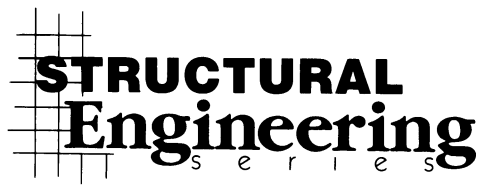
STRUCTURAL DESIGN IN WOOD

STRUCTURAL DESIGN IN WOOD

Judith J. Stalnaker, Ph.D., P.E.
University of Colorado at Denver

and

Ernest C. Harris, Ph.D., P.E.
University of Colorado at Denver



VNR Springer Science+Business Media, LLC

Originally published by Van Nostrand Reinhold in 1989
Softcover reprint of the hardcover 1st edition 1989
Library of Congress Catalog Card Number 88-20842
ISBN 978-1-4684-9998-8 ISBN 978-1-4684-9996-4 (eBook)
DOI 10.1007/978-1-4684-9996-4

Van Nostrand Reinhold
115 Fifth Avenue
New York, NY 10003

Chapman and Hall
2-6 Boundary Row
London, SE1 8HN, England

Thomas Nelson Australia
102 Dodds Street
South Melbourne 3205
Victoria, Australia

Nelson Canada
1120 Birchmount Road
Scarborough, Ontario M1K 5G4, Canada

16 15 14 13 12 11 10 9 8 7 6 5 4 3

Library of Congress Cataloging-in-Publication Data

Stalnaker, Judith J.
Structural design in wood.

Includes index.
1. Building, Wooden. 2. Structural design.
I. Harris, Ernest C. II. Title.
TA666.S67 1989 624.1'84 88-20842
ISBN 978-1-4684-9998-8

VNR STRUCTURAL ENGINEERING SERIES

Structural Engineering Theory

STRUCTURES: FUNDAMENTAL THEORY AND BEHAVIOR by Richard Gutkowski
STRUCTURAL DYNAMICS, 2nd Ed., by Mario Paz
MICROCOMPUTER-AIDED ENGINEERING: STRUCTURAL DYNAMICS by Mario Paz
EARTHQUAKE RESISTANT BUILDING DESIGN AND CONSTRUCTION, 2nd Ed., by Norman Green
SEISMIC DESIGN FOR BUILDINGS HANDBOOK edited by Farzad Naeim

Steel Design

STEEL DESIGN FOR ENGINEERS AND ARCHITECTS by Rene Amon, Bruce Knobloch and Atanu Mazumder

Concrete Design

HANDBOOK OF CONCRETE ENGINEERING by Mark Fintel
STRUCTURAL DESIGN GUIDE TO THE ACI BUILDING CODE, 3rd Ed., by Paul F. Rice, Edward S. Hoffman, David P. Gustafson and Albert J. Gouwens
TORSION OF REINFORCED CONCRETE by T. Hsu
MODERN PRESTRESSED CONCRETE, 3rd Ed., by James R. Libby

Masonry

SIMPLIFIED MASONRY SKILLS by R. Kreh

Wood

MECHANICS OF WOOD AND WOOD COMPOSITES by Jozsef Bodig and Benjamin Jayne
STRUCTURAL USE OF WOOD IN ADVERSE ENVIRONMENTS edited by Robert W. Meyer and Robert M. Kellogg
STRUCTURAL DESIGN IN WOOD by Judith J. Stalnaker and Ernest C. Harris

Tall Buildings

DEVELOPMENTS IN TALL BUILDINGS by the Council on Tall Buildings
ADVANCES IN TALL BUILDINGS by the Council on Tall Buildings
SECOND CENTURY OF THE SKYSCRAPER by the Council on Tall Buildings

Other Structures-Related Books

ICE INTERACTION WITH OFFSHORE STRUCTURES by A.B. Cammaert and D.B. Muggeridge

FOUNDATION ENGINEERING HANDBOOK by Hans Winterkorn and H.Y. Fang

FOUNDATION ENGINEERING FOR DIFFICULT SUBSOIL CONDITIONS by Leonardo Zeevaert

ADVANCED DAM ENGINEERING edited by Robert Jansen

TUNNEL ENGINEERING HANDBOOK by John Bickel and T.R. Kuesel

SURVEYING HANDBOOK edited by Russell Brinker and Roy Minnick

Preface

Why another textbook on the design of wood structures? In many years of teaching structural design in wood, the authors have used virtually every textbook available, as well as using only a code and no textbook at all. The textbooks used have included both the old and the relatively modern; some have been fairly good, but in our opinion each has deficiencies. Some books have too few solved examples. Others omit important material or have an arrangement making them difficult to use as formal teaching tools. By writing this book, we intend to correct such deficiencies.

