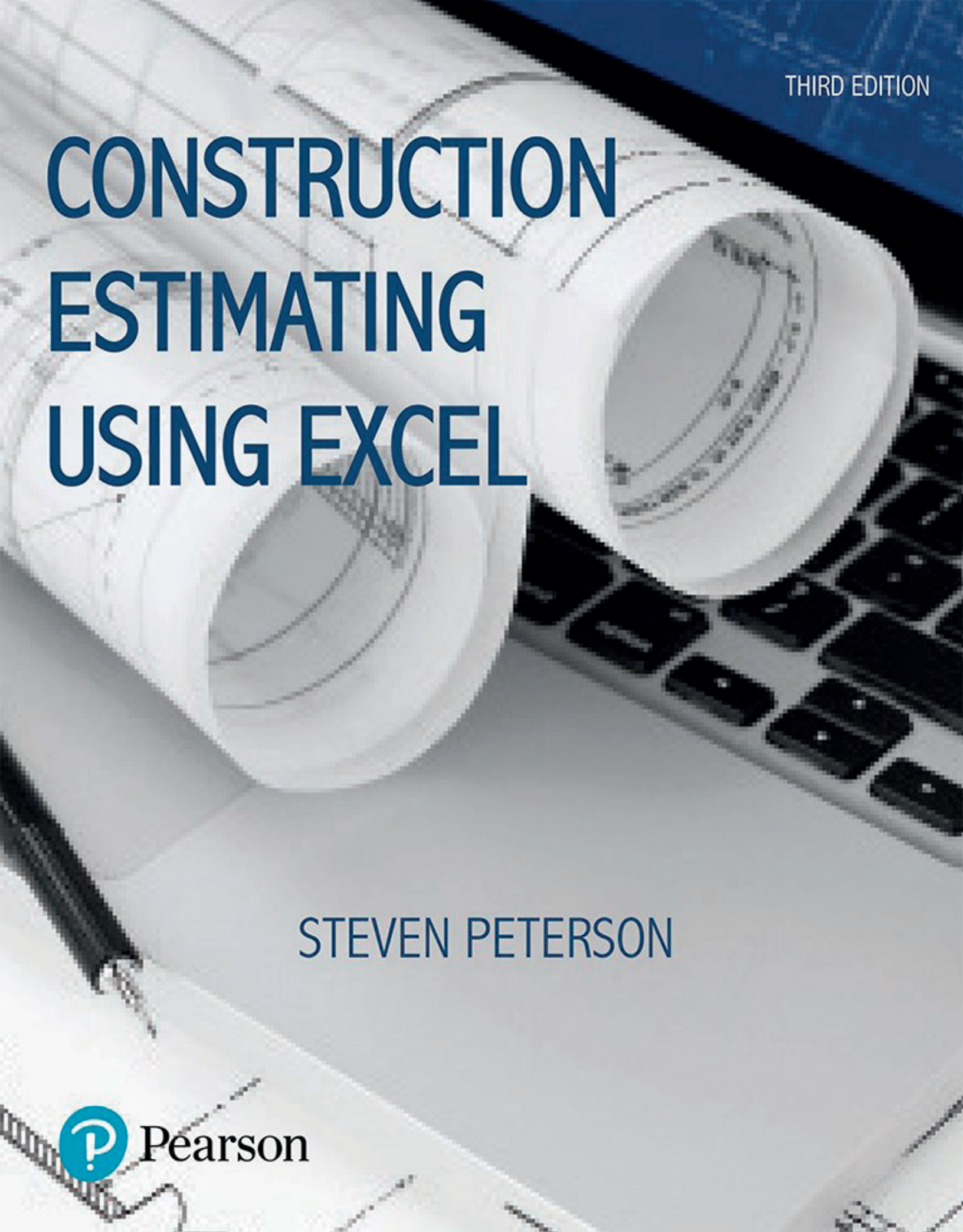
THIRD EDITION
CONSTRUCTION ESTIMATING USING EXCEL
STEVEN PETERSON
Pearson

Construction Estimating Using Excel

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Construction Estimating Using Excel

THIRD EDITION

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DEDICATION

This book is dedicated to Bill Thiede,
who taught me how to estimate.

