

Sixth Edition



Estimating Construction Costs



Robert L. Peurifoy
Garold D. Oberlender

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PREFACE

This book presents the basic principles of estimating the time and cost of construction projects. To prepare an accurate estimate the estimator must perform a careful and thorough analysis of the work to be performed. The analysis includes the type and quantity of work, type and size of equipment to install the work, and jobsite conditions that are unique to the project that can impact the time and cost of construction.

This book emphasizes the thought process that is required of the estimator to analyze job conditions and assess the required labor, equipment, and methods of construction that will be necessary to perform the work. To assemble a complete estimate for bid purposes, the estimator must combine his or her knowledge of construction methods and techniques into an orderly process of calculating and summarizing the cost of a project.

Estimating is not an exact science. Knowledge of construction, common sense, and judgment are required. Experienced estimators agree that the procedures used for estimating vary from company to company, and even among individuals within a company. Although there are variations, fundamental concepts that are universally applicable do exist. The information contained in this book presents the fundamental concepts to assist the reader in understanding the estimating process.

In preparing this sixth edition, the author has retained the fundamental concepts of estimating that have made this book successful for many years. Example problems have been revised with more explanations regarding assumptions used in the calculations. Throughout the book, the example problems are presented in a consistent format, beginning with the quantities of materials and production rates through pricing labor, material, and equipment. All example problems are revised in this edition of the book. Also, homework problems are updated.

This revised edition of the book has reorganized and consolidated chapters to increase the clarity of the subject matter for the reader. The previous chapter on interior finish, millwork, and wallboards is merged into the chapter on carpentry. The previous chapter on floor finishes is merged into the chapter on floor systems. The chapter on glass and glazing is deleted. New material on unit cost estimating is added to the section of approximate estimates in Chapter 1. The new 50 divisions of the Construction Specifications Institute (CSI) are added and discussed in Chapter 2. The material is expanded on expected net risk analysis for assigning contingency in Chapter 3 and a new section on parametric estimating is added in Chapter 4, Conceptual Cost Estimating.

Major revisions to Chapter 5, Cost of Construction Labor and Equipment, include additional examples of calculating labor costs. New sections are added with example problems for calculating the depreciation cost of equipment by

several methods, including straight-line, double-declining-balance, and sum-of-the-years digits. New sections are added on investment costs, ownership costs and comparing costs of renting versus owning equipment based on hours used per year. A new section on transporting sand and aggregate with track loaders is added to Chapter 6, Handling and Transporting Materials.

Chapter 7, Earthwork and Excavation, has updated photos and many new sections, including production rates, efficiency factors, dozers, graders, and preparing subgrades with GPS guidance systems. Chapter 8, Highways and Pavement, has revised example problems that are reorganized to show more details in preparing cost estimates for asphalt and concrete pavements. New photos are added to Chapter 9, Foundations, including pile driving rig, drilled shaft drilling rig, and steel casings. Chapter 10, Concrete Structures, has updated photos of formwork and revised example problems. Chapter 11, Steel Structures, has added photos of a truck-mounted crane erecting steel trusses and an iron worker erecting steel beams to better illustrate the process of erecting steel structures.

Chapter 12, Carpentry, is revised to include carpentry, interior finish, millwork, wallboards and Chapter 13, Roofing and Flashing, has a new photo of laborers installing asphalt shingles. Chapter 14, Masonry, retains the information of the previous edition with revised example problems. Chapter 15 is revised to include floor systems and finishes. A new section is added to Chapter 16 on painting that presents content on the covering capacity of paints and the table of approximate labor-hours required to apply paint is updated. The section on types of pipe is reorganized for clarity in Chapter 17, Plumbing. Updated prices of electrical material is presented in Chapter 18, Electrical Wiring, and a revised example problem is presented in Chapter 19, Sewage Systems.

Chapter 20, Water Distribution Systems, is completely rewritten with new sections added on pipe currently used in the construction industry, including polyethylene (PE) pipe, polyvinyl chloride (PVC) plastic pipe, ductile iron pipe (DIP), and reinforced concrete pipe (RIP). The section on horizontal directional drilling (HDD) is revised with a new photo of a horizontal directional drilling machine. The topics in Chapter 21, Total Cost of Engineering Projects, are expanded, including the cost of right-of-ways and easements, and engineering expenses. New sections are added on permit expenses and bringing off-site utilities to a project.

