C	2,500'		M		40	M	100	12
13	#12-3/C	3,500'		M		35	M	122.5	13
14	#12-2/C	4,500'		M		30	M	135	14
15	MC CABLE SUPPORTS & FASTNERS	1,200		C		3	C	36	15
16	HANG SUPPORT WIRES FROM 20' DN TO 10' LEVEL	100		C		16	C	16	16
17									17
18	MISC TAGS, TAPE, TIES, TESTING, ETC.	ALLOW		AL		0	AL	32	18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL		872.5	

Figure 4-1M

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 11 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

SITE LIGHTING REQ'S PER DRWG # PHE-1, E-1 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	O-□ SL-1 20' ALUM POLE W/ 1-400W 480V,	12		Q		7.5	EA	90	1
2	3' ARM & SINGLE HEAD H. P. SODIUM W / LAMP								2
3									3
4	O-□-O SL-2 20' ALUM POLE W/2-400W 480V,	12		Q		12	EA	144	4
5	2-3' ARMS & TWIN HEAD H. P. SODIUM W / LAMPS								5
6									6
7	7' X 30" RND CONCRETE BASES (3' AFG) (PRECAST)	24		Q		3	EA	72	7
8	EXCAVATION / BACKFILL FOR BASES	24		Q		0	AL	8	8
9	1-1/4" PVC 90-DEG ELBOWS IN / BASES	48		C		0	0	0	9
10	5/8" X 10' COPPER GROUND RODS	24		EA		1.8	EA	43.2	10
11	5/8" GROUND ROD CLAMPS	24		EA		0.25	EA	6	11
12	3/4" PVC SLEVES FOR GROUND RODS	240'		C		0	0	0	12
13									13
14	1-1/4" PVC SCHLD 40 CONDUIT IN / TRENCH	1,000'		C		3	C	30	14
15	1-1/4" PVC CONNECTORS	4		C		20	C	0.8	15
16	1-1/4" PVC COUPLINGS	165		C		0	0	0	16
17	1-1/4" PVC 90-DEG ELBOWS	4		C		20	C	0.8	17
18									18
19	TRENCH 36" D X 12" W (Q: SUBCONTRACT QUOTATION)	1,000'		Q		layout	0	24	19
20	ALLOW FOR DIRECT BURIAL WARNING TAPE	1,000		M		2	M	2	20
21									21
22	#8 CU THHN STRANDED WIRE	500'		M		12	M	6	22
23	#10	1,500'		M		10	M	15	23
24	#12	1,000		M		8	M	8	24
25									25
26	MISC TAGS, TAPE, SPLICING, TESTING, ETC.	ALLOW		AL		0	AL	16	26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL		465.8	

Figure 4-1N

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 12 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

LIGHTING FIXTURES PER DRWG # E-3 THRU E-6 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	TYPE "A" 2' X 4' 3 32 W LAMPS 277V LAY-IN	75		Q		1.3	EA	97.5	1
2	TYPE "B" 2' X 4' 2 32 W LAMPS 277V LA Y-IN	8		Q		1.1	EA	8.8	2
3	TYPE "C" 2' X 2' 2 32 W U LAMPS 277V LAY-IN	12		Q		1	EA	12	3
4	TYPE "D" 1' X 4' 1 32 W LAMP 277V SURFACE	18		Q		1	EA	18	4
5	TYPE "E" UNIV' MTD. EXIT SIGN 277V (OFFICE AREA)	7		Q		0.75	EA	5.25	5
6	TYPE "E-1" DF	9		Q		0.75	EA	6.75	6
7	TYPE "F" WALL MTD 100W HPS W/P FIXT	25		Q		2	EA	50	7
8	TYPE "G" WALL MTD 50W HPS W/P FIXT	8		Q		2	EA	16	8
9	TYPE "H" L.V. HI-HAT 277V W / PL LAMP	22		Q		1	EA	22	9
10	TYPE "H-1" L.V. WALL WASH 277V W MR LAMPS	18		Q		1	EA	18	10
11	TYPE "J" HI-BAY 480V 400 W MH LAMPS	160		Q		2.5	EA	400	11
12	TYPE " J-1" HI-BAY 480V 250 W MH LAMPS	36		Q		2.5	EA	90	12
13	TYPE "K" EMER EXIT LGT W/ EMER 2 HEADS	18		Q		1.5	EA	27	13
14	TYPE "K-1"	8		Q		1.5	EA	12	14
15									15
16	32 WATT WARM WHITE FLUOR. LAMPS	259		C		3	C	7.75	16
17	32 WATT WARM WHITE FLUOR. U LAMPS	24		C		3	C	0.7	17
18	400 WATT MH LAMPS	160		C		10	C	16	18
19	250 WATT MH LAMPS	36		C		10	C	3.6	19
20	100 WATT HPS LAMPS	25		C		10	C	2.5	20
21	50 WATT HPS LAMPS	8		C		10	C	0.8	21
22	9 WALL LV PL LAMPS	22		C		5	C	1.1	22
23	50 WATT LV MR LAMPS	18		C		5	C	0.9	23
24									24
25	BOX FOR HI-BAY FIX W / LOOP, HOOK, & SAFETY CHAIN	196		Q		0.75	EA	147	25
26	WALL OUTLET BOXES	40		C		35	C	14	26
27	CEILING OUTLET BOXES	25		C		35	C	8.75	27
28	4-11/16" SQ. 2-1/8" D JB W BLANKS	18		C		50	C	9	28
29	4" SQ JB W BLANKS	40		C		25	C	10	29
30	FLEX FIXTURE WHIPS W/ THHN WIRE	135		C		10	C	13.5	30
31	FIX HOLD-DOWN CLIPS, SUPPORTS, HANGERS, ETC.	ALLOW		AL		0	AL	16	31
32	MISC. SPLICING,TAPE, TAGS, TESTING, ETC.	ALLOW		AL		0	AL	16	32
			TOTAL			TOTAL		1,050.90	

