

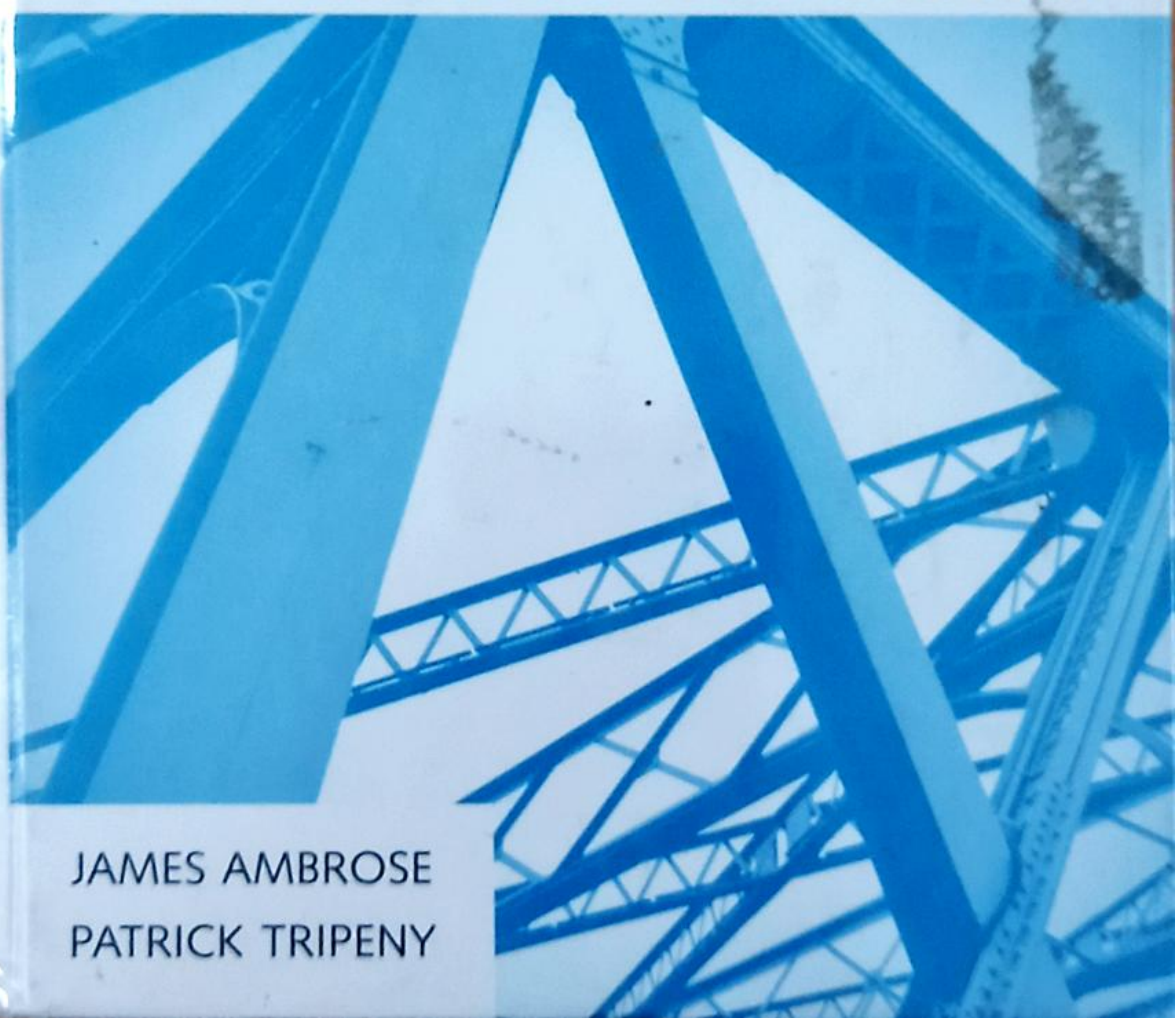


PARKER/AMBROSE SERIES OF SIMPLIFIED DESIGN GUIDES

Twelfth Edition

SIMPLIFIED ENGINEERING

for ARCHITECTS AND BUILDERS



JAMES AMBROSE
PATRICK TRIPENY

SIMPLIFIED ENGINEERING FOR ARCHITECTS AND BUILDERS

12th Edition

JAMES AMBROSE AND PATRICK TRIPENY

00077267
WILEY

Cover image: © gny0375/Shutterstock
Cover design: Wiley

This book is printed on acid-free paper. ©

Copyright © 2016 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at www.wiley.com/go/permissions.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with the respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor the author shall be liable for damages arising herefrom.

For general information about our other products and services, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Cataloging-in-Publication Data is available.

