STEVEN J. PETERSON | FRANK R. DAGOSTINO

ESTIMATING
in BUILDING CONSTRUCTION

Pearson

NINTH EDITION

Estimating in Building Construction

NINTH EDITION

Steven J. Peterson
Weber State University

Frank R. Dagostino

Pearson

330 Hudson Street, NY, NY 10013

Vice President, Portfolio Management: Andrew Gilfillan
Editorial Assistant: Lara Dimmick
Senior Vice President, Marketing: David Gesell
Marketing Coordinator: Elizabeth MacKenzie-Lamb
Director, Digital Studio and Content Production: Brian Hyland
Managing Producer: Jennifer Sargunar
Content Producer (Team Lead): Faraz Sharique Ali
Manager, Rights Management: Johanna Burke
Operations Specialist: Deidra Smith
Cover Design: Cenveo Publisher Services
Cover Photo: Unkas Photo/Shutterstock
Full-Service Management and Composition: Integra Software Services
Printer/Binder: LSC Communications, Inc.
Cover Printer: Phoenix Color/Hagerstown
Text Font: Times LT Pro 10/12

Acknowledgments of third-party content appear on the appropriate page within the text.

Library of Congress Cataloging-in-Publication Data

Names: Dagostino, Frank R., author. | Peterson, Steven J., author.
Title: Estimating in building construction / Steven J. Peterson, Weber State University, Frank R. Dagostino.
Description: Ninth edition. | Boston : Pearson, [2017] | Original edition by Frank R. Dagostino.
Identifiers: LCCN 2017009514| ISBN 9780134701165 | ISBN 013470116X
Subjects: LCSH: Building—Estimates. | Building—Estimates—Data processing.
Classification: LCC TH435 .D18 2017 | DDC 692/.5—dc23 LC record available at https://lccn.loc.gov/2017009514

1 17

Pearson

ISBN-10: 0-13-470116-X
ISBN-13: 978-0-13-470116-5

To my father for encouraging me to get an education and my mother for her loving support. SP

This page intentionally left blank

PREFACE

The ninth edition continues to build on the strong foundation of the previous editions. The need for estimators to understand the theory behind quantification is critical and must be fully understood prior to performing any computerized estimating. This underlying premise has been one of the guiding principles that began with Mr. Dagostino and continues with the current author. This edition uses extensive examples and exercises to demonstrate the estimating methodology and the organization of the estimate. Estimating is an art that relies heavily on the judgment of the person performing the takeoff. A person's estimating skills can only be developed with practice; therefore, the reader is encouraged to work the example problems and apply the skills taught in this book. Since the estimate is used throughout the project, the assumptions and methodologies assumed must be documented and organized so that subsequent users will have access to this knowledge.

NEW TO THIS EDITION

The intent of this revision is to expand the estimating material covered by this book and to bring other material in line with current industry practices. The following is a list of key changes and additions that have been made to this edition:

- Chapter 5 has been updated to Autodesk Revit 2017.
- The Social Security tax rates have been updated in Chapter 7.
- A chapter (Chapter 9) has been added covering specialty contractors.
- Chapter 15 (formerly Chapter 14), Thermal and Moisture Protection, has been rewritten.
- Chapter 17 (formerly Chapter 16), Finishes, has been rewritten.
- The text has been aligned to the student learning outcomes for major accreditation bodies.
- Labor and equipment costs have been updated.
- The appendices have been reorganized.

During the past few years, higher education has been moving to outcome-based learning, which requires accredited programs to measure their students' ability to meet the required outcomes. Currently in the United States there are four accreditation standards for construction management and construction engineering programs, which are as follows: (1) American Council for Construction Education (ACCE); (2) ABET—Engineering Accreditation Commission, for construction engineering; (3) ABET—Engineering Technology, for construction engineering technology; and (4) ABET—Applied Science, for construction management. Although each of these standards are different, they all focus on three general outcomes, which can be summarized as follows. Construction management/engineering students should be able to:

- Prepare construction cost estimates.
- Effectively communicate in writing.
- Understand ethics as it relates to estimating.

This text has been aligned to these outcomes.

Feedback on this book can be submitted at stevenjpeterson9@gmail.com.

Steven Peterson

This page intentionally left blank

CONTENTS

CHAPTER **ONE**

INTRODUCTION TO ESTIMATING

1–1 GENERAL INTRODUCTION

Building construction estimating is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analyzed, quantified, and priced. Because the estimate is prepared before the actual construction, much study and thought must be put into the construction documents. The estimator who can visualize the project and accurately determine its cost will become one of the most important persons in any construction company.

For projects constructed with the design-bid-build delivery system, it is necessary for contractors to submit a competitive cost estimate for the project. The competition in construction bidding is intense, with multiple firms vying for a single project. To stay in business, a contractor must be the lowest-qualified bidder on a certain number of projects, while maintaining an acceptable profit margin. This profit margin must provide the general contractor an acceptable rate of return and compensation for the risk associated with the project. Because the estimate is prepared from the working drawings and the project manual for a building, the ability of the estimator to visualize all of the different phases of the construction project becomes a prime ingredient in successful bidding.

The working drawings usually contain information relative to the design, location, dimensions, and construction of the project, while the project manual is a written supplement to the drawings and includes information pertaining to materials and workmanship, as well as information about the bidding process. The project manual is often mistakenly referred to as the specifications because it contains the technical specifications, but it contains much more. The working drawings and the project manual constitute the majority of the contract documents, define the scope of work, and *must* be considered together when preparing an estimate. The two complement each other, and they often overlap in the information they convey. The bid submitted must be based on the scope of work provided by the owner or the architect. The estimator is responsible for including everything contained in the drawings and the project manual in the submitted bid. Because of the complexity of the drawings and the project manual, coupled with the potential cost of an error, the estimator must read everything thoroughly and recheck all items. Initially, the plans and the project manual must be checked to ensure that they are complete. Then the estimator can begin the process of quantifying all of the materials presented. Every item included in the estimate must contain as much information as possible. The quantities determined for the estimate will ultimately be used to order and purchase the needed materials. The estimated quantities and their associated projected costs will become the basis of project controls (e.g., budget and baseline schedule) in the field.

Estimating the ultimate cost of a project requires the integration of many variables. These variables fall into either direct field costs or indirect field costs. The indirect field costs are also referred to as general conditions or project overhead costs in building construction. The direct field costs are the material, labor, equipment, or subcontracted items that are permanently and physically integrated into the building. For example, the labor and materials for the foundation of the building would be a direct field cost. The indirect field costs are the costs for the items that are required to support the field construction efforts. For example, the project site office would be an indirect field cost. In addition, factors such as weather, transportation, soil conditions, labor strikes, material availability, and subcontractor availability need to be integrated into the estimate. Regardless of the variables involved, the estimator must strive to prepare as accurate an estimate as possible. Since subcontractors or specialty contractors may perform much of the work in the field, the estimator must be able to articulate the scope of work in order for these companies to furnish a price quote. The complexity of an estimate requires organization, the estimator's best judgment, complete specialty contractors' (subcontractors') bids, accurate quantity takeoffs, and accurate records of completed projects.

The design-build and construction-manager/general-contractor (CM/GC) project delivery systems are gaining in popularity. In the design-build delivery system, the contractor acts as both the designer and the general contractor. In the CM/GC delivery system, the contractor and some of the key subcontractors are involved in the design process, providing expertise in construction methods and costs, as well as managing the construction process. Integrated project delivery (IPD), a relatively new delivery system, involves the owners, designers, contractor, and some of the key subcontractors in the design process. IPD differs from the CM/GC delivery system in that the owners, designers, contractor, and key subcontractors share governance, risk, contingency, and the profit on the project. All of these delivery systems require the contractor to provide cost estimates for the proposed project throughout the design process.

At the conceptual stage of the project, the contractor prepares a cost estimate based on the project's concept. This is known as a conceptual estimate. When performing a conceptual estimate, typically, drawings are not available or they are very limited. What exists is often verbal or written description of the project scope, which may be accompanied by a few sketches. When preparing this type of estimate, the contractor makes assumptions about virtually every aspect of the project. The conceptual estimate is used early in the design process to check to see if the owners' wants are in line with their budget and is often used as a starting point to begin contract negotiations.

During the design process, the contractor prepares and maintains a cost estimate based on the current, but incomplete, design. In addition, the contractor may prepare estimates that are used to select between building materials and to determine whether the cost to upgrade the materials is justified. What all these estimates have in common is that the design is incomplete. Once the design is complete, the contractor can prepare a detailed estimate for the project.

1–2 ESTIMATING METHODS

The required level of accuracy coupled with the amount of information about the project that is available will dictate the type of estimate that can be prepared. These estimating methods require different amounts of time to complete and produce different levels of accuracy for the estimate. The relationship between the time to complete the estimate and the accuracy of the estimate is shown in Figure 1.1. The different estimating methods are discussed below.

Detailed Estimate

The detailed estimate includes determination of the quantities and costs of everything that is required to complete the project. This includes materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of the profit. To perform this type of estimate, the contractor must have a complete set of contract documents. Each item of the project should be broken down into its parts and estimated.

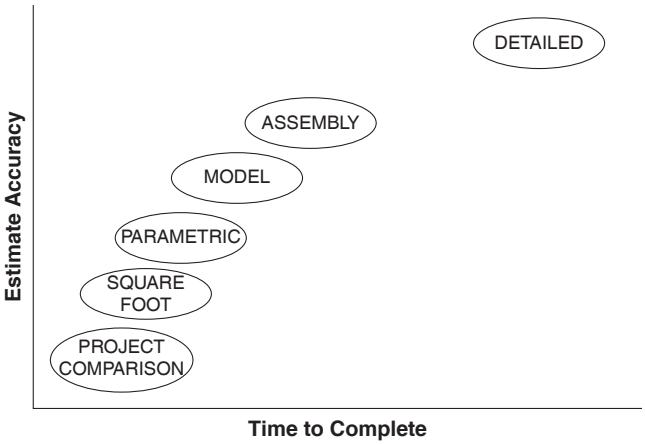


FIGURE 1.1. Estimating Time versus Accuracy.

Each piece of work that is to be performed by the contractor has a distinct labor requirement that must be estimated. The items that are to be installed by others need to be defined and priced. Caution needs to be exercised to ensure that there is agreement between the contractor and the subcontractor as to what they are to do and whether they are only to install or both supply and install the items. In addition, there needs to be an agreement about who is providing support items such as cranes and scaffolding. The contractor is responsible for making sure that the scope of work is divided among the contractor and subcontractors so that there are no overlaps in the individual scope of works and that everything has been included in someone's scope of work.

The detailed estimate must establish the estimated quantities and costs of the materials, the time required for and costs of labor, the equipment required and its cost, the items required for overhead and the cost of each item, and the percentage of profit desired, considering the investment, the time to complete, and the complexity of the project. The principles used to prepare the detailed estimates are covered in Chapters 4 and 6 through 21.

Assembly Estimating

In assembly estimating, rather than bidding each of the individual components of the project, the estimator bids the components in groups known as assemblies. The components of an assembly may be limited to a single trade or may be installed by many different trades. An example of a simple assembly would be a residential light switch, which includes a single-gang box, a single-pole switch, cover plate, two wire nuts, and an allowance of 20 feet of NM-B 12-gage wire. The entire assembly would be installed by an electrician. A residential electrical estimate could be prepared using assemblies for the switches, outlets, lights, power panels, and so forth rather than determining the individual components. An example of a complex assembly would be a metal-stud, gypsum-board partition wall, which would include bottom track, metal studs, top track, drywall, screws, tape, joint compound, insulation, primer, paint, and

other miscellaneous items needed to construct the wall. This assembly would be installed by multiple trades.

Many high-end estimating computer programs, such as WinEst and Timberline, allow the user to prepare detailed estimates by taking off assemblies. For the switch assembly, the estimator would take off the number of switch assemblies needed for the project, and the software would add one single-gang box, one single-pole, one cover plate, two wire nuts, and 20 feet of NM-B 12-gage wire to the detailed estimate for each switch assembly. This simplifies the estimating process and increases the productivity of the estimator.

Assembly estimating is also useful for conceptual and preliminary estimates. By using broad assemblies, an estimate can be prepared quickly for an entire building. For example, an estimate for a warehouse can be prepared by using assembles for the spot footings, the continuous footings, the foundation wall, the floor slab (slab, reinforcement, granular base, vapor barrier, and fine grading), the exterior wall, personnel doors, overhead doors, joist and deck roof structure (including supports), roof insulation, roofing, wall cap, skylights, bathrooms, fire sprinklers, heating, lighting, and power distribution. This type of estimate can be prepared in hours instead of spending days preparing a detail estimate. The trade-off is that this type of estimate has many broad assumptions and is less accurate. This type of assembly estimating is good for estimates prepared with limited drawings, to compare design approaches, and as a check of a detailed estimate. If the assembly price comes from previously completed projects, it is assumed that this project is identical to the completed projects. This assumption is clearly not valid in the construction of buildings. Weather conditions, building materials, and systems as well as design and construction team members change from project to project, all adding to the uniqueness of every project. Skill and judgment must be used while preparing this type of assembly estimate to ensure that proper adjustments are made by taking into account the varying conditions of each project. Companies such as RSMeans publish annual guides (such as *Square Foot Costs*) that contain pricing for assemblies. Assembly estimating is discussed in Chapter 22.

Square-Foot Estimates

Square-foot estimates are prepared by multiplying the square footage of a building by a cost per square foot and then adjusting the price to compensate for differences in the building heights, length of the building perimeters, and other building components. In some cases, a unit other than square footage is used to measure the size of the building. For example, the size of a parking garage may be measured by the number of parking stalls in the garage. The information required to produce a square-foot estimate is much less than is needed to prepare a detailed estimate. For example, a schematic set of design drawings (a single-line floor plan and key elevations) would have the dimensions that are necessary to prepare a square-foot estimate. Square-foot estimates are helpful to check whether the project, as designed, is within the owner's budget. Like an assembly estimate that uses broad assemblies, care must be exercised while preparing a square-foot estimate to ensure that the projects used to determine the cost per square foot are similar to the proposed project. Companies such as RSMeans publish annual guides (such as *Square Foot Costs*) that contain a range of unit costs for a wide variety of building types. These guides provide a number of adjustments to compensate for varying building components, including the city where the project is located. Square-foot estimating is discussed in Chapter 22.

Parametric Estimates

Parametric estimates use equations that express the statistical relationship between building parameters and the cost of the building. The building parameters used in the equation may include the gross square footage, number of floors, length of perimeter, percentage of the building that is common space, and so forth. For an equation to be usable, the parameters used in the equation must be parameters that can be determined early in the design process; otherwise the equation is useless. Parametric estimates are similar to square-foot estimates; however, the equations used in parametric estimates are more complex and may use log functions, ratios of parameters, and multiplication of parameters. Parametric estimating is useful for preparing conceptual estimates based on assumptions of key building parameters or estimates based upon early designs. As with square-foot estimates and assembly estimates that use broad assemblies, care must be taken to ensure that the proposed project is similar to the projects from which the equation has been derived.

Model Estimating

Model estimating uses computer models to prepare an estimate based on a number of questions answered by the estimator. Model estimating is similar to assembly estimating, but it requires less input from the estimator. For example, an estimate may be prepared for a warehouse by answering the following questions:

- What is the length of the building?
- How many bays are along the length of the building?
- What is the width of the building?
- How many bays are along the width of the building?
- What is the wall height above the grade?
- What is the depth (from the grade) to the top of the footing?
- What is the floor thickness?
- Do you want wire mesh in the slab?
- How many roof hatches do you want?
- How many personnel doors do you want?
- How many and what size of overhead doors do you want?
- How many and what size of skylights do you want?
- Do you want fire sprinklers?
- What bathroom facilities do you want (separate male and female, unisex, or none)?

On the basis of the answers to these questions, the model prepares a preliminary estimate for the project. Logic is built into the model, such that the model selects the necessary components for the estimate based upon the answers to the questions. For example, the size of the spot footings in the center of the building that support the roof and their costs are selected based on the area of the roof the footings support, which is equal to the width of a bay multiplied by the length of a bay. The length and width of the bays are calculated from the first four questions. A simple model estimate (Warehouse.xls) for a warehouse is provided on the companion website. This model makes many assumptions as to the design of the warehouse, such as assuming the exterior wall is constructed of concrete masonry units (CMU). The model ignores the site and excavation cost, which needs to be added to the estimate from the model to get a complete estimate.

Estimating models may be complex and may prepare a detailed estimate for the entire project, or the models may be simple and prepare a preliminary estimate for part of a project. As with square-foot estimates, assembly estimates that use broad assemblies, and parametric estimates, care must be taken to make sure that the proposed project is similar to the projects from which the model was developed.

Project Comparison Estimates

Project comparison estimates are prepared by comparing the cost of a proposed project to a completed project. When preparing an estimate using this method, the estimator starts with the costs of a comparable project and then makes adjustments for differences in the project. For example, an estimate for the buildings in an apartment project may be prepared from a project built using the same plans during the previous year in a nearby city. In this example, the prices from the completed project need to be adjusted for inflation, changes in the availability and cost of labor, changes in the plans made to meet city codes, and so forth. In most cases, the site should be estimated using another method because of the many differences in site conditions. As with other estimating methods that do not prepare a detailed list of materials, care must be taken to ensure that the proposed project is similar to the completed project. The project comparison method is discussed in Chapter 22.

1–3 ESTIMATING OPPORTUNITIES

For anyone who is not aware of the many opportunities in the estimating field, this section will review some of the areas in which knowledge of estimating is necessary. Generally, knowledge of the procedures for estimating is required by almost everyone involved in or associated with the field of construction. From the estimator, who may be involved solely with the estimating of quantities of materials and the pricing of the project, to the carpenter, who must order the materials required to build the framing for a home, this knowledge is needed to do the best job possible at the most competitive cost. Others involved include the project designer, drafters, engineers, contractors, subcontractors, material suppliers, and material representatives. In the following sections, a few of the estimating opportunities are described.

Architectural Offices. The architectural office will require estimates at three design stages: preliminary (rough square-foot or project comparison costs), cost evaluation during drawing preparation (usually more accurate square-foot or assembly costs), and a final estimate (usually based on material and installation costs, to be as accurate as possible). For projects built using the design-build or CM/GC delivery systems, the preliminary estimate is often used during negotiation with the general contractor. Once the general contractor is hired, the general contractor's estimator will prepare the remaining estimates.

In large offices, the estimating may be done by an estimator hired primarily to do all the required estimating. In many offices, the estimating may be done by the chief drafter, head or lead architect, or perhaps someone else in the office who has developed the required estimating skills. There are also estimating services or consultants who perform estimates on a for-fee basis.

Engineering Offices. The engineering offices involved in the design of building construction projects include civil, structural, mechanical (plumbing, heating, air-conditioning), electrical, and soil analysis. All of these engineering design phases require preliminary estimates, estimates while the drawings are being prepared, and final estimates as the drawings are completed. They are prepared in the same way estimates are prepared by the architects.

General Contractors. For design-bid-build projects, the general contractor makes *detailed* estimates that are used to determine what the company will charge to do the required work.

The estimator will have to take off the quantities (amounts) of each material; determine the cost to furnish (buy and get to the site) and install each material in the project; assemble the bids (prices) of subcontractors; as well as determine all of the costs of insurance, permits, office staff, and the like. In smaller companies, one person may do the estimating, whereas in larger companies several people may work to negotiate a final price with an owner or to provide a competitive bid.

On projects built using the design-build or CM/GC delivery system, the contractor's scope of work involves providing assistance to the owners, beginning with the planning stage and continuing through the actual construction of the project. Under these delivery systems, the estimators will also provide preliminary estimates and then update them periodically until a final price is set.

Estimating with Quantities Provided by the Designer. Estimating for projects with quantity surveys provided by the designer involves reviewing the specifications for the contract and material requirements, reviewing the drawings for the type of construction used, and assembling the materials used. The estimator will spend part of the time getting prices from subcontractors and material suppliers and the rest of the time deciding on how the work may be most economically accomplished.

Subcontractors. Subcontractors may be individuals, companies, or corporations hired by the general contractor to do a particular portion of the work on the project. Subcontractors are available for all the different types of work required to build any project and include excavation, concrete, masonry (block, brick, stone), interior partitions, drywall, acoustical ceilings, painting, erection of steel and precast concrete, windows, metal and glass curtain walls, roofing, flooring (resilient, ceramic and quarry tile, carpeting, wood, terrazzo), and interior wall finishes (wallpaper, wood paneling, and sprayed-on finishes). The list continues to include all materials, equipment, and finishes required.

The use of subcontractors to perform all of the work on the project is an acceptable model in building construction. The advantage of this model is that the general contractor can distribute the risk associated with the project to a number of different entities. In addition, the subcontractors and craft personnel perform the same type of work on a repetitive basis and are therefore quasi experts in their niche. However, the general contractor relinquishes a substantial amount of control over the project when this method is employed. The more that the contractor subcontracts out, the more the field operation becomes involved in coordination rather than direct supervision of craft personnel.