Figure 4-10

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 13 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

DEVICES, BOXES, & PLATES PER DRWG # E-2 THRU E-6 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	20 AMP SP DECOR WALL SWITCHES IVORY	28		C		35	C	9.8	1
2	20 AMP SP TOGGLE WALL SWITCHES BROWN	12		C		35	C	4.2	2
3	20 AMP 3-WAY DECOR WALL SWITCHES IVORY	8		C		40	C	3.2	3
4	20 AMP 3-WAY TOGGLE WALL SWITCHES BROWN	6		C		40	C	2.4	4
5	20 AMP 4-WAY TOGGLE WALL SWITCHES IVORY	2		C		45	C	0.9	5
6	20 AMP SINGLE RECEPT DECOR IVORY	4		C		35	C	1.4	6
7	20 AMP DUPLEX RECEPT DÉCOR IVORY	128		C		35	C	44.8	7
8	20 AMP 2P 3W 208V SINGLE RECEPT BROWN	4		C		35	C	1.4	8
9	30 AMP 2P 3W 208V SINGLE RECEPT BROWN	2		C		40	C	0.8	9
10	30 AMP 3P 4W 208V SINGLE RECEPT BROWN	2		C		45	C	0.9	10
11									11
12	1 GANG METAL WALL OUTLET BOXES NEW WORK	165		C		35	C	57.75	12
13	2 GANG	8		C		40	C	3.2	13
14	3 GANG	3		C		45	C	1.35	14
15	4" SQ X 2-1/8" DEEP BOXES	24		C		40	C	9.6	15
16	4-11/16" X 2-1/8" DEEP BOXES	2		C		50	C	1	16
17									17
18	1 GANG DECOR WALL PLATES SMOOTH IVORY	128		C		0	0	0	18
19	2 GANG	2		C		0	0	0	19
20	3 GANG	1		C		0	0	0	20
21	4" SQ 1 GANG TOGGLE SWITCH COVERS	14		C		0	0	0	21
22	4" SQ 2 GANG	1		C		0	0	0	22
23	4" SQ SINGLE RECEPT COVER 20 AMP	4		C		0	0	0	23
24	4" SQ SINGLE RECEPT COVER 30 AMP	2		C		0	0	0	24
25	4-11/16" SQ 2 GANG TOGGLE SWITCH COVERS	2		C		0	0	0	25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL		142.7	

Figure 4-1P

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 14 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

