Estimating in Building Construction 9th edition Peterson Solutions Manual

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Instructor's Manual

for

ESTIMATING IN BUILDING CONSTRUCTION

Ninth Edition

Steven J. Peterson

Weber State University

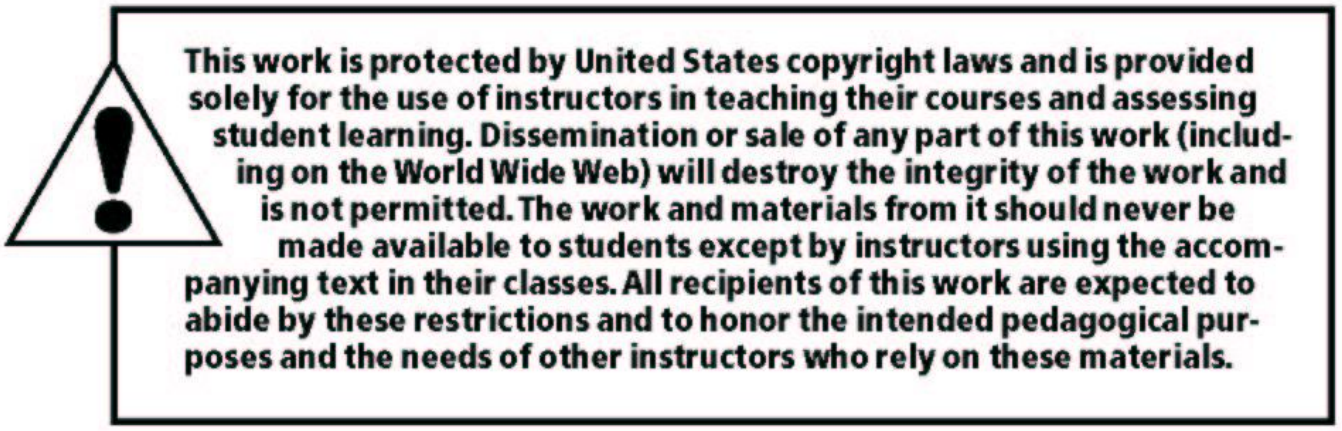
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Preface

The following key changes have been made to this edition:

- 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 by major accreditation bodies.
- Pricing has been updated.
- The appendices have been reorganized.
- A larger image resource bank has been included in the instructor resources.

It is my hope that these changes will help you provide a more meaningful educational experience for your students.

Best wishes,

Steven Peterson

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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 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. This book includes multiple sets of plans that may be used to prepare an estimate. Each chapter, where applicable, includes homework problems related to these plans. By completing the following problems, the students will complete an estimate for the Real Estate Office:
    - Chapter 6 Problems 12 and 13
    - Chapter 7 Problems 31 and 32
    - Chapter 9 Problem 7
    - Chapter 10 Problem 48
    - Chapter 11 Problem 64
    - Chapter 12 Problem 22
    - Chapter 14 Problems 45 and 46
    - Chapter 15 30 through 32
    - Chapter 16 Problems 19 and 20
    - Chapter 17 Problems 33 through 37
    - Chapter 18 Problem 9
    - Chapter 19 Problem 9
    - Chapter 20 Problem 6
- Effectively communicate in writing. Chapter 9 Problem 7 requires the student to write scopes of work for the Real Estate Office in Appendix E that clearly communicate the work to be performed by the specialty contractor. The following problems required the student to prepare written responses:
    - Chapter 1, Problems 11 and 12
    - Chapter 2 Problem 14
    - Chapter 3 Problem 13
    - Chapter 4 Problems 9 and 10
    - Chapter 5 Problems 8 and 9
    - Chapter 8 Problem 10
    - Chapter 9 Problem 7
- Understand ethics as it relates to estimating:
    - Chapter 4, Problem 13

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Chapter 1—Introduction to Estimating

LEARNING OBJECTIVES

Gain an overall picture of estimating including the difference types of estimates, the careers available to estimators, what it takes to be a successful estimator, and what comprises the contract documents on which the estimate is based.

ACTIVITIES

1. Invite an estimator from industry to discuss his or her job with the students. Have him or her answer the following questions:
   - How does he or she go about estimating a project?
   - What are the different types of estimating method he or she uses?
   - What roll does estimating play in the success of his or her company?
   - What does it take to be a successful estimator?

   Encourage them to tell estimating related stories.

2. Discuss Problems 11 and 12 from the chapter.

INSTRUCTIONAL RESOURCES

PowerPoint Slides: Chapter 01.ppt

SOLUTIONS TO THE REVIEW QUESTIONS

1. What information is contained in the working drawings?

   The working drawings are the actual plans (drawings, illustrations) from which the project will be constructed. Those drawings contain the dimensions and locations of building elements, the materials required, and delineate how they fit together.