The subcontractor carefully checks the drawings and project manual and submits a price to the construction companies that will be bidding on the project.

The price given may be a unit or lump-sum price. If a subcontractor's bid is presented as what he or she would charge per unit, then it is a *unit price* (such as per square foot, per block, per thousand brick, per cubic yard of concrete) bid. For example, the bid might be $5.25 per linear foot (lf) of concrete curbing. Even with unit price bids, the subcontractors need to perform a quantity takeoff in order to have an idea of what is involved in the project, at what stages they will be needed, how long it will take to complete their work, and how many workers and how much equipment will be required. The subcontractor needs the completed estimate to determine what the reasonable amount for overhead and profit is. Typically, as the quantity of work increases, the associated unit cost of jobsite overhead decreases. For example, the cost of mobilization for a 100 lf of curb is $1,000 or $10 per lf; if the quantity had been 1,000 lf, it would have been $1 per lf. The subcontractor would not know how much to add to the direct field cost unit price for overhead unless a quantity takeoff had been performed.

If the subcontractor submits a lump-sum bid, then he or she is proposing to install, or furnish and install, a portion of work: For example, the bid might state, "agrees to furnish and install all Type I concrete curbing for a sum of $12,785.00."

Each subcontractor will need someone (or several people) to check specifications, review the drawings, determine the quantities required, and put the proposal together. It may be a full-time estimating position or part of the duties assumed, perhaps in addition to purchasing materials, helping to schedule projects, working on required shop drawings, or marketing.

Material Suppliers. Suppliers submit price quotes to the contractors (and subcontractors) to supply the materials required for the construction of the project. Virtually every material used in the project will be estimated, and multiple price quotes will be sought. Estimators will have to check the specifications and drawings to be certain that the materials offered will meet all of the requirements of the contract and required delivery dates.

Manufacturers' Representatives. Manufacturers' representatives represent certain materials, product suppliers, or manufacturers. They spend part of their time visiting contractors, architects, engineers, subcontractors, owners, and developers to be certain that they are aware of the availability of the material, its uses, and approximate costs. In a sense they are salespeople, but their services and the expertise they develop in their product lines make good manufacturers' representatives welcome not as salespersons, but as needed sources of information concerning the materials and products they represent. Representatives may work for one company, or they may represent two or more.

Manufacturers' representatives will carefully check the specifications and drawings to be certain that their materials meet all requirements. If some aspect of the specifications or drawings tends to exclude their product, or if they feel there may be a mistake or misunderstanding in these documents, they may call the architects/engineers and discuss it with them. In addition, many times they will be involved in working up various cost analyses of what the materials' or products' installed cost will be and in devising new uses for the materials, alternate construction techniques, and even the development of new products.

Project Management. Project management companies specialize in providing professional assistance in planning the construction of a project and keeping accurate and updated information about the financial status of the project. Owners who are coordinating large projects often hire such companies. Among the various types of owners are private individuals, corporations, municipal government agencies (such as public works and engineering departments), and various public utility companies.

The firms involved in project management, as well as someone on the staff of the owner being represented, must be knowledgeable in estimating and scheduling projects.

Government. When a government agency is involved in any phase of construction, personnel with experience in construction and estimating are required. Included are local, state or province, and nationwide agencies, including those involved in highways, roads, sewage treatment, schools, courthouses, nursing homes, hospitals, and single- and multifamily dwellings financed or qualifying for financing by the government.

Employees may be involved in preparing or assisting to prepare preliminary and final estimates; reviewing estimates from architects, engineers, and contractors; the design and drawing of the project; and preparation of the specifications.

Professional Quantity Surveyors. Professional quantity surveyors are for-hire firms or individuals who make unit quantity takeoffs of the materials required to build a project. They are available to provide this service to all who need it, including governmental agencies.

Freelance Estimators. Freelance estimators will do a material takeoff of a portion or entire project for whoever may want a job done. This estimator may work for the owner, architect, engineer, contractor, subcontractor, material supplier, or manufacturer. In some areas, the estimator will do a material takeoff of a project being competitively bid and then sell the quantity list to one or more contractors who intend to submit a bid on the project.

Many times a talented individual has a combined drafting and estimating business. Part of the drafting business may include preparing shop drawings (drawings that show sizes of materials and installation details) for subcontractors, material suppliers, and manufacturers' representatives.

Residential Construction. Estimators are also required for the contractors, material suppliers, manufacturers' representatives, and most of the subcontractors involved in residential construction. From the designer who plans the house and the drafter who draws the plans and elevations to the carpenters who put up the rough framing and the roofers who install the roofing material, knowledge of estimating is necessary.

The designer and drafter should plan and draw the house plans using standard material sizes when possible (or being aware of it when they are not using standard sizes). In addition, they will need to give preliminary and final estimates to the owner. Workers need to have a basic knowledge of estimating so they can be certain that adequate material has been ordered and will be delivered by the time it is needed.

Computer Software. The use of computers throughout the world of construction offers many different types of opportunities to the estimator. Job opportunities in all the areas mentioned earlier will be centered on the ability to understand, use, and manipulate computer software. The software available today integrates the construction drawings, estimating, bidding, purchasing, and management controls of the project. Some construction consultants specialize in building databases for computerized estimating systems and training estimators in the use of these systems.

1–4 THE ESTIMATOR

Most estimators begin their career doing quantity takeoff; as they develop experience and judgment, they develop into estimators. A list of the abilities most important to the success of an estimator follows, but it should be more than simply read through. Any weaknesses affect the estimator's ability to produce complete and accurate estimates. If individuals lack any of these abilities, they must (1) be able to admit it and (2) begin to acquire the abilities they lack. Those with construction experience, who are subsequently trained as estimators, are often most successful in this field.

To be able to do quantity takeoffs, the estimator must:

1. Be able to read and quantify plans.
2. Have knowledge of mathematics and a keen understanding of geometry. Most measurements and computations are made in linear feet, square feet, square yards, cubic feet, and cubic yards. The quantities are usually multiplied by a unit price to calculate material costs.
3. Have the patience and ability to do careful, thorough work.
4. Be computer literate and use computer takeoff programs such as On-Screen Takeoff or Paydirt.

To be an estimator, an individual needs to go a step further. He or she must:

1. Be able, from looking at the drawings, to visualize the project through its various phases of construction. In addition, an estimator must be able to foresee problems, such as the placement of equipment or material storage, and then develop a solution and determine its estimated cost.
2. Have enough construction experience to possess a good knowledge of job conditions, including methods of handling materials on the job, the most economical methods of construction, and labor productivity. With this experience, the estimator will be able to visualize the construction of the project and thus get the most accurate estimate on paper.
3. Have sufficient knowledge of labor operations and productivity to thus convert them into costs on a project. The estimator must understand how much work can be accomplished under given conditions by given crafts. Experience in construction and a study of projects that have been completed are required to develop this ability.
4. Be able to keep a database of information on costs of all kinds, including those of labor, material, project overhead, and equipment, as well as knowledge of the availability of all the required items.
5. Be computer literate and know how to manipulate and build various databases and use spreadsheet programs and other estimating software.

6. Be able to meet bid deadlines and still remain calm. Even in the rush of last-minute phone calls and the competitive feeling that seems to electrify the atmosphere just before the bids are due, estimators must "keep their cool."
7. Have good writing and presentation skills. With more bids being awarded to the best bid, rather than the lowest bid, being able to communicate what your company has to offer, what is included in the bid, and selling your services is very important. It is also important to communicate to the project superintendent what is included in the bid, how the estimator planned to construct the project, and any potential pitfalls.

People cannot be taught experience and judgment, but they can be taught an acceptable method of preparing an estimate, items to include in the estimate, calculations required, and how to make them. They can also be warned against possible errors and alerted to certain problems and dangers, but the practical experience and use of good judgment required cannot be taught and must be obtained over time.

How closely the estimated cost will agree with the actual cost depends, to a large extent, on the estimators' skill and judgment. Their skill enables them to use accurate estimating methods, while their judgment enables them to visualize the construction of the project throughout the stages of construction.

1–5 QUANTITY SURVEYING

In Canada and parts of Europe and on most road construction projects in the United States, the estimated quantities of materials required on the project are determined by a professional quantity surveyor or engineer and provided to the interested bidders on the project. Figure 1.2 is an example of the quantities that would be provided by a quantity surveyor or engineer for the construction of a sewer line. This is often referred to as a unit price bid.

In this method of bidding, the contractors are all bidding based on the same quantities, and the estimator spends time developing the unit prices. For example, the bid may

Item No.	Description	Quantity
1	Mobilization (Insurance and Bond Included)	1 lump sum
2	12-inch Reinforce Concrete Pipe—Varying Depths	24 lf
3	18-inch Reinforce Concrete Pipe—Varying Depths	6,696 lf
4	24-inch Reinforce Concrete Pipe—Varying Depths	1,176 lf
5	36-inch Reinforce Concrete Pipe—Varying Depths	1,160 lf
6	42-inch Reinforce Concrete Pipe—Varying Depths	1,560 lf
7	54-inch Reinforce Concrete Pipe—Varying Depths	2,096 lf
8	Catch Basin 3 feet x 3.67 feet (depth < 6 feet)	58 each
9	Catch Basin 3 feet x 5.33 feet (depth < 6 feet)	1 each
10	Catch Basin 4 feet x 3.67 feet (depth < 6 feet)	4 each
11	Catch Basin 4.5 feet x 3.67 feet (depth < 6 feet)	2 each
12	Catch Basin 5.75 feet x 3.67 feet (depth < 6 feet)	12 each
13	Cleanout 3 feet x 3.67 feet (depth < 6 feet)	7 each
14	Cleanout 4 feet x 3.67 feet (depth < 6 feet)	5 each
15	Cleanout 5.25 feet x 3.67 feet (depth < 6 feet)	1 each
16	Cleanout 5.75 feet x 3.67 feet (depth < 6 feet)	1 each
17	Combo Box 4.5 feet x 3.67 feet (depth < 6 feet)	1 each
18	Post Construction Sewer Main Television	12,712 lf
19	18-inch Slip under Railroad	1 lump sum
20	42-inch Slip under Railroad	1 lump sum
21	End Section	1 lump sum
22	Tie to Existing Sewer	1 lump sum

FIGURE 1.2. Quantity Survey.

be $78.74 per linear foot (lf) of 18-inch reinforced concrete pipe. Because all of the contractors are bidding on the same quantities, they will work on keeping the cost of purchasing and installing the materials as low as possible.

As the project is built, the actual number of units required is checked against the original number of units on which the estimates were made. For example, in Figure 1.2, the original quantity survey called for 6,696 lf of 18-inch reinforced concrete pipe. If 6,703 lf were actually installed, then the contractor would be paid for the additional 7 lf. If 6,690 lf were used, then the owner would pay only for the 6,690 lf installed and not the 6,696 lf in the original quantity survey. This type of adjustment is quite common. When errors do occur and there is a large difference between the original quantity survey and the actual number of units, an adjustment to the unit price is made. Small adjustments are usually made at the same unit rate as the contractor bid. Large errors may require that the unit price be renegotiated.

If the contractor is aware of potential discrepancies between the estimated quantities and those that will be required, the contractor may price his or her bid to take advantage of this situation. With a belief that the estimated quantities are low, the contractor may reduce his or her unit price to be the low bidder. If the assumption is true, the contractor has the potential to make the same profit by distributing the project overhead over a greater number of units.

1–6 TYPES OF BIDS

Basically, the two bidding procedures by which the contractor gets to build a project for owners are as follows:

1. Competitive bidding
2. Negotiated bidding

Competitive bidding involves each contractor submitting a lump-sum bid or a proposal in competition with other contractors to build the project. The project may be awarded based on the price or best value. When the project is awarded based on the price, the lowest lump-sum bidder is awarded the contract to build the project as long as the bid form and proper procedures have been followed and this bidder is able to attain the required bonds and insurance. When the project is awarded based upon the best value, the proposals from the contractors are rated based on specified criteria with each criterion given a certain percentage of the possible points. The criteria may include review of the capabilities of the assigned project team, the company's capabilities and its approach to the project (including schedule), proposed innovation, method of mitigating risk, and price. The price is often withheld from the reviewers until the other criteria have been evaluated to prevent the price from affecting the ratings of the other criteria. Most commonly, the bids must be delivered to the person or place specified by a time stated in the instruction to bidders.

The basic underlying difference between negotiated work and competitive bidding is that with negotiated work the parties arrive at a mutually agreed-upon price, terms and conditions, and contractual relationship. This arrangement often entails negotiations back and forth on virtually all aspects of the project, such as materials used, sizes, finishes, and other items that affect the price of the project. Owners may negotiate with as many contractors as they wish. This type of bidding is often used when owners know which contractor they would like to build the project, in which case competitive bidding would waste time. The biggest disadvantage of this arrangement is that the contractor may not feel the need to work quite as hard to get the lowest possible prices as when a competitive bidding process is used.

1–7 CONTRACT DOCUMENTS

The bid submitted for any construction project is based on the contract documents. If an estimator is to prepare a complete and accurate estimate, he or she must become familiar with all of the documents. The documents are listed and briefly described in this section. Further explanations of the portions and how to bid them are contained in later chapters.

For design-bid-build projects, the contract documents consist of the *invitation to bid*, *instructions to bidders*, *bid form*, *owner–contractor agreement*, *general conditions*, *supplementary general conditions*, *technical specifications*, and the *working drawings*, including all *addenda* incorporated in the documents before their execution. All of these documents become part of the *contract*.

Invitation to Bid. The invitation to bid invites potential contractors to bid on the project and provides a brief summary of the project, including project scope and size, location, and project's owner.

Instructions to Bidders. The instructions to bidders provide bidders with the procedures that must be followed to submit a complete bid and contain such information as the date, time, and place the bid is due, and attendance at pre-bid meetings.

Bid Form. The bid form is a standard form that all contractors use to submit their bids.

Owner–Contractor Agreement. The owner–contractor agreement is the document that formalizes the construction contract, and it is the basic contract. It incorporates by reference all of the other documents and makes them part of the contract. It also states the contract sum and time allowed to construct the project.

General Conditions. The general conditions define the rights, responsibilities, and relations of all parties to the construction contract.

Supplementary General Conditions (Special Conditions). Because conditions vary by locality and project, the supplementary general conditions are used to amend or supplement portions of the general conditions.

Technical Specifications. The technical specifications are written instructions concerning project requirements that describe the quality of materials to be used and their performance. The technical specifications supplement the information on the working drawings.

Working Drawings. The actual plans (drawings, illustrations) from which the project is to be built are the working drawings. They contain the dimensions and locations of building elements and materials required, and delineate how they fit together.

Addenda. The addenda statement is a drawing or information that modifies the basic contract documents after they have been issued to the bidder, but prior to the taking of bids. They may provide clarification, correction, or changes in the other documents.

For projects built with the design-build and CM/GC delivery systems, the contract documents are more limited than for projects built with the design-bid-build delivery system because the contractor is involved in the design and selection of the specifications for the project. These documents can be as simple as an agreement with a conceptual description of the project.

1–8 BIDDING INFORMATION

There are several sources of information pertaining to the projects available for bidding. Public advertising (advertisement for bids) is required for many public contracts. The advertisement is generally placed in newspapers, trade magazines, and journals, and notices are posted in public places and on the Internet. Private owners often advertise in the same manner to attract a large cross section of bidders (Figure 1.3). Included in the advertisement is a description of the nature, extent, and location of the project; the owner; the availability of bidding documents; bond requirements; and the time, manner, and place that the bids will be received.

INVITATION TO BID FROM NEWSPAPER

REQUEST FOR BIDS: Mt. Ogden Development is seeking bids on the construction of a Real Estate Office from qualified general contractors.

PROJECT LOCATION: 4755 S. West Street, Ogden, Utah 84403

RECIEPT OF BIDS: Sealed bids will be received at the owner's office until 3:00 p.m. local time on April 20, 2017, at which time the bids will be publically opened and read aloud. Bids should be addressed to Mr. John M. Smith, President, Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403 and should be clearly marked "**HOLD FOR BID OPENING—REAL ESTATE OFFICE.**" Bids shall remain good for 60 days after the bid opening.

A certified check or cashier's check on a state or national bank or a bid bond from an acceptable surety authorized to transact business in Utah, in the amount of not less than five percent (5%) of the greatest total amount of the bid must accompany each bid as a guarantee that, if awarded the contract, the bidder will within ten (10) calendar days after Award of Contract enter into contract and execute performance and payment bonds on the forms provided in the project manual.

Bids must be completed and submitted on the forms provided in the project manual. Incomplete bids will invalidate the bid and the bid will be rejected and returned to the bidder. The right to accept any bid, or to reject any or all bids and to waive all formalities is hereby reserved by the owner.

SCOPE OF WORK: The work includes a 3,600-square-foot, wood-frame office building with asphalt shingle roof.

COMPLETION DATE: The project is to be completed and ready for occupancy 150 calendar days after the Award of Contract.

BIDDING DOCUMENT: Construction documents for the Real Estate Office can be obtained from Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403. Electronic copies of the plans are available free of charge. A limited number of printed copies are available for general contractors. A deposit of $100 per set is required for printed copies. The deposit will be returned if the documents are returned in good condition within two weeks after the bid opening; otherwise, no refund will be made. Checks should be made out to Mt. Ogden Development.

PRE-BID CONFERENCE: A pre-bid conference will be held on March 23, 2017, at 1:00 p.m. on the site of the proposed project. All bidders are required to attend this conference.

FIGURE 1.3. Advertisement for Bids.

Reporting services, such as *Dodge Reports* and *Engineering News Record* (ENR), provide information about projects that are accepting bids or proposals. The *Dodge Reports* are issued for particular, defined localities throughout the country, and separate bulletins are included that announce new projects within the defined area and provide a constant updating on jobs previously reported. The updating may include a listing of bidders, low bidders, awards of contracts, or abandonment of projects. In short, the updates provide information that is of concern to the contractors.

Local contractor groups may provide reporting services similar to *Dodge Reports* and provide plan rooms where interested parties may review the drawings and project manual of current projects.

1–9 AVAILABILITY OF CONTRACT DOCUMENTS

The contract document for most projects are available in electronic format, which can be printed or used in estimating software (such as On-Screen Takeoff). This reduces the cost of reproducing the drawings and project manual, making it economical to distribute them to numerous contractors and subcontractors, which makes it easier to get the most competitive prices on a project. The contract document may be obtained from the architect/engineer or accessed through an online plan room. When paper copies of the contract documents are available, the architect/engineer will limit the number of sets available and require a deposit to ensure the safe return of the documents.

Some subcontractors and suppliers still prefer to work with paper copies of the plans. The general contractors often set aside space in their offices where the subcontractors' and material suppliers' estimators may work. In this manner, the contract documents never leave the contractor's office and are available to serve a large number of bidders who want to use the paper copies.

1–10 SOURCES OF ESTIMATING INFORMATION

For matters relevant to estimating and costs, the best source of information is your historical data. These figures allow for the pricing of the project to match how the company actually performs its construction work. This information takes into account the talent and training of the craft personnel and the management abilities of the field staff personnel. In addition, it integrates the construction companies' practices and methodologies. This is why a careful, accurate accounting system combined with accuracy in field reports is so important. If all of the information relating to the job is tracked and analyzed, it will be available for future reference. Computerized cost accounting systems are very helpful in gathering this information and making it readily available for future reference. See *Construction Accounting and Financial Management* by Steven J. Peterson for more information on managing construction accounting systems.

There are several "guides to construction cost" manuals available; however, a word of extreme caution is offered regarding the use of these manuals. They are only *guides*; the figures should *rarely* be used to prepare an actual estimate. The manuals may be used as a guide in checking current prices and should enable the estimator to follow a more uniform system and save valuable time. The actual pricing in the manuals is most appropriately used in helping architects check approximate current prices and facilitate their preliminary estimate. In addition to these printed guides, many of these companies provide electronic databases that can be utilized by estimating software packages. However, the same caution needs to be observed as with the printed version. These databases represent an average of the methodologies of a few contractors. There is no simple way to convert this generalized information to match the specifics of the construction companies' methodologies.

WEB RESOURCES

construction.com/dodge/

enr.construction.com

REVIEW QUESTIONS

1. What information is contained in the working drawings?
2. What information is contained in the technical specifications?
3. What is the relationship between the working drawings and the technical specifications?
4. How does the work involved in being an estimator for a general contractor differ from that of an estimator who works for a subcontractor?
5. What is the difference between doing a quantity takeoff and doing a full detailed estimate?
6. What additional skills must the estimator have to be able to take a quantity survey and turn it into a detailed estimate?
7. What is the difference between competitive and negotiated bidding?
8. What is the difference between a detailed estimate and a square-foot estimate?
9. What are the contract documents, and why are they so important?
10. Why is it important to bid only from a full set of contract documents?
11. For this assignment, you will explore the role estimating plays in the construction industry by interviewing a person whose job duties include estimating. Begin by setting up an interview with an estimator, project manager, project engineer, superintendent, foreperson, architect, engineer, construction material salesperson, or freelance estimator. During the interview, ask the person the

following questions and ask follow-up questions as necessary. Be respectful of their time and limit your interview to 20 minutes, unless the person offers to extend the interview. Be sure to thank the person before you leave and mail them a thank-you note within 48 hours of the interview. After the interview, prepare written responses to the following questions and be prepared to discuss your findings in class, if your instructor chooses to do so:

a. What are the estimates used for (ordering materials, preliminary budget, etc.)?

b. At what stage of the construction process (early-design, late-design, bidding, construction, etc.) does the estimate occur?

c. What are the consequences if the estimate is slightly wrong? If it is very wrong?

d. How do they prepare an estimate? After the interview, decide which estimating method (detailed, assembly, square-foot, parametric, model, or project comparison) best describes the type of estimates he or she prepared.

e. How long does it take to prepare an estimate?

f. What skills are required to become a good estimator?

g. What experience is required to get a job like his or hers?

