WEBSITE

FIFTH EDITION

HOW TO ESTIMATE with RSMeans Data

BASIC SKILLS FOR BUILDING CONSTRUCTION

Saleh A. Mubarak, Ph.D. and RSMeans

RSMeans
FROM THE GORDIAN GROUP®

WILEY

How to Estimate with

RSMeans Data

Basic Skills for Building Construction

Fifth Edition

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Preface

This fifth edition is a continuation of the success of this book. Success can never come as a coincidence or by luck. It comes only through planned, hard, and intelligent work.

Professional estimators quantify the needed resources—materials, labor, and equipment—required by the scope of a project, and then price these items. This is a two-phase process that includes quantity takeoff and cost estimating. To complete the quantity takeoff, the estimator examines plans and specifications to determine total quantities of materials required, as well as labor and equipment. During the cost estimating phase, the estimator examines the direct costs of installed materials and equipment, labor rates, construction equipment and tool costs, and indirect expenses, such as overhead and profit. Inflation and market conditions are additional factors to consider. The estimator needs also to be familiar with the contract, especially the sections relevant to or impacting the cost.

Special problem-solving skills are required to obtain an accurate estimate. No matter what source is used, construction cost data are rarely available in the perfect format for a particular estimate. Data must often be adapted in some way, such as changing the number of units, the location, production rates, or the type of labor. Frequently, there is “math and more” to be done beyond what is required to produce the quantity takeoff, such as converting units of measure, adjusting for overtime, allowing for difficult access to the site, or factoring in other special considerations. Time-cost trade-off is another important consideration as owners and contractors need in some situations to accelerate the project, which has direct and perhaps complicated impact on the total cost.

This book provides information about how the costs in RSMeans Building Construction Cost Data (BCCD) are developed and presented. It also provides numerous sample problems that show how to apply this cost information. Following these guidelines will enable you to use the BCCD “to the max,” creating a detailed estimate, made more accurate by utilizing the full capabilities of the data.

There are many changes in the fifth edition. Chapter 3, “Cost Estimating: An Introduction” has been expanded, adding new sections. I found this chapter particularly important for those who want to get an idea on construction cost estimating without reading an entire book on the subject. More examples and exercises were added. The CSI MasterFormat has been updated according to the 2016 version, which is periodically being updated by the Construction Specifications Institute (CSI) since the major update in 2004 that took the number of divisions from 16 to 50. Chapter 4, “General Requirements,” was expanded and moved to the front of the book.

The book now is published by Wiley, an international leader in publishing scientific and professional books. RSMeans is still involved with the book, particularly in updating the materials related to the online estimating (construction cost estimating database and software).[1]

The answers and solutions to the exercises were rearranged on a companion website (www.wiley.com/go/constructionestim5e) where users of the book will be given access. The solutions to Exercises—Set B will be available online only to instructors.

Included with this workbook is access to RSMeans Online Estimating, the electronic version of RSMeans Building Construction Cost Data. Students should redeem their access codes at this URL:

www.rsmeans.com/academic.aspx. Professionals can access RSMeans Online through a 30-day trial at this URL: www.rsmeans.com/free-trial.aspx. Users can practice their skills in creating a complete construction estimate using the building plans for a residential and a light commercial structure (provided online).

All numbers in the examples and exercises in this book are based on the 2017 RSMeans BCCD (Building Construction Cost Database).

This book focuses on solution techniques for the various types of estimating problems and on using RSMeans Online Estimating to create a spreadsheet estimate. Theoretical explanations of the various estimating techniques are beyond the scope of this publication.

As we improve in each new edition, we are striving for perfection, which humans can never reach. To me, this is good news because it means there is always room for improvement. This is what motivates us to keep improving with no limitation or ceiling. I hope all users of this book—instructors, students, professionals, and others—to communicate with me or the publisher for any idea or correction that can improve this book. The author can be reached at the email address cpmxpert@gmail.com.