VOICE & DATA COMMUNICATIONS WIRING REQUIREMENTS PER DRWG # E-3 & E-4 PER SPEC SECT 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	PATCH PANEL FLOOR STAND	1		Q		2	EA	2	1
2	64-PORT DATA PATCH PANEL TO MOUNT ON STAND	1		Q		0.5	EA	0.5	2
3	SHELF FOR PATCH PANEL	1		Q		1	EA	1	3
4	WIRE MANAGER	1		Q		0.5	EA	0.5	4
5	GROUND CLAMP FOR STAND	1		EA		0.25	EA	0.25	5
6	ALLOW FOR GROUND WIRE FROM STAND TO BLDG GND	ALLOW		AL		0	AL	1.5	6
7	6' LONG PATCH CORDS	36		Q		0.15	EA	5.4	7
8	COMBO VOICE/DATA WALL PLATES W/ LABELS	32		Q		0.18	EA	5.75	8
9	DATA CONNECTORS AT PANEL AND WALL PLATES	64		Q		0.25	EA	16	9
10	1 GANG WALL OUTLET BOXES	32		C		35	C	11.2	10
11									11
12	100 PAIR 110 VOICE BLOCK	1		Q		0.5	EA	0.5	12
13	VOICE CONNECTORS AT WALL PLATES	32		Q		0.15	EA	4.8	13
14	VOICE CABLES TO PUNCH DOWN AT 110 BLOCK	32		Q		0.06	EA	1.9	14
15	2' TO 8' PATCH CORDS	48		Q		0.05	EA	2.4	15
16									16
17	CATEGORY 5 DATA CABLE PLENUM 32 X 100' EA	3,500'		Q		5	M	17.5	17
18	CATEGORY 3 VOICE CABLE PLENUM 32 X 100' EA	3,500'		Q		5	M	17.5	18
19	TESTING CABLES	64		EA		0.2	EA	12.8	19
20	J-HOOKS FOR CABLES	100		EA		0.25	EA	25	20
21									21
22	MISC. HANGERS, WALL SLEEVES, TIES, ETC.	ALLOW		AL		0	AL	8	22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		134.5	

Figure 4-1Q

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 15 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

FIRE ALARM SYSTEM REQUIREMENTS PER DRWG # E-2 THRU E-5 AND SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	MAIN FIRE ALARM PANEL 16 ZONES	1		Q		18	EA	18	1
2	REMOTE F.A. ANNUNCIATOR 16 ZONES & BACK BOX	1		Q		16	EA	16	2
3	MANUAL PULL STATIONS W/BOX	12		Q		0.8	EA	9.6	3
4	COMBO VISUAL / AUDIO SIGNALS W/BOX	18		Q		1	EA	18	4
5	SMOKE DETECTORS	12		Q		1	EA	12	5
6	DUCT DETECTORS W/SAMPLE TUBE	4		Q		2	EA	8	6
7	SPRINKLER FLOW SWITCH	1		FBO		1.5	EA	1.5	7
8	SPRINKLER ALARM SIGNAL	1		FBO		1	EA	1	8
9	END OF LINE RESISTORS	16		Q		0.25	EA	4	9
10	#16 4/C PLENUM RATED F. A. CABLE	3,500'		M		13	M	45.5	10
11	#16 2/C	1,000'		M		11	M	11	11
12	HANGERS, SUPPORTS, TIES	ALLOW		AL		0	AL	16	12
13	DEVICE OUTLET BOXES	42		C		35	C	14.7	13
14	4" SQ BOX & COVER	6		C		25	C	1.5	14
15	WALL SLEEVES	ALLOW		AL		0	AL	8	15
16	TESTING	ALLOW		AL		0	AL	16	16
17	MISC. SPLICING, TAGS, TAPE, ETC.	ALLOW		AL		0	AL	8	17
18									18
19									19
20									20
21									21
22	(FBO= FURNISHED BY OTHERS)								22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		208.8	