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PREFACE

The second hand of the clock swept rapidly toward the 12, signifying that it was 15 minutes to 1. Fifteen minutes until the bid I was working on was due. I had 10 minutes until our secretary would call for the final price, giving her just enough time to write the number on the bid forms, seal the bid, and turn it in. The bid had been tallied and was ready to go, with the exception of one blank line. The words "Asphalt Paving" along with the blank space to the right glared at me. I had yet to receive a number from my asphalt contractor, who had promised me that he would get me a bid. I called his phone number. No answer! There was only one thing left for me to do. I had to do an asphalt takeoff myself, and I had only 8 minutes left. Quickly I grabbed my scale, turned it to match the scale at the bottom of the drawing ($1/8'' = 1'$), and began to determine the quantity of asphalt needed for the parking lot. Cutting corners where I could, scribbling numbers on a piece of scratch paper, and punching the numbers on my calculator, I arrived at the square footage of the asphalt. It wasn't exact, but it was close. I then multiplied the square footage by the estimated cost per square foot for the asphalt. The phone rang as I added my estimated cost for the asphalt to the bid. It was our secretary calling for the bid. I gave her the number, and she read it back to me.

I relaxed for the next 20 minutes, waiting for our secretary to call back with the bid results. The phone rang again and it was our secretary. We had won the bid. As I was enjoying the thrill of victory, I glanced at the plans and the words "Warning: Half Size Drawings" jumped off the page. The thrill of victory turned into a large lump in my stomach as I realized why I had won the bid. I had forgotten to double all my measurements as I measured the asphalt, so I had only 25% of the money I needed to purchase the asphalt for the project. Quickly, and carefully this time, I took off the asphalt again. Indeed, I only had a quarter of the asphalt I needed, and it would take all the profit in the job and then some to pay for it.

By working hard during the buyout process, I was able to get the project back on budget. I did this by finding local subcontractors and suppliers for the items I had bid myself who would do the work for less than I had budgeted. In the end, we made a fair profit on the job, but that does not make up for the money we left on the table because of my error.

The job of an estimator is to forecast as accurately as possible the likely cost of a construction project, as well as the required amounts of materials, labor, and equipment necessary to complete the work. Because of the high degree of uncertainty in estimating these items, estimating is more of an art than a science.

There are three key pillars that support the success of an estimator. The first is an understanding of the construction process—how things are built and how the pieces are put together. The second is an understanding of the fundamental principles of estimating. Estimates that are not based on these fundamental principles are nothing more than wild guesses. The third pillar is experience. For a person to become a good estimator, it is required that he or she develops good judgment on how to apply estimating principles. Will Rogers reportedly said, "Good judgment comes from experience, and a lot of that comes from bad judgment."[1] The pillar of experience can only be acquired through practice.

The purposes of this book are to: (1) give beginning estimators an understanding of the fundamental principles of estimating, (2) provide beginning estimators with practical estimating experience, (3) give beginning estimators a basic understanding of how to use spreadsheets, such as Microsoft Excel,[2] to increase their estimating productivity and reduce errors, and (4) give experienced estimators another view on estimating and a chance to improve their estimating skills.

[1] Will Rogers as posted on http://www.brainyquote.com/quotes/quotes/w/willrogers411692.html; accessed August 5, 2016.

[2] Microsoft® Excel is a registered trademark of the Microsoft Corporation in the United States and other countries.

This book is divided into five sections. The first section introduces the reader to estimating. The second section introduces the quantity takeoff and teaches the reader how to determine the quantity of materials needed to complete the project. The third section shows how to put costs to the estimate. The fourth section shows how to finalize the bid, incorporate the estimate into the schedule, and buy out the project, and also discusses bidding ethics. The fifth section teaches how to tap into the power of computer spreadsheets—specifically Microsoft® Excel—and demonstrates how spreadsheets can be used to automate estimating functions. It also provides a chapter on estimating methods used to prepare conceptual and preliminary estimates. To provide practice in estimating, three drawing sets are included—a residential garage, a residence, and a retail building.

I hope that you will take the time to carefully read each chapter, work the problems at the end of each chapter, and prepare estimates for the drawings sets included with the book. Doing this will help you begin to gain the experience needed to be a successful estimator.

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

I would like to thank the following people for providing reviews of the manuscript: Dennis Dorward (Pennsylvania College of Technology), Kristen Gundvaldson (Southeast Technical Institute), Darwin Olson (Anoka Technical College), Mark Steinle (Casper College), James William White (Indiana University–Purdue University Indianapolis), and Manoochehr Zoghi (California State University, Fresno).

STUDENT LEARNING OUTCOMES

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 program, 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. This book includes both a residential and a commercial set of plans. Each chapter, where applicable, includes homework problems related to these plans. By completing the homework problems associated with either the residential plans or the commercial plans, the students will prepare a complete construction estimate. See the instructor's guide for more information on which problems relate to preparing these estimates.
- Effectively communicate in writing. Chapter 24 covers writing a scope of work and Chapter 28 covers writing proposals and communicating by e-mail. The material in these chapters can be used in part to meet the outcome related to written communication.
- Understand ethics as it relates to estimating. Chapter 31 addresses ethic as it relates to estimating and can be used in part to meet the outcome related to ethics.

NEW TO THIS EDITION

The following is a list of key changes that have been made to this edition.