The prime purpose of this book is to serve as a classroom text for the engineering or architecture student. It will, however, also be useful to designers who are already familiar with design in other materials (steel, concrete, masonry) but need to strengthen, refresh, or update their capability to do structural design in wood. Design principles for various structural materials are similar, but there are significant differences. This book shows what they are.

The book has features that the authors believe set it apart from other books on wood structural design. One of these is an abundance of solved examples. Another is its treatment of loads. This book will show how actual member loads are computed. The authors have found that students, more often than not, have difficulty recognizing how load is transferred from one member to another—for example, how to proceed from a specified intensity of floor live load and type and thickness of floor material to knowing the actual load per unit length reaching the beam in question. Worked-out examples and student homework problems will illustrate the process.

Another significant feature that we believe sets this book apart is its inclusion of "structural planning." Most textbooks show only the selection of member proportions or number of connectors in a joint to satisfy a given, completely defined situation. This book, on the other hand, shows the thinking process needed to determine whether or not the member is required in the first place. Following this, the spacing and continuity of the member are decided, its loads are determined, and finally its shape and size are selected.

We believe that illustrating structural planning as well as detailed member and connection design is of considerable value in helping the student make the transition from the often simplistic classroom exercises to problems of the real world. Problems for solution by the student follow the same idea. The first problems in each subject are the usual textbook-type problems, but in most chapters these are followed by problems requiring the student to make structural planning decisions as well. The student may be required, given a load source, to find the magnitude of the applied loads and decide upon a grade of wood. Given a floor plan, the student may be required to determine a layout of structural members. The authors have used most of the problems in their classes, so the problems have been tested.

The book presents many of the design examples in the form of "computation sheets," solutions in the form of actual design office computations. This is intended to reinforce the instruction given in Chapter 1 regarding neatness and orderliness in design computations.

The book refers frequently to two codes—the National Design Specification for Wood Construction and the Uniform Building Code. Wherever possible, however, the basic princi-

ples behind code requirements are explained, and where the authors are aware of code shortcomings, that too is pointed out. We refer frequently to code requirements in the belief that theory with no exposure to real life is not good education. What is needed is balance between the theoretical and the practical (the latter is *not* a bad word).

The authors have included an example of designing for shear using "two-beam" action, so that users of the book can better understand the NDS provisions on the subject. However, the authors do not recommend using "two-beam" action for design.

In general, the book assumes that the user will be familiar with structural analysis. In fact, the authors intend that the book will reinforce the principles of structural analysis using wood as a vehicle.

The authors use the book in a three semester-hour beginning course and find that sufficient material remains that a second course could be taught from the same book. The prerequisite for the first course should be mechanics of materials as a minimum, including the subjects of shear and moment diagrams, flexural deflections, and axial forces in truss members. A more rigourous course in structural analysis, though desirable as a prerequisite, is not essential.

Chapter 5 (Connections—Nails, Screws, and Bolts) is intentionally in an unconventional position. The authors realize that most books cover connections after member design has been presented. They realize also that (1) because of its position in the course, connection design is something most students learn about almost as an afterthought (as though the subject is of lesser importance than the design of members); and (2) structural failures are far more frequent in the connections than in the members themselves. Further, design of members can be done more effectively if the designer considers how the member will be connected, before making a final selection of member size. With these thoughts in mind, the authors present the subject of connections *before* going on to the design of structural members.

Those who prefer to present the subject in the conventional sequence can merely go on to Chapter 6, delaying the study of Chapter 5 until after Chapter 8 (glulam design). It should work equally well with either sequence.

In the authors' beginning three-hour course in timber structure design, Chapters 1 through 7, 9, 10, 11, most of 8, and parts of 12, 13, and 14 are included.

The book is written to stand alone. Our many instructors may find it beneficial to ask their students to purchase the National Design Specification for Wood Construction from the Publications Department of the National Forest Products Association, 1250 Connecticut Avenue N.W., Washington, D.C. 20036.

JUDITH J. STALNAKER
ERNEST C. HARRIS
Denver, Colorado

Contents

STRUCTURAL DESIGN IN WOOD