INSTRUCTOR’S MANUAL
TO ACCOMPANY
CONSTRUCTION ESTIMATING WITH EXCEL

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Welcome to the Instructor’s Manual and companion files (IM Resource Files) to *Construction Estimating with Excel*. This instructor’s manual and IM Resource Files have been put together to help you get the most out of *Construction Estimating with Excel*.

The instructor’s manual consists of a section for each of the 34 chapters in the textbook and a section for a computerized bid-day simulation called BidSim. The sections for each of the chapters contain (1) a list of learning objectives for the chapter, (2) instructional hints for the instructor, (3) potential activities that may be used in class or assigned to students to be completed out of class, (4) instructional resources, including the IM Resource Files and websites,
which may be used as part of the classroom instruction, and (5) detailed solutions to the problems at the end of the chapters. The final section includes instruction on how to setup and run the BidSim game in your class.

The IM Resource Files contains the following items:

- AutoCAD Drawings from Chapters 5 through 18, which are found in the Drawings folder. These may be modified to create new estimating quantity takeoff problems for tests, quizzes, or practice exercises.

- The Excel files as they should appear at the completion of Chapters 3, 32, 33, and 34, which are found in the Excel Exercises folder. This allows the instructor to teach Chapter 32 without the students completing Chapter 3; and to teach Chapter 34 without the students completing Chapter 33.

- The Excel Test folder contains a test that may be given to students to assess their proficiency in setting up the Excel spreadsheets from the Excel Quick Tips of Construction Estimating with Excel. This test consists of having the students setup the Excel Quick Tips before class, bringing copies of the spreadsheets to class, entering the given data in the spreadsheets, and printing a copy of the spreadsheets. This test requires the students have access to a computer during the test. The folder consists of instruction to be given to the students before the assigned test and a sample test.

- PowerPoint slides for Chapters 1, 2, and 4 through 31, which are found in the PowerPoint Lectures folder and may be used as lectures or provided to the students as handouts to guide them through the key points of each chapter.

- Completed spreadsheets from the Excel Quick Tips, which are found in the Quick Tip folder. These may be used to demonstrate to the student how the spreadsheets should work when completed or they may be provided to students. Although, these spreadsheets may be provided to the students, the students will gain much needed experience by setting the spreadsheets up by themselves.

- Also included is a Word document (Equations.doc) containing all of the equations from Construction Estimating with Excel.

- Also included are Detail estimate sheets for the Johnson Residence (Johnson Residence Estimate.xls) and for the West Street Video (West Street Video Estimate.xls) whose plans are located in Appendix F of the textbook. They include the quantities, but not the pricing.

To obtain these files please also download the corresponding files to accompany this Instructor's Manual found in the Instructor's Resource Center, under the same ISBN as this manual and titled, IM Resource Files.

Teaching Excel can be quite the challenge. In a classroom of students, one often finds the students range from novices with Excel to experienced users, from students who struggle to
understand how to use the computer to students who catch on quickly. The challenge comes when the instructor has to teach this wide variety of students as a group, helping the novices and slow to catch on without having the experienced and quick to learn becoming bored. There are three approaches that may be used to teach the students Excel.

First, take the students step-by-step through the exercises in the Chapters 3, 32, 33, and 34. This only will work when all of the students are at the same level of experience with Excel and learn at a similar speed. If the group in not homogeneous, this method becomes very frustrating to the students and the instructor.

Second, demonstrate the key commands used in each chapter to the students and then let the students complete the exercises in the chapters on their own at their own pace. It is best if the students can complete the exercises during lab time when the instructor or a lab aid is available to answer their questions and help them solve any problems they encounter. This is the method I prefer when teaching Chapters 3, 32, 33, and 34.

Finally, have the students read and complete the exercise on their own. Like the second method, it is best if the students can do this in a supervised lab environment. This is the method I prefer when I have the students setup the Excel Quick Tips.

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CHAPTER 1: THE ART OF ESTIMATING

LEARNING OBJECTIVES

At the completion of this chapter the student should be able to:

- Explain the role estimating plays in the success of a construction company.
- Identify what skills are needed to become a good estimator.
- Explain the role of the bid package in the estimating process.
- Identify the tools available to estimators.
- Explain why practice is important.