- The Excel contents have been updated to Excel 2016, the latest version of Excel available at the time of this revision.
- A number of changes have been made to ensure that the material in this book aligns with the ACCE and ABET student learning outcomes.
- The material and equipment costs and labor rates have been updated to reflect the costs at the time of this revision.
- Chapters 33 and 34 have been combined into a single chapter and a chapter covering estimating methods used to prepare conceptual and preliminary estimates has been added as Chapter 34.
- The use of data from RSMeans (along with six sample pages from their books) has been added.
- A discussion of the Fair Labor Standards Act, which covers the labor laws dealing with non-exempt employees, has been added.
- A discussion of the Davis–Bacon Act, which covers the pay rates for employees on projects funded by the federal government, has been added.
- The problem sets from Chapters 21 and 22 have been expanded.
- An appendix with sample equipment costs has been added.

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The sample Excel spreadsheets in this book are to provide the reader with examples of how Excel may be used in estimating, and as such, are designed for a limited number of estimating situations. Before using the spreadsheets in this book, the reader should understand the limits of the spreadsheet and carefully verify that the spreadsheets: (1) are applicable to his or her estimating situation and (2) produce an acceptable answer. The reader assumes all risks from the use and/or performance of these spreadsheets. The drawings included with this text are for educational purposes only and are not to be used for construction.

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BRIEF CONTENTS

CONTENTS

PART ONE

INTRODUCTION TO ESTIMATING

In this section, you will be introduced to the art of estimating, the estimating process, and Microsoft Excel 2016. These chapters will prepare you for the rest of the book. For those of you who struggle with math or just want to review the mathematical principles used in estimating, a review of estimating math is given in Appendix A.

CHAPTER **ONE**

THE ART OF ESTIMATING

In this chapter you will be introduced to the art of estimating. You will learn what it takes to become a good estimator, the components of a bid package, and the tools used by an estimator. Finally, you will be introduced to computerized estimating.

Estimating is the process of determining the expected quantities and costs of the materials, labor, and equipment for a construction project. The goal of the estimating process is to project, as accurately as possible, the estimated costs for a construction project, as well as the required amount of materials, labor, and equipment necessary to complete the work. The American Institute of Architects defines the work as "the construction and services required by the Contract Documents . . . and includes all other labor, materials, equipment and services provided . . . by the Contractor to fulfill the Contractor's obligations."[1] The work is often referred to as the *scope of work*.

Estimating plays a key role in the operation of construction companies. Accurate estimates are needed for a company to be successful in the bidding process while maintaining a reasonable profit margin. If the estimates are too high, the company may starve to death because of the lack of work. If the estimates are too low, the company may lose money and go bankrupt. The estimator is constantly walking a fine line between bidding too low and too high.

THE ESTIMATOR

The estimator is the person responsible for preparing the cost estimates. Large companies may employ an estimating department with one or more full-time estimators. The estimating department is often charged with preparing all of the company's estimates. In smaller companies, the project managers or the company's owner may be responsible for preparing the estimates. Regardless of their job title, employees who are responsible for preparing estimates are estimators. The estimator is responsible for seeing that the estimate accurately determines the quantity of materials, labor, and equipment and incorporates the costs to complete the required scope of work along with a reasonable profit while remaining competitive with other firms in the market. Great skill is required to balance the need to be competitive with the need to be profitable.

To be a good estimator a person must possess the following skills:

- An estimator must have a sound understanding of the construction methods, materials, and the capacities of skilled labor. Because of the great variety of work, it is impossible for an estimator to be versed in all forms of construction. Therefore, an estimator must specialize in one or more areas of construction. An estimator may specialize in a subcontractor trade such as electrical, mechanical, or excavation. An estimator may also specialize in an area of construction such as residential, tenant finish, or highway construction. Because the methods of construction, the preferred materials of construction, and the skill of labor vary from market to market, estimators must also specialize in a specific market area, such as a state or region.
- An estimator must possess the basic skills needed to determine the quantities of materials, labor, and equipment necessary to complete a project. This requires the estimator to read blueprints, understand the design that the architect or engineer has specified, and determine the quantities needed to complete the project. Because much of an estimator's time is spent working with quantities, estimators must have strong mathematical skills. A review of estimating math is given in Appendix A.