ISBN 978-1-118-97504-6 (hardback)
978-1-118-97531-2 (epdf)
978-1-118-97530-5 (epub)

00077567

Printed in the United States of America

10987654321

CREATIVE MIND BOOKS CENTER

(c i p c x i t)

05 SEP 2019

CONTENTS

Preface to the Twelfth Edition	xi
Preface to the First Edition	xv
Introduction	xvii
PART I FUNDAMENTAL FUNCTIONS OF STRUCTURES	1
1 Investigation of Forces, Force Systems, Loading, and Reactions	3
1.1 Properties of Forces / 3	
1.2 Static Equilibrium / 7	
1.3 Force Components and Combinations / 8	
1.4 Graphical Analysis of Concurrent Force Systems / 13	
1.5 Algebraic Analysis of Nonconcurrent Force Systems / 17	
1.6 Laws of Equilibrium / 21	
1.7 Loads and Reactive Forces / 24	

1.8	Load Sources / 28	
1.9	Load Combinations / 40	
1.10	Determination of Design Loads / 41	
1.11	Design Methods / 43	
2	Investigation of Axial Force Actions	47
2.1	Forces and Stresses / 47	
2.2	Deformation / 51	
2.3	Suspension Cables / 56	
2.4	Funicular Arches / 61	
2.5	Graphical Analysis of Planar Trusses / 64	
2.6	Algebraic Analysis of Planar Trusses / 73	
2.7	Cable-Stayed Structures / 80	
2.8	Compression Members / 83	
3	Investigation of Structures for Shear and Bending	86
3.1	Direct Shear Stress / 86	
3.2	Shear in Beams / 87	
3.3	Bending Moments in Beams / 91	
3.4	Sense of Bending in Beams / 98	
3.5	Tabulated Values for Beam Behavior / 105	
3.6	Development of Bending Resistance / 109	
3.7	Shear Stress in Beams / 113	
3.8	Continuous and Restrained Beams / 117	
3.9	Members Experiencing Compression Plus Bending / 132	
3.10	Rigid Frames / 142	
3.11	Buckling of Beams / 150	
3.12	Second-Order Analysis / 153	
3.13	Computer Software for Structural Analysis / 155	
4	Structural Systems and Planning	157
4.1	General Considerations for Structural Systems / 158	
4.2	Shear Wall and Diaphragm Structural System / 161	
4.3	Braced Frame Systems / 162	
4.4	Moment Frame Systems / 164	
4.5	Wood Construction / 166	
4.6	Steel Construction / 172	
4.7	Concrete Construction / 177	

PART II	WOOD CONSTRUCTION	185
5	Wood Spanning Elements	187
5.1	Structural Lumber / 188	
5.2	Reference Design Values for Allowable Stress Design / 189	
5.3	Design Controls for Load and Resistance Factor Design / 198	
5.4	Design for Bending / 200	
5.5	Beam Shear / 203	
5.6	Bearing / 204	
5.7	Deflection / 206	
5.8	Behavior Considerations for LRFD / 209	
5.9	Joists and Rafters / 217	
5.10	Decking for Roofs and Floors / 221	
5.11	Plywood / 222	
5.12	Glued-Laminated Products / 226	
5.13	Wood Fiber Products / 227	
5.14	Assembled Wood Structural Products / 228	
6	Wood Columns	231
6.1	Slenderness Ratio for Columns / 232	
6.2	Compression Capacity of Simple Solid Columns, ASD Method / 232	
6.3	Column Load Capacity, LRFD Method / 240	
6.4	Stud Wall Construction / 242	
6.5	Columns with Bending / 244	
7	Connections for Wood Structures	252
7.1	Bolted Joints / 252	
7.2	Nailed Joints / 254	
7.3	Plywood Gussets / 258	
7.4	Investigation of Connections, LRFD Method / 258	
7.5	Formed Steel Framing Elements / 259	
PART III	STEEL CONSTRUCTION	263
8	Steel Structural Products	265
8.1	Design Methods for Steel Structures / 265	
8.2	Materials for Steel Products / 267	
8.3	Types of Steel Structural Products / 270	