Note

[1]In the past four editions, RS Means provided with this book a CD containing construction cost estimating database and a software called CostWorks. Although the CD is still available for purchase separately, this fifth edition of the book uses the online estimating instead.

Acknowledgments

This fifth edition comes on the heels of the fourth edition, when this book was published by Wiley, an international leader in publishing. RSMeans, the leading company in construction cost estimating databases, in still a partner and contributor to the book, including the construction cost estimating database and software. Both organizations have been superb in support and service. My experience with RS Means goes back to 1986 when I used their Building Construction Cost Data (BCCD) book as a graduate student. I have used it again as a professor since 1990.

I would like to thank the engineering team at Gordian for their help with this edition. I would also like to thank the team at Wiley for great support. Wiley took care of my book *Construction Project Scheduling and Control* and did a great job. They are the world's experts in publishing and marketing scientific books, and I am glad they are publishing this book as well.

I must also recognize the contribution of Tom Bledsaw, currently with Draper, Inc. and formerly with ITT educational Services as the national chair, School of Drafting and Design, and Harold Grimes, the department chair of construction management and general education at Redstone College, as reviewers of this edition.

Finally, I owe a lot of gratitude to the numerous friends and colleagues who passed their comments on the book to me. As humans, we are far from perfection, but I take this as a motivator: there is always room for improvement.

Introduction

RSMeans data from Gordian provides accurate and up-to-date cost information to help owners, developers, architects, engineers, contractors and others carefully and precisely project and control the cost of both new building construction and renovation projects.

This book is based on the RSMeans Building Construction Costs Database, BCCD, which has been printed in books for over 80 years and is now available online. Along with the BCCD online database, RSMeans has provided a cost estimating software. We will refer to it in the book as the RSMeans Online Estimating. It offers a single line item, assemblies, and square foot estimating programs. Users of the book will be given free access to limited use as a supplement to this book.

Instructional Information

First, the user needs to register. Once registration is complete, user can long in to the site: www.rsmeansonline.com.

The user will be directed to the “Welcome to RSMeans Online!” page, where he/she needs to set own preferences (Figure 00.1).

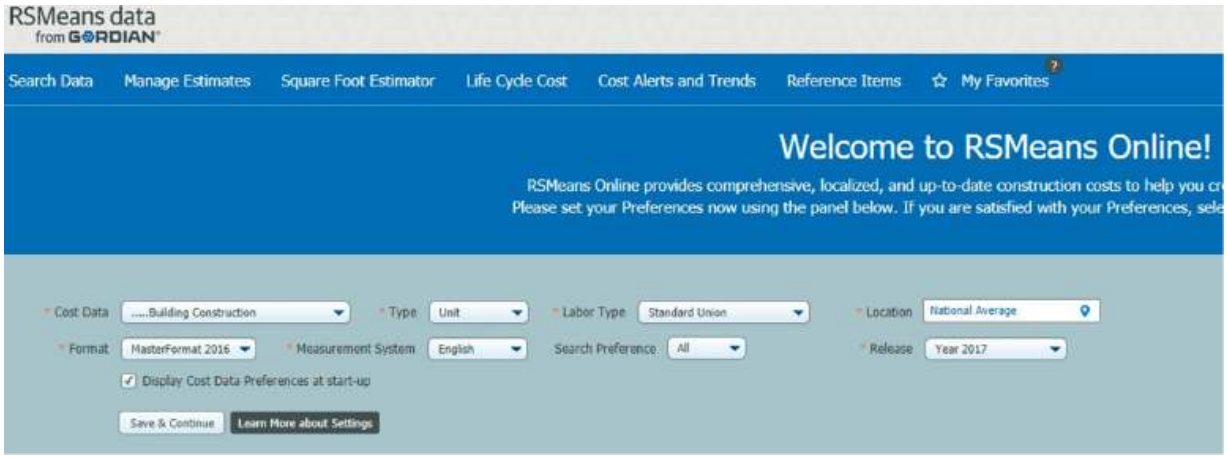

Figure 00.1

Complete the choice of preferences and then click “Save & Continue”. This screen will appear every time the user logs in unless the “Display Cost Data Preferences at start-up” is unchecked.