- An estimator must be a good communicator, both verbally and in written form. Part of an estimator's job is to obtain pricing from vendors and subcontractors. To do this, the estimator must convince vendors and subcontractors to bid on projects, communicate what pricing is needed, and—when the company has won the job—communicate the responsibilities of the vendors and subcontractors in the form of purchase orders and subcontracts provided to the vendor, subcontractor, superintendent, and so forth. Estimators may also be required to present estimates to owners—which requires good presentation skills—or prepare proposals—which requires good writing skills.
- An estimator must possess strong computer skills. Much of today's estimating is performed using computer software packages, such as Excel, takeoff packages such as On-Screen Takeoff, and estimating software packages. Estimators also need to be able to prepare contracts, proposals, and other documents using a word processing program.
- An estimator must be detail-oriented. Estimators must carefully and accurately determine the costs and quantities needed to complete the project. Simple mistakes—such as forgetting that the drawings are half-scale or not reading the specifications carefully enough to realize that an unusual concrete mix has been specified—can quickly turn a successful project into an unprofitable job and, in extreme cases, bankrupt a company.
- An estimator must have the confidence to quickly prepare takeoffs and make decisions under pressure. Bid days are hectic. Many vendors and subcontractors wait until the last hour to submit their bids. As the time of the bid closing approaches, the estimator must compare and incorporate new pricing as it is received and fill in missing pricing with limited time and information at his or her disposal. Making a bad decision or failing to make a decision under pressure can cause the company to lose the bid or take an unprofitable job.
- Finally, an estimator must have a desire for constant improvement. One way to do this is to get involved with a professional origination such as the American Society of Professional Estimators (ASPE). Other ways include studying other estimating books and attending seminars. Much of a company's success or failure rides on the abilities of the estimator to obtain profitable work.

Because of the high degree of uncertainty in estimating costs, estimating is more of an art than a science. As with any art, only by practicing can one become a good estimator. One would not expect to become a good pianist after a few lessons. It takes practice. Likewise, becoming a good estimator takes practice. But practice is not enough. Practicing bad estimating skills will only turn a person into a bad estimator. Truly, practice makes permanent. To be a good estimator, a person must practice using good estimating skills; and for a person to practice good estimating skills, he or she must have a sound understanding of the fundamental principles of estimating. This understanding can only be obtained by studying the art of estimating.

If you want to become a good estimator, it is very important to study and practice estimating. The following is a list of things that you can do as you read this book to become a good estimator:

- Carefully read each chapter. The chapters provide you with explanations of the basic principles of estimating.
- As you read each example problem, check the math with a calculator. This will help you to gain a greater understanding of the estimating principles.
- Many of the quantity takeoff problems can be solved using the five methods (counted items, linear components, sheet and roll goods, volumetric goods, and quantity-from-quantity goods) found in Chapter 4. Be sure that you completely understand each of these methods. As you read each chapter, keep a list of which of the five methods to use for each problem type and how each problem type differs from the general methods covered in Chapter 4.
- When reading the example problems that are based upon the garage drawings that accompany this book, refer to these drawings and see if you can get a similar quantity of materials. Minor differences will occur due to difference in rounding.
- Complete all of the computer exercises and sidebars. Take existing sidebars and customize them to your estimating situation. This will help you to become proficient with Excel.
- Work all of the problems at the end of the chapters. Have your instructor or a fellow estimator look over your solutions. These problems have been provided to give you practice in solving simple estimating problems.
- Prepare complete estimates for the Johnson Residence and West Street Video projects listed in Appendix G. Have your instructor or a fellow estimator look over your estimate. (The loose project drawings are provided in a separate package shrink-wrapped to this text.)

In addition to these things, practice estimating whenever you get the chance. Volunteer to help an estimator with his or her estimate. Ask questions of fellow estimators. Remember, learning to estimate takes time.

TYPES OF ESTIMATES

There are three common types of estimates. They are the conceptual estimate, preliminary estimate, and final or detailed estimate.

The conceptual estimate is an estimate prepared while the project is still in a conceptual state. The conceptual

estimate is used to study the feasibility of a project or to compare two potential design alternatives (for example, a concrete structure versus a steel structure or three stories versus four stories). These estimates are based on a description of the project or on very limited drawings and as such are the least accurate type of estimate.

The preliminary estimate is an estimate prepared from a partially completed set of drawings. A preliminary estimate is often performed when the drawings are 35% to 50% complete and is used to check to see if the proposed design is on budget and to identify changes to the design that need to be made to meet the budget. Preliminary estimates may be performed any time before the bid. Preliminary estimates are more accurate than conceptual estimates because more information about the design is available.

Chapter 34 covers three estimating methods—project comparison, square-foot, and assembly estimating—that may be used to prepare conceptual and preliminary estimates.

Final or detailed estimates are used to prepare bids and change orders, order materials, and establish budgets for construction projects. They are prepared from a complete or nearly completed set of drawings and are the most accurate type of estimate.