2. What information is contained in the technical specifications?

   The technical specifications are written instructions concerning project requirements that describe the quality of materials to be used and their performance.

3. What is the relationship between the working drawings and the technical specifications?

   The working drawings usually contain information relative to design, location, dimensions, and construction of the project, while the technical specifications are a written supplement to the drawings and include detailed information pertaining to materials and workmanship.

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?

   The estimator for the general contractor is responsible for a detailed estimate for the whole project. They must compile costs on everything that is integrated into the project and put it together into a bid for the entire project. An estimator for a subcontractor will prepare an estimate only for the part

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of the project for which they will be involved. For example they may be bidding only the masonry on the project.

5. What is the difference between doing a quantity takeoff and doing a full detailed estimate?

A quantity takeoff (QTO) is an estimate of the amount of in place materials required for the construction of a project. A full detailed estimate is an estimate that covers everything required for the construction of the project and includes both costs and quantities for materials, labor, and equipment and subcontractor costs.

6. What additional skills must the estimator have to be able to take a quantity survey and turn it into a detailed estimate?

a. Be able, from looking at the drawings, to visualize the project through its various phases of construction.

b. 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.

c. Have sufficient knowledge of labor operations and productivity to thus convert them into costs on a project.

d. 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.

e. Be computer literate and know how to manipulate and build various databases and use spreadsheet programs and other estimating software.

f. 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.”

g. Have good writing and presentation skills.

7. What is the difference between competitive and negotiated bidding?

Competitive bidding involves each contractor submitting a bid in competition with other contractors to build the project. In most cases the lowest bidder is awarded the contract to build the project as long as the bid form and proper procedures have been followed and the contractor is able to attain the required bonds and insurance. Negotiated bidding involves the contractor working with the owner (or through the owner's architect-engineer) to arrive at a mutually acceptable price for the construction of the project. It often involves negotiations back and forth on materials used, sizes, finishes, and other items which affect the price of the project.

8. What is the difference between a detailed estimate and a square-foot estimate?

The detailed estimate includes determination of the quantities and costs of everything required to complete the project. This includes the materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of profit. 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 perimeter, and other building components. Square-foot estimates require less information to prepare and are less accurate.

9. What are the contract documents, and why are they so important?

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The contract documents consist of the invitation to bid, instructions to bidders, bid form, owner-contractor agreement, general conditions of the contract, supplementary general conditions, technical specifications, and the working drawings, including all addenda incorporated in the documents before their execution. All of these taken together form the contract. These documents provide the legal basis for the construction of the project.

10. Why is it important to bid only from a full set of contract documents?

It is important to bid from a full set of contract documents to be certain you have all of the required information. If part of the documents are missing that portion of the project would most likely be left out of the bid. Errors of omission can be catastrophic for a contractor.

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?

The answers to these questions will vary from interviewee to interviewee.

12. 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. 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.

The answers to this question will vary from project to project.

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

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Fire sprinklers are not required
Separate male and female bathrooms are required

The estimated cost is $1,137,495. See Problem 01-13.xlsx, which is available on the instructor's website.

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Chapter 2—Contracts, Bonds, and Insurance

LEARNING OBJECTIVES

Learn how different contracting methods, bonding requirements, and insurance requirements affect the bidding process.

ACTIVITIES

1. Invite an insurance agent to the class to discuss the different types of insurance used on a construction project. Have him or her answer the following questions:
   - What types of insurance are needed for a construction project and what types of losses do they cover?
   - How do you go about getting a project insured?
   - What steps can you take to reduce insurance costs?

2. Invite a bonding agent to the class to discuss the use of bonds in the construction industry. Have him or her answer the following questions:
   - How does one go about establishing a bonding line?
   - What factors does the bonding company take into account when establishing the maximum size of project and the total work on hand for a contractor?
   - How can a contractor increase the bonding limits for the company?

3. Obtain two different subcontracts. They may be obtained from local contractors or downloaded from the internet. Divide the students into groups and have them compare the two contracts and answer the following questions:
   - Which contract is better? Why is it better?
   - Are there clauses that are included in the contract you did not chose that you would like to have added to the contract you chose? What are they? Why would you like to add them?
   - Are there clauses that are in the contract you chose that you would like to delete? What are they and why would you like to delete them?

   Have the groups present their responses in class or discuss their answers in class. You may want to have the groups take different perspectives, such as the general contractor's, subcontractor's, architect's/engineer's, or the owner's.