Figure 4-1R

ESTIMATE SHEET ESTIMATE NO: 234-11/02

JOB: XYZ TECH OFFICE AND WAREHOUSE #J-16 PAGE NO: 16 OF 16

COMPTON COMPLEX OFFICES AND WAREHOUSING, INC. WARETOWN, MASS 12345-0006

MECHANICAL EQUIPMENT REQUIREMENTS PER DRWG # E-2 THRU E-5 PER SPEC SECT. 16

ESTIMATED BY: DENIS SMITH CHCK'D BY: MKR DATE: 11-29-02

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1	ROOFTOP EX FANS 15 HP 480V 3 phase	8	0	FBO		1.75	EA	14	1
2	ROOFTOP EX FANS 10 HP 480V 3 phase	4	0	FBO		1.5	EA	6	2
3	ROOFTOP EX FANS 5 HP 480V 3 phase	6	0	FBO		1.5	EA	9	3
4	HVAC PACKAGED UNITS 60AMP 480V 3 phase	4	0	FBO		2.5	EA	10	4
5	HVAC PACKAGED UNITS 30AMP 480V 3 phase	2	0	FBO		1.5	EA	3	5
6	MAGNETIC STARTERS 15 HP SIZE 2 480V	8	0	FBO		2.75	EA	22	6
7	MAGNETIC STARTERS 10 HP SIZE 1 480V	4	0	FBO		2.35	EA	9.4	7
8	MAGNETIC STARTERS 5 HP SIZE 0 480V	6	0	FBO		2	EA	12	8
9	60 AMP 3P 480V N/F W/P DISC SWITCH	4		EA		2.5	EA	10	9
10	30 AMP 3P 480V N/F W/P DISC SWITCH	20		EA		1.5	EA	30	10
11	15 HP FLEXIBLE MOTOR WHIPS W/P	8		EA		0	0	0	11
12	10 HP FLEXIBLE MOTOR WHIPS W/P	4		EA		0	0	0	12
13	5 HP FLEXIBLE MOTOR WHIPS W/P	6		EA		0	0	0	13
14	1" FLEXIBLE WHIPS FOR EQUIPMENT	4		EA		0.5	EA	0.2	14
15	3/4"	2		EA		0.4	EA	0.8	15
16									16
17	PROVIDE POWER FOR ATC CONTROL PANEL (120V)	ALLOW		AL			AL	0.75	17
18	MISC. SPLICING,TAGS, TAPE, TEST, ETC.	ALLOW		AL		0	AL	8	18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
				TOTAL		TOTAL		135.15	

Figure 4-15

RECAPITULATION SHEET

ESTIMATE NO: _____

JOB _____ SHEET NO: ____ OF _____

ESTIMATED BY _____ CHECKED BY _____ DATE: _____

SHEET NO	ESTIMATE SHEETS DESCRIPTION	$ MATERIAL	HOURS

NONPRODUCTIVE LABOR	HOURS
HANDLING MATERIAL	
SUPERVISION	
TRAVEL TIME	
OVERTIME	
NONWORKING PERSONNEL	
TOTAL (A)	
JOB EXPENSE	
SCAFFOLDS, LIFTS COSTS	
STORAGE	
INSPECTION, PERMIT FEES	
LICENSE FEE	
FREIGHT CHARGES	
AS-BUILT DRAWINGS	
INSURANCE	
WATCHMAN	
PRO RATA CHARGES	
TRANSPORTATION, TOLLS, ETC.	
TELEPHONE AND OFFICE COSTS	
TOTAL (B)	

MISC. MATERIAL (C) AND LABOR (D)		
NONPRODUCTIVE LABOR (A)		
TOTALS: MATERIAL (C) & LABOR (D)		
(D)	Hours Labor@	
	Hours Labor@	
	Hours Labor@	
Taxes: Soc. Sec Unemp		
Workmen's Compensation Insurance		
LABOR GROSS TOTAL		
JOB EXPENSE (B)		
MATERIAL (C)		
TOTAL PRIME COST		
% OVERHEAD		
TOTAL NET COST		
% PROFIT		
SELLING PRICE (NO BOND)		
BOND COST		
SELLING PRICE (W / BOND)		
FINAL QUOTED PRICE		

RECAPITULATION SHEET (BACK)

1. THE CONTRACTOR MUST INVESTIGATE THE REQUIREMENTS OF EACH GOVERNMENT AGENCY AS IT RELATES TO SALES TAXES ON BOTH MATERIALS AND LABOR, AND INCLUDE ALL OF THESE COSTS IN EACH PROPOSAL!
2. Nonproductive labor section contains various areas of costs that are affected by noninstallation labor factors. These items may or may not apply to all proposals, but remind the contractor that there may be labor costs beyond the actual labor cost associated with the project. This may also remind the contractor that there may be other items of nonproductive labor cost that should be addressed in the proposal.
3. Job expense section contains important direct project-related costs. These dollar costs may or may not be applicable to each proposal submitted by the contractor. This may also remind the contractor that there may be additional job-related expenses to be considered.
4. Labor hour section allows the contractor to apply different labor rates as they may apply to the level of grade of the workers who physically install or direct the installations.
5. Taxes section allows the contractor to include such taxable items of labor as they may apply to the project.
6. Overhead section is a cost of doing business for the contractor. This cost may include insurances, office supplies, postage, contractor's building facility, utilities, office personnel payroll, telephone, association fees, periodicals, facility maintenance, rolling stock upkeep and fuel, rental of office equipment, support programs costs, etc. Include any other costs that are fixed as they relate to the business inside the contractor's facilities.
7. Profit is relative to the size of the proposal and the amount the contractor anticipates.
8. Bond section gives the contractor the ability to include the cost of a bid bond, performance bond, and/or payment bonds.