9 Steel Beams and Framing Elements	276
9.1 Factors in Beam Design / 276	
9.2 Inelastic Versus Elastic Behavior / 278	
9.3 Nominal Moment Capacity of Steel Beams / 285	
9.4 Design for Bending / 291	
9.5 Design of Beams for Buckling Failure / 296	
9.6 Shear in Steel Beams / 299	
9.7 Deflection of Beams / 305	
9.8 Safe Load Tables / 313	
9.9 Steel Trusses / 319	
9.10 Manufactured Trusses for Flat Spans / 320	
9.11 Decks with Steel Framing / 328	
9.12 Concentrated Load Effects on Beams / 330	
10 Steel Columns and Frames	334
10.1 Column Shapes / 334	
10.2 Column Slenderness and End Conditions / 336	
10.3 Safe Axial Loads for Steel Columns / 338	
10.4 Design of Steel Columns / 341	
10.5 Columns with Bending / 352	
10.6 Column Framing and Connections / 356	
11 Bolted Connections for Steel Structures	359
11.1 Bolted Connections / 359	
11.2 Design of a Bolted Connection / 371	
11.3 Bolted Framing Connections / 377	
11.4 Bolted Truss Connections / 379	
12 Light-Gage Formed Steel Structures	383
12.1 Light-Gage Steel Products / 383	
12.2 Light-Gage Steel Decks / 384	
12.3 Light-Gage Steel Systems / 389	
PART IV CONCRETE CONSTRUCTION	391
13 Reinforced Concrete Structures	393
13.1 General Considerations / 393	
13.2 General Application of Strength Methods / 400	
13.3 Beams: Ultimate Strength Method / 401	

13.4 Beams in Site-Cast Systems / 414	
13.5 Spanning Slabs / 429	
13.6 Shear in Beams / 435	
13.7 Development Length for Reinforcement / 449	
13.8 Deflection Control / 459	
14 Flat-Spanning Concrete Systems	462
14.1 Slab-and-Beam Systems / 463	
14.2 General Considerations for Beams / 470	
15 Concrete Columns and Compression Members	475
15.1 Effects of Compression Force / 475	
15.2 General Considerations for Concrete Columns / 479	
15.3 Design Methods and Aids for Concrete Columns / 489	
15.4 Special Considerations for Concrete Columns / 499	
16 Foundations	505
16.1 Shallow Bearing Foundations / 505	
16.2 Wall Footings / 506	
16.3 Column Footings / 514	
16.4 Pedestals / 522	
PART V STRUCTURAL SYSTEMS FOR BUILDINGS	527
17 General Considerations for Building Structures	529
17.1 Choice of Building Construction / 529	
17.2 Structural Design Standards / 530	
17.3 Structural Design Process / 531	
17.4 Development of Structural Systems / 532	
18 Building One	536
18.1 General Considerations / 536	
18.2 Design of the Wood Structure for Gravity Loads / 537	
18.3 Design for Lateral Loads / 543	
18.4 Alternative Steel and Masonry Structure / 554	
18.5 Alternative Truss Roof / 562	
18.6 Foundations / 564	

19 Building Two	566
19.1 Design for Gravity Loads / 568	
19.2 Design for Lateral Loads / 571	
19.3 Alternative Steel and Masonry Structure / 574	
20 Building Three	577
20.1 General Considerations / 577	
20.2 Structural Alternatives / 581	
20.3 Design of the Steel Structure / 583	
20.4 Alternative Floor Construction with Trusses / 592	
20.5 Design of the Trussed Bent for Wind / 596	
20.6 Considerations for a Steel Rigid Frame / 601	
20.7 Considerations for a Masonry Wall Structure / 602	
20.8 The Concrete Structure / 609	
20.9 Design of the Foundations / 632	
Appendix A: Properties of Sections	635
A.1 Centroids / 635	
A.2 Moment of Inertia / 638	
A.3 Transferring Moments of Inertia / 642	
A.4 Miscellaneous Properties / 646	
A.5 Tables of Properties of Sections / 649	
Glossary	662
References	673
Quick Reference to Useful Data	675
Index	677

The classic reference for structural design and construction—completely revised and updated

S*implified Engineering for Architects and Builders* is the gold standard for the industry and the reference of choice for designers and constructors. The revisions and updates in this new *Twelfth Edition* reflect the most current practices for designing structures. Plus, this innovative guide goes beyond the covers to provide support for instructors and students on an accompanying website—including a complete instructor's manual and a study guide for students to reinforce complex material.

Architects and builders get the same accessible primer on investigating and designing buildings along with the clear presentation of engineering principles they've come to expect from the Parker/Ambrose brand.

Simplified Engineering for Architects and Builders, Twelfth Edition is the total learning solution for structural design.

JAMES AMBROSE is Editor of the Parker/Ambrose Series of Simplified Design Guides. He practiced as an architect in California and Illinois, and as a structural engineer in Illinois. He was a professor of architecture at the University of Southern California. **PATRICK TRIPENY** is the Director of the Center for Teaching and Learning Excellence and is a Professor of Architecture at the University of Utah. He teaches the architectural structures sequence in the School of Architecture and the graduate design studio. He is the recipient of several teaching awards including the ACSA/AIAS New Faculty Teaching Award in 2001 and the University of Utah's Early Career Teaching Award in 2000-2001.

Cover Design: Wiley
Cover Image: © gyn9037/Shutterstock

Subscribe to our free Engineering eNewsletter at
wiley.com/enewsletters

Visit wiley.com/engineering

WILEY

ISBN 978-1-118-97504-6



9 781118 975046