On the main page, we have the main menu with these options:

1. Search Data: Display of the database, cost line items or assemblies
2. Manage Estimates: Manages the estimates you created
3. Square Foot Estimator: A special program for conceptual estimating with more than 100 commercial and residential models available
4. Life Cycle Cost: An option for improving the long-term performance of buildings and gauge installed costs versus long-term facility maintenance costs
5. Cost Alerts and Trends: An option to receive notifications and track cost trends for the materials, labor, and equipment
6. Reference Items: Supplemental information such as a list of abbreviations, city cost index, crews, labor rates, references (notes that relate to cost line items),

estimating tips, dictionary (for cost-related terms), a video tutorial, and student edition materials

7. My Favorites: A special database for items and assemblies you choose as favorite so it will be easy to reuse later

You can always click on the green button “Guide Me” on the upper right-hand side for valuable help lessons.

More explanation on creating and managing estimates through examples in the following chapters.

A Cautionary Note: Numerical Rounding and Mathematical Judgment

Construction cost estimating is not an exact science. It depends on many uncertain factors (labor productivity, price escalation, and so forth) that make absolute accuracy impossible. It is a prediction of future expenses. Assumptions will have to be made about waste factors, contingency costs, takeoff techniques, and many other unknown or uncertain factors. Given the same set of plans and specifications, several estimators will come up with different project totals, all of which will probably differ from the final project cost. The good estimator is the one who gets his estimates consistently close to the actual cost.

Mathematical Intuition

Scholars differ and argue on the definition of *mathematical intuition* and what factors play in measuring or increasing it. In the context of construction cost estimating, we can simply state that a cost estimator must possess a minimum level of mathematical intuition to enable him or her to make good common sense judgments on numbers and to

judge whether a number is too high or too low. Such intuition is essential to avoid major mistakes that may lead to financial losses and other negative consequences. Cost estimators with good mathematical intuition also can provide, in most cases, a ballpark figure for the cost of a proposed project without sophisticated methods and tools.

Although scholars may argue, again, on how much of this mathematical intuition is inherited and how much is acquired, there is no question that any human being can enhance it by learning a few simple techniques and continuous practice. It is just like any other mental and physical power that humans possess; it increases—or at least is maintained—by practice, and decreases by neglect and lack of practice. This point is becoming increasingly important as we have entered the digital age and accumulated plenty of electronic gadgets. Technological advancements and inventions continue day after day with no end (or even a slowdown) in sight.

Our increasing dependence on such gadgets is leaving a negative effect on many talents such as the mathematical intuition. For example, there is no question that the quality of the average human's handwriting has declined because of the overwhelming use of computer and other electronic devices' keyboards. People now depend more on their cell phones rather their own memory to store telephone numbers and other information. New technologies have also automated many processes such as structural analysis and design, medical diagnosis, and automotive mechanical and electrical diagnosis. As wonderful as it seems to many people, this should trigger an alarm: many people are losing their professional intuition and analytical capability. They are becoming too dependent on technologies to the point they cannot function or perform simple tasks without their electronic devices. Computers and other electronic gadgets are wonderful tools that can and do help

tremendously, but they should never be a replacement for the human intelligence, thinking, and creativity.

To the cost estimator, there are simple exercises that can help build or at least maintain this intuition, such as calculating the value of the groceries or other commodities purchased from a store, including any percent discount and sales tax, and then comparing this approximate total to the cashier's total. One can calculate or estimate the monthly payment on a purchased car and compare it with the amount provided by the salesperson. Practice estimating the height of a high-rise building (in feet or meters, or number of floors), the number of bricks in a pallet or group of pallets of bricks, or the number of openings (doors and windows) in a building. It is always a good idea to do quick and approximate mental math and then compare the answer to the one produced by the computer, calculator, or other devices. When the two answers are significantly different, you might discover that the other answer (the supposedly accurate one) is wrong, either through human input error or a software flaw.