12. Review a copy of the contract documents (drawings and project manual) for a construction project. Contract documents may be reviewed at a contractor's, subcontractor's, architect's, or engineer's office or may be downloaded from the Internet. Write a brief summary of how the contract documents are organized. Be sure to discuss both the project manual and the drawings. Be prepared to discuss your findings in class, if your instructor chooses to do so.

13. Using the Warehouse.xls Excel file that accompanies this text, determine the estimated cost of a warehouse with the following parameters:

Building length—210 feet

Number of bays on the length side of the building—7 each

Building width—120 feet

Number of bays on the width of the building—4 each

Wall height above grade—22 feet

Depth to top of footing—12 inches

Floor slab—6 inches thick with wire mesh

Number of roof hatches—2 each

Number of personnel doors—4 each

Number of 14-foot-wide by 14-foot-high overhead doors—14 each

Number of 4-foot by 4-foot skylights—28 each

Fire sprinklers are not required

Separate male and female bathrooms are required

CHAPTER **TWO**

CONTRACTS, BONDS, AND INSURANCE

2–1 THE CONTRACT SYSTEM

Contracts may be awarded either by a single contract for the entire project or by separate contracts for the various phases required for the completion of the project. The single contract comprises all work required for the completion of a project and is the responsibility of a single, prime contractor (often referred to as the general contractor). This centralization of responsibility provides that one of the distinctive functions of the general contractor is to plan, direct, and coordinate all parties involved in completing the project. The subcontractors (including mechanical and electrical) and material suppliers involved in the project are responsible directly to the general contractor, who in turn is responsible directly to the owner. The general contractor must ensure that all work is completed in accordance with the contract documents, that the work is completed on time, and that all subcontractors and vendors have been paid.

Under the system of separate contracts, the owner signs separate agreements for the construction of various portions of a project. The separate awards are often broken into the following phases:

1. General construction
2. Plumbing
3. Heating, ventilating, and air-conditioning (HVAC)
4. Electrical
5. Sewage disposal (if applicable)
6. Elevators (if applicable)
7. Specialties
8. Other

In this manner, the owner retains the opportunity to select the contractors for the various important phases of the project. Also, the responsibility for the installation and operation of these phases is directly between the owner and contractors rather than through the general contractor. In this contracting scheme, the owner or the owner's agents provide the coordination between the contractors.

There is disagreement as to which system provides the owner with the best and the most cost-effective project. In certain states, laws require the award of separate contracts when public money is involved. Most general contractor trade organizations favor single contracts, but in contrast, most large specialty contract groups favor separate contracts. Owners, however, must critically evaluate their needs and talents and decide which method will provide them with the best product.

Under the single contract, the general contractor will include a markup on the subcontracted items as compensation for the coordination effort and associated risk. If one of the subcontractors is unable to perform, the general contractor absorbs the added cost of finding a replacement and any associated delays. It is this markup that encourages the owner to use separate contracts. If no general contractor assumes the responsibility for the management and coordination of the project, then the owner must shoulder this responsibility and its associated risk. If the owner does not have the talents or personnel to accomplish these tasks, he or she must hire them. The architect, for an added fee, may provide this service, or a construction management firm that specializes in project coordination may be hired.

2–2 TYPES OF AGREEMENTS

The owner–contractor agreement formalizes the construction contract. It incorporates, by reference, all other contract documents. The owner selects the type of agreement that will be signed: It may be a standard form of agreement such as those promulgated by the American Institute of Architects (AIA) or by other professional or trade organizations, such as ConsensusDocs prepared by the Associated General Contractors of America.

The agreement generally includes a description of the project and contract sum. Other clauses pertaining to alternates accepted, completion date, bonus and penalty clauses, and any other items that should be considered are included.

... agrees to build the project in accordance with the contract documents herein described for the lump sum of $275,375.00 ....

FIGURE 2.1. Lump-Sum Agreement.

No contract should ever be signed until the attorneys for all parties have had a chance to review the document. Each party's attorney will normally give attention only to matters that pertain to his or her client's welfare. All contractors should employ the services of an attorney who understands the nuances of the construction industry and property law.

Types of agreements generally used are as follows:

1. Lump-sum agreement (stipulated sum, fixed price)
2. Unit-price agreement
3. Cost-plus-fee agreement

Lump-Sum Agreement (Stipulated Sum, Fixed Price)

In a *lump-sum agreement*, the contractor agrees to construct the project in accordance with the contract documents, for a set price arrived at through competitive bidding or negotiation. The contractor agrees that the work will be satisfactorily completed regardless of the difficulties encountered. This type of agreement (Figure 2.1) provides the owner advance knowledge of construction costs and requires the contractor to accept the bulk of the risk associated with the project. The accounting process is simple, and it creates centralization of responsibility in single-contract projects. It is also flexible with regard to alternates and changes required on the project. However, the cost of these changes may be high. When the owner issues a change order, the contractor is entitled to additional monies for the actual work and for additional overhead, as well as additional time. If the original work is already in place, then the cost of the change order includes not only the cost of the new work but also the cost of removing the work that has already been completed. The later in the project that change orders are issued, the greater their cost. Therefore, changes need to be identified as early as possible to minimize their impact on the construction cost and completion date. Seeking input from the contractor on the constructability of the project, adequacy of the drawings, and any recommended changes during the design process helps reduce the number of change orders. Contractors should help their clients understand that changes in the design during the construction phase are more expensive and increase the construction time more than if they were made during the design process. In addition, the contractor should not begin work on any change orders prior to receiving written authorization from the owner. The owner is responsible for covering the cost of the change orders. Poorly prepared contract document, working drawings, and technical specifications increase the owner's risk that costly change orders will occur on the project.

The major disadvantages to the contractor of lump-sum agreements are that the majority of the risk is placed upon the general contractor, and he or she has to guarantee a price even though all of the costs are estimated. If the work cost more to complete than expected, the contractor must cover the costs. Conversely, if the work cost less to complete than expected, the contractor reaps the savings.

Because of the very nature and risks associated with the lump-sum price, it is important that the contractor be able to accurately understand the scope of the project work required at the time of bidding.

Unit-Price Agreement

In a *unit-price agreement*, the contractor bases the bid on estimated quantities of work and on the completion of the work in accordance with the contract documents. The owner of the contracting agency typically provides the quantity takeoff. This type of contracting is most prevalent in road construction. Because of the many variables associated with earthwork, the main component of road projects, it is virtually impossible to develop exact quantities. The owner, therefore, provides the estimated quantities, and the contractors are in competition over their ability to complete the work rather than their quantity estimating ability. Figure 2.2 is an example of unit-price quantities.

Bidders will base their bids on the quantities provided or will use their estimate of the quantities to determine their unit-price bids. If contractors have insight into the quantities, they can use that information to their competitive advantage. The contractor's overhead is either directly or indirectly applied to each of the unit-price items. If the contractor believes that the stated quantities are low, the overhead can be spread over a greater quantity rather than the quantity provided by the owner. This allows the contractor to submit a

No.	Quantity	Unit	Item
025-254-0300	1,000	L.F.	Curb, Straight
025-254-0400	75	L.F.	Curb, Radius
022-304-0100	600	C.Y.	Compacted crushed stone base
025-104-0851	290	Tons	1½" thick asphalt

FIGURE 2.2. Typical Quantity Survey.

lower bid while making the same or more profit. In government agency projects, the low bidder will be determined based on the owner-provided quantities. In Figure 2.3, the illustration shows the unit-price bid tabulation for a project.

Payments are made based on the price that the contractor bids for each unit of work and field measurements of the work actually completed. A field crew that represents the owner must make the verification of the in-place units, meaning that neither the owner nor the contractor will know the exact cost of the project until its completion. The biggest advantages of the unit-price agreement are as follows:

1. It allows the contractors to spend most of their time working on pricing the labor and materials required for the project while checking for the most economical approach to handle the construction process.
2. Under lump-sum contracts, each contractor does a quantity takeoff, which considerably increases the chances for quantity errors and adds overhead to all the contractors.

The owner assumes the risk that the quantities are accurate. If the quantities increase, the owner's cost will increase. If the quantities decrease, the owner's cost will decrease.

The contractors assume the risk that they can complete each work item for the stated unit cost. If they can complete an item of work for less than expected, their profit increases. If they spend more money than expected to complete an item, they must cover the cost overrun. There is also risk to the contractor associated with using the owner's quantities without checking them. If the quantities are too high, the contractor's overhead will be spread over fewer units of work and the overhead cost per unit increases, which will decrease the contractor's profit. If the quantities are too low, the contractor's overhead will be spread over more units of work and the overhead cost per unit decreases, which will increase the contractor's profit and results in the owner overpaying for the item. Because of this, contracts may contain a clause that the unit prices will be renegotiated if the actual quantities are different from the bid quantities by a specified amount (such as 10 percent).

Cost-Plus-Fee Agreement

In a *cost-plus-fee agreement*, the contractor is reimbursed for the construction costs as defined in the agreement. However, the contractor is not reimbursed for all items, and a complete understanding of reimbursable and nonreimbursable items is required. For example, the cost of the project manager may be reimbursable or it may be considered part of the construction company's overhead and is not a reimbursable cost inasmuch as the construction company is expected to cover its overhead out of the fee paid on the project. This arrangement is often used when speed, uniqueness of the project, and quality take precedence. This contract arrangement allows for construction to begin before all the drawings and specifications are completed, thus reducing the time required to complete the project. The contract should detail the accounting requirements, record keeping, and purchasing procedures. There are many types of fee arrangements, any of which may be best in a given situation. The important point is that whatever the arrangement, not only the amount of the fee but also how and when it will be paid to the contractor must be clearly understood by all parties.

Cost-plus-fee contracts include a project budget developed by the members of the project team. Although the owner typically is responsible for any expenditure over the project budget, all team members have an intrinsic motivation to maintain the project budget. The members of the project team put their professional reputation at risk. It is unlikely that an owner would repeatedly hire a contractor who does not complete projects within budget. The same holds true for architects if they design projects that are typically over budget; they most likely will not get repeat business. When dealing with owners and developers, there is little elasticity in the project budget. Their financing, equity partners, and rental rates are based on a construction budget, and few sources for additional funds are available.

Percentage Fee. A percentage fee is where the contractor's fee is based on a specified percentage of the construction costs. The advantage of the percentage fee is that it allows the owner to save fees paid to the contractor when construction costs go down. The major disadvantage is that the fee increases with construction costs, so there is little incentive on the contractor's part to keep costs low. The primary incentive for a contractor to keep costs under control is the maintenance of his or her reputation. Under a percentage fee, the owner assumes the risk of cost overruns on the project.

Fixed Fee. A fixed fee is where the contractor is paid a fixed fee for the project regardless of the cost of the project. The advantage of the fixed fee is that it removes the

Unit Price Bid Tabulation

				Contractor 1		Contractor 2		Contractor 3	
No.	Quantity	Unit	Item	Bid Unit Price	Estimated Item Cost	Bid Unit Price	Estimated Item Cost	Bid Unit Price	Estimated Item Cost
025-254-0300	1,000	L.F.	Curbs, Straight	$5.35	$5,350.00	$5.50	$5,500.00	$6.25	$6,250.00
025-254-0400	75	L.F.	Curbs, Radius	$9.25	$693.75	$9.36	$702.00	$8.00	$600.00
022-304-0100	600	C.Y.	Compacted Base	$31.50	$18,900.00	$32.50	$19,500.00	$38.50	$23,100.00
025-104-0851	290	Tons	1½" Thick Asphalt	$42.50	$12,325.00	$43.75	$12,687.50	$45.00	$13,050.00
Total					$37,268.75		$38,389.50		$43,000.00

FIGURE 2.3. Unit-Price Bid Tabulation.

temptation for the contractor to increase construction costs to increase his or her fee. The disadvantage is that the contractor has little incentive to keep the costs low, because the fee is the same if the project is over budget or under budget. Under a fixed fee, the owner assumes the risk of cost overruns on the project.

Fixed Fee with Guaranteed Maximum Cost. With a fixed fee with a guaranteed maximum cost (g-max) the contractor is paid a fixed fee for the project, but also guarantees that the construction cost will not exceed a specified amount. For the owner, the fixed fee with a guaranteed maximum cost combines the advantages of a fixed fee (there is no incentive for the contractor to increase construction costs) with the guarantee that construction costs will not exceed the specified amount. The disadvantage for the contractor is that he or she assumes the risk that the construction costs will exceed the guaranteed maximum cost. Under a fixed fee with a guaranteed maximum cost, the owner assumes the risk of cost overruns until the guaranteed maximum cost is reached, at which time the contractor assumes the risk of cost overruns. One disadvantage of the fixed fee with a guaranteed maximum cost is that drawings and specifications must be complete enough to allow the contractor to set a realistic maximum cost.

Sometimes the owner and the contractor share the saving between the guaranteed maximum cost and the actual construction costs. The advantage of this type of arrangement is that it provides an incentive to contractors to keep the costs down since the contractor and owner share in any savings.

Sliding Scale Fee. With a sliding scale fee, the fee decreases as the costs increase. The sliding scale fee provides an answer to the disadvantage of the percentage fee, because as the cost of the project increases, the percentage of the fee decreases. The contractor is motivated to provide strong leadership so that the project will be completed swiftly at a low cost. The disadvantage is that extensive changes may require modifications of the scale.

Fixed Fee with a Bonus and Penalty. With this type of fixed fee, the contractor is reimbursed the actual cost of construction plus a fee. A target cost estimate is set up; and if the cost is less than the target amount, the contractor receives a bonus in the form of a percentage of the savings. If the cost goes over the target figure, a penalty is deducted from the fee.

2–3 AGREEMENT PROVISIONS

Although the exact type and form of agreement may vary, certain provisions are included in all of them. Contractors must check each of those items carefully before signing the agreement.

Scope of the Work. The agreement should specify all of the work that the contractor needs to complete to fulfill his or her obligations to the owner. Typically, the contractor agrees to furnish all material and perform all of the work for the project in accordance with the contract documents. The scope of work should reference the drawings, the project manual (general conditions, supplementary general conditions, technical specifications, etc.), and all addenda issued before the execution of the agreement. The scope of work should clearly identify the project, as well as the project's architect and the date the drawings were issued. When multiple versions of the drawings have been issued, it is a good idea to include an attachment to the agreement that lists all of the drawings and the date they were issued. After execution of the agreement, the scope of work is modified by change orders.

Time of Completion. The agreement should specify the starting and completion time. Starting time should never precede the execution date of the contract. The completion date is expressed either as a number of days or as a specific date. If the number of days is used, it is best expressed in calendar days and not working days to avoid subsequent disagreements about what constitutes a working day, and subsequently the completion date. If working days are used, the agreement must clearly identify what constitutes a working versus a nonworking day. Any liquidated damages or penalty and bonus clauses are usually included here; they should be clearly written and understood by all parties concerned.

Contract Sum. Under a lump-sum agreement, the *contract sum* is the amount of the accepted bid or negotiated amount. The accepted bid amount may be adjusted by the acceptance of alternates or by minor revisions that were negotiated with the contractor after receiving the bid. In agreements that involve cost-plus conditions, there are generally articles identifying the costs for which the owner reimburses the contractor. Customarily, not all costs paid by the contractor are reimbursed by the owner; reimbursable and nonreimbursable items should be listed. The contractor should be certain that all costs incurred in the construction are included somewhere. Also, in cost-plus-fee agreements, the exact type of compensation should be stipulated.

Progress Payments. Because of the cost and duration of construction projects, contractors must receive progress payments as work is completed. These payments are based on the completed work and stored materials. However, the owner typically retains a portion of all progress payments as security to ensure project completion and payment of the contractor's financial obligations.

The *due date* for payments is any date mutually acceptable to all concerned. In addition, the agreement needs to spell out the maximum time the architect/engineer can hold the contractor's application for payment and how soon the owner must pay the contractor after the architect makes out the certificate of payment. There should also be some mention of possible contractor action if these dates are not

met. Generally, the contractor has the option of stopping the work. Some contracts state that if the contractor is not paid when due, the owner must also pay interest at the legal rate in force in the locale of the building.

Retained Percentage. It is customary for the owner to withhold a certain percentage of the payments, which is referred to as *retainage* and is protection for the owner to ensure the completion of the contract and payment of the contractor's financial obligations. The most typical retainage is 10 percent, but other percentages are also used. On some projects, this retainage is continued through the first half of the project, but not through the last half.

In some states, the retainage is set by statute and limits the owner's liability for the nonpayment to subcontractors and suppliers to the amount retained. In these states, if the owner retains less than the percentage specified, liability is still the amount set by statute.

Schedule of Values. The contractor furnishes the architect/engineer with a statement, called a *schedule of values*, that shows contract prices for specific items within the project. This statement breaks the project into quantifiable components. Sometimes contractors overvalue the initial items on the project to generate additional cash flow early in the project to cover the construction costs and undervalue items performed at the end of the project. This practice is referred to as *front-end loading*.

Work in Place and Stored Materials. The *work in place* is usually calculated as a percentage of the work that has been completed. The amounts allowed for each item in the schedule of values are used as the base amounts due on each item. The value of the work completed is equal to the percentage of the work in place for each line item in the schedule of values multiplied by the contract price or the value for that line item. The contractor may also receive payment for materials stored on the site or some other mutually agreed-upon location. The contractor may have to present proof of purchase, bills of sale, or other assurances to receive payment for materials stored off the job site.

Acceptance and Final Payment. The acceptance and final payment sets a time for the final payment to the contractor. When the final inspection, certification of completion, acceptance of the work, required lien releases, and other conditions required by the contract are completed, the contractor will receive the *final payment*, which is the amount of retainage withheld throughout the construction period. Many agreements are set up so that if full completion is held up through no fault of the contractor, the architect can issue a certificate for part of the final retainage.

2–4 BONDS

Often referred to as *surety bonds*, bonds are written documents that describe the conditions and obligations relating to the agreement. (In law, a surety is one who guarantees payment of another party's obligations.) The bond is not a financial loan or insurance policy, but serves as an endorsement of the contractor. The bond guarantees that the contract documents will be complied with and all costs relative to the project will be paid. If the contractor is in breach of contract, the surety must complete the terms of the contract. Contractors most commonly use a corporate surety that specializes in construction bonds. The owner will reserve the right to approve the surety company and form of bond, as the bond is worth no more than the company's ability to pay.

To eliminate the risk of nonpayment, the contract documents will, on occasion, require that the bonds be obtained from one specified company. To contractors, this may mean doing business with an unfamiliar company, and they may be required to submit financial reports, experience records, and projects (in progress and completed), as well as other material, which could create a long delay before the bonds are approved. It is up to the owner to decide whether the surety obtained by the contractor is acceptable or to specify a company. In the latter case, the contractor has the option of complying with the contract documents or not submitting a bid on the project. No standard form of surety bond is applicable to every project. Statutory bonds are bond forms that conform to a particular governing statute; they vary from one jurisdiction to another. Nonstatutory bonds are used when a statutory form is not required. There is no standard form of bond that is nationally accepted. The customary bond forms used by the surety companies are generally employed.

Bid Bond

The *bid bond* ensures that if a contractor is awarded the bid within the time specified, the contractor will enter into the contract and provide all other specified bonds. If the contractor fails to do so without justification, the bond will be forfeited to the owner. The amount forfeited will in no case exceed the amount of the bond or the difference between the original bid and the next highest bid that the owner may, in good faith, accept. The contractor's surety usually provides these bonds free or for a small annual service charge. The usual contract requirements for bid bonds specify that they must be 5 to 10 percent of the bid price, but higher percentages are sometimes used. Contractors should inform the surety company once the decision to bid for a project is made, especially if it is a larger amount than they usually bid or if they already have a great deal of work. Once a surety writes a bid bond for a contractor, that company is typically obligated to provide the other bonds required for the project. Surety companies therefore may do considerable investigation of contractors before they will write a bid bond for them, particularly if it is a contractor with whom they have not done business before or with whom they have never had a bid bond.