INSTRUCTIONAL HINTS

- One of the keys to motivating students to study estimating is for them to understand why it is important for them to develop estimating skills. Helping them understand that people other than estimators (such as foreperson, superintendents, and project managers) are often required to prepare estimates for materials, labor, and equipment. The lecture on this chapter should help students see why it is important to learn estimating.
- Estimating can only be learned by practice. The textbook contains hundreds of problems for the student to practice on. The lecture on this chapter should help students understand that to develop their estimating skills they need to complete the problems at the end of each chapter.
ACTIVITIES

- Invite a representative from industry to discuss the importance of estimating in the construction industry and the types of estimates different people prepare within their company.

INSTRUCTIONAL RESOURCES

- PowerPoint slide show:  *PowerPoint Lectures\Chapter 01.ppt* from the IM Resource Files
- Information on MasterFormat (including downloadable copy):  [www.csinet.org](http://www.csinet.org)

SOLUTIONS TO THE TEXTBOOK PROBLEMS


2. “The construction and services required by the Contract Documents…and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations” (*General Conditions of the Contract for Construction*, The American Institute of Architects, AIA Document A201-1997, p 9).

3. Accurate estimates are needed for a company to be successful in the bidding process, while maintaining a reasonable profit margin.

4. The estimator is the person responsible for preparing the cost estimates regardless of their job title.

5. An estimator must: have a sound understanding of the construction methods, materials, and the capacities of skilled labor; the basic skills needed to determine the quantities of materials, labor, and equipment necessary to complete a project; be a good communicator, both verbally and in writing; possess strong computer skills; be detailed oriented; have the confidence to quickly prepare takeoffs and make decisions under pressure; and have a desire for contestant improvement.

6. Estimating is an art, and like any art, you can only become good at it by practicing.

7. Estimates are prepared from bid packages. The bid package defines the scope of work for the construction project.

8. Architect’s and engineer’s scales, roller wheel, digitizer, calculator, paper forms, spreadsheets, and estimating software packages.

9. The advantages include the software is inexpensive, it is easily adapted to the
styles and estimating procedures of the company, and it easily performs the mundane calculations. The disadvantage is it is less automated than an estimating software package.

10. The advantages include it automates many takeoff functions which decrease the time it takes to prepare an estimate, includes a database, can takeoff assemblies, and the takeoff is easily manipulated and printed in different formats. The disadvantages are it is expensive and takes a lot of time to setup and maintain the database.

CHAPTER 2: OVERVIEW OF THE ESTIMATING AND BIDDING PROCESS

LEARNING OBJECTIVES

At the completion of this chapter the student should be able to:

- Describe the steps taken to complete an estimate.
- Identify the general scope of work and the items which need to be bid to complete an estimate.

INSTRUCTIONAL HINTS

- During the lecture show how the different topics shown in Figure 2-1 relate to the chapters in the textbook. This will help them understand the organization of the course. The relationships are as follows:
  - Request subcontractor quotes: Chapter 24
  - Quantity takeoff: Chapters 4 – 18
  - Materials pricing: Chapter 19
  - Labor pricing: Chapters 20, 21, and 23
  - Equipment pricing: Chapter 22 and 23
  - Prepare bid documents: Chapter 28
  - Combine pricing: Chapters 25 and 26
  - Review bids for errors: Chapter 27
  - Submit the bid: Chapter 28
  - Project buyout: Chapter 29

ACTIVITIES

- Provide the students with copies of the Summary worksheet shown in Figure 2-2 and have them identify the items on the Summary worksheet which need to be bid to complete the bid for the Johnson Residence, the West Street Video, or another set of plans. Appendix B in Construction Estimating with Excel contains
INSTRUCTIONAL RESOURCES

- PowerPoint slide show:  *PowerPoint Lectures\Chapter 02.ppt* from the IM Resource Files
- Summary worksheet:  The Summary tab of *Excel Exercises\Chapter 32.xls* from the IM Resource Files
- Bid for the Johnson Residence:  *Johnson Residence Estimate.xls*
- Bid for the West Street Video:  *West Street Video Estimate.xls*

SOLUTIONS TO THE TEXTBOOK PROBLEMS

1. Get additional help, eliminate some of the estimating steps, or decide not to bid on the project.

2. It gives the surety time to prepare the bid bond, obtain the necessary signatures on the bond, and mail it to the contractor; thus eliminating the need to make a special trip to the surety’s office to pick up the bond.