Sometimes shortcut methods (methods which produce a close, but less accurate answer) are used to prepare bids in order to bid more projects in less time. This may save time during the bidding process, but can cause cost-control problems for the company. When shortcut methods are used to order materials, the wrong materials or wrong quantities are often delivered to the site, which results in delays and increased construction costs. When a shortcut method produces a quantity within a few percent of the correct answer, it is hard to determine if a quantity overrun is due to poor material use in the field or inaccuracy in the estimating process. Similarly, when a quantity underrun occurs, it is unclear if it is due to good material use in the field or inaccuracy in the estimating process. For cost-control purposes, it is important to have an accurate quantity and cost estimate for all items, including an estimate for both unavoidable and avoidable waste. Unavoidable waste is waste that is a result of the difference between design dimensions and the size of materials. For example, when carpeting a nine-foot by nine-foot room with carpet that comes in 12-foot-wide rolls, you will have a three-foot-wide strip of waste unless it can be used elsewhere. Avoidable waste is waste that can be avoided by good use of materials in the field. It is not uncommon to have one framing crew use 5% more materials to frame the same house as another crew. The extra materials used are avoidable waste. Avoidable waste also includes materials that are damaged or destroyed on the job.

The primary focus of this book is on preparing accurate final or detail estimates, although many of these principles apply to conceptual and preliminary estimates.

BID PACKAGE

Estimates are prepared from bid packages. The bid package defines the scope of work for the construction project. A well-developed bid package includes a set of plans and a project manual.

The plans graphically show building dimensions and where different materials are used. The process of converting the building dimensions and details into estimated quantities is known as the quantity takeoff. The estimator will prepare the bid from the quantity takeoff. Typically, the plans are organized as follows: civil plans, architectural plans, structural plans, mechanical and plumbing plans, and electrical plans. The project manual provides a lot of information for the bidder. The typical project manual includes the following items:

Invitation to Bid: The purpose of the invitation to bid is to invite bidders to bid on the project and give a bidder enough information to decide whether he or she wants to bid on the project. Often, public agencies are required to invite all qualified bidders to bid on the work. This is typically done by posting the invitation to bid in a few predetermined locations (for example, the local library and the public agency's office) and by printing it in the local newspaper. The invitation to bid is also placed at the front of the project manual. The invitation to bid provides a project description, contact information for the owner and design professional (architect or engineer), bid date, restrictions on bidders, expected price range, and the expected duration of the project.

Bid Instructions: Bid instructions are instructions that must be followed to prepare a responsive bid. The goal of the bid instructions is to help the bidders provide a complete bid with all the necessary documents (for example, bid bond and schedule of values). Bidders may be disqualified for not following these instructions, which may result in a bidder losing the job even though he or she was the lowest bidder.

Bid Documents: Public agencies and owners typically use standard forms for the submission of the bid. These forms may include bid forms, bid-bond forms, a schedule of values, and contractor certifications. A sample bid form is shown in Figure 1-1. The bid bond is discussed in the next paragraph. The schedule of values breaks the bid into smaller portions and is used to determine and evaluate the amount of the progress payments. A sample schedule of values is shown in Figure 1-2. Estimators should read these documents carefully and comply fully with their requirements. Bidders can be disqualified for not submitting all of the required bid documents.

Bonds: Bonds include the bid bond, the payment bond, and the performance bond. Bonds are issued

Bid Form

Owner:
West Street Video
John M. Smith, President
P.O. Box 1256
Ogden, Utah 84403

Project:
West Street Video
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 sum of

$_____dollars ($_____).
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 1-1 Bid Form

by sureties. Bid bonds are provided by the contractor at the time of the bid. The bid bond guarantees that the contractor—should he or she be the lowest bidder—will sign the contract and provide the payment and performance bonds. The payment and performance bonds are provided when the contract for the work is signed. The payment bond guarantees that the vendors, subcontractors, and labor will be paid for the work they perform on the project. In the event that the vendors, subcontractors, and labor are not paid on the project, the surety will step in and make the necessary payments. The performance bond guarantees that the contractor will complete the construction project. In the event that the contractor fails to complete the project, the surety will step in and complete the project. Providing payment and performance bonds can increase the costs of the project by 1% to 2%.

Contract: Public agencies and owners often use standard contracts. Estimators should read the contract carefully and include any costs associated with meeting the terms of the contract in their bid.

General Conditions: Public agencies and owners often use standard general conditions. General conditions affect the cost to complete the work. The general conditions identify the relationships among the owner, design professionals, and the contractor and addresses provisions that are common to the entire project; for example, how changes in the scope of work are to be processed or the need for cleanup. Estimators should read the general conditions carefully and include any costs associated with the general conditions in their bid.

Special Conditions: Special conditions are additional conditions that apply to this specific project. Like the general conditions, the special conditions affect the cost to complete the work. Estimators should read the special conditions carefully and include any costs associated with the special conditions in their bid.