RECAPITULATION SHEET

ESTIMATE NO: _____

JOB _____ SHEET NO: _____ OF _____

ESTIMATED BY _____ CHECKED BY _____ DATE: _____

SHEET NO	ESTIMATE SHEETS DESCRIPTION	$ MATERIAL	HOURS

NONPRODUCTIVE LABOR	HOURS
HANDLING MATERIAL	
SUPERVISION	
TRAVEL TIME	
OVERTIME	
NONWORKING PERSONNEL	
TOTAL (A)	
JOB EXPENSE	
SCAFFOLDS, LIFTS COSTS	
STORAGE	
INSPECTION, PERMIT FEES	
LICENSE FEE	
FREIGHT CHARGES	
AS-BUILT DRAWINGS	
INSURANCE	
WATCHMAN	
PRO RATA CHARGES	
TRANSPORTATION, TOLLS, ETC.	
TELEPHONE AND OFFICE COSTS	
TOTAL (B)	

MISC. MATERIAL (C) AND LABOR (D)		
NONPRODUCTIVE LABOR (A)	- - - - - -	
TOTALS: MATERIAL (C) & LABOR (D)		
(D)	Hours Labor@	
	Hours Labor@	
	Hours Labor@	
Taxes: Soc. Sec Unemp		
Workmen's Compensation Insurance		
LABOR GROSS TOTAL		
JOB EXPENSE (B)		
MATERIAL (C)		
TOTAL PRIME COST		
% OVERHEAD		
TOTAL NET COST		
% PROFIT		
SELLING PRICE (NO BOND)		
BOND COST		
SELLING PRICE (W / BOND)		
FINAL QUOTED PRICE		

RECAPITULATION SHEET (BACK)

1. THE CONTRACTOR MUST INVESTIGATE THE REQUIREMENTS OF EACH GOVERNMENT AGENCY AS IT RELATES TO SALES TAXES ON BOTH MATERIALS AND LABOR, AND INCLUDE ALL OF THESE COSTS IN EACH PROPOSAL!
2. Nonproductive labor section contains various areas of costs that are affected by noninstallation labor factors. These items may or may not apply to all proposals, but remind the contractor that there may be labor costs beyond the actual labor cost associated with the project. This may also remind the contractor that there may be other items of nonproductive labor cost that should be addressed in the proposal.
3. Job expense section contains important direct project-related costs. These dollar costs may or may not be applicable to each proposal submitted by the contractor. This may also remind the contractor that there may be additional job-related expenses to be considered.
4. Labor hour section allows the contractor to apply different labor rates as they may apply to the level of grade of the workers who physically install or direct the installations.
5. Taxes section allows the contractor to include such taxable items of labor as they may apply to the project.
6. Overhead section is a cost of doing business for the contractor. This cost may include insurances, office supplies, postage, contractor's building facility, utilities, office personnel payroll, telephone, association fees, periodicals, facility maintenance, rolling stock upkeep and fuel, rental of office equipment, support programs costs, etc. Include any other costs that are fixed as they relate to the business inside the contractor's facilities.
7. Profit is relative to the size of the proposal and the amount the contractor anticipates.
8. Bond section gives the contractor the ability to include the cost of a bid bond, performance bond, and/or payment bonds.

ESTIMATE SHEET

ESTIMATE NO: _____

JOB: _____ PAGE NO: _____ OF _____

ESTIMATED BY: _____ CHCK'D BY: _____ DATE: _____

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL			

ESTIMATE SHEET

ESTIMATE NO: _____

JOB: _____ PAGE NO: _____ OF _____

ESTIMATED BY: _____ CHCK'D BY: _____ DATE: _____

	DESCRIPTION OF MATERIALS	MATERIALS				LABOR HOURS			
		QUANTITY	UNIT COST	PER	AMOUNT	UNIT	PER	AMOUNT	
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30
31									31
32									32
			TOTAL			TOTAL			