Performance Bond

The *performance bond* guarantees to the owner that the contractor will perform all work in accordance with the contract documents and that the owner will receive the project

built in substantial agreement with the contract documents. It protects the owner against default on the part of the contractor up to the amount of the bond. The warranty period of one year is usually covered under the bond. The contractor should check the documents to see if this bond is required and in what amount, and must also make the surety company aware of all requirements. Most commonly, these bonds must be made out in the amount of 100 percent of the contract price.

Payment Bond

The payment bond, also referred to as a labor and material bond, guarantees the payment of the contractor's bill for labor and materials used or supplied on the project. It acts as protection for the third parties and the owner, who are exempted from any liabilities in connection with claims against the project. In public works, the statutes of that state or entity will determine whether a specific item of labor or material is covered. Claims must be filed in accordance with the requirements of the bond. Most often a limitation is included in the bond stating that the claimant must give written notice to the general contractor, owner, or surety within a specified number of days after the last day the claimant performed any work on the project or supplied materials to it.

The payment and performance bonds are issued together. Bonding rates vary from contractor to contractor. Sample rates are found in Figure 2.4. On a bond for $662,000 issued using the rates in Figure 2.4, the contractor would pay $25 per $1,000 on the first $100,000 ($0 to $100,000), $15 per $1,000 on the next $400,000 ($100,001 to $500,000), and $10 per $1,000 on the remaining $162,000 ($500,001 to $662,000) for a total cost of $10,120. This cost is calculated as follows:

$$\$100{,}000 \times \frac{\$25}{\$1{,}000} + \$400{,}000 \times \frac{\$15}{\$1{,}000} + \$162{,}000 \times \frac{\$10}{\$1{,}000} = \$10{,}120$$

Subcontractor Bonds. Subcontractors may be required to provide the general contractor payment and performance bonds. Subcontractor bonds protect the general contractor against financial loss and litigation due to default by a subcontractor. Because these bonds vary considerably, general contractors may require the use of their own bond forms or reserve the right of approval of both the surety and form of the bond. These types of bonds are often used when the general contractor is required to post a bond for the project. This arrangement protects the general contractor, reduces risk, and allows the general contractor greater bonding capacity by reducing the risk the general contractor's surety is taking.

Bonding Rate
$25/$1,000 on first $100,000
$15/$1,000 on next $400,000
$10/$1,000 on next $2,000,000

FIGURE 2.4. Sample Bond Rates.

License or Permit Bond. The license or permit bond is required of the general contractor when a state law or municipal ordinance requires a contractor's license or permit. The bond guarantees compliance with statutes and ordinances. A permit bond may be required to guarantee the contractor's work when the contractor cut into a public road.

2–5 OBTAINING BONDS

The surety company will thoroughly check out a contractor before it furnishes a bid bond. The surety checks such items as financial stability, integrity, experience, equipment, and professional ability of the firm. The contractor's relations with sources of credit will be reviewed, as will current and past financial statements. At the end of the surety company's investigations, it will establish a maximum bonding capacity for that particular contractor. The investigation often takes time to complete, so contractors should apply well in advance of the time at which they desire bonding; waits of two months are not uncommon. Each time the contractor requests a bid bond for a particular job, the application must be approved. If the contractor is below the workload limit and there is nothing unusual about the project, the application will be approved quickly. If a contractor's maximum bonding capacity is approached, or if the type of construction is new to the particular contractor or is not conventional, a considerably longer time may be required. The surety puts the contractor under a thorough review before giving a bond for a project to be sure that the contractor is not overextended.

To be successful, the contractor requires equipment, working capital, and an organization. None of these should be spread thin. The surety checks the contractor's availability of credit so that, if already overextended, the contractor will not take on a project that is too big. The surety will want to know if the contractor has done other work similar to that about to be bid upon. If so, the surety will want to know the size of the project. The surety will encourage contractors to stay with the type of work in which they have the most experience. The surety may also check progress payments and the amount of work to be subcontracted. If the surety refuses the contractor a bond, the contractor must first find out why and then attempt to demonstrate to the surety that the conditions questioned can be resolved.

The contractor must remember that the surety is in business to make money and can only do so if the contractor is successful. The surety is not going to take any unnecessary chances in the decision to bond a project. At the same time, some surety companies are more conservative than others. If contractors believe that their surety company is too conservative or not responsive enough to their needs, they should shop around, talk with other sureties, and try to find one that will work with their organization. If contractors are approaching a surety for the first time, they should pay particular attention to what services the company provides. Some

companies provide a reporting service that includes projects being bid and low bidders. Also, when contractors are doing public work, the surety company can find out when the particular contractor can expect to get payment and what stage the job is in at a given time. Contractors need to select the company that seems to be the most flexible in its approach and offers the greatest service.

2–6 INSURANCE

Contractors must carry insurance to protect their business assets, and because it is often required by the contract documents. The contractor's selection of an insurance broker is of utmost importance, because the broker must be familiar with the risks and problems associated with construction projects. The broker must also protect the contractor against the wasteful overlapping of protection, yet there can be no gaps in the insurance coverage that might cause the contractor serious financial loss. Copies of the insurance requirements in the contract documents should be forwarded immediately to the insurance broker. The broker should be under strict instructions from the contractor that all insurance must be supplied in accordance with the contract documents. The broker will then supply the cost of the required insurance to the contractor for inclusion in the bidding proposal.

Insurance is not the same as a bond. With an insurance policy, the responsibility for specified losses is shouldered by the insurance company. In contrast, with a bond, the bonding companies will fulfill the obligations of the bond and turn to the contractor to reimburse them for all the money that they expended on their behalf.

In addition to the insurance required by the contract documents, the contractor also has insurance requirements. Certain types of insurance are required by state statute. For example, some states require all employers to obtain workers' compensation and automotive insurance. In addition, there is other insurance that is required but provided by governmental agencies, such as unemployment, which is discussed in Chapter 7. Insurance that is usually carried includes workers' compensation insurance, builder's risk, commercial general liability, automotive, marine, inland marine, property, business personal property, errors and omissions, and insurance umbrellas.

Workers' Compensation. A workers' compensation insurance policy provides benefits to employees or their families if they are killed or injured during the course of work. The rates charged for this insurance vary by state, type of work, and the contractor. The contractor's experience rating depends on the company's work record with regard to accidents and claims. Contractors with the fewest claims enjoy lower premiums. Workers should be classified correctly to keep rates as low as possible. The rate charged is expressed as a percentage of payroll or (dollars per $100 of payroll) and will vary considerably. The contractor pays the cost of the policy in full. Workers' compensation insurance is discussed in more depth in Chapter 7.

Builder's Risk. Builder's risk insurance protects projects under construction against direct loss due to fire and lightning. This insurance also covers temporary structures, sheds, materials, and equipment stored at the site. The cost usually ranges from $0.40 to $1.05 per $100 of valuation, depending on the project location, type of construction, and the company's past experience with a contractor. If desirable, the policy may be extended to all direct loss causes, including windstorms, hail, explosions, riots, civil commotion, vandalism, and malicious mischief. Also available are endorsements that cover earthquakes and sprinkler leakage.

Commercial General Liability. Commercial general liability insurance covers liability arising out of negligent actions by the contractor and the company's employees, and includes bodily injury, property damage or loss, and other personal injury such as slander or damage to reputation. The cost is based on a percentage of wages.

Automotive. Automotive insurance covers vehicles used on public roads including cars, trucks, portable office trailers used on the job site, and construction equipment that drives on public roads, such as dump trucks. Automotive insurance covers the company against liability arising out of the operation of the vehicles, damage to the vehicles, and theft of the vehicles.

Marine. Marine insurance covers equipment used on waterways, such as barges and boats, and provides similar protection as automotive insurance.

Inland Marine. Inland marine insurance covers off-road construction equipment, such as backhoes, scrapers, and dump trucks not licensed for use on public roads, and provides similar protection as automotive insurance.

Property. Property insurance covers real property (real estate) owned by the contractor, such as office buildings, shops, and warehouse. Property insurance protects the contractor against loss of the structure and some liability arising from injuries that occur on the property.

Business Personal Property. Business personal property insurance covers the contents of a building, such as computers and furniture.

Commercial general liability, automotive, marine, inland marine, property, and business personal property are usually included in one policy.

Errors and Omissions. Errors and omissions insurance covers liability arising from errors or omissions by the designers of a project. Design-build contractors should carry errors and omissions insurance.

Umbrella. An umbrella insurance policy goes on top of all the company's insurance, increasing the limits of coverage. It is often cheaper to purchase an umbrella policy than it is to raise the limits on all of the policies.

Life. A company may take out a life insurance policy on key personnel (such as the owner) where the company is the beneficiary to protect the company against losses incurred due to the death of the employee.

The contract documents may require that the insurance indemnify (cover) the owner, architect, and engineer against liability arising out of actions of the contractor. This is done by naming the owner, architect, and engineer as an additionally insured on the insurance policy. Contractors should be named as an additionally insured on their subcontractors' insurance policies and verify that all their subcontractors carry the required insurance.

WEB RESOURCE

sio.org

REVIEW QUESTIONS

1. What is a single contract, and what are its principal advantages and disadvantages for the owner?
2. What are separate contracts, and what are the principal advantages and disadvantages for the owner?
3. With separate contracts, describe three options available to the owner for managing the contractor's work on the project.
4. List and briefly define the types of agreements that may be used for the owner's payment to the contractor.
5. What is the "time of completion," and why must it be clearly stated in the contract agreement provisions?
6. What are progress payments, and why are they important to the contractor?
7. What is retainage, where is the amount specified, and why is it used?
8. What is a bid bond, and how does it protect the owner?
9. Where would information be found on whether a bid bond was required and, if so, its amount?
10. What are performance bonds? Are they required on all proposals?
11. How are the various surety bonds that may be required on a specific project obtained?
12. How does insurance differ from a surety bond?
13. What are the different types of insurance that a contractor should maintain and what do they cover?
14. Review a copy of the contract documents (drawings and project manual) for a construction project. Contract documents may be reviewed at a contractor's, subcontractor's, architect's, or engineer's office or may be downloaded from the Internet. Answer the following questions and be prepared to discuss your findings in class, if your instructor chooses to do so.
    - **a.** What type of agreement (lump-sum, unit-price, or cost-plus-fee) is used for the project? If it is a cost-plus-fee agreement, how is the fee determined, and is there a guaranteed maximum price?
    - **b.** What is the scope of the work for the project?
    - **c.** What provisions are included in the contract documents regarding the time of completion? What penalties are there for failing to meet the completion date? Is there a bonus for completing the project ahead of schedule?
    - **d.** How are progress payments handled? When are they due? How quickly will they be paid?
    - **e.** Will retention be withheld? If so, how much? What are the requirements for the release of retention?
    - **f.** How is final acceptance handled? What inspections are required? What forms, documents, maintenance and operation manuals, certifications, red-line drawings, and so on need to be submitted before final acceptance?
    - **g.** What bonds are needed for the job?
    - **h.** What are the insurance requirements for the project?

CHAPTER **THREE**

PROJECT MANUAL

3–1 INTRODUCTION

The project manual, often referred to as the specifications, is a document that accompanies the drawings and includes information on how to bid the project, the contractual obligations of the successful contractor, and the specifications for the materials used in the construction. In this book, the term "project manual" is used when referring to the complete written document or a set of documents that accompanies the plans. The term "project manual" is used rather than specifications because the project manual contains so much more than just the specifications. The term "specifications" is used when referring to the material or technical specifications.

The contractor submits a bid or proposal based on the drawings and the project manual. The contractor is responsible for everything contained in the project manual and what is covered on the drawings. The project manual should be read thoroughly and reviewed when necessary. Contractors have a tendency to read only the portions of the project manual that refer to materials and workmanship; however, they are also responsible for anything stated in the proposal (or bid form), the information to bidders, the general conditions, and the supplementary general conditions.

There is a tendency among estimators to simply skim over the project manual. Reading the average project manual is time consuming, but many important items are mentioned only in the project manual and not on the drawings. Because the project manual is part of the contract documents, the general contractor is responsible for the work and materials mentioned in it.

The project manual contains items ranging from the types of bonds and insurance required to the type, quality, and color of materials used on the job. A thorough understanding of the materials contained in the specification portion of the project manual may make the difference between being the low bidder and not—the difference between making money on the job and not.

There is no question that skimming the project manual is risky. Either the bids will be too high, because of contingency allowances added to cover uncertainty in the bid, or too low, from not including required items.

The project manual is generally presented in the following sequence:

1. Invitation to bid (advertisement for bidders)
2. Instructions to bidders
3. Bid (or proposal) forms
4. Form of owner–contractor agreement
5. Form of bid bond
6. Forms of performance and payment bonds
7. General conditions of the contract
8. Supplementary general conditions
9. Specifications (technical specifications)

Separate contracts and many large projects often have a separate project manual for the mechanical and electrical trades.

3–2 CONSTRUCTION SPECIFICATIONS INSTITUTE

The Construction Specifications Institute (CSI), an organization formed in 1948 to improve the quality of constructions specifications, has developed a standard format for organizing the specification known as the MasterFormat. Prior to 2004, the MasterFormat consisted of 17 divisions (0 through 16). In 2004, the MasterFormat was revised to include 50 divisions (0 through 49), with many of the divisions being reserved for future use. Each division is subdivided into specific areas; for example, division 8 covers openings (doors, windows, and skylights), while the subdivision 08 50 00 deals specifically with windows. Subdivision 08 50 00 is further divided, and subdivision 08 51 00 deals with all types of metal windows. Subdivision 05 51 00 is subdivided by type of metal window, with 08 51 13 dealing with aluminum windows. The MasterFormat has found wide acceptance in the construction industry. The first two levels of the MasterFormat are shown in Figure 3.1. The CSI MasterFormat also ties in easily with

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

00 00 00 PROCUREMENT AND CONTRACTING REQUIREMENTS
00 10 00 SOLICITATION
00 20 00 INSTRUCTIONS FOR PROCUREMENT
00 30 00 AVAILABLE INFORMATION
00 40 00 PROCUREMENT FORMS AND SUPPLEMENTS
00 50 00 CONTRACTING FORMS AND SUPPLEMENTS
00 60 00 PROJECT FORMS
00 70 00 CONDITIONS OF THE CONTRACT
00 90 00 REVISIONS, CLARIFICATIONS, AND MODIFICATIONS

DIVISION 01 – GENERAL REQUIREMENTS

01 00 00 GENERAL REQUIREMENTS
01 10 00 SUMMARY
01 20 00 PRICE AND PAYMENT PROCEDURES
01 30 00 ADMINISTRATIVE REQUIREMENTS
01 40 00 QUALITY REQUIREMENTS
01 50 00 TEMPORARY FACILITIES AND CONTROLS
01 60 00 PRODUCT REQUIREMENTS
01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS
01 80 00 PERFORMANCE REQUIREMENTS
01 90 00 LIFE CYCLE ACTIVITIES

DIVISION 02 – EXISTING CONDITIONS

02 00 00 EXISTING CONDITIONS
02 20 00 ASSESSMENT
02 30 00 SUBSURFACE INVESTIGATION
02 40 00 DEMOLITION AND STRUCTURE MOVING
02 50 00 SITE REMEDIATION
02 60 00 CONTAMINATED SITE MATERIAL REMOVAL
02 70 00 WATER REMEDIATION
02 80 00 FACILITY REMEDIATION

DIVISION 03 – CONCRETE

03 00 00 CONCRETE
03 10 00 CONCRETE FORMING AND ACCESSORIES
03 20 00 CONCRETE REINFORCING
03 30 00 CAST-IN-PLACE CONCRETE
03 40 00 PRECAST CONCRETE
03 50 00 CAST DECKS AND UNDERLAYMENT
03 60 00 GROUTING
03 70 00 MASS CONCRETE
03 80 00 CONCRETE CUTTING AND BORING

DIVISION 04 – MASONRY

04 00 00 MASONRY
04 20 00 UNIT MASONRY
04 40 00 STONE ASSEMBLIES
04 50 00 REFRACTORY MASONRY
04 60 00 CORROSION-RESISTANT MASONRY
04 70 00 MANUFACTURED MASONRY

DIVISION 05 – METALS

05 00 00 METALS
05 10 00 STRUCTURAL METAL FRAMING
05 20 00 METAL JOISTS
05 30 00 METAL DECKING
05 40 00 COLD-FORMED METAL FRAMING
05 50 00 METAL FABRICATIONS
05 70 00 DECORATIVE METAL

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 00 00 WOOD, PLASTICS, AND COMPOSITES
06 10 00 ROUGH CARPENTRY
06 20 00 FINISH CARPENTRY
06 40 00 ARCHITECTURAL WOODWORK
06 50 00 STRUCTURAL PLASTICS
06 60 00 PLASTIC FABRICATIONS
06 70 00 STRUCTURAL COMPOSITES
06 80 00 COMPOSITE FABRICATIONS

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 00 00 THERMAL AND MOISTURE PROTECTION
07 10 00 DAMPPROOFING AND WATERPROOFING
07 20 00 THERMAL PROTECTION
07 25 00 WEATHER BARRIERS
07 30 00 STEEP SLOPE ROOFING
07 40 00 ROOFING AND SIDING PANELS
07 50 00 MEMBRANE ROOFING
07 60 00 FLASHING AND SHEET METAL
07 70 00 ROOF AND WALL SPECIALTIES AND ACCESSORIES
07 80 00 FIRE AND SMOKE PROTECTION
07 90 00 JOINT PROTECTION

DIVISION 08 – OPENINGS

08 00 00 OPENINGS
08 10 00 DOORS AND FRAMES
08 30 00 SPECIALTY DOORS AND FRAMES
08 40 00 ENTRANCES, STOREFRONTS, AND CURTAIN WALLS
08 50 00 WINDOWS
08 60 00 ROOF WINDOWS AND SKYLIGHTS
08 70 00 HARDWARE
08 80 00 GLAZING
08 90 00 LOUVERS AND VENTS

DIVISION 09 – FINISHES

09 00 00 FINISHES
09 20 00 PLASTER AND GYPSUM BOARD
09 30 00 TILING
09 50 00 CEILINGS
09 60 00 FLOORING
09 70 00 WALL FINISHES
09 80 00 ACOUSTIC TREATMENT
09 90 00 PAINTING AND COATING

DIVISION 10 – SPECIALTIES

10 00 00 SPECIALTIES
10 10 00 INFORMATION SPECIALTIES
10 20 00 INTERIOR SPECIALTIES
10 30 00 FIREPLACES AND STOVES
10 40 00 SAFETY SPECIALTIES
10 50 00 STORAGE SPECIALTIES
10 70 00 EXTERIOR SPECIALTIES
10 80 00 OTHER SPECIALTIES

DIVISION 11 – EQUIPMENT

11 00 00 EQUIPMENT
11 10 00 VEHICLE AND PEDESTRIAN EQUIPMENT
11 20 00 COMMERCIAL EQUIPMENT
11 30 00 RESIDENTIAL EQUIPMENT
11 40 00 FOODSERVICE EQUIPMENT
11 50 00 EDUCATIONAL AND SCIENTIFIC EQUIPMENT
11 60 00 ENTERTAINMENT AND RECREATION EQUIPMENT
11 70 00 HEALTHCARE EQUIPMENT
11 80 00 FACILITY MAINTENANCE AND OPERATION EQUIPMENT
11 90 00 OTHER EQUIPMENT

DIVISION 12 – FURNISHINGS

12 00 00 FURNISHINGS
12 10 00 ART
12 20 00 WINDOW TREATMENTS
12 30 00 CASEWORK
12 40 00 FURNISHINGS AND ACCESSORIES
12 50 00 FURNITURE
12 60 00 MULTIPLE SEATING
12 90 00 OTHER FURNISHINGS

DIVISION 13 – SPECIAL CONSTRUCTION

13 00 00 SPECIAL CONSTRUCTION
13 10 00 SPECIAL FACILITY COMPONENTS
13 20 00 SPECIAL PURPOSE ROOMS
13 30 00 SPECIAL STRUCTURES
13 40 00 INTEGRATED CONSTRUCTION
13 50 00 SPECIAL INSTRUMENTATION

DIVISION 14 – CONVEYING EQUIPMENT

14 00 00 CONVEYING EQUIPMENT
14 10 00 DUMBWAITERS
14 20 00 ELEVATORS
14 30 00 ESCALATORS AND MOVING WALKS
14 40 00 LIFTS
14 70 00 TURNTABLES
14 80 00 SCAFFOLDING
14 90 00 OTHER CONVEYING EQUIPMENT

DIVISION 21 – FIRE SUPPRESSION

21 00 00 FIRE SUPPRESSION
21 10 00 WATER-BASED FIRE-SUPPRESSION SYSTEMS
21 20 00 FIRE-EXTINGUISHING SYSTEMS
21 30 00 FIRE PUMPS
21 40 00 FIRE-SUPPRESSION WATER STORAGE

DIVISION 22 – PLUMBING

22 00 00 PLUMBING
22 10 00 PLUMBING PIPING
22 30 00 PLUMBING EQUIPMENT
22 40 00 PLUMBING FIXTURES

FIGURE 3.1. CSI MasterFormat Divisions (2016 Edition).