Schedule of Values

General Requirements	$ _____
Grading and Excavation	$ _____
Utilities	$ _____
Asphalt	$ _____
Site Concrete	$ _____
Landscaping	$ _____
Concrete	$ _____
Masonry	$ _____
Rough Carpentry	$ _____
Finish Carpentry	$ _____
Cabinetry and Countertops	$ _____
Insulation	$ _____
Roofing	$ _____
Doors and Windows	$ _____
Finishes	$ _____
Plumbing	$ _____
Fire Sprinklers	$ _____
HVAC	$ _____
Electrical	$ _____
Total	$ _____

FIGURE 1-2 Schedule of Values

Technical Specifications: Technical specifications identify the quality of materials, installation procedures, and workmanship to be used on the project. The specifications also specify the submittal and testing requirements for individual building components. Estimators must read these carefully and understand their implications. Bidding the wrong specification can lead to losing the bid unnecessarily or winning a bid that you do not have sufficient funds to complete. The specifications are typically organized according to the MasterFormat.[2] The 2004 edition expanded the MasterFormat from 16 divisions to 50 divisions (00 to 49).[3] The 2016 MasterFormat is organized as follows:

Division 00: Procurement and Contracting Requirements
Division 01: General Requirements
Division 02: Existing Conditions
Division 03: Concrete
Division 04: Masonry
Division 05: Metals
Division 06: Wood, Plastics, and Composites
Division 07: Thermal and Moisture Protection
Division 08: Openings
Division 09: Finishes
Division 10: Specialties
Division 11: Equipment
Division 12: Furnishings
Division 13: Special Construction
Division 14: Conveying Equipment
Division 21: Fire Suppression
Division 22: Plumbing
Division 23: Heating, Ventilating, and Air Conditioning (HVAC)
Division 25: Integrated Automation
Division 26: Electrical
Division 27: Communications
Division 28: Electronic Safety and Security
Division 31: Earthwork
Division 32: Exterior Improvements
Division 33: Utilities
Division 34: Transportation
Division 35: Waterway and Marine Construction
Division 40: Process Interconnections
Division 41: Material Processing and Handling Equipment

Division 42: Process Heating, Cooling, and Drying Equipment

Division 43: Process Gas and Liquid Handling, Purification, and Storage Equipment

Division 44: Pollution and Waste Control Equipment

Division 45: Industry-Specific Manufacturing Equipment

Division 46: Water and Waste Equipment

Division 48: Electrical Power Generation

Other Inclusions: Other documents such as a soils report and environmental inspections may be included in the project manual. The soils report describes the soil conditions and the water table at the construction site, which greatly affect the excavation costs. Estimators should take this information into account when preparing an estimate for a project.

Included by Reference: Other documents may be included in the specifications by reference. Documents included by reference are not physically attached to the project manual but are treated as if they were. Documents that are often included by reference include standard agency specifications and other readily available standards (for example, American Society for Testing and Materials [ASTM] and American National Standards Institute [ANSI] standards). Estimators need to understand the implication of these standards because they affect how the work is performed or are used to determine compliance with a specification.

ESTIMATING TOOLS

The estimator has a number of tools at his or her disposal to help prepare the estimate. They range from simple paper forms to powerful estimating computer programs. An estimator's tools include the following:

Architect's and Engineer's Scales: Plans are prepared at a reduced scale. Architect's and engineer's scales allow the estimator to measure dimensions from the plans. The architect's scale typically includes the following scales: 1″ = 1′, 1/2″ = 1′, 1/4″ = 1′, 1/8″ = 1′, 3/16″ = 1′, 3/32″ = 1′, 3/4″ = 1′, 3/8″ = 1′, 11/2″ = 1′, and 3″ = 1′. The engineer's scale typically includes the following scales: 1:10, 1:20, 1:30, 1:40, 1:50, and 1:60. Architect's and engineer's scales are shown in Figure 1-3.

Plan Measurer: A plan measurer or wheel measures the length of a line by rolling the wheel of the measurer along the item to be measured. A plan measurer has the advantage of being able to follow curved lines more easily than an architect's or engineer's scale. Analogue plan measurers have fixed scales, such as 1/2″ = 1′, 1/4″ = 1′, and 1/8″ = 1′; digital plan measurers have more scales available and often include the ability to create custom scales. A digital plan measurer is shown in Figure 1-4.