CHANGE ORDER RECAPITULATION SHEET

CUSTOMER _____ PROJECT _____

DATE _____ JOB NO. _____ C.O. NO. _____

1- RIGGING CHARGES	
2- EQUIPMENT	
3- MATERIALS	
4- SUNDRIES (5% OF LINE 3)	
5- SALES TAXES	
6- LABOR (SEE BELOW)	
7- SUPERVISION (10% OF LINE 6)	
8- TEMPORARY LIGHT & POWER	
9- ACCEPTANCE TESTING	
10- ESTIMATING & BREAKDOWN	
11- BLUEPRINT CHARGES	
12- ENGINEERING & COORDINATION (3% OF LINE 6)	
13- INSURANCE COVERAGE	
14- DELAY IMPACT	
15- TRUCKING ON SITE	
16- STORAGE	
17- TOOL FACTOR (1% OF LINE 3)	
18- CLEAN UP (1% OF LINE 6)	
19- HOISTING / LIFTING	
20- RENTAL EQUIPMENT	
21- PERMIT % INSPECTION FEES	

_____	Total Jrnymn hrs @-----	_____	_____	TOTAL COST--------
_____	" Forman hrs @----	_____	_____	% OVERHEAD-----
_____	" Super'nt hrs @---	_____	_____	SUBTOTAL----------
				% PROFIT----------
	TOTAL LABOR----------			C.O. PRICE----------
	(ENTER ON LINE 6 ABOVE)			

CHANGE ORDER RECAPITULATION SHEET

CUSTOMER _____ PROJECT _____

DATE _____ JOB NO. _____ C.O. NO. _____

1- RIGGING CHARGES	
2- EQUIPMENT	
3- MATERIALS	
4- SUNDRIES (5% OF LINE 3)	
5- SALES TAXES	
6- LABOR (SEE BELOW)	
7- SUPERVISION (10% OF LINE 6)	
8- TEMPORARY LIGHT & POWER	
9- ACCEPTANCE TESTING	
10- ESTIMATING & BREAKDOWN	
11- BLUEPRINT CHARGES	
12- ENGINEERING & COORDINATION (3% OF LINE 6)	
13- INSURANCE COVERAGE	
14- DELAY IMPACT	
15- TRUCKING ON SITE	
16- STORAGE	
17- TOOL FACTOR (1% OF LINE 3)	
18- CLEAN UP (1% OF LINE 6)	
19- HOISTING / LIFTING	
20- RENTAL EQUIPMENT	
21- PERMIT % INSPECTION FEES	

_____	Total Jrnymn hrs @-----	_____	_____	TOTAL COST--------
_____	" Forman hrs @----	_____	_____	% OVERHEAD-----
_____	" Super'nt hrs @---	_____	_____	SUBTOTAL----------
	TOTAL LABOR----------			% PROFIT----------
	(ENTER ON LINE 6 ABOVE)			C.O. PRICE----------

EST. NO: _____

ROUGH TAKEOFF SHEET

SHEET NO: ____ OF: _____

JOB: _____

DATE: _____

LOCATION												
TOTALS												

EST. NO: _____

ROUGH TAKEOFF SHEET

SHEET NO: ____ OF: _____

JOB: _____

DATE: _____

LOCATION												
TOTALS												

EST. NO:____________________

FEEDER SCHEDULE

SHEET NO: ____OF______

JOB: ________________________

DATE: ________________

FEEDER NO	FROM	TO	CONDUIT					WIRE			MISC.		
			SIZE	LENGTH	ELS	TERM	BEND	# WIRES	SIZE	LENGTH			

EST. NO:____________________

JOB: ____________________

FEEDER SCHEDULE

SHEET NO: ____OF______

DATE:________________

FEEDER NO	FROM	TO	CONDUIT					WIRE			MISC.		
			SIZE	LENGTH	ELS	TERM	BEND	# WIRES	SIZE	LENGTH			

CONTRACTOR NAME: _____ DATE: _____

PROJECT NAME: _____

PROJECT LOCATION: _____

REQUEST FOR INFORMATION (RFI)

TO: _____

_____

SUBJECT: _____

INFORMATION REQUESTED: _____

_____

_____

_____

_____

_____

_____

_____

_____

SENDER: _____ TEL#: _____

REPLY: _____

_____

_____

_____

_____

_____

SIGNATURE: _____ DATE: _____

REQUEST FOR INFORMATION (RFI)

1. The RFI is an important tool for both the contractor and others who are involved in the project. Too many times phone calls and undocumented conversations lead to major disagreements that may involve large sums of money.
2. The RFI is used to document all questions and/or clarifications sought by the party issuing the RFI, thus avoiding the possibility of serious consequences.
3. The RFI can be used during the bidding phase as well as the construction phase of the project.
4. The recipient of the RFI is requested to respond to the information sought by the sender.

