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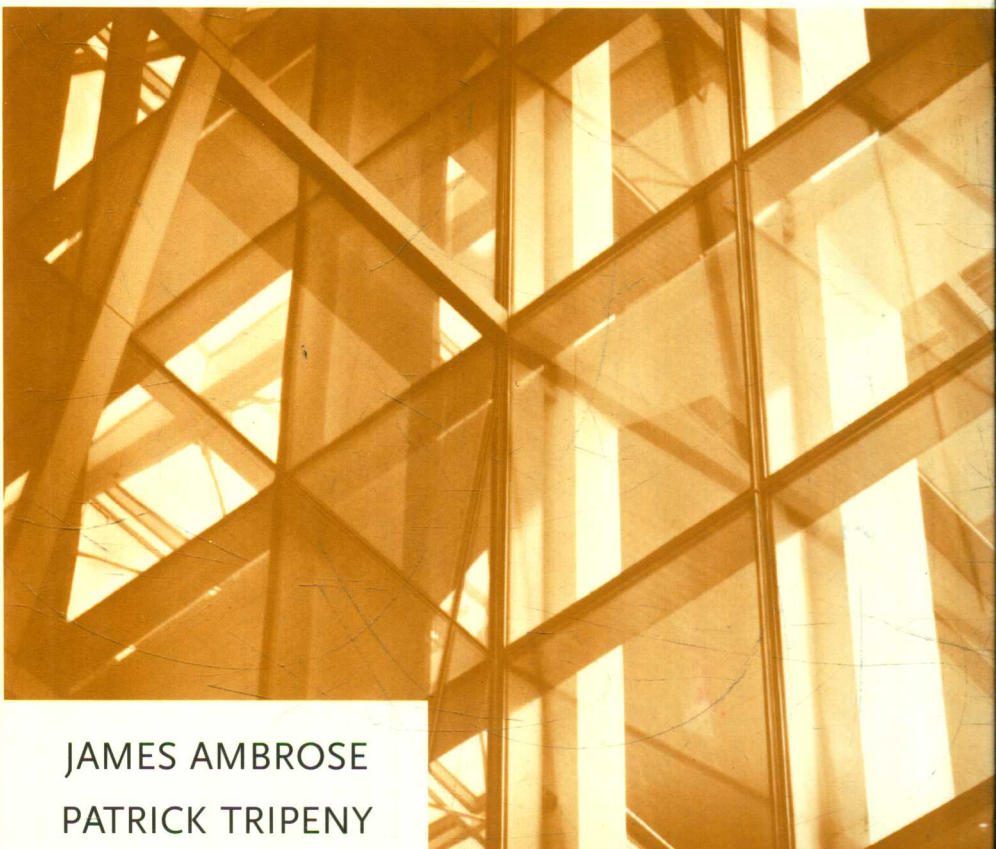
Eleventh Edition

SIMPLIFIED ENGINEERING
for ARCHITECTS AND BUILDERS



JAMES AMBROSE
PATRICK TRIPENY

SIMPLIFIED ENGINEERING FOR ARCHITECTS AND BUILDERS

Eleventh Edition

JAMES AMBROSE AND PATRICK TRIPENY

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SIMPLIFIED ENGINEERING FOR ARCHITECTS AND BUILDERS

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PREFACE TO THE ELEVENTH EDITION

This book treats the topic of design of structures for buildings. As with previous editions, the material in this book has been prepared for persons lacking formal training in engineering. Mathematical work is limited mostly to simple algebra. It is thus well suited for programs in architecture and building construction.

However, as most programs in civil engineering offer little opportunity for study of the general fields of building planning and construction, this book may well be useful as a supplement to engineering texts. The emphasis here is on the development of practical design, which typically involves a relatively small effort in structural investigation and a lot of consideration for circumstantial situations relating to the existence of the building structure.

Changes that occur in reference sources and in design and construction practices make it necessary to revise the material in this book periodically. This edition has indeed received such an updating, although the reader is advised that these changes are continuous, so

that it is inevitable that some material present here will be out-dated in a short time. However, the concentration in this work is on fundamental concepts and processes of investigation and design; thus the use of specific data is of less concern to the learning of the fundamental material. For use in any actual design work, data should be obtained from current references.