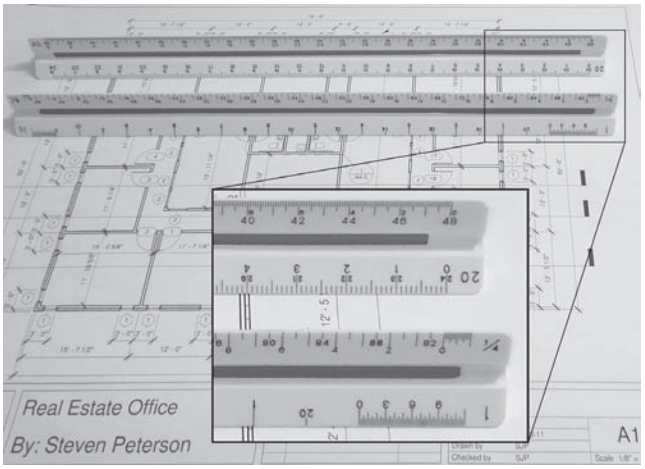

FIGURE 1-3 Architect's Scale (bottom) and Engineer's Scale (top)

Digitizer: A digitizer consists of an electronic mat and stylus or puck. The digitizer can measure distances and areas. The digitizer may operate as a stand-alone tool or be connected to a software package. Digitizers have an unlimited number of scales and can perform mathematical functions on distances and areas. A digitizer is shown in Figure 1-5.

Takeoff Packages: The digitizer is being replaced by takeoff packages, such as On Center Software's On-Screen Takeoff and Trimble's Paydirt that allows the user to determine the quantity of material needed from a digital set of drawings. These software packages make determining the length, perimeter, area, and volume quick and easy. On-Screen Takeoff will even allow the user to determine the length of the perimeter, number of tiles, and length of grid needed for a dropped acoustical ceiling by having the estimator trace the

FIGURE 1-4 Digital Plan Measurer

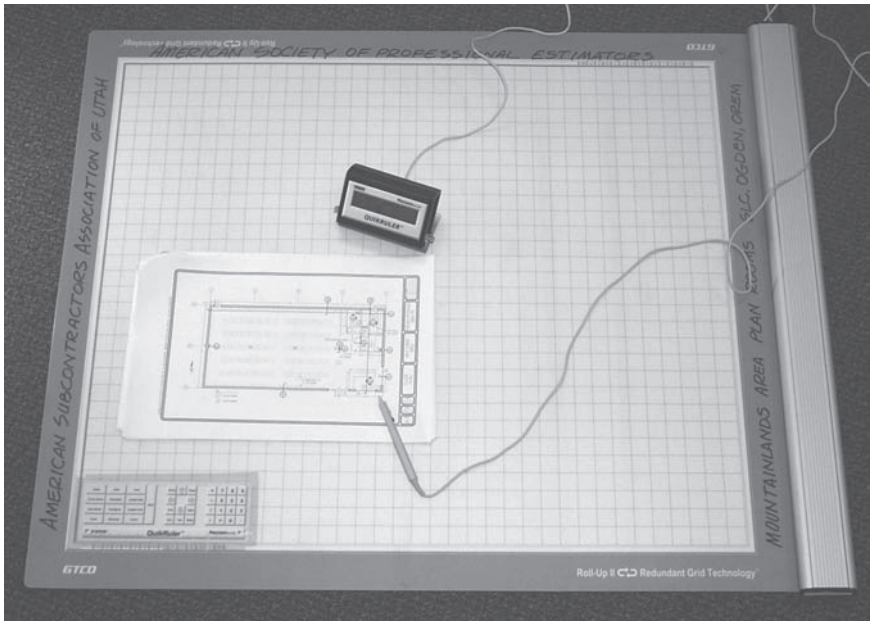

FIGURE 1-5 Digitizer

perimeter of the ceiling. These software packages can be integrated with spreadsheet or other estimating packages.

Building Information Modeling Software: An up and coming trend in the architectural, engineering, and construction (AEC) community is to design buildings using building information modeling (BIM) software, which allows the building to be designed in 3D. Many BIM software packages, such as Autodesk's Revit®, allow estimators to extract quantities from the model.

iPad and Plan Tables: Often the plans and project manuals are available in a digital format, such as pdf file. iPads and larger format plan tables are becoming common tools for the estimator.

Calculator and Paper Forms: In the days before computers, most estimates were prepared by using paper estimating forms and calculators. Some estimates are still prepared in this way, particularly estimates that are prepared in the field; however, with iPads, laptop computers, and portable printers, even paper estimates in the field are being replaced by computerized estimates.

Spreadsheets: With the increased use of computers in the construction industry and spreadsheet programs such as Excel, many companies have converted their estimating forms into computer spreadsheets. Spreadsheets have the advantage of automating the calculations and allowing the estimator to see the effects of minor changes in seconds. Developing spreadsheets for use in estimating is covered in Part V of this book.

Estimating Software: Estimating software packages, such as Trimble WinEst, combines the advantages of a computer spreadsheet with a database. This automates the estimating even further. Estimating software has the additional advantage of being capable of taking off assemblies as a single item. For example, an estimator can take off a wall assembly that includes the top and bottom plates, the studs, insulation inside the wall, and the finish material on both sides of the wall as a single component. Estimating software also allows the estimator to print the bid information in different formats for different uses with little or no setup.