Chapter 22, Computer Estimating, is revised with additional material on the use of computers in preparing estimates for bidding purposes. A new section is added on typical steps in computer estimating to give the reader a fundamental introduction to computer estimating. Calculation routines and alternates are other new sections added to the chapter which address the process of integrating spreadsheets into commercial software and the process of evaluating the cost of alternate construction methods during the estimating process and before submitting a bid, respectively. Another new section on reviewing the estimate provides a system of checking for errors in an estimate. The HCSS/Student software can be obtained at the website: www.mhhe.com/peurifoy_oberlender6e.

The appendix in the book is an example bid document that contains drawings for a simple project that can be used for applying the estimating processes

presented in this book. The project is ideal for class presentations of quantity takeoff calculations and for applying the principles of estimating presented in this book. The drawings can also be used for assigning estimating homework problems to students or assignment of semester projects for students to work in teams to prepare an estimate. The material in the appendix can be obtained at the McGraw-Hill website: www.mhhe.com/peurifoy_oberlender6e.

The website also includes a password-protected instructor's manual. For students, technical specifications for a sample project are included. Also available for students is a student edition computer estimating software program, HeavyBid/Student, courtesy of HCSS (Heavy Construction Systems Specialists, Inc.).

I would like to thank HCSS for permission to include their HeavyBid/Student software with this book. In particular, a special thanks to Mike Rydin of HCSS for his assistance in revising material in the computer estimating chapter. Also, the author appreciates the many equipment manufacturers, dealers, and construction contractors who generously provided updated photographs presented throughout this revised edition of the book.

I would like to thank Carisa Ramming for her careful review, helpful comments, and advice in the development of this sixth edition. McGrawHill and I would also like to thank the following reviewers for their many comments and suggestions: Maury Fortney, Walla Walla Community College; Raymond Gaillard, Northeast Mississippi Community College; Amine Ghanem, California State University Northridge; Alex Mills, Oklahoma State University – Tulsa; and Neil Opfer, University of Nevada Las Vegas.

I wish to recognize and pay tribute to the late Robert L. Peurifoy for his pioneering work as an author and teacher of construction engineering in higher education. Throughout my career, Mr. Peurifoy was an inspiration to me as a teacher, mentor, colleague, and friend.

Finally, I greatly appreciate the patience and tolerance of my wife, Jana, for her understanding and support during the writing and editing phases of the sixth edition of this book.

Garold D. Oberlender, Ph.D, P.E.



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ABOUT THE AUTHORS

Robert L. Peurifoy (deceased) was a distinguished author, professor, and consulting engineer in the engineering and construction profession. He received his B.S. and M.S. degrees in civil engineering from the University of Texas. He taught civil engineering at the University of Texas and Texas A&I College and construction engineering at Texas A&M University and Oklahoma State University. Mr. Peurifoy served as a highway engineer for the U.S. Bureau of Public Roads and was a contributing editor of *Roads and Streets* magazine. He was the author of two other books: *Construction Planning, Equipment, and Methods* and *Formwork for Concrete Structures*, 4th ed., coauthored with Garold D. Oberlender. He also wrote over 50 magazine articles dealing with construction. He was a long-time member of the American Society of Civil Engineers, which presents an award that bears his name.

Garold D. Oberlender, Ph.D, P.E. is professor emeritus of civil engineering at Oklahoma State University, where he served as coordinator of the Graduate Program in Construction Engineering and Project Management. He received his B.S. and M.S. degrees in civil engineering from Oklahoma State University and his Ph.D in civil engineering from the University of Texas at Arlington. He has more than 40 years of experience in teaching, research, and consulting engineering related to the design and construction of projects. He is author of the McGraw-Hill publication *Project Management for Engineering and Construction*, 2nd ed., and *Formwork for Concrete Structures*, 4th ed., coauthored with Robert L. Peurifoy. Dr. Oberlender is a registered professional engineer in several states, a member of the National Academy of Construction, a fellow in the American Society of Civil Engineers, and a fellow in the National Society of Professional Engineers.

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