

MECHANICAL AND ELECTRICAL EQUIPMENT

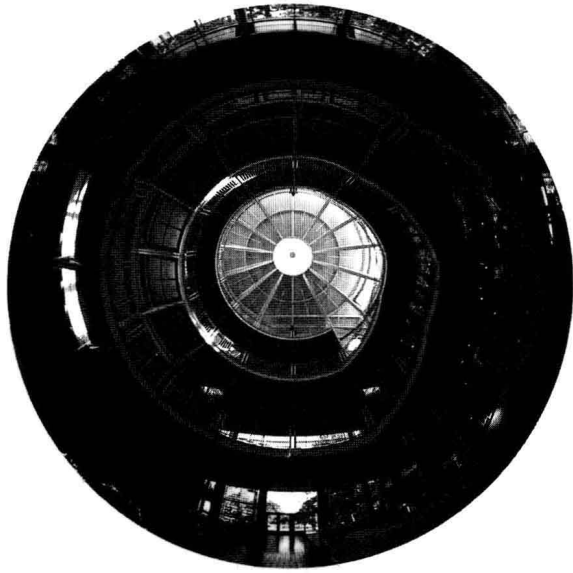
ELEVENTH EDITION



FOR BUILDINGS

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ELEVENTH EDITION



Mechanical and Electrical Equipment for Buildings

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John Wiley & Sons, Inc.

Part opener pages are from the drawing set for the Lillis Business Complex at University of Oregon, designed by SRG Partnership, Portland, OR.

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

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Library of Congress Cataloging-in-Publication Data:

Mechanical and electrical equipment for buildings / Walter T. Grondzik . . . [et al.]. — 11th ed.

p. cm.

Includes index.

ISBN 978-0-470-19565-9 (cloth)

1. Buildings—Mechanical equipment. 2. Buildings—Electric equipment. 3. Buildings—Environmental engineering. I. Grondzik, Walter T.

TH6010.S74 2010

626—dc22 2008049902

Printed in the United States of America

10 9 8 7 6 5 4 3 2

ELEVENTH EDITION

Mechanical and Electrical Equipment for Buildings

Preface

SEVEN DECADES AND A FEW GENERATIONS have passed since the first edition of *Mechanical and Electrical Equipment for Buildings* was published in 1935. At its birth, this book was 429 pages long. Now, in the 11th edition, the book is more than 1700 pages, an increase of 400%. Many new topics have been added, and a few have disappeared; computer simulations are now routinely used in system design; equipment and distribution systems have undergone major changes; mechanical cooling has become commonplace; fuel choices have shifted (coal has moved from an on-site to an off-site energy source). In recent editions, the book has increasingly added discussions of “why” to its historic focus upon “how-tos.”

Most of the systems presented in this book involve energy consumption. As North American society has moved from its early reliance on renewable energy sources (wind, water, and horse power) to today’s seemingly endless addiction to nonrenewable fossil fuels, it has also added vastly to its population and increased its per capita energy use. The resulting environmental degradation (primarily evident in air and water quality) has spurred efforts to reverse this decline. Governmental regulations are a part of such efforts, but this book emphasizes the investigation of alternative fuels and design approaches that go beyond those minimally acceptable to society. Designers are encouraged to take a leadership role in mitigating environmental degradations.

On this note, it is becoming increasingly clear that global warming is well under way. It may be less clear to what precise extent our hugely increased carbon-based energy consumption is responsible, with its associated heat release and gaseous additions to the atmosphere. But it is very clear that the world’s supply of fossil fuel is diminishing, with future consequences for all buildings (and their occupants) that today rely so thoroughly on nonrenewable energy sources.

The buildings of today contribute to negative global consequences that will impact future generations, and our approach to mechanical and electrical systems must consider how best to minimize and mitigate—if not negate—such negative environmental impacts. Thus, on-site resources—daylighting, passive solar heating, passive cooling, solar water heating, rainwater, wastewater treatment, photovoltaic electricity—share the spotlight with traditional off-site resources (natural gas, oil, the electrical grid, water and sewer lines). On-site processes can be area-intensive and labor-intensive and can involve increased first costs that require years to recover through savings in energy, water, and/or material consumption. Off-site processes are usually subsidized by society, often with substantial environmental costs. On-site energy use requires us to look beyond the building, to pay as much attention to a building’s context as to the mechanical and electrical spaces, equipment, and systems within.

Throughout the many editions of this book, another trend has emerged. Society has slowly moved from systems that centralize the provision of heating, cooling, water, and electricity toward those that encourage more localized production and control. Increased sophistication of digital control systems has encouraged this trend. Further encouragement comes from multipurpose buildings whose schedules of occupancy are fragmented and from corporations with varying work schedules that result in partial occupancy on weekends. Another factor in this move to decentralization is worker satisfaction; there is increasingly solid evidence that productivity increases with a sense of individual control of one’s work environment. Residences are commonly being used as office work environments. Expanding communications networks have made this possible. As residential designs thus become more complex (with office-quality lighting, zones

for heating/cooling, sophisticated communications, noise control), our nonresidential work environments become more attractive and individual.

Air and water pollution problems stemming from buildings (and their systems and occupants) are widely recognized and generally condemned. A rapidly increasing interest in green design on the part of clients and designers may help to mitigate such problems, although green design is hopefully just an intermediate step in the journey to truly sustainable solutions.

Another pervasive pollutant affecting our quality of life is noise. Noise impacts building siting, space planning, exterior and interior material selections—even the choice of cooling systems (as with natural ventilation). Air and water pollution can result in physical illness, but so can noise pollution, along with its burden of mental stress.