4. Discuss Problem 14 from the chapter. You may choose to have the students obtain a set of construction documents from a contractor or you may provide them with a set of construction documents. The students should all have different sets.

INSTRUCTIONAL RESOURCES

PowerPoint Slides: Chapter 02.ppt
The surety information office (www.sio.org) has presentations on bonding for use in the classroom.

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SOLUTIONS TO THE REVIEW QUESTIONS

1. What is a single contract, and what are its principal advantages and disadvantages for the owner?

   The single contract comprises all of the work required for the completion of a project and is the responsibility of a single prime contractor. This centralization of responsibility provides that one of the distinctive functions of the prime contractor is to plan, direct, and coordinate all parties involved in completing the project. All of the subcontractors (including mechanical and electrical) and material suppliers involved in the project are responsible directly to the prime contractor, who in turn is responsible directly to the owner. The prime contractor must insure that all of the work is completed in accordance with the contract documents, that the work is completed on time, and that all of the subcontractors and vendors have been paid

2. What are separate contracts, and what are the principal advantages and disadvantages for the owner?

   Under the system of *separate contracts* the owner signs separate agreements for the construction of various portions of a project. 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 their agents provide the coordination between the contractors.

3. With separate contracts, describe three options available to the owner for managing the contractor's work on the project.

   The owner may pay the general contractor to do the coordination, pay the architect/engineer or a construction management company, or handle it themselves.

4. List and briefly define the types of agreements that may be used for the owner's payment to the contractor.

   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.

   Unit-Price Agreement - the contractor bases the bid on estimated quantities of work and on completion of the work in accordance with the contract documents. Payments are made based on the price that the contractor bids for each unit of work, and field checks with measurements of work actually completed.
   Cost-Plus-Fee Agreements - the contractor is reimbursed for the construction costs as defined in the agreement. However, the contractor is not reimbursed for all items and complete understanding of reimbursable and non-reimbursable costs is required.

5. What is the "time of completion," and why must it be clearly stated in the contract agreement provisions?

   The time of completion is used to determine the amount of time the contractor has to complete the project. It should be in the original contract documents. Often there are incentives for early completion and costs for late completion.

6. What are progress payments, and why are they important to the contractor?

   Progress payments are the periodic payments made by the owner to the contractor. They are important to the contractor because they use this money to pay all expenses associated with the project. The timing and payment procedures should be detailed in the contract documents.

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7. What is retainage, where is the amount specified, and why is it used?

A percentage of the payments from the owner to the contractor that is withheld for the protection of the owner and suppliers. This money is withheld to insure completion of the project and payment of the bills associated with the project.

8. What is a bid bond, and how does it protect the owner?

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 they fail to do so without justification, the bond shall be forfeited to the owner. The amount forfeited shall 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.

9. Where would information be found on whether a bid bond was required and, if so, its amount?

Bid bond requirements are stated in the advertisement of bidders. They are usually amplified in the specifications.

10. What are performance bonds? Are they required on all proposals?

The performance bond guarantees the owner that, within limits, 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 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 also. 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.

11. How are the various surety bonds that may be required on a specific project obtained?

Surety bonds can only be obtained through companies who specialize in issuing surety bonds. The contractor will have to request the surety company to provide the bonds.

12. How does insurance differ from a surety bond?

With insurance an insurance company assumes the financial liability for a specified loss. The surety guarantees the performance of a contractor. The surety company will try to recover any losses from the contractor.

13. What are the different types of insurance that a contractor should maintain and what do they cover?

Workers' Compensation Insurance. Provides benefits to employees or their families if they are killed or injured during the course of work.

Builder's Risk Insurance. Protects projects under construction against direct loss due to fire and lightning. May also include windstorms, hail, explosions, riots, civil commotion, vandalism, malicious mischief, earthquakes, and sprinkler leakage.

Commercial General Liability. Covers 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.

Automotive. Covers vehicles used on public roads including cars, trucks, portable office trailers used on the job site, and construction equipment driving on public roads, such as dump trucks.

Marine. Covers equipment used on waterways, such as barges and boats.

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Inland Marine. Covers off-road construction equipment, such as backhoes, scrapers, and dump trucks not licensed for use on public roads.

Property. Covers real property (real estate) owned by the contractor, such as office buildings, shops, and warehouse.

Business Personal Property. Covers the contents of a building, such as computers and furniture.

Errors and Omissions. Covers liability arising from errors or omissions by the designers.

Umbrella. Goes on top of all the company's insurance, increasing the limits of coverage.

Life. Pays in the event of the death of a key employee.

14. 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. 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, etc., need to be submitted before final acceptance?
    g. What bonds are needed for the job?
    h. What are the insurance requirements for the project?

    The answers to this exercise will vary from project to project.

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