PREFACE

This text introduces engineering and architectural students to the basic techniques required for analyzing the majority of structures and the elements of which most structures are composed, including beams, frames, arches, trusses, and cables. Although the authors assume that readers have completed basic courses in statics and strength of materials, we briefly review the basic techniques from these courses the first time we mention them. To clarify the discussion, we use many carefully chosen examples to illustrate the various analytic techniques introduced, and whenever possible, we select examples confronting engineers in real-life professional practice.

Features of This Text

1. **Historical Notes**. New to this edition are historical notes that have been added to various chapters providing points in the history of accomplishments and developments in structural analysis methods.
2. **Expanded treatment of design loads.** Chapter 2 is devoted to a comprehensive discussion of loads that include dead and live loads, snow, earthquake, and wind loads Based on the ANSI/ASCE 7 Standard. The presentation aims to provide students with a basic understanding of how design loads are determined for practical design of multistory buildings, bridges, and other structures.
3. **New homework problems.** A substantial number of the problems are new or revised for this edition (in both metric and U.S. Customary System units), and many are typical of analysis problems encountered in practice. The many choices enable the instructor to select problems suited for a particular class or for a particular emphasis.
4. **Computer problems and applications.** Computer problems, some new to this edition, provide readers with a deeper understanding of the structural behavior of trusses, frames, arches, and other structural systems. These carefully tailored problems illustrate significant aspects of structural behavior that, in the past, experienced designers needed many years of practice to understand and to analyze correctly. The computer problems are identified with a computer screen icon and begin in Chapter 4 of the text. The computer problems can be solved using the Educational Version of the commercial software RISA-2D that is available to

users at the textbook website. However, any software that produces deflected shapes as well as shear, moment, and axial load diagrams can be used to solve the problems. An overview on the use of the RISA-2D software and an author-written tutorial are also available at the textbook website.

5. **Improved layout of example problems.** The content of the examples has been clarified by showing them on one page or two facing pages—surrounded by boxes—so students can see the complete problem without turning the pages.
6. **Expanded discussion of the general stiffness method.** Chapter 16, on the general stiffness method, provides a clear transition from classical methods of analysis to those using matrix formulations for computer analysis, as discussed in Chapters 17 and 18.
7. **Realistic, fully drawn illustrations.** The illustrations in the text provide a realistic picture of actual structural elements and a clear understanding of how the designer models joints and boundary conditions. Photographs complement the text to illustrate examples of building and bridge failures.
8. **Problem solutions have been carefully checked for accuracy.** The authors have carried out multiple checks on the problem solutions but would appreciate hearing from users about any ambiguities or errors. Corrections can be sent to Professor Chia-Ming Uang (cmu@ucsd.edu).
9. **Textbook Website.** A text specific website is available to users at www.mhhe.com/leet. The site offers an array of tools, including lecture slides, an image bank of the text's art, helpful Web links, and the RISA-2D educational software.
10. **Hands-on Mechanics.** Hands-on Mechanics is a website designed for instructors who are interested in incorporating three-dimensional, hands-on teaching aids into their lectures. Developed through a partnership between the McGraw-Hill Engineering Team and the Department of Civil and Mechanical Engineering at the United States Military Academy at West Point, this website not only provides detailed instructions for how to build 3-D teaching tools using materials found in any lab or local hardware store, but also provides a community where educators can share ideas, trade best practices, and submit their own original demonstrations for posting on the site. Visit www.handsonmechanics.com for more information.

Contents and Sequence of Chapters

We present the topics in this book in a carefully planned sequence to facilitate the student's study of analysis. In addition, we tailor the explanations to the level of students at an early stage in their engineering education. These

explanations are based on the authors' many years of experience teaching analysis.

Chapter 1 provides a historical overview of structural engineering (from earliest post and lintel structures to today's high-rises and cable bridges) and a brief explanation of the interrelationship between analysis and design. We also describe the essential characteristics of basic structures, detailing both their advantages and their disadvantages.

Chapter 2 on loads is described above in *Features of This Text*.

Chapters 3, 4, and 5 cover the basic techniques required to determine bar forces in trusses, and shear and moment in beams and frames. The methods developed in these chapters are used to solve almost every problem in the remainder of the text.

Chapters 6 and 7 interrelate the behavior of arches and cables and cover their special characteristics (of acting largely in direct stress and using materials efficiently).

Chapter 8 covers methods for positioning live load on determinate structures to maximize the internal force at a specific section of a beam, frame, or bars of a truss.

Chapters 9 and 10 provide methods used to compute the deflections of structures to verify that a structure is not excessively flexible and to analyze indeterminate structures by the method of consistent deformations.

Chapters 11, 12, and 13 introduce several classical methods for analyzing indeterminate structures. Although most complex indeterminate structures are now analyzed by computer, certain traditional methods (e.g., moment distribution) are useful to estimate the forces in highly indeterminate beams and frames to establish initial properties of members for the computer analysis.

Chapter 14 extends the influence line method introduced in Chapter 8 to the analysis of indeterminate structures. Engineers use the techniques in both chapters to design bridges or other structures subject to moving loads or to live loads whose position on the structure can change.

Chapter 15 gives approximate methods of analysis, used to estimate the value of forces at selected points in highly indeterminate structures. With approximate methods, designers can verify the accuracy of computer studies or check the results of more traditional, lengthy hand analyses described in earlier chapters.

Chapters 16, 17, and 18 introduce matrix methods of analysis. Chapter 16 extends the general stiffness method to a variety of simple structures. The matrix formulation of the stiffness method is applied to the analysis of trusses (Chapter 17) and to the analysis of beams and frames (Chapter 18).

ACKNOWLEDGMENTS

As the senior author, I would like to acknowledge the many hours of editing and support provided by my wife Judith Leet, over a forty-year period; her help is deeply appreciated.

I would also like to thank Richard Scranton, Saul Namyet, Robert Taylor, and Marilyn Scheffler for their help with the first edition, and Dennis Bernal who wrote Chapter 18, all then of Northeastern University.

For their assistance with the first McGraw-Hill edition, we thank Amy Hill, Gloria Schiesl, Eric Munson and Patti Scott of McGraw-Hill and Jeff Lachina of Lachina Publishing Services.

For their assistance with the second and third editions, we thank Amanda Green, Suzanne Jeans, Jane Mohr and Gloria Schiesl of McGraw-Hill; Rose Kernan of RPK Editorial Services Inc.; and Patti Scott, who edited the second edition.

For their assistance with this fourth edition, we thank Debra Hash, Peter Massar, Lorraine Buczek, Joyce Watters and Robin Reed of McGraw-Hill, and Rose Kernan of RPK Editorial Services Inc.

We also wish to thank Bruce R. Bates of RISA Technologies for providing an educational version of the RISA-2D computer program with its many options for presenting results.

We would like to thank the following reviewers for their much appreciated comments and advice:

William Cofer, *Washington State University*
Ross B. Corotis, *University of Colorado- Boulder*
Gianluca Cusatis, *Rensselaer Polytechnic Institute*
Robert K. Dowell, *San Diego State University*
Fouad Fanous, *Iowa State University*
Terje Haukaas, *University of British Columbia*
Yue Li, *Michigan Technological University*
Thomas Miller, *Oregon State University*

Kenneth Leet
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