In addition to updating, each new edition affords an opportunity to reconsider the organization, presentation, and scope of the material contained in the book. This new edition therefore offers some minor alterations of the basic content of previous editions, although just about everything contained in the previous edition is here somewhere. Some trimming has occurred, largely in order to add new material without significantly increasing the size of the book. For this edition, major reorganization has been achieved in the basic material in Part I.

One change in this edition is the addition of a treatment of the load and resistance factor design (LRFD) method for wood structures. However, the allowable stress design (ASD) method has been retained for work in wood structures, as it is still highly favored by designers. This affords an opportunity for the reader to learn the basic procedures of both methods.

In recent editions it has been the practice to provide answers for all of the computational exercise problems. However, this book receives considerable use as a course text, and several teachers have requested that some problems be reserved for use without given answers. To accommodate this request in this edition, additional exercise problems have been provided, with answers given only to alternate problems. There remains, however, at least one problem—relating to each text demonstration problem—for which an answer is provided; this is to accommodate readers using this book for a self-study program.

For text demonstrations, as well as for the exercise problems, it is desirable to have some data sources contained in this book. We are grateful to various industry organizations for their permission to use excerpts from these data sources, acknowledgment for which is provided where data is provided.

Both personally—as the authors of this edition—and as representatives of the academic and professional communities, we must express our gratitude to John Wiley & Sons for its continued publication of this highly utilized reference source. We are truly grateful for the sympathetic and highly competent support provided by the Wiley editors and production staff.

Finally, we need to express the gratitude we have to our families. Writing work, especially when added to an already full-time occupation, is very time consuming. We thank our spouses and children for their patience, endurance, support, and encouragement in permitting us to achieve this work.

JAMES AMBROSE
PATRICK TRIPENY

PREFACE TO THE FIRST EDITION

(The following is an excerpt from Professor Parker's preface to the first edition.)

To the average young architectural draftsman or builder, the problem of selecting the proper structural member for given conditions appears to be a difficult task. Most of the numerous books on engineering which are available assume that the reader has previously acquired a knowledge of fundamental principles and, thus, are almost useless to the beginner. It is true that some engineering problems are exceedingly difficult, but it is also true that many of the problems that occur so frequently are surprisingly simple in their solution. With this in mind, and with a consciousness of the seeming difficulties in solving structural problems, this book has been written.

In order to understand the discussions of engineering problems, it is essential that the student have a thorough knowledge of the various terms which are employed. In addition, basic principles of forces in equilibrium must be understood. The first section of this book,

"Principles of Mechanics," is presented for those who wish a brief review of the subject. Following this section are structural problems involving the most commonly used building materials, wood, steel, reinforced concrete, and roof trusses. A major portion of the book is devoted to numerous problems and their solution, the purpose of which is to explain practical procedure in the design of structural members. Similar examples are given to be solved by the student. Although handbooks published by the manufacturers are necessities to the more advanced student, a great number of appropriate tables are presented herewith so that sufficient data are directly at hand to those using this book.

Care has been taken to avoid the use of advanced mathematics, a knowledge of arithmetic and high school algebra being all that is required to follow the discussions presented. The usual formulas employed in the solution of structural problems are given with explanations of the terms involved and their application, but only the most elementary of these formulas are derived. These derivations are given to show how simple they are and how the underlying principle involved is used in building up a formula that has practical application.

No attempt has been made to introduce new methods of calculation, nor have all the various methods been included. It has been the desire of the author to present to those having little or no knowledge of the subject simple solutions of everyday problems. Whereas thorough technical training is to be desired, it is hoped that this presentation of fundamentals will provide valuable working knowledge and, perhaps, open the doors to more advanced study.

HARRY PARKER
Philadelphia, Pennsylvania
March, 1938

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INTRODUCTION

The principal purpose of this book is to develop the topic of *structural design*. However, to do the necessary work for design, use must be made of various methods of *structural investigation*. The work of investigation consists of the consideration of the tasks required of a structure and the evaluation of the responses of the structure in performing these tasks. Investigation may be performed in various ways, the principle ones being the use of modeling by either mathematics or the construction of physical models. For the designer, a major first step in any investigation is the visualization of the structure and the force actions to which it must respond. In this book, extensive use is made of graphic illustrations in order to encourage the reader in the development of the habit of first clearly *seeing* what is happening, before proceeding with the essentially abstract procedures of mathematical investigation.

Structural Mechanics

The branch of physics called *mechanics* concerns the actions of forces on physical bodies. Most of engineering design and investigation is

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