MasterFormat® Numbers and Titles used in this book are from *MasterFormat*®, published by CSI and Construction Specifications Canada (CSC), and are used with permission from CSI. For those interested in a more in-depth explanation of *MasterFormat*® and its use in the construction industry visit www.masterformat.com or contact:

CSI
110 South Union Street, Suite 100
Alexandria, VA 22314
800-689-2900
www.csinet.org

22 50 00 POOL AND FOUNTAIN PLUMBING SYSTEMS
22 60 00 GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 00 00 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)
23 10 00 FACILITY FUEL SYSTEMS
23 20 00 HVAC PIPING AND PUMPS
23 30 00 HVAC AIR DISTRIBUTION
23 40 00 HVAC AIR CLEANING DEVICES
23 50 00 CENTRAL HEATING EQUIPMENT
23 60 00 CENTRAL COOLING EQUIPMENT
23 70 00 CENTRAL HVAC EQUIPMENT
23 80 00 DECENTRALIZED HVAC EQUIPMENT

DIVISION 25 – INTEGRATED AUTOMATION

25 00 00 INTEGRATED AUTOMATION
25 10 00 INTEGRATED AUTOMATION NETWORK EQUIPMENT
25 30 00 INTEGRATED AUTOMATION INSTRUMENTATION AND TERMINAL DEVICES
25 50 00 INTEGRATED AUTOMATION FACILITY CONTROLS
25 90 00 INTEGRATED AUTOMATION CONTROL SEQUENCES

DIVISION 26 – ELECTRICAL

26 00 00 ELECTRICAL
26 10 00 MEDIUM-VOLTAGE ELECTRICAL DISTRIBUTION
26 20 00 LOW-VOLTAGE ELECTRICAL DISTRIBUTION
26 30 00 FACILITY ELECTRICAL POWER GENERATING AND STORING EQUIPMENT
26 40 00 ELECTRICAL PROTECTION
26 50 00 LIGHTING

DIVISION 27 – COMMUNICATIONS

27 00 00 COMMUNICATIONS
27 10 00 STRUCTURED CABLING
27 20 00 DATA COMMUNICATIONS
27 30 00 VOICE COMMUNICATIONS
27 40 00 AUDIO-VIDEO COMMUNICATIONS
27 50 00 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 00 00 ELECTRONIC SAFETY AND SECURITY
28 10 00 ACCESS CONTROL
28 20 00 VIDEO SURVEILLANCE
28 30 00 SECURITY DETECTION, ALARM, AND MONITORING
28 40 00 LIFE SAFETY
28 50 00 SPECIALIZED SYSTEMS

DIVISION 31 – EARTHWORK

31 00 00 EARTHWORK
31 10 00 SITE CLEARING
31 20 00 EARTH MOVING
31 30 00 EARTHWORK METHODS
31 40 00 SHORING AND UNDERPINNING
31 50 00 EXCAVATION SUPPORT AND PROTECTION
31 60 00 SPECIAL FOUNDATIONS AND LOAD-BEARING ELEMENTS
31 70 00 TUNNELING AND MINING

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 00 00 EXTERIOR IMPROVEMENTS
32 10 00 BASES, BALLASTS, AND PAVING
32 30 00 SITE IMPROVEMENTS
32 70 00 WETLANDS
32 80 00 IRRIGATION
32 90 00 PLANTING

DIVISION 33 – UTILITIES

33 00 00 UTILITIES
33 10 00 WATER UTILITIES
33 30 00 SANITARY SEWERAGE
33 40 00 STORMWATER UTILITIES
33 50 00 HYDROCARBON UTILITIES
33 60 00 HYDRONIC AND STEAM ENERGY UTILITIES
33 70 00 ELECTRICAL UTILITIES
33 80 00 COMMUNICATIONS UTILITIES

DIVISION 34 – TRANSPORTATION

34 00 00 TRANSPORTATION
34 10 00 GUIDEWAYS/RAILWAYS
34 20 00 TRACTION POWER
34 40 00 TRANSPORTATION SIGNALING AND CONTROL EQUIPMENT
34 50 00 TRANSPORTATION FARE COLLECTION EQUIPMENT
34 70 00 TRANSPORTATION CONSTRUCTION AND EQUIPMENT
34 80 00 BRIDGES

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION

35 00 00 WATERWAY AND MARINE CONSTRUCTION
35 10 00 WATERWAY AND MARINE SIGNALING AND CONTROL EQUIPMENT
35 20 00 WATERWAY AND MARINE CONSTRUCTION AND EQUIPMENT
35 30 00 COASTAL CONSTRUCTION
35 40 00 WATERWAY CONSTRUCTION AND EQUIPMENT
35 50 00 MARINE CONSTRUCTION AND EQUIPMENT
35 70 00 DAM CONSTRUCTION AND EQUIPMENT

DIVISION 40 – PROCESS INTERCONNECTIONS

40 00 00 PROCESS INTERCONNECTIONS
40 10 00 GAS AND VAPOR PROCESS PIPING AND DUCTWORK
40 20 00 LIQUIDS PROCESS PIPING
40 30 00 SOLID AND MIXED MATERIALS PIPING AND CHUTES
40 40 00 PROCESS PIPING AND EQUIPMENT PROTECTION
40 60 00 PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS
40 70 00 INSTRUMENTATION FOR PROCESS SYSTEMS
40 80 00 COMMISSIONING OF PROCESS SYSTEMS
40 90 00 PRIMARY CONTROL DEVICES

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT

41 00 00 MATERIAL PROCESSING AND HANDLING EQUIPMENT
41 10 00 BULK MATERIAL PROCESSING EQUIPMENT
41 20 00 PIECE MATERIAL HANDLING EQUIPMENT
41 30 00 MANUFACTURING EQUIPMENT
41 40 00 CONTAINER PROCESSING AND PACKAGING
41 50 00 MATERIAL STORAGE
41 60 00 MOBILE PLANT EQUIPMENT

DIVISION 42 – PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

42 00 00 PROCESS HEATING, COOLING, AND DRYING EQUIPMENT
42 10 00 PROCESS HEATING EQUIPMENT
42 20 00 PROCESS COOLING EQUIPMENT
42 30 00 PROCESS DRYING EQUIPMENT

DIVISION 43 – PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

43 00 00 PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT
43 10 00 GAS HANDLING EQUIPMENT
43 20 00 LIQUID HANDLING EQUIPMENT
43 30 00 GAS AND LIQUID PURIFICATION EQUIPMENT
43 40 00 GAS AND LIQUID STORAGE

DIVISION 44 – POLLUTION AND WASTE CONTROL EQUIPMENT

44 00 00 POLLUTION AND WASTE CONTROL EQUIPMENT
44 10 00 AIR POLLUTION CONTROL
44 20 00 NOISE POLLUTION CONTROL
44 30 00 ODOR CONTROL
44 40 00 WATER POLLUTION CONTROL EQUIPMENT
44 50 00 SOLID WASTE CONTROL AND REUSE
44 60 00 WASTE THERMAL PROCESSING EQUIPMENT

DIVISION 45 – INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

45 00 00 INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT
45 20 00 USER-DEFINED TEXTILES AND APPAREL MANUFACTURING EQUIPMENT
45 30 00 USER-DEFINED PETROLEUM AND COAL PRODUCTS MANUFACTURING EQUIPMENT
45 40 00 USER-DEFINED FABRICATED METAL PRODUCT MANUFACTURING EQUIPMENT
45 50 00 USER-DEFINED FURNITURE AND RELATED PRODUCT MANUFACTURING EQUIPMENT

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

46 00 00 WATER AND WASTEWATER EQUIPMENT
46 20 00 WATER AND WASTEWATER PRELIMINARY TREATMENT EQUIPMENT
46 30 00 WATER AND WASTEWATER CHEMICAL FEED EQUIPMENT
46 40 00 WATER AND WASTEWATER CLARIFICATION AND MIXING EQUIPMENT
46 50 00 WATER AND WASTEWATER SECONDARY TREATMENT EQUIPMENT
46 60 00 WATER AND WASTEWATER ADVANCED TREATMENT EQUIPMENT
46 70 00 WATER AND WASTEWATER RESIDUALS HANDLING AND TREATMENT

DIVISION 48 – ELECTRICAL POWER GENERATION

48 00 00 ELECTRICAL POWER GENERATION
48 10 00 ELECTRICAL POWER GENERATION EQUIPMENT
48 30 00 COMBINED HEAT AND POWER GENERATION
48 70 00 ELECTRICAL POWER GENERATION TESTING

FIGURE 3.1. (*Continued*)

computer programs and cost accounting systems. It is not necessary to memorize the major divisions of the format; their constant use will facilitate their memorization.

3–3 INVITATION TO BID (ADVERTISEMENT FOR BIDS)

In public construction, public agencies must conform to regulations that relate to the method they use in advertising for bids. Customarily, the notice of proposed bidding is posted in public places and on the Internet, and by advertising for bids in newspapers (Figure 3.2), trade journals, and magazines. Where, how often, and over what period of time the advertisement is published will vary considerably according to the jurisdictional regulations. An estimator must not be bashful. If contractors are interested in a certain project, they should never hesitate to call and ask when it will be bid, when and where the agencies will advertise for bids, or for any other information that may be of importance.

Generally, the advertisement describes the location, extent, and nature of the work. It will designate the authority under which the project originated. Concerning the bid, it will give the place where bidding documents are available and list the time, manner, and place where bids will be received. It will also list bond requirements and start and completion dates for the work.

In private construction, owners often do not advertise for bidders. They may choose to negotiate with a contractor of choice, put the job out to bid on an invitation basis, or put the project out for competitive bidding open to anyone who wants to bid. If the owner puts a job out for competitive bidding, the architect/engineer will call the construction reporting services, which will pass the information on to their members or subscribers.

3–4 INSTRUCTIONS TO BIDDERS (INFORMATION FOR BIDDERS)

Instructions to bidders is the document that states the procedures to be followed by all bidders. It states in what manner the bids must be delivered; the time, date, and location of bid opening; and whether it is a public opening. (Bids may be either opened publicly and read aloud or opened privately.) The *instructions to bidders* states where the drawings and the project manual are available and the amount of the deposit required. It also lists the form of owner–contractor agreement to be used, bonds required, times of starting and project completion, and any other bidder requirements.

Each set of instructions is different and should be read carefully. In reading the instructions to bidders, contractors

INVITATION TO BID FROM NEWSPAPER

REQUEST FOR BIDS: Mt. Ogden Development is seeking bids on the construction of a Real Estate Office from qualified general contractors.

PROJECT LOCATION: 4755 S. West Street, Ogden, Utah 84403

RECIEPT OF BIDS: Sealed bids will be received at the owner's office until 3:00 p.m. local time on April 20, 2017, at which time the bids will be publically opened and read aloud. Bids should be addressed to Mr. John M. Smith, President, Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403 and should be clearly marked "**HOLD FOR BID OPENING—REAL ESTATE OFFICE.**" Bids shall remain good for 60 days after the bid opening.

A certified check or cashier's check on a state or national bank or a bid bond from an acceptable surety authorized to transact business in Utah, in the amount of not less than five percent (5%) of the greatest total amount of the bid must accompany each bid as a guarantee that, if awarded the contract, the bidder will within ten (10) calendar days after Award of Contract enter into contract and execute performance and payment bonds on the forms provided in the project manual.

Bids must be completed and submitted on the forms provided in the project manual. Incomplete bids will invalidate the bid and the bid will be rejected and returned to the bidder. The right to accept any bid, or to reject any or all bids and to waive all formalities is hereby reserved by the owner.

SCOPE OF WORK: The work includes a 3,600-square-foot, wood-frame office building with asphalt shingle roof.

COMPLETION DATE: The project is to be completed and ready for occupancy 150 calendar days after the Award of Contract.

BIDDING DOCUMENT: Construction documents for the Real Estate Office can be obtained from Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403. Electronic copies of the plans are available free of charge. A limited number of printed copies are available for general contractors. A deposit of $100 per set is required for printed copies. The deposit will be returned if the documents are returned in good condition within two weeks after the bid opening; otherwise, no refund will be made. Checks should be made out to Mt. Ogden Development.

PRE-BID CONFERENCE: A pre-bid conference will be held on March 23, 2017, at 1:00 p.m. on the site of the proposed project. All bidders are required to attend this conference.

FIGURE 3.2. Invitation to Bid.

should note special items. Figure 3.3 is an example of a set of instructions to bidders.

Bids. Be sure to check exactly where the bids are being received. Be sure to check each addendum to see if the time or location has been changed. It is rather embarrassing (as well as unprofitable) to wind up in the wrong place at the right time or in the right place at the wrong time. Typically, bids will be returned unopened if they are submitted late. Figure 3.4 is an example of a bid form.

Commencement and Completion. Work on the project will commence within a specified period after the execution of the contract. Sometimes the time of completion is spelled out in the contract documents; other times the contractor will have to determine the number of calendar days to complete the project. The completion date must be realistic, as most contractors have a tendency to be overly optimistic with work schedules. At the same time, they should not be overly conservative since it may cause the owner concern over the company's ability to expedite the work.

Responsibility of Bidders. Contractors should read the responsibilities to bidders section thoroughly, as it indicates some of the things that the contractor should do during the preparation of the bid, such as review all of the drawings

INSTRUCTIONS TO BIDDERS

DEFINITIONS: All definitions in the General Conditions, AIA Document A201, apply to the Instructions to Bidders.

SCOPE OF WORK: The work includes a 3,600-square-foot, wood-frame office building with asphalt shingle roof.

OWNER: Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403

ARCHITECT: Studio Design and Architecture, 2525 East Street, Ogden, Utah 84403

RESPONSIBILITY: By making a bid, bidders represent that they have read and understand the Contract Documents. It is also each bidder's responsibility to visit the site and become familiar with any local conditions which may affect the work.

BIDDING REQUIREMENTS: Bids must be completed and submitted on the forms provided in the project manual. All blanks pertinent to the bid must be filled in.

BID SECURITY: A certified check or cashier's check on a state or national bank or a bid bond from an acceptable surety authorized to transact business in Utah, in the amount of not less than five percent (5%) of the greatest total amount of the bid must accompany each bid as a guarantee that, if awarded the contract, the bidder will within ten (10) calendar days after Award of Contract enter into contract and execute performance and payment bonds on the forms provided in the project manual.

PAYMENT AND PERFORMANCE BONDS: The Owner reserves the right to require the bidder to furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising from the performance of the Contract in such form and amount as the Owner may require. In the event the Owner elects to require said executed bond, the Owner shall cause the Contract sum to be increased by the cost to the Contractor of said bond.

AWARD OR REJECTION OF BID: The right to accept any bid, or to reject any or all bids and to waive all formalities is hereby reserved by the owner. Incomplete bids will invalidate the bid and the bid will be rejected and returned to the bidder. The Owner reserves the right to reject a bid if the data is not submitted as required by the Contract Documents, if no Bid Security has been furnished, or if the bid is any way incomplete or irregular.

POST-BID INFORMATION: Within seven (7) days after the Contract signing, the Contractor shall submit an itemized statement of costs for each major item of work and a list of the proposed subcontractors for approval.

BIDS: Sealed bids will be received at the owner's office until 3:00 p.m. local time on April 20, 2017, at which time the bids will be publically opened and read aloud. Bids should be addressed to Mr. John M. Smith, President, Mt. Ogden Development, 5204 South Street, Ogden, Utah 84403 and should be clearly marked "HOLD FOR BID OPENING—REAL ESTATE OFFICE." All bidders are invited to be present at the bid opening. Bids shall remain good for 60 days after the bid opening.

COMPLETION DATE: The project is to be completed and ready for occupancy 150 calendar days after the Award of Contract.

PRE-BID CONFERENCE: A pre-bid conference will be held on March 23, 2017, at 1:00 p.m. on the site of the proposed project. All bidders are required to attend this conference.

SUBSTITUTIONS: All bids must be based on the materials and equipment described in the bidding documents. Requests for material substitutions must be submitted to the Architect, in writing, not less than ten (10) days prior to the bid date. Any approval of proposed substitutions will be set forth in an addendum.

INTERPRETATIONS: All requests for interpretations or correction of any ambiguity, inconsistency, or error in the bidding documents must be made in writing not less than seven (7) days prior to the bid date. Interpretations and corrections will be issued as an addendum by the Architect. Only written interpretations and corrections are binding. Interpretations and corrections are not binding when made verbally and not spelled out in writing.

FIGURE 3.3. Instructions to Bidders.

Bid

Owner:
Mt. Ogden Development
Mr. John M. Smith, President
5204 South Street
Ogden, Utah 84403

Project:
Real Estate Office
4755 S. West Street
Ogden, Utah 84403

Dear Sirs:

Having carefully examined the bid documents including the plans, specifications, and other related documents; visited the proposed site of the work; and being familiar with other conditions surrounding construction of the proposed project including the availability of material and labor, the undersigned proposes to furnish all labor, material, equipment, supplies, tools, transportation, services, licenses, fees, permits, sales tax, and so forth required by the bid documents for the followings sums:

Base Bid $_____dollars ($_____).

Alternate #1 $_____dollars ($_____).

The undersigned also agrees to complete the work in 150 calendar days.

We acknowledge the following addenda: _____

Enclosed is a _____(bond or check), as required, in the sum of 5% of the bid.

This bid shall remain good for 60 days after the bid opening.

Respectfully Submitted:

SEAL (if a Corporation)

Company _____

By _____

Address _____

_____

License No. _____

Date _____

FIGURE 3.4. Bid Form.

and the complete project manual, visiting the site, and so on. By submitting a bid, the contractor assumes these responsibilities even if they do not complete them. This prevents the contractors from claiming that they did not know about a contract or design requirement or a site condition.

Award or Rejection of Bid. The owner may reserve the right to the following:

1. Reject any or all bids
2. Accept a bid other than the lowest
3. Reject any bid not prepared and submitted in accordance with the contract documents

These are common stipulations that in effect allow the owner to select a bidder other than the lowest bidder. Government entities may be required to use the lowest bidder, and when they are not required, they must have clearly defined criteria for selecting the best bidder before receiving the bids.

Many owners are now selecting the contractor based on the best bid. The best bid is based upon a set of criteria established in the bid documents. The scoring is separated into two parts: the technical proposal and the price proposal. The technical proposal covers how the contractor is going to complete the work and may include the project's team, design, safety, quality control, public relations, schedule, and other factors. Each technical proposal is rated for each criterion, and a final score is calculated by summing the score for each criterion multiplied by the weighting for that criterion. The scoring of the technical proposal

is completed before the price proposal is opened to prevent the price from affecting the scoring of the technical proposal. The price proposal is combined with the score for the technical proposal using a predetermined mathematical formula such as the following:

$$\frac{(\text{Price Proposal} + \text{Duration} \times \$\ 100{,}000/\text{day})}{\text{Technical Score}}$$

3–5 BID FORM

If a prepared *bid form* (Figure 3.4) is included in the project manual, the contractor must use this form to present the bid. By using a prepared bid form, the owner can evaluate all bids on the same basis.

The bid form stipulates the price for which the contractor agrees to perform all of the work described in the contract documents. It also ensures that if the owner accepts the bid within a certain time, the contractor must enter into an agreement or the owner may keep the bid security as liquidated damages.

The bid must be submitted according to the requirements in the instructions to bidders. Any deviation from these requirements for the submission of the bid may result in the bid being rejected.

Contractors must fill in all blanks of the bid form acknowledge receipt of all addenda, submit the required number of copies of the bid form, supply proper bid security, and be at the right place at the right time. Countless bids have never been opened, because they were delivered a few minutes late; others have been rejected, because a blank space was not filled in.

3–6 FORM OF OWNER–CONTRACTOR AGREEMENT

The owner–contractor agreement form spells out exactly the type or form of agreement between the owner and the contractor. The agreement may be a standard form published by the American Institute of Architects (AIA), in which case the form may be referenced rather than including a copy of the form in the project manual. Government agencies controlling the work usually have their own forms of agreement; the same is true for many corporations. In these cases, a copy of the agreement is included in the project manual. If the contract agreement is unfamiliar, the contractor should have his or her lawyer review it before submitting the bid. If the form of agreement is unacceptable, the contractor may prefer not to bid that particular project. Types of agreements are discussed in Chapter 2.

3–7 GENERAL CONDITIONS

The *general conditions* assembled and published by the AIA is the most commonly used standard form. Many branches of government as well as large corporations have also assembled their own versions of general conditions. The contractor must carefully read each article and make appropriate notes. In some cases, it is best for the contractor to give a copy of the general conditions to a lawyer for review and comment. If contractors decide it is not in their best interest to work under the proposed set of general conditions, the architect/engineer should be informed of the reasons and asked if they would consider altering the conditions. If not, the contractor may decide it is best not to bid for the project. Typically, all general conditions will include, in one form or another, the 14 topics included in the AIA general conditions. The general conditions clearly spell out the rights and responsibilities of all the parties. Obviously, the most stringent demands are placed on the contractors, because they are entrusted with the responsibility of actually building the project.