3. The subcontractor will need to find a time to come in, look at the plans and specifications, and prepare their estimate. When dealing with a limited number of plan sets, it can be quite a challenge to give all of the subcontractors a chance to look at the plans within the allowed time for the bid.

4. To ensure you have a bid for each category of work, rather than having multiple bids in one category and no bids in another category.

5. They carry the most risk should the contractor have to bid these items themselves.

6. Vendors often do not guarantee their quantities are accurate, and the estimator should prepare their own quantity survey to make sure there are sufficient quantities of materials to complete the work.

7. Mark blanks with Post-its®.

8. To avoid missing items or having items included in the bid twice (for example, two subcontractors on the project have an item included in their bids).

9. Completeness of the scope of work, price, and past experience with the subcontractor.

10. Subcontractor or vendor contact information, project name, what they are bidding, any specific exclusions, if freight and sales tax are included, bid price, the date and
time the bid was received, and who took the bid.

11. To avoid forgetting to get some of the necessary information.

12. Profit markup, overhead markup, building permit costs, bonding costs, and sales tax.

13. Company’s overhead costs. The project specific overhead should be bid as part of the project costs.

14. The process of hiring subcontractors and procuring materials and equipment for the construction project.

15. During project buyout and the close-out audit

CHAPTER 3: INTRODUCTION TO EXCEL

LEARNING OBJECTIVES

At the completion of this chapter the student should be able to:

- Perform basic operations in Excel including: managing workbooks and worksheets, entering data, formatting worksheets and cells, creating headers and footers, and printing worksheets.
- Explain the difference between absolute and relative references.
- Use the ROUND, ROUNDUP, ROUNDDOWN, CEILING, FLOOR, SUM, AVERAGE, and IF functions.
- Explain how to test worksheets and why it is important.

INSTRUCTIONAL HINTS

- Tailor the lecture to the Excel experience level of your students. If most of your students have little experience with Excel, teach all of the topics in the chapter. If most of your students are experienced Excel users, teach the Order of Operation, the Absolute and Relative Reference, and the Basic Functions sections of the chapter.
- Teach the student to build the equations in steps. For example, have them build the nested IF statement used in Step 10 of Exercise 3-7 in two steps. First, setup and test the first IF statement as follows:
  \[ =\text{IF}(A10<A11,"Less Than",""") \]

  then add the second IF statement as follows:

  \[ =\text{IF}(A10<A11,"Less Than",\text{IF}(A10=A11,"Equal to","Greater Than")) \]
Emphasize testing of spreadsheets under a variety of conditions. The students should make sure the spreadsheet works not only for the example but other situations as well.

Be sure the students save a copy of the exercises in this chapter. Exercises 3-1 to 3-5 and 3-7 to 3-9 build upon each other. Exercise 3-1 must be completed before beginning Exercise 3-2, and so forth. The completed Exercise 3-9 will be used as the starting point for Chapter 32’s exercises.

ACTIVITIES

Have the students complete Exercises 3-1 to 3-9 in class. If the student does not have time to complete all of the exercises in class they should complete them as part of the homework. It is best if this can be done in a supervised lab.

INSTRUCTIONAL RESOURCES

Completed spreadsheet for Exercises 3-1 to 3-5 and 3-7 to 3-9: Excel Exercises\Chapter 3.xls from the IM Resource Files.

SOLUTIONS TO THE TEXTBOOK PROBLEMS

1. A workbook is an Excel file. A worksheet is a page or division within the workbook. Worksheets are represented by the tabs at the bottom of the workbook.

2. Left click on the Save button on the Standard toolbar, typing Ctrl+S, or by selecting File-Save… from the Menu bar.

3. By selecting Insert-Worksheet from the Menu bar.

4. By right clicking on the worksheet tab and selecting Move or Copy… from the popup menu or by selecting Edit-Move or Copy Sheet… from the Menu bar to bring up the Move or Copy dialogue box. The user checks the Create a copy check box and selects location where the new sheet is to be inserted in the Before sheet: list box.