This book is written primarily for the North American building design community and has always emphasized examples from this region. Yet other areas of the world, some with similar traditions and fuel sources, have worthy examples of new strategies for building design utilizing on-site energy and energy conservation. Thus, some buildings from Europe and Asia appear in this 11th edition, along with many North American examples. Listings of such buildings (and associated researchers and designers) have been included in the index of this edition.

Building system design is now widely undertaken using computers, often through proprietary software that includes hundreds of built-in assumptions. This book encourages the designer to take a rational approach to system design: to verify intuitive design moves and assumptions and to use computers as tools to facilitate such verification, but to use patterns and approximations to point early design efforts in the right direction. Hand calculations have the added benefit of exposing all pertinent variables and assumptions to the designer. This in itself is a valuable rationale for conducting some portion of an analysis manually. Rough

hand-calculated results should point in the same direction as results obtained with a computer; the greater the disparity, the greater the need to check both approaches. This is not to disparage the use of simulations, which are valuable (if not indispensable) in optimizing complex and sometimes counterintuitive systems.

This book is written with the student, the architect- or engineer-in-training, and the practicing professional in mind. Basic theory, preliminary design guidelines, and detailed design procedures allow the book to serve both as an introductory text for the student and as a more advanced reference for both professional and student. This work is intended to be used as a textbook for a range of courses in architecture, architectural engineering, and building/construction management.

A “MEEB 11” World Wide Web (WWW) site will provide supporting materials to enhance learning about and understanding the concepts, equipment, and systems dealt with in this book. The opportunity to provide color images via this medium is truly exciting. As with previous editions, an Instructor’s Manual has been developed to provide additional support for this 11th edition. The manual, prepared by Kristen DiStefano, Walter Grondzik and Alison Kwok, outlines the contents and terminology in each chapter; highlights concepts of special interest or difficulty; and provides sample discussion, quiz, and exam questions. The manual is available to instructors who have adopted this book for their courses.

Mechanical and Electrical Equipment for Buildings continues to serve as a reference for architectural registration examinees in the United States and Canada. We also hope to have provided a useful reference book for the offices of architects, engineers, construction managers, and other building professionals.

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Visit **www.wiley.com/go/meeb**
for the expanding set of learning resources that accompany this book.

Acknowledgments

Many people and organizations have contributed knowledge, materials, and insights to the several editions of this book. We begin this acknowledgment with those from whose work we have borrowed at length: J. Douglas Balcomb, Baruch Givoni, John Tillman Lyle, Murray Milne, William McGuinness, and Victor Olgyay; ASHRAE (the American Society of Heating, Refrigerating and Air-Conditioning Engineers), the American Solar Energy Society (ASES), the Illuminating Engineering Society of North America (IESNA), the National Drinking Water Clearinghouse, the National Small Flows Clearinghouse, the National Fire Protection Association (NFPA); and the many equipment manufacturers whose product information and photographs are used to illustrate the book.

Several professionals provided valuable assistance in assembling materials, and clarifying ideas and details. These include Michael Utzinger and Joel Krueger (Aldo Leopold Legacy Center), Vikram Sami (Blue Ridge Parkway Destination Center), Craig Christiansen (NREL research reports), William Lowry (climate of cities), Daniel Panetta (AIWPS and recycling at California Polytechnic, San Luis Obispo), Dr. Jonathan Stein (computer applications), John A. Van Deusen (vertical transportation), and Martin Yoklic (cooltower performance analysis).

In addition to drawings by Michael Cockram (whose work first appeared in the 8th edition), we are very pleased to include in this 11th edition illustrations by Lisa Leal, Nathan Majeski, and Jonathan Meendering (who also helped illustrate the 10th edition). We continue to thank those who assisted with illustrations for the 10th edition: Dain Carlson, Amanda Jo Clegg, Eric Drew, and Erik Winter—students (now professionals) who embrace the principles and concepts of environmental technology in their design work and therefore clearly understood what they were drawing. We also acknowledge the many architects and engineers who provided illustrations of their buildings and design artifacts that

appear throughout the book—citations to these firms and individuals are found throughout the book.

Testing in the classroom is a particularly valuable way to find needed improvements in any textbook. Students at the University of Oregon have, over many years, raised probing questions whose answers have resulted in changes to succeeding editions. Valuable suggestions have come from many graduate teaching fellows at the University of Oregon, particularly Rachel Auerbach, Christina Bollo, Alfredo Fernandez-Gonzalez, Sara Goenner, Jeff Guggenheim, Susie Harriman, Jake Keeler, Angela Matt, Jonathan Meendering, Tobin Newburgh, Roger Ota, Therese Peffer, Troy Peters, David Posada, Barbara Reed, Amanda Rhodes, Nick Rajkovich, Jonathan Thwaites, and Michael Walsh. Michael Ober provided unrestrained encouragement with a YouTube video special for “MEEB.” Former Oregon students who helped with research include Troy Anderson, Daniel Irurah, Reza Javandel, Jeff Joslin, and Emily Wright.

A large portion of the work involved in producing a manuscript is accomplished by supporting personnel. Among these, we wish particularly to thank Jackie Kingen for coordinating illustrations for this edition. Britni Jessup, Jocelynn Gebhart, Amanda Rhodes, Lisa Leal, and Rachel Auerbach receive thanks for long hours of assistance with file coordination and project management. Adrienne Leverette—thanks for your surprise visit and assistance. Special, and very sincere, thanks go to Theodore J. Kwok, who gave extensive and prompt input on database development and troubleshooting.

Finally, we are indebted to the staff at John Wiley & Sons for their diligent and highly professional work, especially Amanda Miller, vice president and publisher; Paul Drougas, acquisitions editor; Lauren Olesky, associate developmental editor; Sadie Abuhoff, editorial assistant; Kerstin Nasdeo, production manager, Abby Saul, production assistant; and Devra Kunin at Foxxe Editorial Services, copyeditor.

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