3–8 SUPPLEMENTARY GENERAL CONDITIONS

The *supplementary general conditions* of the project manual amends or supplements portions of the general conditions. It is through these supplemental conditions that the general conditions are geared to all the special requirements of geography, local requirements, and individual project needs. Part of the supplemental conditions cancels or amends the articles in the general conditions, while the remaining portion adds articles.

Contractors must carefully check the supplementary conditions, as each set is different. Items that may be covered in this section include insurance, bonds, and safety requirements. Also included may be comments concerning the following:

1. Pumping and shoring
2. Dust control
3. Temporary offices
4. Temporary enclosures
5. Temporary utilities
6. Temporary water
7. Material substitution
8. Soil conditions
9. Signs
10. Cleaning
11. Shop drawings—drawings that illustrate how specific portions of the work will be fabricated and/or installed
12. Surveys

As the contractor reviews the supplementary general conditions, notes must be made of the many requirements included in them, as they may be costly, and an amount to cover these items must be included in the estimate. When actually figuring the estimate, contractors should go through the entire supplementary general conditions carefully, noting all items that must be covered in the bid and deciding how much to allow for each item.

3–9 SPECIFICATIONS

Specifications, as defined by the AIA, are the written descriptions of materials, construction systems, and workmanship. The AIA further states that defining the quality of materials and the results to be provided by the application of construction methods is the purpose of the specifications.

The *specifications* (sometimes referred to as the technical specifications) generally follow the CSI MasterFormat. These specifications include the type of materials required, their required performance, and the method that must be used to obtain the specified result. When a particular method is specified, the contractor should base the bid on that methodology. Although deviations may be allowed once the contract has been signed, those items can be handled through the use of change orders. If an alternative method is assumed in the estimate and later denied by the architect, the contractor would have to shoulder any losses.

The material portion of the specifications usually mentions the physical properties, performance requirements, handling, and storage requirements. Often, specific brands or types of material are listed as the required standard of quality. Sometimes, two or three acceptable brands are specified, and the contractor has a choice of which to supply. If the contractor wishes to substitute another manufacturer's materials, it must be done in accordance with the contract documents.

Results that may be specified include items such as the texture of the material, appearance, noise reduction factors, allowable tolerances, heat loss factors, and colors.

3–10 ALTERNATES

In many projects, the owner requests prices for alternate methods or materials of construction (Figure 3.5). These alternates are generally spelled out on a separate listing in the project manual, and they are listed on the bid form. The alternates may be either an *add price* or a *deduct price*, which means that contractors either add the price to the base bid (the price without any alternatives) or deduct it from the base bid. The price for any alternates must be complete and include all taxes, overhead, and profit. When an owner has a limited budget, the system of alternates allows a choice on how to best spend the available money.

Since lump-sum contracts are awarded on the basis of the total base bid, plus or minus any alternates accepted, there is always a concern that the owner will select alternates in a way that will help a particular contractor become the low bidder. This concern has become so great that some contractors will not bid for projects with a large number of alternates. To relieve the contractor of this concern, many architects include in the contract documents the order of acceptance of the alternates. Alternates deserve the same estimating care and consideration as the rest of the project, so contractors should not rush through them or leave them until the last minute.

3–11 ADDENDA

The period after the basic contract documents have been issued to the bidders and before the bids are due is known as the *bidding period.* Any amendments, modifications, revisions, corrections, and explanations issued by the architect/engineer during the bidding period are effected by issuing the *addenda* (Figure 3.6). The statements, and any drawings included, serve to revise the basic contract documents. They notify the bidder of any corrections in the documents, interpretations required, and any additional requirements, as well as other similar matters. The addenda must be in writing.

Because the addenda become part of the contract documents, it is important that all general contractors promptly receive copies of them. Many architect/engineer offices send copies to all parties who have the plans and the project manual (including the plan rooms). The addenda are also of concern to the subcontractors, material suppliers, and manufacturers' representatives who are preparing proposals for the project, as the revisions may affect their bids.

The receipt of the addenda for a particular project by the reporting service will be noted in the information the service sends to their subscribers. It is suggested that the contractor call the architect/engineer's office several days before bids are to be received, and again the day before to check that all addenda have been received. Most bid forms have a space provided in which the contractor must list the addenda received. Failure to complete this space may result in the bid being disqualified. For subcontractor bids that are used to bid the project, the contractors should verify that the addenda have been received by subcontractor and incorporated into his or her bid.

3–12 ERRORS IN THE SPECIFICATIONS

Ideally, the final draft of the specifications should be written concurrently with the preparation of the working drawings. The specification writer and production staff should keep each other posted on all items so that the written and graphic portions of the document complement and supplement each other.

ALTERNATES

ALTERNATE #1: The Contractor shall state in the Bid Form the amount to be added to the bid to furnish and install triple-pane windows in lieu of the double-paned windows.

FIGURE 3.5. Alternates.

ADDENDUM NO. 1

Real Estate Office

For

Mt. Ogden Development
5204 South Street
Ogden, Utah 84403

March 27, 2017

GENERAL

The bid date and time have been moved to 2:00 p.m. local time on April 27, 2017 at the owner's office.

SPECIFICATIONS

9.1. Change the specification to read: Tile to be 4-inch by 4-inch, thin set tile.

9.2. Add the following as approved carpets for this specification:

Totally Enterprises Soldy Elite

Invision Brisk

FIGURE 3.6. Addendum.

Many architects/engineers have been highly successful in achieving this difficult balance. Unfortunately, there are still offices that view specification writing as dull and dreary. For this reason, they sometimes assign a person not sufficiently skilled to this extremely important task. Also, many times, the specifications are put off until the last minute and then rushed so that they are published before they have been proofread. Some architects/engineers brush off the errors that arise with "we'll pick it up in an addendum."

Another practice that results in errors is when the architect/engineer uses the specifications from one job on a second job, which involves cutting a portion of the old specification out and inserting portions to cover the new job. Inadvertently, items are usually left out in such cases.

The real question is what to do when such an error is found. If the error is discovered early in the bidding period and no immediate answer is needed, the error is kept on a sheet that specifically lists all errors and omissions. Contractors are strongly urged to keep one sheet solely for the purpose of errors and omissions so that they can find the error when they need to. Most specifications require that all requests for interpretations must be made in writing and state how many days before the date set for opening bids they must be received. Check for this (often in instructions to bidders) and note it on the errors and omissions sheet. It is further stipulated in the project manual that all interpretations will be made in writing in the form of addenda and sent to all bidders. In actual practice, it is often accepted that estimators will telephone the architect's/engineer's office and request clarifications (interpretations, really). If the interpretation will materially affect the bid, the contractor must be certain to receive it in writing to avoid later problems. If there are contradictions between the drawings and the specifications, they should also attempt to get them resolved as early in the bidding period as possible.

In keeping a list of all discrepancies (errors) and any items not thoroughly understood, contractors should make notations about where on the drawings and in the project manual the problems occur. In this manner, when they ask for clarification, it is relatively easy to explain exactly what they want. The architect/engineer should not be contacted about each problem separately, but about a few at a time. Often the contractors will answer the questions themselves as they become more familiar with the drawings and the project manual. When calling architects/engineers, contractors need to be courteous, as everyone makes mistakes and being courteous will help keep them on your side. Besides, the information may have been included, but simply overlooked. Contractors should not wait until bids are due to call with questions, since verbal interpretations often will not be given, and even if they are, the person who knows the answers may not be available at the time. Regardless of the project or the type of estimate, the keynotes to success are cooperation and organization.

WEB RESOURCES

aia.org

csinet.org

REVIEW QUESTIONS

1. What types of information are found in the project manual?
2. Why is it important for the estimator to review carefully the entire project manual?
3. Describe the CSI MasterFormat and how it is used.
4. What types of information are provided in the invitation to bid?
5. Why is it important that the bids be delivered at the proper time and place?
6. How do the supplementary general conditions differ from the general conditions?
7. What information is contained in the specifications (technical specifications) of the project manual?
8. Explain what an alternate is and how it is handled during the bidding process.
9. Why is it important to prepare the alternate amounts carefully and thoroughly?
10. Explain what an addendum is and when it is used.
11. Why is it important that the estimator be certain that all addenda have been received before submitting a bid?
12. How should the estimator handle any errors or omissions that may be found in the contract documents?
13. Review a copy of the contract documents (drawings and project manual) for a construction project. Contact documents may be reviewed at a contractor's, subcontractor's, architect's, or engineer's office or may be downloaded from the Internet. Answer the following questions and be prepared to discuss your findings in class, if your instructor chooses to do so.

    a. How can a contractor obtain a set of contract documents?

    b. Are the contract documents on file at plan rooms, trade associations, or government agencies? If so, where are they on file?

    c. When and where is the bid due?

    d. What needs to be submitted for the bid to be complete?

    e. Do the contract documents use a standard contract prepared by the American Institute of Architects, a trade association, or government agency? If so, who prepared the contract?

    f. Do the contract documents use a standard set of general conditions prepared by the American Institute of Architects, a trade association, or government agency? If so, who prepared the general conditions?

    g. Do the contract documents contain supplementary general conditions? If so, how do they modify the general conditions?

    h. What alternatives need to be included in the bid?

    i. Have any addendums been issued for the project? Is so, how do they modify or clarify the contract documents?

    j. What allowances, if any, need to be included in the bid?

    k. Select one section from the technical specifications and answer the following questions. Be sure to select a section that deals with specific components of the building (e.g., doors, concrete, and masonry).

        i. What scope of work does this section cover? What is specifically included? What is specifically excluded?

        ii. What submittals, if any, are required under this section?

        iii. How does this section address quality?

        iv. What materials are required to complete the work under this section?

        v. What installation procedures are required by this section?

        vi. What warranties are required for this section?

        vii. What else is contained in this section?

        viii. What did you find interesting about this section?

CHAPTER **FOUR**

THE ESTIMATE

4–1 ROLL OF ESTIMATING

Estimating and the estimator play a key role in the success or failure of a construction company. It is by preparing estimates and submitting bids from these estimates that the company secures work. For the company to be successful, the estimator must prepare careful accurate bids for the construction projects. If the estimates are too high, the resulting bid is too high and the company may lose work that it otherwise might have won. Without work the company goes out of business. If the estimates are too low, the company may win work that it cannot complete and make a reasonable profit on, or worse yet, it may lose money on the project. If a company routinely loses money on projects, it won't be long before the company goes bankrupt or decides to go out of business before the owners lose all their money. When a company goes out of business, not only do the owners lose the money that they could have made, but the employees lose their jobs and their subcontractors' and suppliers' businesses may suffer because of the loss of their business. No other employee in the construction company has as great of an impact on the success and profitability of the construction company as the estimator. Many people are counting on him or her to win profitable work so they can have stable employment.

Because so many people are relying on the estimate, it is important that every estimate is prepared with a high degree of accuracy. There is no shortcut to preparing a detailed estimate that accounts for every item needed to complete the building. This can be a tedious and time-consuming process, but is essential to preparing accurate estimates.

4–2 ORGANIZATION

The estimator must maintain a high degree of organization throughout the estimate development stage. A well-organized estimate improves the probability of getting the work, facilitating the actual work in the field, and completing the work within budget. The organization required includes a plan for completing the estimate and maintaining complete and up-to-date files. It must include a complete breakdown of costs for the project, both of work done by company forces (in-house) and of work done by subcontractors. Using appropriate software can be an effective way to keep organized. The estimate information should include quantities, material prices, labor conditions, costs, weather conditions, job conditions, delays, plant costs, overhead costs, and salaries of forepersons and superintendents. All data generated during the development of the estimate must be stored in an orderly manner. The estimating costs are often stored in spreadsheets, databases, or estimating software packages. The original paper documents may be stored in file cabinets and archived after a specified period, or they may be scanned and stored electronically.

The estimate of the project being bid must be systematically done, neat, clear, and easy to follow. The estimator's work must be kept organized to the extent that in an unforeseen circumstance (such as illness or accident), someone else might step in, complete the estimate, and submit a proposal on the project. If the estimate is not organized and easy to read and understand, then there is no possible way that anyone can pick up where the original estimator left off. The easiest way for you to judge the organization of a particular estimate is to ask yourself if someone else could pick it up, review it and the contract documents, and be able to complete the estimate. Ask yourself: Are the numbers labeled? Are calculations labeled? Where did the numbers come from? What materials are being estimated? An organized estimate is also important in case the estimator leaves the company before the project is complete. If he or she leaves, someone else needs to be able to order the materials and answer questions as to what was included in the bid.

4–3 NOTEBOOK

A *notebook* should be kept for each estimate prepared. The notebook should be broken down into several areas: the workup sheets, summary sheets, errors and omissions

sheets, proposals received from subcontractors, proposals received from material suppliers and manufacturers' representatives, and notes pertaining to the project. Also, a listing of all calls made to the architect/engineer should be kept together, specifying who called, who was contacted at the architect/engineer's office, the date of the call, and what was discussed. The notebook should be neat and easy to read and understand.

Every page of the estimate should be numbered and initialed by the person who prepared that portion of the estimate. In addition, every page of the estimate should be checked and verified, and that person's initials should be placed on the page. This rather cumbersome procedure is required to help answer questions that may arise later. When construction begins and the estimate is used to purchase materials, if there are questions concerning a specific item, the estimator can be found and asked to clarify any questions.

4–4 TO BID OR NOT TO BID

It is impossible for a contractor to submit a proposal for every project that goes out to bid. Through personal contact and the reporting services, the contractor finds out what projects are out for bid and then must decide on which projects to submit a proposal. There are many factors to consider when deciding to bid or not to bid on a project. Here are some of the questions estimators should ask themselves when deciding whether or not to bid:

- Is this a job we are likely to get? If we are unlikely to win the job, we will be better off spending our time bidding jobs that we are more likely to win.
- Can we make a profit on this job? If not, we should not bid on it.
- Do we have the cash to fund the job? What is the retention rate? We often pay for labor, some materials, and other expenses before getting paid by the owner. When we get paid, the owner often holds retention. If we do not have sufficient cash to cover our costs until payment is received from the owner and cover the cost of retention, we should not bid on the job.
- Is a bond required? If so, do we have the bonding capacity to bid on the job? Can we get a bond for the job? If a bond is required and we cannot get a bond we cannot bid on the project.
- Have we successfully completed jobs of similar type and size? Do we have the expertise to successfully complete this job? If not, we should look for other work to bid.
- Where is the job located? Do we have subcontractors and material suppliers in the area? Are we familiar with the local market? Can we manage the project from our existing office or will we need a local office? Moving into a new area is a challenge. We need to make sure that we have the support system (suppliers, subcontractors, offices, etc.) in place to support the construction or can establish it. If not, we should not bid on the project.
- What is the reputation of the designers (architect, engineers)? Are they easy to work with? Are their construction documents complete? Even the best of project can turn into a nightmare when you are dealing with a difficult designer or poor construction documents. When either of these exists, it doesn't necessarily mean that we should not bid, but if we choose to bid, we need to incorporate the costs associated with dealing with a difficult designer and poor construction documents into our estimate.
- Do the owners have the funding to pay for the project? Do they pay on time? If they do not have the funding, we should not bid on the project. If they are slow to pay, we will need to have additional cash to cover our expenses until we receive payment; and cash cost money (interest), which needs to be included in our estimate. We may be better off bidding projects where the owners pay promptly.
- What is the reputation of the owners? Are they easy to work with? Like working with difficult designers, we may decide not to bid on projects with difficult owners; or if we decide to bid, we need to include the costs of dealing with difficult owners in the bid.
- Do we have the qualified personnel (both trade and management) needed to complete the project? If not, can we hire the labor that we need? Can we subcontract it out? Are the necessary labor union contracts in place? Can we bring labor in from surround areas? If we cannot staff the project with qualified personnel, we cannot bid on the project.
- Do we have the equipment we need? If not, can we purchase, lease, or rent it? If we cannot obtain the equipment needed on the project, then we cannot bid on the project.

There are also certain projects for which a contractor is not allowed to submit a proposal. The owners may accept proposals only from contractors who are invited to bid; other projects may have certain conditions pertaining to work experience or years in business that must be met.

Once the contractor has decided to bid on a particular project, arrangements need to be made to pick up the contract documents. The estimator should proceed with the estimate in a manner that will achieve the greatest accuracy and completeness possible. The accuracy required must be in the range of 98 to 99 percent for all major items on the estimate.

4–5 PLANNING THE ESTIMATE

The need for organization during the estimating process is critical. There are many decisions that need to be made concerning the logistics of who will do which portion of the estimate and when. In small companies, the estimate is often prepared by a single person who may be responsible for both preparing the estimate and managing the project. In large companies, the estimate may be prepared by a team of estimators whose only function is to prepare the estimates. Figure 4.1 is a diagrammatic representation of the steps that are required to

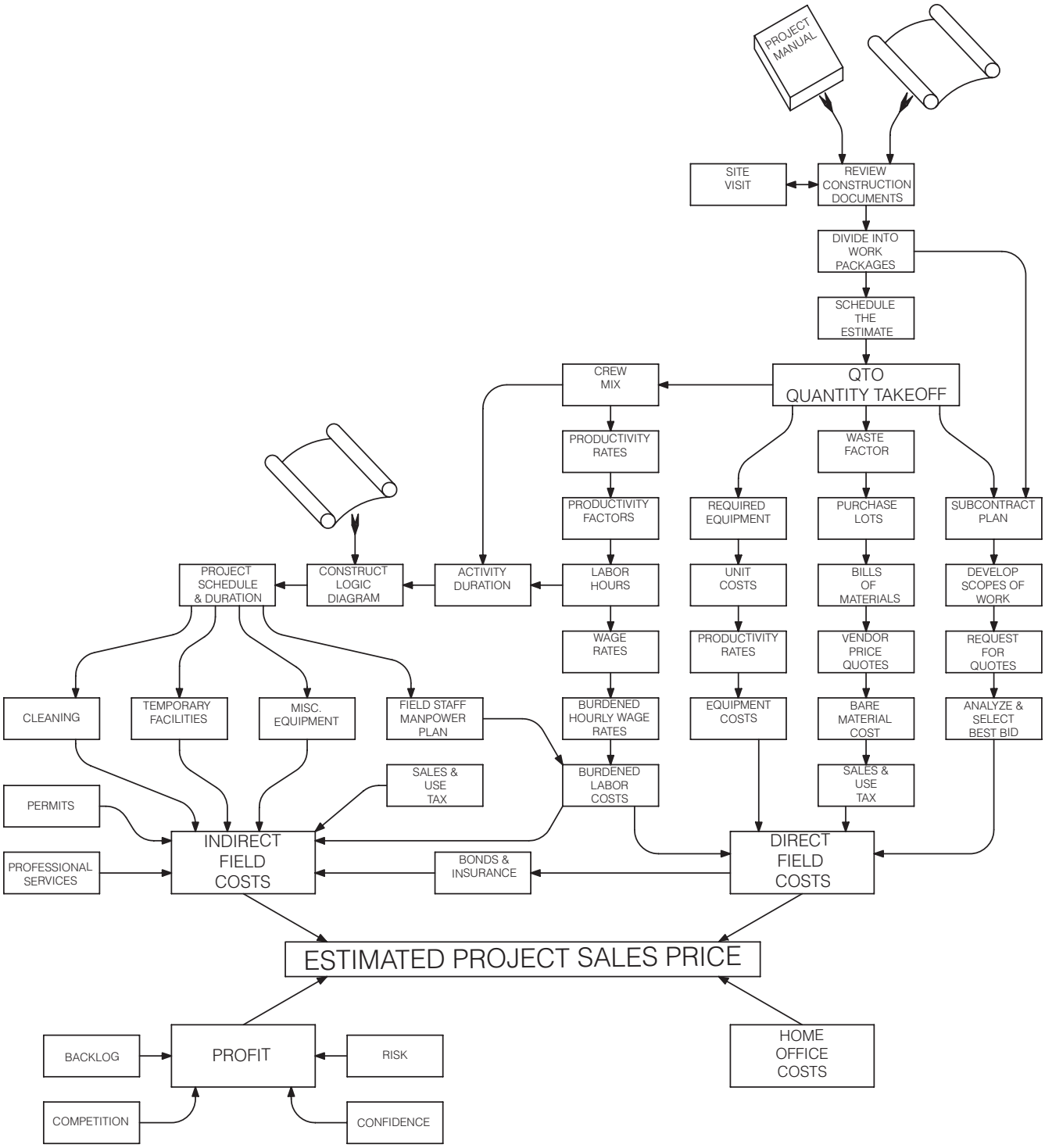


FIGURE 4.1. The Estimate Process.

complete an estimate. The size of the company and the company's culture will determine who will complete each of these steps and to what level the organization of the estimate will be broken down. As such, the organization of the estimate will be different from company to company. Figure 4.1 gives the reader a basic foundation on which to build their own estimating style and their own way of organizing the estimate. The steps in in Figure 4.1 will be discussed in this chapter.

Planning the estimate consists of four key activities (Figure 4.2): review of the construction documents (plans and project manual), site visit, dividing into work packages, and scheduling the estimate.