5. By right clicking the tab of the worksheet to be renamed and selecting Rename from the popup menu or double left clicking on the tab, editing the name, and clicking on any cell or type Enter to save the name change.

6. The contents would return to Cell H15 and the user would have to use the cut command before pasting.

7. Place the cursor over the rights side of a column’s heading and hold down the left mouse button to drag the right side of the column to the desired width or double left
click on the right side of the column’s heading to have Excel automatically change the width of the column to the width necessary to show the data in the widest cell within the column.

8. By selecting the desired cells and then selecting the desired font from the **Font** dropdown box located on the Formatting toolbar or by selecting the font in the **Font: combo box of the Font tab of the Format Cells dialogue box. The Format Cells dialogue box is accessed by selecting the desired cells and performing one of the following actions: (1) by typing Ctrl+1 (typing the 1 key while holding down the Ctrl key), (2) right clicking on one of the selected cells and selecting **Format Cells...** from the popup menu, or (3) by selecting **Format-Cells...** from the Menu bar.

9. Merges the selected cells together and centers the data in the cells.

10. Select **File-Page Setup...** from the Menu bar to bring up the Page Setup dialogue box, select the **Header/Footer** tab, select the **Custom Header...** button to bring up the Header dialogue box, place the cursor in one of the sections, left click the **Tab** button (not the Tab key), and click the **OK** button twice to close the Header dialogue box and the Page Setup dialogue box.

11. Select **File-Page Setup...** from the Menu bar to bring up the Page Setup dialogue box, select the **Header/Footer** tab, select the **Custom Header...** button to bring up the Header dialogue box, place the cursor in one of the sections, left click the **Date** button, and click the **OK** button twice to close the Header dialogue box and the Page Setup dialogue box.

12. Raise values to a power.

13. The steps are as follows:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raise 2 to the 5th power</td>
<td>(32+4/2)*2-1</td>
</tr>
<tr>
<td>2</td>
<td>Divide 4 by 2</td>
<td>(32+2)*2-1</td>
</tr>
<tr>
<td>3</td>
<td>Add 32 and 2</td>
<td>(34)*2-1</td>
</tr>
<tr>
<td>4</td>
<td>Multiply 34 by 2</td>
<td>68-1</td>
</tr>
<tr>
<td>5</td>
<td>Subtract 1 from 68</td>
<td>67</td>
</tr>
</tbody>
</table>

14. The values are as follows:

<table>
<thead>
<tr>
<th>Cell</th>
<th>Value</th>
<th>Cell</th>
<th>Value</th>
<th>Cell</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B16</td>
<td>=$B4</td>
<td>C16</td>
<td>=$B4</td>
<td>D16</td>
<td>=$B4</td>
</tr>
<tr>
<td>B17</td>
<td>=$B5</td>
<td>C17</td>
<td>=$B5</td>
<td>D17</td>
<td>=$B5</td>
</tr>
<tr>
<td>B18</td>
<td>=$B6</td>
<td>C18</td>
<td>=$B6</td>
<td>D18</td>
<td>=$B6</td>
</tr>
</tbody>
</table>

15. 120
16. 17.3

17. Error

18. Error

19. By selecting **File-Page Setup**... from the Menu bar to bring up the Page Setup dialogue box, selecting the **Sheet** tab, typing the beginning row followed by a colon followed by the ending row in the **Rows to repeat at top**: text box, and clicking on the **OK** button to close the Page Setup dialogue box.

20. Change the page breaks, the locations where one page stops and another begins, on the worksheet.

**CHAPTER 4: FUNDAMENTALS OF THE QUANTITY TAKEOFF**

**LEARNING OBJECTIVES**

At the completion of this chapter the student should be able to:

- Explain the purpose and the procedures for preparing a quantity takeoff.
- Explain the purpose of a work package and how they are developed.
- Identify the four main categories of building components and identify what items are associated with each of these categories.
- Explain how waste is added to an estimate.