Some Helpful Suggestions

Rounding numbers must be done systematically and with care to avoid the introduction of significant errors. It is recommended when performing calculations that you enter dimensions without rounding, especially those to be multiplied by a large quantity. The amount of error in rounding depends on the number(s) the rounded number is multiplied by.

For example, assume an elevated concrete slab is 211′-11″ long, 120′-0″ wide, and 7.5″ thick. The volume is 588.66 CY. If we rounded the length to 212′, the volume would be 588.89 CY, an error of 0.23 CY. However, if we rounded the

thickness to 8″ instead of 7.5″, the volume would be 627.90 CY, a whopping 39.24 CY error.

The explanation is easy: the first error represents a 1″ × 120′ × 7.5″ strip (two small and one large dimensions). The second error represents a 211′-11″ × 120′ × 0.5″ strip (one small and two large dimensions). It is important to be careful with such practices, and avoid rounding in early stages of the estimate.

The estimator should have a sense of the size of the error introduced by rounding to ensure that it will not significantly affect the total estimate. Mathematical intuition and good common sense judgment are a must for a good estimator. As one estimator said, “While the price of one item may be too high or too low, the overall estimate should be pretty accurate.”

Be careful when using manual or electronic tools for measuring dimensions. The results produced by rolling pens, digitizing boards, and other tools vary by device and user. Again, the estimator must use common sense judgment to make sure no unmanageable error is introduced into the estimate.

If using a handheld calculator, use one with ordinary fractions capability (*b*/*c*), so you can enter 8″ as 8/12 ft, rather than the decimal fraction 0.67. This eliminates the introduction of a rounding error. Follow the same concept when using Excel.

Avoid false accuracy. As cost estimating is a *prediction* of future expenses, final answers should be rounded to a reasonable degree. As a rule of thumb, a figure with four significant digits is an acceptable accuracy. It would be ridiculous to estimate the total cost of a construction project as $2,148,387.23. This is *false accuracy* because it gives the reader a feeling that this number is very

accurate, while in fact it is not. If it refers to *actual* expenses, the previous number may be true and accurate. The following are some examples:

Estimate	**Estimate Rounded**
$122,778.34	$122,800 or 123,000
$367,289.45	$367,000
$2,446,983	$2,447,000
$53,674,294.55	$53,670,000
$453,681,302.88	$453,700,000

In any mathematical operation, the highest level of accuracy for the answer is the same as the accuracy of the least accurate number of that operation. For example, consider:

$$A = B + C \times (D/E) - F$$

where *B, C, D, E,* and *F* are all real numbers.

The highest accuracy for *A* is the same as the least accuracy for *B, C, D, E,* or *F*. Note that when exact numbers are used, they have a perfect accuracy (or infinite number of significant digits). For example, if we are calculating the volume, in cubic yards, of a concrete footing that measures 3′-4″ by 3′-4″ by l′-4″, the answer would be:

$$\text{Volume (in CY)} = \frac{\text{Length (in feet)} \times \text{Width (in feet)} \times \text{Depth (in feet)}}{27\ \text{CF/CY}}$$

$$= \frac{(40/12 \times 40/12 \times 16/12)}{27\ \text{feet}^3/\text{yard}^3} = 0.548696845\ \text{CY}$$

The answer can be rounded to any number of significant digits we desire, such as 0.55, 0.549, 0.5487, and so on.

Suppose volume is written as:

$$\text{Volume} = \frac{(3.33' \times 3.33' \times 1.33)}{(27\ \text{feet}^3/\text{yard}^3)} = 0.546\ \text{cubic yards}$$

The answer cannot have more than three significant digits because the least accurate number used in the operation had only three significant digits.