The first step in preparing an estimate is careful review of the construction documents (plans and project manual). It is important that the estimator has a clear understanding of the scope of work that needs to be performed so that he

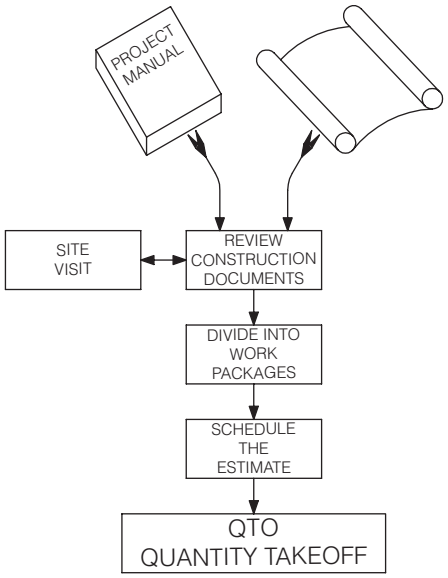


FIGURE 4.2. Planning the Estimate.

or she can prepare a complete estimate for the construction project. The following is a list of steps the estimator should take when reviewing a set of construction documents:

1. Carefully check the drawings and the project manual to be sure that you have everything, including all addenda. Not all architectural and engineering offices number their drawings in the same manner, so sometimes there can be confusion as to whether you have all the drawings. Architectural drawings are usually prefixed with the letter A. Structural drawings may be prefixed with the letter S, or they may be included with the architectural drawings. Mechanical drawings may be prefixed with M, P, or HVAC. Electrical drawings typically use the designation E. Some jobs have no prefixes before the numbers, but in these circumstances the pages are typically labeled Sheet 1 of 25. Typically, the front of the project manual or the drawings contains a list of all the drawings included in the set. Check all sources to ensure that you have received all of the drawings. If there are any discrepancies, check with the architect/engineer and complete your set. Follow the same procedure with the project manual. Check the list in the front of the project manual against what was received.
2. Scan the drawings to get a feel for the project. How large is it? What shape is it? What are the principal materials? Pay particular attention to the elevations. At this step, it is important that the estimator understands the project. Make a note of exterior finish materials, the amount of glass required, and any unusual features.
3. Review the floor plans, again getting the "feel" of the project. The estimator should begin to note all unusual plan features of the building. Look it over; follow through the rooms, starting at the front entrance. Again, make a note of what types of walls are used. Note whether enlarged floor plans show extra dimensions or whether special room layouts are required.
4. Begin to examine the wall sections for a general consideration of materials, assemblies, and makeup of the building. Take special note of any unfamiliar details and assemblies; circle them lightly with a red pencil or a highlighter so that you can refer to them readily.
5. Review the structural drawings. Note what types of structural systems are being used and what types of construction equipment will be required. Once again, if the structural system is unusual, the estimator should make a mental note to spend extra time on this area.
6. Review the mechanical and electrical drawings, paying particular attention to how they will affect the general construction, underground work requirements, outlet requirements, chases in walls, and other items of this sort. Even under separate contracts, the mechanical and electrical portions must be checked.
7. The submitted bid is based on the drawings and the project manual. You are responsible for everything contained in the project manual as well as what is covered on the drawings. Read and study the project manual thoroughly and review it when necessary. Take notes on all unusual items contained in the project manual.

Another important step is to visit the site after making a preliminary examination of the drawings and the project manual. The visit should be made by the estimator or by other experienced persons, including members of the proposed project execution team. By including these persons on the site visit, expertise and estimate ownership will be enhanced. The information that is obtained from the site visit will influence the bidding of the project. It is a good idea to take pictures of the site to reference when preparing the bid. The site investigation will be discussed in the next section.

Once the estimator has reviewed the construction documents and visited the site, he or she should have enough of an understanding of the project to divide it into work packages. A work package is a specific portion of the project's scope of work that will be assigned to a particular group. For example, a work package for a residence may include all of the drywall needed to complete the residence and a subcontractor will be hired to complete the drywall. Another work package for the residence may be the labor and equipment to complete the wood framing, which will be performed by one of the contractor's framing crews. Another work package may be the lumber to complete the wood framing, which will be purchased from a lumber supplier.

When preparing work packages, the estimator should be careful that all of the project's scope of work is included in a work package and that none of the work package overlap. If part of the scope of work is not included in any work package, its cost will be left out of the bid and the contractor will have to cover these costs out of the contingency or profit. If part of the project's scope of work is included in two or more work packages, its cost is included multiple times in

the bid, which increases the likelihood that the contractor will lose the bid because the bid was too high.

When preparing the work packages, the estimator should make sure of the following:

- All of the sections of the technical specifications have been assigned to a work package.
- When a section of the technical specifications is assigned to two or more work packages, each work package's responsibility has been clearly defined and the complete specification section is covered without overlap.
- The notes taken during the review of the construction document and the site visit have been addressed in the work package.

Once the work packages have been defined, a schedule may be prepared for the estimate. The same care used in preparing a construction schedule for the project should be used in preparing a schedule for the estimate.

Since the preparation of an estimate is a corroborative effort, it is essential that all persons have input into when certain items are required and that they understand the interrelationships between the responsible parties. Therefore, all estimating team members should be involved in the development of the overall estimate schedule.

Another helpful tool when preparing an estimate is a bar chart schedule that details when the activities comprising the estimate will be completed. In addition, the persons who are responsible for those activities should be listed on the schedule. Figure 4.3 is a sample bar chart schedule (prepared using MS Project) for completing an estimate. The bars and milestones will be tracked as the activities are completed.

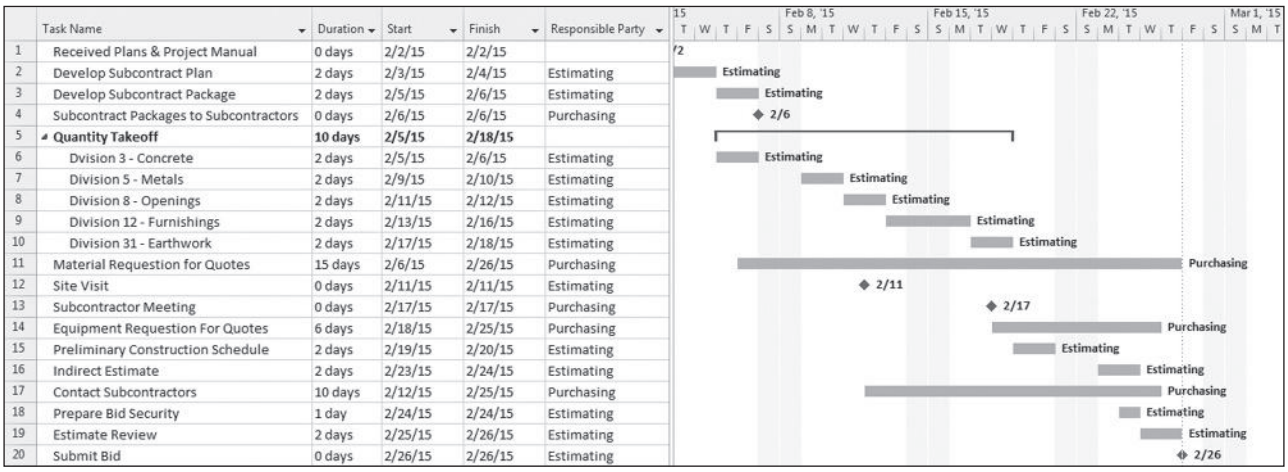
4–6 SITE INVESTIGATION

It is often required by the contract documents that the contractor visit the site and attend a pre-bid conference. The importance of the visit and the items to be checked vary depending on the type of the project and its location. Examples of the type of information that should be collected during the site visit are as follows:

1. Site access
2. Availability of utilities (electric, water, telephone)
3. Site drainage
4. Transportation facilities
5. Any required protection or underpinning of adjacent property
6. A rough layout of the site locating the proposed office trailer, storage trailers, and equipment locations
7. Subsurface soil conditions (bring a post hole digger to check this)

When a contractor expands to relatively new and unfamiliar areas, it is important that the contractor also become familiar with the surround area. Examples of the type of information that should be collected when beginning to work in a new area are as follows:

1. Local ordinances and regulations, and note any special requirements (permits, licenses, barricades, fences)
2. The local labor situation and local union rules
3. Availability of construction equipment rentals and the type and conditions of what is available as well as the cost
4. Prices and delivery information from local material suppliers (request proposals for the project)
5. The availability of local subcontractors (note their names, addresses, and what type of work they usually handle)
6. The conditions of the roads leading to the project, low bridges, and load limits on roads or bridges
7. Housing and feeding facilities if workers must be imported
8. Banking facilities



	Task Name	Duration	Start	Finish	Responsible Party
1	Received Plans & Project Manual	0 days	2/2/15	2/2/15	
2	Develop Subcontract Plan	2 days	2/3/15	2/4/15	Estimating
3	Develop Subcontract Package	2 days	2/5/15	2/6/15	Estimating
4	Subcontract Packages to Subcontractors	0 days	2/6/15	2/6/15	Purchasing
5	**Quantity Takeoff**	**10 days**	**2/5/15**	**2/18/15**	
6	Dvision 3 - Concrete	2 days	2/5/15	2/6/15	Estimating
7	Division 5 - Metals	2 days	2/9/15	2/10/15	Estimating
8	Division 8 - Openings	2 days	2/11/15	2/12/15	Estimating
9	Division 12 - Furnishings	2 days	2/13/15	2/16/15	Estimating
10	Division 31 - Earthwork	2 days	2/17/15	2/18/15	Estimating
11	Material Requestion for Quotes	15 days	2/6/15	2/26/15	Purchasing
12	Site Visit	0 days	2/11/15	2/11/15	Estimating
13	Subcontractor Meeting	0 days	2/17/15	2/17/15	Purchasing
14	Equipment Requestion For Quotes	6 days	2/18/15	2/25/15	Purchasing
15	Preliminary Construction Schedule	2 days	2/19/15	2/20/15	Estimating
16	Indirect Estimate	2 days	2/23/15	2/24/15	Estimating
17	Contact Subcontractors	10 days	2/12/15	2/25/15	Purchasing
18	Prepare Bid Security	1 day	2/24/15	2/24/15	Estimating
19	Estimate Review	2 days	2/25/15	2/26/15	Estimating
20	Submit Bid	0 days	2/26/15	2/26/15	Estimating

FIGURE 4.3. Sample Estimate Schedule.

4–7 QUANTITY TAKEOFF

Once the work packages have been established, the estimator may begin the takeoff of the quantities required. Each item must be accounted for, and the estimate itself must be as thorough and complete as possible. The items should be listed in the same manner and with the same units of measure in which the work will be constructed on the job. Whenever possible, the estimate should follow the general setup of the specifications. The materials should be grouped in the packages that they will be ordered; for example, the first floor lumber and the second floor lumber may be in separate packages so that they can be ordered separately. This work is done on a workup sheet. As each item is estimated, the type of equipment to be used for each phase should be listed. The list will vary depending on the equipment owned and what is available for rent.

At the time the estimator is preparing the quantity takeoff on workup sheets, the following tasks can also be ongoing:

a. Notify subcontractors, material suppliers, and manufacturers' representatives that the company is preparing a bid for the project and ask them if they intend to submit bids on the project.

b. Begin to make a list of all items of overhead that must be included in the project. This will speed up the future pricing of these items.

c. Send a copy of all insurance requirements for the project to your insurance company and all bonding requirements to your bonding company.

4–8 MATERIALS

Using the quantity takeoff, the estimator must include the cost of the materials in the direct field costs. The process for doing this is shown in Figure 4.4.

The first step is for the contractor to add waste factors to the quantities from the quantity takeoff. Waste occurs on a construction project for three basic reasons. Some waste is inherent in the design and cannot be avoided. For example, if you were carpeting a 10-foot by 10-foot room you would have to order a 10-foot by 12-foot piece of carpet because carpet comes in 12-foot-wide rolls. Some waste occurs because it is more cost-effective to include the waste than it is to eliminate the waste. For example, we could carefully hand grade the base below a concrete slab to within a hundredth of a foot, but the cost to do so exceeds the cost of leaving the grade a little low and using a little more concrete to pour the slab. The third type of waste is one that occurs due to misuse of materials, poor construction practices, allowing materials to be damaged, and so on. This type of waste should be minimized on the job.

Once a waste factor has been added, the quantity of materials must be rounded to purchasing lots or standard ordering units. If you needed 5.4 sheets of 7/16 OSB, you would round the ordering quantity to the next full sheet for 6 sheets. If you were ordering a large quantity of OSB, you may round up to the next full bunk (bundle) of OSB to take advantage of quantity pricing. The materials are then placed

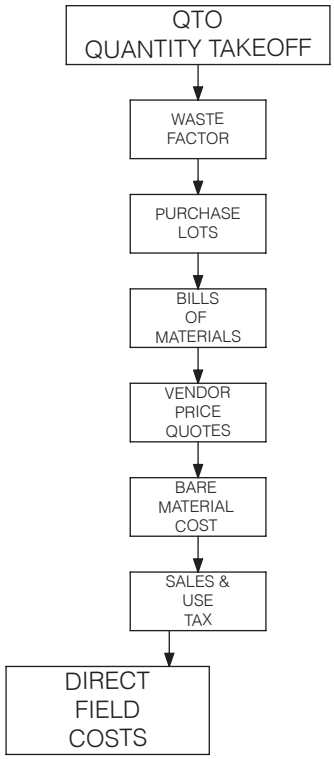


FIGURE 4.4. Estimating Materials.

on a bill (list) of materials. A bill of materials is prepared for different material supplier categories used on the job (e.g., concrete, rebar, and lumber).

For each project being bid, the contractor will request quotations from materials suppliers and manufacturers' representatives for all materials required. This is often done by sending them a copy of the bill of materials for the category of materials that they supply and asking them to provide pricing for the materials. Although on occasion a manufacturer's price list may be used, it is more desirable to obtain written quotations that spell out the exact terms of the freight, taxes, time required for delivery, materials included in the price, and the terms of payment (Figure 4.5). The written bids should be checked against the specifications to make certain that the specified material was bid.

The material costs from the selected supplier quote are entered on the workup sheet (see Section 4–14), which is used to calculate the bare material costs for all of the materials in a specific category. Sales and use tax are then added to the bare material costs. Remember that the sales tax that must be paid on a project is the tax in force in the area in which the project is being built; sometimes cities have different rates than the county in which they are located. Contractors should take time to verify the sale tax rate. Other costs, including all necessary freight, storage, transportation, insurance, and inspection costs, if they have not been included in the supplier's quote, are added to the bare material cost. All of these costs must be included in the material costs to establish an accurate budget for the material

Rocky Mountain Brick
713 Charles Blvd.
Ogden, Utah 84403
April 20, 2017

Ace Construction
501 Hightower St.
Ogden, Utah 84403

Re: Real Estate Office for Mt. Ogden Development

To Whom It May Concern:

We are pleased to quote on the materials required for the above referenced project. All of the materials listed below meet the requirements as specified in the drawings and specifications.

2 1/4 × 3 5/8 × 7 5/8 brick $450/1000 brick

All prices quoted are delivered (FOB Jobsite) without sales tax. Terms are 2/10 net 30.

FIGURE 4.5. Materials Price Quote.

cost. The invoices from the material suppliers, which will include these costs, will then be tracked against the budget. The total material cost is then entered as direct field costs on the summary sheet (see Section 4–15).

4–9 LABOR

Using the quantity takeoff, the estimator must include the cost of the labor performed by the crews in the direct field cost. The process for doing this is shown in Figure 4.6. Estimating labor costs is covered in detail in Chapter 7.

The first step is to determine the crew mix to be used to install the material. For example, a masonry crew may consist of three masons and two helpers. Next the productivity rate is established for the crew. Where possible, this should be obtained from historical data. The productivity rate is then adjusted by a productivity factor, which takes into account the unique job conditions. When the job conditions are better than average, the productivity factor increases the production of the crew; and when job conditions are worse than average, the productivity factor decreases production. The quantity of materials from the quantity takeoff, the productivity rate, and the productivity factor are used to calculate the labor hours required to install the materials, and the labor hours are entered on the workup sheet (see Section 4–14).

Next the wage rates for each worker classification used in the crew mix are determined. The labor burden is added to these wages to get the burdened hourly wage rate. Labor burden includes cash equivalents and allowances paid to the employee, payroll taxes, unemployment insurance, workers' compensation insurance, general liability insurance, insurance benefits (health, dental, and life), retirement contributions, union payments, and vacation, holiday, and sick leave. The total burdened labor cost is calculated and is then entered as direct field costs on the summary sheet (see Section 4–15).

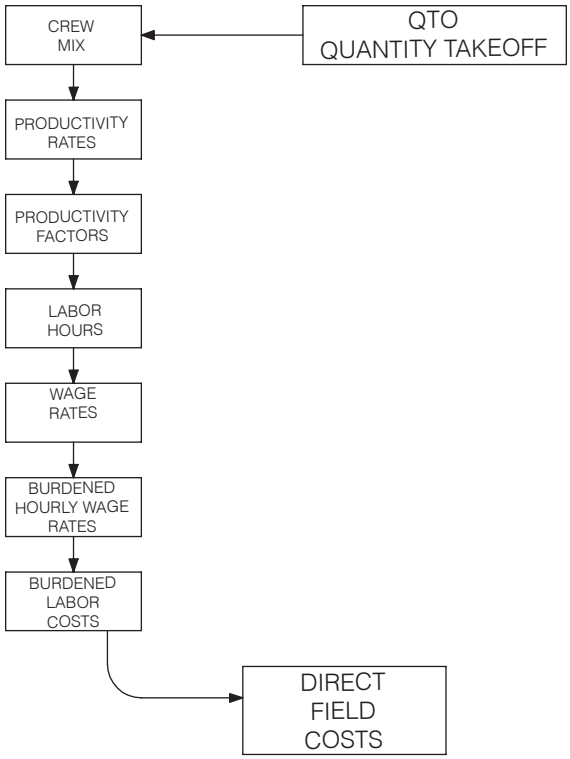


FIGURE 4.6. Estimating Labor.

4–10 EQUIPMENT

Using the quantity takeoff, the estimator must include the cost of the equipment in the direct field cost. The process for doing this is shown in Figure 4.7.

The first step is to determine the required equipment for the job. The estimator must determine if the company has the available equipment and, if not, whether the equipment will be purchased, leased, or rented. The estimator then determines the unit cost for the equipment. Estimating equipment costs is covered in detail in Chapter 8.

Using the productivity rates, used to determine labor costs, and the unit equipment costs, the equipment costs for the project is calculated on a workup sheet (see Section 4–14) and is then entered as direct field costs on the summary sheet (see Section 4–15).

4–11 SPECIALTY CONTRACTORS

A *specialty contractor* or *subcontractor* is a separate contractor hired by the general contractor to perform certain portions of the work. The amount of work that the general contractor will subcontract varies from project to project. Some federal and state regulations limit the proportion of a project that may be subcontracted, but this is rarely the case in private work. There are advantages and disadvantages to using specialty contractors. Trades such as plumbing, electrical, and heating and air-conditioning have a tradition of being performed by specialty contractors, due to their

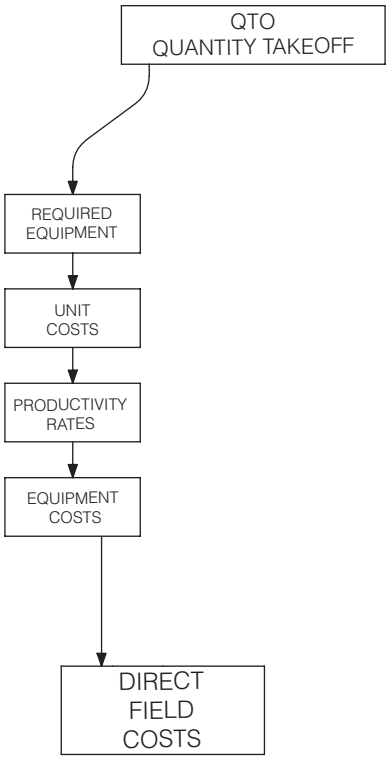


FIGURE 4.7. Estimating Equipment.

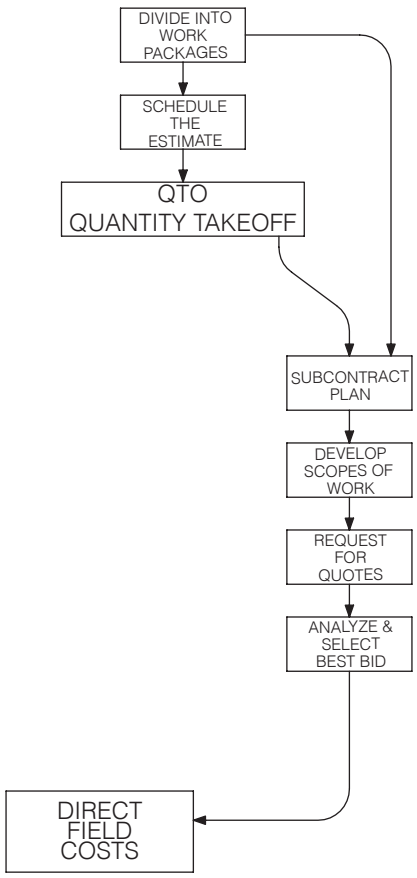


FIGURE 4.8. Estimating Using Specialty Contractor.

specialized nature and licensing requirements. However, contractors can now be found who are capable of performing every aspect of the construction project. Contractors today can construct entire projects without having any direct-hire craft personnel. The use of specialty contractors has gained popularity as a means to reduce risk and overhead; however, the contractor gives up a substantial amount of control when subcontracting the entire project.