CONTRACTOR NAME: _____ DATE: _____

PROJECT NAME: _____

PROJECT LOCATION: _____

REQUEST FOR INFORMATION (RFI)

TO: _____

_____

SUBJECT: _____

INFORMATION REQUESTED: _____

_____

_____

_____

_____

_____

_____

_____

_____

SENDER: _____ TEL#: _____

- -

REPLY: _____

_____

_____

_____

_____

_____

SIGNATURE: _____ DATE: _____

REQUEST FOR INFORMATION (RFI)

1. The RFI is an important tool for both the contractor and others who are involved in the project. Too many times phone calls and undocumented conversations lead to major disagreements that may involve large sums of money.
2. The RFI is used to document all questions and/or clarifications sought by the party issuing the RFI, thus avoiding the possibility of serious consequences.
3. The RFI can be used during the bidding phase as well as the construction phase of the project.
4. The recipient of the RFI is requested to respond to the information sought by the sender.

CONTRACTOR NAME: _____

STREET ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

LICENSE #: _____ STATE PERMIT #: _____ LOCAL PERMIT #: _____

PHONE #: _____ FAX #: _____ EMAIL: _____

WORK AUTHORIZATION FORM

This authorization is accompanied by the Time and Material Sheet(s) that will be filled out at the completion of each day that work is performed. The accompanying Time and Material Sheet(s) are to be approved on a daily basis by the authorizing party. At the completion of the authorized work, the contractor will issue an invoice for the work at the authorized hourly rate of charge and the material cost plus the authorized percentages for overhead and profit.

This is your authorization to perform the following work:

Work to be performed: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Hourly Rate per Worker: Superintendent $_____ Foreman $_____ Journeyman $_____
Other worker as applicable $_____

Percentages for overhead: _____% Profit: _____% (plus applicable taxes)

Authorized By: _____

Address: _____

Phone #: _____

Signature: _____ Date: _____

SEE BACK FOR ADDITIONAL CONDITIONS

WORK AUTHORIZATION FORM (BACK)

1. This form is required to be filled out completely by the contractor's foreman prior to any work being performed.
2. This work authorization form will be accompanied by daily time and material sheets.
3. By authorizing the work to be performed, which is described on the front of this sheet, the authorizing authority agrees to all the conditions set forth herein.
4. The hourly rate of charge is "portal to portal," per worker, per hour for performing the work described on the front of this sheet.
5. The percentages as shown on the front of this sheet will apply for all of the materials necessary to perform the work as indicated and authorized on the front of this sheet. (Applicable taxes will be added as required.)
6. The percentages as shown on the front of this sheet will also apply for materials that need to be ordered from a supply company in order to complete the work as described on the front of this sheet.
7. The percentages as shown on the front of this sheet do not apply to the hourly rate of charge for workers.
8. A copy of this authorization will accompany the contractor's invoice for payment at the completion of the work. NOTE: If the work extends beyond 30 days from the time the authorization to begin the work is received, the contractor may issue a partial invoice for the work completed within those 30 days.
9. This form should be filled out in triplicate: original and one copy for the contractor, and a third copy for the customer.

CONTRACTOR NAME: _____

STREET ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

LICENSE #: _____ STATE PERMIT #: _____ LOCAL PERMIT #: _____

PHONE #: _____ FAX #: _____ EMAIL: _____

WORK AUTHORIZATION FORM

This authorization is accompanied by the Time and Material Sheet(s) that will be filled out at the completion of each day that work is performed. The accompanying Time and Material Sheet(s) are to be approved on a daily basis by the authorizing party. At the completion of the authorized work, the contractor will issue an invoice for the work at the authorized hourly rate of charge and the material cost plus the authorized percentages for overhead and profit.

This is your authorization to perform the following work:

Work to be performed: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Hourly Rate per Worker: Superintendent $_____ Foreman $_____ Journeyman $_____
Other worker as applicable $_____

Percentages for overhead: _____% Profit: _____% (plus applicable taxes)

Authorized By: _____

Address: _____

Phone #: _____

Signature: _____ Date: _____

SEE BACK FOR ADDITIONAL CONDITIONS

WORK AUTHORIZATION FORM (BACK)

1. This form is required to be filled out completely by the contractor's foreman prior to any work being performed.
2. This work authorization form will be accompanied by daily time and material sheets.
3. By authorizing the work to be performed, which is described on the front of this sheet, the authorizing authority agrees to all the conditions set forth herein.
4. The hourly rate of charge is "portal to portal," per worker, per hour for performing the work described on the front of this sheet.
5. The percentages as shown on the front of this sheet will apply for all of the materials necessary to perform the work as indicated and authorized on the front of this sheet. (Applicable taxes will be added as required.)
6. The percentages as shown on the front of this sheet will also apply for materials that need to be ordered from a supply company in order to complete the work as described on the front of this sheet.
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9. This form should be filled out in triplicate: original and one copy for the contractor, and a third copy for the customer.