**INSTRUCTIONAL HINTS**

- In this chapter focus on how different types of material may be calculated using similar procedures. Do not get caught up in trying to learn how to apply these principles to all construction items. The students will gain this understanding as they complete Chapters 5 through 18.
- Realize that some items may fit into two categories depending on how they are used. For example, the metal corner bead on the outside corners of a gypsum board may be a counted item when the corners are short and may be a linear good when the corners are long.

**ACTIVITIES**

- Prepare a list of items that are not included in the chapter. Have the students identify if they are a counted item, a linear component, a roll or sheet good, or a volumetric good.
INSTRUCTIONAL RESOURCES

- PowerPoint slide show: PowerPoint Lectures\Chapter 04.ppt from the IM Resource Files

SOLUTIONS TO THE TEXTBOOK PROBLEMS

1. Build the project in their mind keeping track of the materials, equipment, and labor tasks needed to complete the project.

2. To eliminate many potential problems and delays, due to use of different material, equipment, or construction methods.

3. The number of studs is calculated using Eq. (4-1) as follows:
   \[
   \text{Number} = \frac{75 \text{ ft}}{1 \text{ ft}} + 1 = 76 \text{ studs}
   \]

4. The number of studs is calculated using Eq. (4-1) as follows:
   \[
   \text{Number} = \frac{120 \text{ ft}(12 \text{ in/ft})}{16 \text{ in}} + 1 = 91 \text{ studs}
   \]

5. The number of pieces is calculated using Eq. (4-7) as follows:
   \[
   \text{Number} = \frac{150 \text{ ft}}{20 \text{ ft}} = 8 \text{ pieces}
   \]

6. The number of pieces is calculated using Eq. (4-6) as follows:
   \[
   \text{Number} = \frac{240 \text{ ft}}{[20 \text{ ft} - 18 \text{ in}/(12 \text{ in/ft})]} = 13 \text{ pieces}
   \]

7. Using Eq. (4-11), the effective area of one block is calculated as follows:
   \[
   \text{Effective Area} = (15 \frac{5}{8} \text{ in} + 3/8 \text{ in})(7 \frac{5}{8} \text{ in} + 3/8 \text{ in}) = (16 \text{ in})(8 \text{ in}) = 128 \text{ in}^2
   \]
   The area of the wall equals is calculated as follows:
   \[
   \text{Area} = (\text{Length})(\text{Height}) = (8 \text{ ft})(50 \text{ ft}) = 400 \text{ ft}^2
   \]
   The number of blocks is calculated using Eq. (4-8) as follows:
   \[
   \text{Number} = \frac{400 \text{ ft}^2}{(144 \text{ in}^2/\text{ft}^2)/(128 \text{ in}^2)} = 450 \text{ blocks}
   \]

8. Using Eq. (4-11), the effective area of one brick is calculated as follows:
   \[
   \text{Effective Area} = (7 \frac{1}{2} \text{ in} + 1/2 \text{ in})(2 \frac{1}{2} \text{ in} + 1/2 \text{ in}) = (8 \text{ in})(3 \text{ in}) = 24 \text{ in}^2
   \]
   The area of the wall equals is calculated as follows:
Area = (Length)(Height) = (8 ft)(50 ft) = 400 ft\(^2\)

The number of bricks is calculated using Eq. (4-8) as follows:

\[
\text{Number} = \frac{400 \text{ ft}^2 \times 144 \text{ in}^2/\text{ft}^2}{24 \text{ in}^2} = 2,400 \text{ bricks}
\]

9. Using Eq. (4-14) to find the number of rows, we get the following:

\[
\text{Number}_{\text{Rows}} = \frac{8 \text{ ft} \times 12 \text{ in}/\text{ft}}{7 \frac{5}{8} \text{ in} + 3/8 \text{ in}} = \frac{96 \text{ in}}{8 \text{ in}} = 12 \text{ rows}
\]

Using Eq. (4-17) to get the number of columns, we get the following:

\[
\text{Number}_{\text{Columns}} = \frac{50 \text{ ft} \times 12 \text{ in}/\text{ft}}{15 \frac{5}{8} \text{ in} + 3/8 \text{ in}} = \frac{600 \text{ in}}{16 \text{ in}} = 37.5 \text{ columns}
\]