Using the quantity takeoff, the estimator must include the cost of the specialty contractors in the direct field cost. The process for doing this is shown in Figure 4.8.

The first step is to develop a subcontractor plan, deciding what work is to be subcontracted out. The estimator then develops scopes of work for the work to be performed by the subcontractors based upon the work packages.

If specialty contractors are to be used, the contractor must be certain to notify them early in the bidding period so that they have time to prepare a complete, accurate estimate. If rushed, the specialty contractor tends to bid high just for protection against what might have been missed. The contractor notifies the specialty contractor by sending him or her a *request for quote*, which includes the scope for work for which the contractor is requesting a bid. Subcontracting and writing scopes of work are discussed in Chapter 9.

The use of specialty contractors can be economical, but estimates still must be done for each portion of work. Even if the estimator intends to subcontract the work, an estimate of the work should be prepared. It is possible that the estimator will not receive bids for a project before the bid date and will have to use an estimated cost of the work in totaling the bid.

All subcontractors' proposals (Figure 4.9) are compared with the estimator's price; it is important that a subcontractor's price is neither too high nor too low. If either situation exists, the estimator should call the subcontractor and discuss the proposal with him or her.

The specialty contractor's proposal is often phoned, faxed, or e-mailed into the general contractor's office at the last minute because of the subcontractor's fear that the contractor will tell other subcontractors the proposal price and encourage lower bids. This practice is commonly referred to as *bid peddling* or *bid shopping* and is unethical and should be discouraged. To prevent bid shopping, specialty contractors submit their final price only minutes before the bids close, which leads to confusion and makes it difficult for the estimator to analyze all bids carefully. This confusion is compounded by specialty contractors who submit unsolicited bids. These bids come from specialty contractors who were not contacted or invited to submit a bid, but who find out which contractors are bidding for the project and submit a bid. Since these companies are not prequalified, there is an element of risk associated with accepting one of these bids. On the other hand, not using low bids from unsolicited subcontractors places the contractor at a price disadvantage.

McBill Paint
1215 Miriam Rd.
Ogden, Utah 84403
April 20, 2017

Ace Construction
501 Hightower St.
Ogden, Utah 84403

Re: Real Estate Office for Mt. Ogden Development

Gentlemen:

We proposed to provide the labor, materials, and equipment to paint the interior walls and interior doors (including casing) for the sum of $5,097. All materials are bid in accordance with the contract documents, including addendum 1. Our bid includes minor patching and four hours of touch up. Additional patching and touch up will be billed at $50 per hour. We exclude all exterior painting, concrete sealers, and the painting of electrical, plumbing, and mechanical components; including but not limited to, power meters, gas meters, telephone boxes, cable TV boxes, and disconnects. This bid is good for 30 days.

Sincerely,

Charles McBill

FIGURE 4.9. Subcontractor's Proposal.

In checking subcontractor proposals, note especially what is included and what is left out and how soon the proposal must be accepted. Each subsequent proposal may add or delete items. Often the proposals set up certain conditions, such as use of water, heat, or hoisting facilities. The estimator must compare each proposal and select the one that is the most economical. If the proposal must be accepted before the owner has time to accept the general contractor's bid and the general contractor has time to accept the subcontractor's bid, the general contractor must include any anticipated escalation costs for the subcontractor's bid into the estimate or must select a subcontractor's bid that is good for a longer period of time. In Figure 4.9, the subcontractor's bid is good for 30 days.

All costs must be included somewhere. If the subcontractor does not include an item in the proposal, it must be considered elsewhere. A tricky task for the general contractor is the comparison of the individual subcontractor's price quotes. Throughout the estimating process, the general contractor should be communicating with the specific subcontractors concerning the fact that they will submit a price quote and what scope of work is to be included within that quote. However, subcontractors will include items that they were not asked to bid and will exclude items that they were asked to bid. A "bid tabulation" or "bid tab" is used to equalize the scope between subcontractors so that the most advantageous subcontractor's bid can be included in the general contractor's bid. Figure 4.10 is an example of a bid tabulation form. A spreadsheet version of Figure 4.10 (Bid-Tab.xls) is provided on the companion website.

The selected bidders are then entered as direct field costs on the summary sheet (see Section 4–15).

4–12 OVERHEAD AND CONTINGENCIES

In addition to the direct field costs, the estimator must include in the indirect field (project overhead) costs. The process for doing this is shown in Figure 4.11. When preparing the indirect field costs, the estimator should carefully check through the general conditions and supplementary general conditions, making a list of all items contained in the project manual that will affect the cost of the project. Project overhead costs are discussed in detail in Chapter 6.

In order to determine the indirect field costs, the estimator must establish the project's duration. This begins by defining the activities (or tasks) required to complete the project and establishing durations for each activity. For activities that are performed by the company's crews, the duration of the activity can be calculated by dividing the number of labor hours required to complete the activity (which was determined when preparing the labor cost) by the number of labor hours performed by the selected crew in one day. For example, if it is estimated that it will take 110 labor hours to complete the masonry on a project and the masonry will be installed by a crew of three masons and two helpers working eight hour per day, the duration would be three days and is calculated as follows:

$$\frac{110 \text{ labor hours}}{(3 \text{ masons} + 2 \text{ helpers}) \times 8 \text{ hours/day}}$$

$$= 2.75 \text{ days} - \text{say } 3 \text{ days}$$

BID TABULATION

Project: _____ Estimate No. _____
Location: _____ Sheet No. _____
Architect: _____ Date: _____
Subcontract Package: _____ By: _____ Checked: _____

	Scope of Work	Subcontractor 1	Subcontractor 2	Subcontractor 3	Subcontractor 4	Subcontractor 5
	Base Bid					
	Adjustments					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
	Adjusted Bids					

Comments

FIGURE 4.10. Subcontract Bid Tabulation.

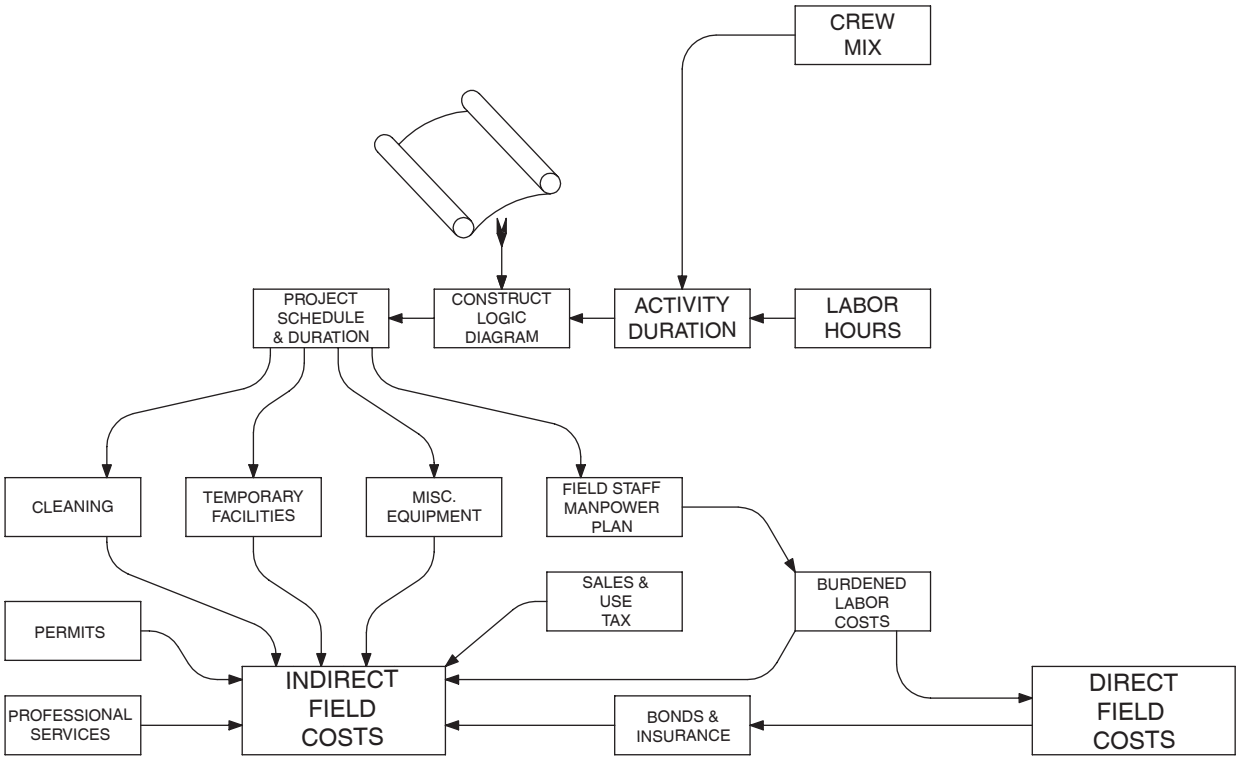


FIGURE 4.11. Estimating Overhead.

The estimator should establish durations for the activities performed by the specialty contractor in consultation with the contractors.

Using the activities, their durations, and information contained on the plans, the estimator must construct a logic diagram for the project, placing the activities in the sequence that they are to be performed to complete the project. From this, the estimator prepares a schedule for the project, including the duration.

Using the project's duration, the estimator can prepare costs for items (such as cleaning, temporary facilities, field

staff, and miscellaneous equipment) that are required for the duration of the project. For cleaning, temporary facilities, and miscellaneous equipment, the costs are equal to the daily, weekly, or monthly cost multiplied by the duration for which they are needed. For field staff, the estimator must prepare a field staff workforce plan identifying the personnel needed on the project. The burdened labor costs are combined with the field staff workforce plan to estimate the indirect labor costs for the project.

To these costs, the estimator must add the cost of permits, professional services (surveying, engineering, testing, etc.), bonds and insurance, and other overhead costs that are not tied to the project's duration. The bond and insurance costs are based upon the direct field costs plus an estimate of the indirect field costs, home office cost, and anticipated profit markup.

The indirect field costs are entered on the summary sheet (see Section 4–15).

4–13 PROFIT AND HOME OFFICE COSTS

Profit and home office costs are added to the direct and indirect field costs to get the anticipated project sales price (or bid).

The home office costs cover the overhead of the company's offices. The home office markup is determined by dividing the expected overhead cost for the office for the year by the anticipate sales for the year. This markup is then added to the bids.

The profit provides the owners a return on their investment. When determining the profit markup, the estimator should take into account, among other things, the company's work backlog, the competition bidding on the project, the risk of the project, and the estimator's confidence in the estimate and the company's ability to complete the project on budget. Profit is discussed in detail in Chapter 21.

4–14 WORKUP SHEETS

The estimator uses two basic types of manual takeoff sheets: the workup sheet and the summary sheet. The *workup sheet* can be a variety of forms contingent upon what is being quantified, and may be used for material, labor, equipment, or a combination of these. Figure 4.12 is an example of a workup sheet that could be used to quantify reinforcing steel. A spreadsheet version of Figure 4.12 (Rebar.xls) is provided on the companion website.

The workup sheet is used to make calculations and sketches and to generally "work up" the cost of each item. Material and labor costs should always be estimated separately. Labor costs vary more than material costs, and the labor costs will vary in different stages of the project. For example, a concrete block wall will cost less for its first 3 feet than for the balance of its height. The labor cost goes up as the scaffold goes up, yet material costs remain the same.

When beginning the estimate on workup sheets, the estimator must be certain to list the project name and location, the date that the sheet was worked on, and the estimator's name. All sheets must be numbered consecutively, and when completed, the total number of sheets is noted on each sheet (e.g., if the total number was 56, sheets would be marked "1

ESTIMATE SUMMARY SHEET
REINFORCING STEEL

Project	Little Office Building	**Estimate No.**	1234
Location	Littleville, TX	**Sheet No.**	1 of 1
Architect	U.R. Architects	**Date**	11/11/20XX
Items	Foundation Concrete	**By**	LHF **Checked** JBC

Cost Code	Description	Dimensions L ft	W ft	Space /ft			Count	Bar Size	Linear Feet	Pounds/ Foot				Quantity	Unit
	Continuous Footings														
	Perimeter - Long Bars	336	3.167	2			8	5	2,688	1.043				2,804	Pounds
	Perimeter - Short Bars	2.83	336	2			673	5	1,905	1.043				1,986	Pounds
	Interior - Long Bars	76	3	2			7	5	532	1.043				555	Pounds
	Interior - Short Bars	2.67	76	2			153	5	409	1.043				426	Pounds
	Dowels														
	Perimeter	4	336	1			337	5	1,348	1.043				1,406	Pounds
	Interior	4	76	1			77	5	308	1.043				321	Pounds
	Foundation Walls														
	Perimeter - Long Bars	336	4	2			9	5	3,024	1.043				3,154	Pounds
	Perimeter - Short Bars	3.67	336	2			673	5	2,470	1.043				2,576	Pounds
	Interior - Long Bars	76	8	2			17	5	1,292	1.043				1,348	Pounds
	Interior - Short Bars	8	76	2			153	5	1,224	1.043				1,277	Pounds
					Count										
	Spread Footings	2.67	2.67	2	3		42	5	112	1.043				117	Pounds
	Dowels	4			3		12	5	48	1.043				50	Pounds
	Column Piers - Vertical Bars	3.67			3		12	5	44	1.043				46	Pounds
	Column Piers - Horizontal Bars	3.33	4	1	3		15	3	50	0.376				19	Pounds
	Drilled Piers														
	Vertical Bars	20			3		18	5	360	1.043				375	Pounds
	Horizontal Bars	3.67	20	1.5	3		93	3	341	0.376				128	Pounds
	Grade Beam - Long Bars	69					6	5	414	1.043				432	Pounds
	Grade Beam - Stirrups	3.67	69	1			70	3	257	0.376				97	Pounds
													Total	**17,117**	**Pounds**

FIGURE 4.12. Estimate Workup Sheet—Reinforcing Steel.

of 56" through "56 of 56"). The estimator must account for every sheet, because if one is lost, chances are that the costs on that sheet will never be included in the bid price. Never alter or destroy calculations; if they need to be changed, simply draw a line through them and rewrite. Numbers that are written down must be clear beyond a shadow of a doubt. Too often a "4" can be confused with a "9," or "2" with a "7," and so on.

Setting up the workup sheets as computerized spreadsheets can increase the estimator's productivity and reduce estimating errors. The spreadsheets should be carefully examined to ensure that they are error free. Cells in the spreadsheet that contain formulas should be locked to prevent the formulas from being accidentally erased or changed. Errors in spreadsheet programs can be costly and repeated over many jobs before the error is found.

All work done in compiling the estimate must be clear and self-explanatory. It should be clear enough to allow another person to come in and follow all work completed and all computations made each step of the way.

When taking off the quantities, estimators must make a point to break down each item into different sizes, types, and materials, which involves checking the specifications for each item they are listing. For example, in listing concrete blocks, they must consider the different sizes required, the bond pattern, the color of the unit, and the color of the mortar joint. If any of these items varies, it should be listed separately. It is important that the takeoff be complete in all details; do not simply write "wire mesh," but "wire mesh $6 \times 6 - W10 \times W10$"—the size and type are very important. If the mesh is galvanized, it will increase your material cost by about 20 percent, so this also should be noted on the sheet. Following the CSI MasterFormat helps organize the estimate and acts as a checklist.

4–15 SUMMARY SHEET

All costs contained on the workup sheets are condensed, totaled, and included on the summary sheet. All items of labor, equipment, material, plant, overhead, and profit must likewise be included. The workup sheets are often summarized into summary sheets that cover a particular portion of the project. Figure 4.13 is an example of a summary sheet used to summarize the concrete contained in the project. Every item on this page is supported by workup sheets. A spreadsheet version of Figure 4.7 (Recap.xls) is provided on the companion website.

In addition to summarizing portions of the project, it is helpful to summarize the entire estimate onto a single page. Figure 4.14 is an example of a summary sheet that could be used to summarize all costs for the entire project. A spreadsheet version of Figure 4.8 (Est-Summary.xls) is provided on the companion website.

The summary sheet should list all the information required, but none of the calculations and sketches that were used on the workup sheets. It should list only the essentials, yet still provide enough information for the person pricing the job not to have to continually look up required sizes, thicknesses, strengths, and similar types of information.

4–16 ERRORS AND OMISSIONS

No matter how much care is taken in the preparation of the contract documents, it is inevitable that certain errors will occur. Errors in the specifications were discussed in Section 3–12, and the same note-taking procedure is used for all other discrepancies, errors, and omissions. The instructions to bidders or supplementary general conditions ordinarily states that if there are discrepancies, the specifications take precedence over drawings and dimensioned figures, and detailed drawings take precedence over scaled measurements from drawings. All important discrepancies (those that affect the estimate) should be checked with the architect/engineer's office.

The estimator should check his or her work carefully and all figures should be double-checked. If possible, the estimator should have someone else check the figures. The most common error is the misplaced decimal point. Other common errors include the following:

- **a.** Errors in addition, subtraction, multiplication, and division
- **b.** Omission of items such as materials, labor, equipment, or overhead
- **c.** Errors in estimating the length of time required to complete the project
- **d.** Errors in estimating construction waste
- **e.** Errors in estimating quantities of materials
- **f.** Errors in transferring numbers from one sheet to another
- **g.** Adding a line to a spreadsheet and not checking to make sure that the new line is included in the total
- **h.** Errors in setting up formulas, items, assemblies, markups, and so forth in estimating software
- **i.** Using typical productivity rates and costs from estimating software without adjusting them for individual project conditions
- **j.** Improper use of estimating software because the user does not understand the limits of the software or the inputs required by the software

Having priced everything, the estimator should make one last call to the architect's or engineer's office to check the number of addenda issued to be sure that they have been received. He or she should double-check the time, date, and place that bids are being received. He or she should carefully review the proposal to make sure that it is complete and that all of the requirements for the submission have been followed.

ESTIMATE SUMMARY SHEET

Project	Little Office Building	**Estimate No.**	1234
Location	Littleville, TX	**Sheet No.**	1 of 1
Architect	U.R. Architects	**Date**	11/11/20XX
Items	Foundation Concrete	**By**	LHF **Checked** JBC

Cost Code	Description	Q.T.O.	Waste Factor	Purch. Quan.	Unit	Crew	Prod. Rate	Wage Rate	Labor Hours	Unit Cost Labor	Unit Cost Material	Unit Cost Equipment	Labor	Material	Equipment	Total
	Continuous Footing #5 Bar															
	(2804+1986+555+426)/2000	2.886	10.00%	3.17	Ton		15	$30.66	43.3	$459.90	$970.00		$1,460	$3,079	$0	$4,539
	Dowels From Footing to Wall															
	(1406+321)/2000	0.864	10.00%	0.95	Ton		15	$30.66	13.0	$459.90	$970.00		$437	$922	$0	$1,359
	Foundation Wall															
	(3154+2576+1348+1277)/2000	4.178	10.00%	4.60	Ton		11	$30.66	46.0	$337.26	$970.00		$1,550	$4,458	$0	$6,008
	Spread Footings w/Dowels															
	(117+50)/2000	0.084	10.00%	0.09	Ton		15	$30.66	1.3	$459.90	$970.00		$42	$90	$0	$132
	Columns Piers															
	#5 Bar	0.023	10.00%	0.03	Ton		24	$30.66	0.6	$735.84	$970.00		$19	$25	$0	$43
	#3 Bar	0.010	10.00%	0.01	Ton		24	$30.66	0.2	$735.84	$970.00		$8	$11	$0	$19
	Drilled Piers															
	#5 Bar	0.188	10.00%	0.21	Ton		24	$30.66	4.5	$735.84	$970.00		$152	$201	$0	$353
	#3 Bar	0.064	10.00%	0.07	Ton		24	$30.66	1.5	$735.84	$970.00		$52	$68	$0	$120
	Grade Beam															
	#5 Bar	0.216	10.00%	0.24	Ton		22	$30.66	4.8	$674.52	$970.00		$160	$230	$0	$391
	#3 Bar	0.049	10.00%	0.05	Ton		22	$30.66	1.1	$674.52	$970.00		$36	$52	$0	$89
	Slab on Grade															
	(1348+1277)/2000	1.313	10.00%	1.44	Ton		13	$30.66	17.1	$398.58	$970.00		$576	$1,401	$0	$1,977
									133.21				**$4,493**	**$10,537**	**$0**	**$15,029**

FIGURE 4.13. Estimate Summary Sheet.