COMPUTERIZED ESTIMATING

Nothing has revolutionized estimating as much as the advent of computers along with spreadsheets, estimating software, and takeoff packages. If used correctly, computers can reduce the time needed to prepare an estimate and decrease the errors in the estimate. If used improperly, they can increase the number of errors in an estimate and decrease the usefulness of the estimate. There are two dangerous mistakes estimators make when using estimating packages.

The first mistake is to turn the thinking over to the computer so the estimator becomes simply a means of entering data into the software package. This happens when the estimator determines the quantity of a given component and enters it into the computer without giving any thought to job conditions and design requirements that may require this component to be handled in a different way than it is usually handled. For example, a hollow-metal door frame for a pair of doors that must be delivered to the tenth floor of an office building up a small elevator must be constructed in pieces and fabricated on site, whereas most door frames are constructed

as a single member. Computers are good for performing repetitive tasks quickly without error. They are good for handling the mindless and boring tasks such as totaling a column for the umpteenth time. Estimators can make a minor change to an estimate and the computer will calculate the changes to the estimate almost instantaneously.

Another danger of just entering data into the computer is that computer spreadsheets and formulas in estimating packages are developed for a limited number of circumstances based on a set of assumptions made by the writer of the spreadsheet or formula. Whenever the estimator uses the spreadsheet or formula on a situation that is outside the conditions anticipated by the developer, the estimator may get an inaccurate estimate from the spreadsheet or formula. To protect against this, the estimator must have an understanding of the limits and design of the spreadsheet or formula and must make sure the spreadsheet's or formula's response is reasonable.

The second mistake is to create a new spreadsheet or formula and use it without properly testing it. After creating a spreadsheet or formula, the developer should test the spreadsheet or formula to make sure it is working properly, not only on the situation that it was developed for, but on other conceivable situations. In addition, the developer should try to make the spreadsheet or formula mess up and then build in ways to prevent other users from making the same mistakes by building in error-checking procedures.

Excel is the most popular estimating package. In a survey performed by the American Society of Professional Estimators, 29% of the respondents reported using Excel as their estimating software, 22% reported using Timberline (now Sage Estimating), and 25% reported using another estimating software package such as WinEst (by Trimble) and HeavyBid (Heavy Construction System Specialists, Inc.).[4] Users of estimating packages commonly augment the software package with Excel worksheets to assist in the quantity takeoff and other support functions.

Spreadsheets have the advantage of being inexpensive. Spreadsheet software can be purchased for about $100 and is often included along with other standard applications—such as word processing—that are sold as a software package for use in offices. In addition to being inexpensive, spreadsheets are easily adapted to the existing style and estimating procedures of the company. A company that uses paper forms can easily create a look-alike form in the spreadsheet and let the software perform the mundane and tedious calculations. Finally, spreadsheets are easy to create. With a little training and effort, anyone can develop spreadsheets for estimating. Developing spreadsheets for estimating in Excel is covered in Part V of this book.

Estimating software packages are powerful computer software applications that have been developed specifically for estimating. There are a number of packages available, with some packages having been designed for building construction and others for heavy and highway construction that involves large amounts of earthwork. Estimating software packages have the advantage of automating the takeoff process and decreasing the time it takes to prepare an estimate by combining a spreadsheet with a database. The database contains a list of standard items along with their cost, labor productivity, labor rates, equipment costs, and formulas used to calculate the quantities and costs of the individual items. Estimating packages often allow the user to create assemblies—a group of items that are needed to create a component such as a wall—and take off the assembly in a single step. Another feature of estimating packages is that the data can be easily manipulated and printed in different formats.

For example, one can print the costs by line item with the sales tax appearing at the bottom of the report or one can have the sales tax allocated to the individual line items. All these features come at a price. Estimating software packages are more expensive than spreadsheets—often costing thousands of dollars. In addition to the dollar costs, they require a large time investment to set up and maintain the database. The pricing in the database must be kept current with market pricing, materials must be set up, formulas must be written and tested, and assemblies must be created. Companies must perform large amounts of estimating to justify the cost and time commitment involved in using an estimating software package.

CONCLUSION

Successful estimates are the lifeblood of a construction company. Winning bids while maintaining a good profit margin is necessary for a construction company to succeed. Accurate quantities and costs are needed for strong cost controls. To be a good estimator, a person must study and practice sound principles of estimating. Computers have greatly changed the way estimators prepare estimates. Computers and software packages, if used properly, can increase the productivity of the estimator while decreasing errors. Estimating software includes spreadsheet packages such as Excel, estimating software such as WinEst and takeoff packages such as On-Screen Takeoff.

PROBLEMS

1. Define estimating.
2. Define work or scope of work.