TIME AND MATERIAL WORK ORDER

CONTRACTOR----- LIC#: _____ PERMIT#:_____	CUSTOMER
NAME:_____	NAME: _____
ADDRESS: _____	ADDRESS: _____
PHONE#:_____ FAX#:_____	PHONE#: _____ FAX#: _____

NAME AND CLASSIFICATION OF THE WORKER	DESCRIPTION OF THE WORK PERFORMED	STRAIGHT TIME HOURS	OVERTIME HOURS	TOTAL HOURS

MATERIAL USED	QUANTITY	$ PRICE EACH	$ TOTAL PRICE
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	

_____TOTAL JOURNEYMAN HOURS @-------	$_____ PER HR=$ _____	MATERIAL COST	$
_____TOTAL FORMAN HOURS @----------	$_____ PER HR=$ _____	LABOR COST	$
_____TOTAL SUPERINTENDENT HRS @-------	$_____ PER HR=$ _____	RENTAL COST	$
_____OTHER _____HRS @----	$_____ PER HR=$ _____	TAX	$
	TOTAL LABOR COST $	TOTAL COST	$

WORKER CLASS': S/SUPERINTENDENT F/FORMAN J/JOURNEYMAN

APPROVED BY: _____ DATE:_____

*****SEE BACK FOR ADDITIONAL CONDITIONS*****

TIME AND MATERIAL WORK ORDER (BACK)

1. The work will not commence until the work authorization form is completed by the party requesting the work to be performed. (Refer to the Work Authorization Form.)
2. This Time and Material Sheet will be filled out on a daily basis by the contractor's workers and approved by the recipient of these services on a daily basis.
3. This sheet details the labor and materials charges as agreed to in the Work Authorization Form.
4. The contractor will include copies of the Time and Material Sheet and the Work Authorization Form with each invoice.
5. This form should be filled out in triplicate: original and one copy for the contractor, and a third copy for the customer.

TIME AND MATERIAL WORK ORDER

CONTRACTOR----- LIC#: _____ PERMIT#:_____	CUSTOMER
NAME:_____	NAME: _____
ADDRESS: _____	ADDRESS: _____
PHONE#:_____ FAX#:_____	PHONE#: _____ FAX#: _____

NAME AND CLASSIFICATION OF THE WORKER	DESCRIPTION OF THE WORK PERFORMED	STRAIGHT TIME HOURS	OVERTIME HOURS	TOTAL HOURS

MATERIAL USED	QUANTITY	$ PRICE EACH	$ TOTAL PRICE
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	
		$ $	

_____TOTAL JOURNEYMAN HOURS @-------	$_____ PER HR=$ _____	MATERIAL COST	$
_____TOTAL FORMAN HOURS @----------	$_____ PER HR=$ _____	LABOR COST	$
_____TOTAL SUPERINTENDENT HRS @-------	$_____ PER HR=$ _____	RENTAL COST	$
_____OTHER _____ HRS @----	$_____ PER HR=$ _____	TAX	$
	TOTAL LABOR COST $	TOTAL COST	$

WORKER CLASS': S/SUPERINTENDENT F/FORMAN J/JOURNEYMAN	
APPROVED BY: _____ DATE:_____	*****SEE BACK FOR ADDITIONAL CONDITIONS*****

TIME AND MATERIAL WORK ORDER (BACK)

1. The work will not commence until the work authorization form is completed by the party requesting the work to be performed. (Refer to the Work Authorization Form.)
2. This Time and Material Sheet will be filled out on a daily basis by the contractor's workers and approved by the recipient of these services on a daily basis.
3. This sheet details the labor and materials charges as agreed to in the Work Authorization Form.
4. The contractor will include copies of the Time and Material Sheet and the Work Authorization Form with each invoice.
5. This form should be filled out in triplicate: original and one copy for the contractor, and a third copy for the customer.