RSMeans uses the following rounding standards:

Prices From	To	Rounded to nearest
$ 0.01	$ 5.00	$0.01
5.01	20.00	0.05
20.01	100.00	1.00
100.01	1,000.00	5.00
1,000.01	10,000.00	25.00
10,000.01	10,000.00	100.00
50,000.01	Up	500.00

Use educated common sense judgment. Human errors and equipment malfunctions are always possible. For example, when entering a number in a calculator or a computer keyboard, you may intend to press the 8 key, but the key got stuck and multiple of 8s were displayed instead, or nothing at all. To minimize such errors, follow these three rules:

1. Always keep an eye on the computer screen or calculator display to make sure it matches the entered number.
2. Apply common sense judgment to the answer. For example, if you are calculating the cost of erecting wood joists for one floor in a 2,000 SF house, and the answer was too high (e.g., $459,000) or too low (e.g., $570), you know there is something wrong. This

judgment depends on the estimator's experience and construction common sense judgment.

3. Be well-organized and maintain a calculation audit trail. In case of a review or a suspected error, it should be easy for you or anyone else to follow your work, step by step.

Chapter 1
Basic Calculations

RSMeans Building Construction Cost Data (*BCCD*) is the most widely used reference book for estimating construction costs in the United States and Canada. The costs for each construction item are broken down into the components of material, labor, equipment, and overhead and profit. The book also contains square foot costs by project type. The square foot cost data must be adjusted to fit the specific location, size, and conditions of a particular project. RSMeans Online Estimating and Cost Works[1] are electronic versions of the *BCCD* and contain all the same information plus additional features—including the ability to adjust all cost figures by a specific location factor, apply quantities to line items, and export cost data to a spreadsheet.

RSMeans Cost Data Format

The RSMeans Unit Price Line

All RSMeans unit price (UP) data are presented in the same basic format (Figure 1.1).

033053.40 Concrete In Place

Line Number	Description	Unit	Crew	Daily Output	Labor Hours	Bare Material	Bare Labor	Bare Equipment	Bare Total	Total O&P
033053400010	CONCRETE IN PLACE									
033053400020	Including forms (4 uses), Grade 60 rebar, concrete (Portland cement									
033053400050	Type I), placement and finishing unless otherwise indicated									
033053400300	Beams (3500 psi), 5 kip per L.F., 10' span	C.Y.	C14A	15.62	12.804	330.00	635.00	53.50	1018.50	1389.00
033053400350	25' span	C.Y.	C14A	18.55	10.782	345.00	535.00	45.00	925.00	1239.50

Figure 1.1

Each line in the RSMeans database contains information unique to that line: a specific 12-digit number address, detailed description, crew, daily output of the task using

the noted crew, labor hours for the task using the specific crew, and a unit of measurement. Also included are the unit bare cost (material, labor, equipment, and total) and the total unit cost, including overhead and profit.

Unit price information is presented according to the 50 divisions of the Construction Specifications Institute (CSI) MasterFormat 2016. These divisions are divided into major subdivisions and then into subsections of similar items. Within each subsection, items are arranged alphabetically by type. Each line item is unique.

Address Number

The address number of the line item shown here can be read as three parts:

03 30 Cast-In-Place Concrete is the Level Two, CSI MasterFormat subdivision. The first two digits of that number represent the Level One, MasterFormat division. (For this item, it is Division 3, or 03, which is Concrete.)

03 30 53 Miscellaneous Cast-In-Place Concrete is the Level Three subdivision.

Concrete In Place is the Level Four, RSMeans major classification. It appears in the RSMeans book as a line **03 30 53**. **40**, while it appears in RSMeans online estimating as just the number **40** in the extreme left and right columns.

0350 (first column from left in the RSMeans book and second column from left in RSMeans online estimating) is the RSMeans individual line number.