McGRAW-HILL PROFESSIONAL ARCHITECTURE

Daylighting for Sustainable Design

MARY GUZOWSKI

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McGraw-Hill
New York San Francisco Washington, D.C. Auckland Bogotá
Caracas Lisbon London Madrid Mexico City Milan
Montreal New Delhi San Juan Singapore
Sydney Tokyo Toronto

Library of Congress Cataloging-in-Publication Data

Guzowski, Mary.
Daylighting for sustainable design / Mary Guzowski.
p. cm.
Includes bibliographical references and index.
ISBN 0-07-025439-7
1. Daylighting. 2. Light in architecture. 3. Architectural design—History—20th century. I. Title.
NA2542.3.G89 1999
720'.47—dc21 99-32791
CIP

McGraw-Hill
A Division of The McGraw-Hill Companies

2 3 4 5 6 7 8 9 0 DOC/DOC 0 9 8 7 6 5 4 3 2 1 0

ISBN 0-07-025439-7

The sponsoring editor for this book was Wendy Lochner, the editing supervisor was Christine Furry, and the production supervisor was Sherri Souffrance. This book was set in Matt Antique by North Market Street Graphics.

Printed and bound by R.R. Donnelley & Sons Company.

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Daylighting for Sustainable Design

With love and appreciation to
James Lindbeck
and all things wild

In wildness is the preservation of the world.

—HENRY DAVID THOREAU

List of Projects

Alberts & von Huut
ING Bank, Amsterdam, the Netherlands

Alvar Aalto
Mount Angel Library, Mount Angel, Oregon
Seinäjoki Library, Seinäjoki, Finland

Arthur Erickson
Anthropology Museum, University of British Columbia, Vancouver, British Columbia

Behnisch & Partner
German Bundestag, Bonn, Germany

Bennetts Associates
PowerGen Headquarters, Coventry, England

Cannon & Associates
Center for Environmental Sciences and Technology Management (CESTM), Albany, New York

Carlos Scarpa
Brion Family Chapel, near Treviso, Italy
Passagno Plaster Cast Gallery, Passagno, Italy

Clare Design
Clare House, Buderim, Australia
Rainbow Shores Housing, near the Sunshine Coast, Australia

Doug Pollard Architects
Boyne River Ecology Centre (The Grange), Shelbourne, Ontario

Emilio Ambasz
Lucille Halsell Conservatory, San Antonio, Texas

Eric Asmussen
Vidar Clinic, Rudolf Steiner Seminariet, Järna, Sweden

Foster and Partners
Business Promotion Centre, Duisburg, Germany
Carre d'Art, Nimes, France
Commerzbank, Frankfurt, Germany

Frank Gehry
Weisman Art Museum, Minneapolis, Minnesota

Fritz Haller
School in Solothurn, Switzerland

Georg Feinhals
Administration Building for Stadwerke Aachen, Aachen, Germany

Glenn Murcutt
House at Bingie Point, Australia
Paddington House, Australia

Herzog & de Meuron
Residential and Commercial Building, Basel, Switzerland

Herzog + Partner (Thomas Herzog)
Prototype House and Studio, Bavaria
Wilkhahn Factory, Bad Münder, Germany
Youth Hostel, Windberg, Bavaria

HHS Planar + Architeckten Heger
Demonstration Project for Expo Wohnen

Ingenhoven, Overdiek and Partner
Headquarters for RWE AG, Essen, Germany

Innovative Design
Durant Middle School, Raleigh, North Carolina

Jersey Devil
Palmetto House, Florida

Jørn Utzon
Bagsvaerd Church, Copenhagen, Denmark

Jürgen Hansen and Ralf Petersen
Allopro Administration Building, Germany

Kaija and Heikki Sirens
Chapel at Otaniemi, Espoo, Finland

Kaira-Lahdelma-Mahlamäki Partnership Company
The Finnish Forest Museum, Punkaharju, Finland

Kiss Cathcart Anders
Advanced Photovoltaic Systems Pilot Plant, Trenton, New Jersey

Kurt Ackermann and Partner
Office for Josef Gartner & Sons, Gundelfingen, Germany

Le Corbusier
Notre Dame du Haut, Ronchamp, France
Chapel at La Tourette, Eveux-sur-l'Arbresle, France

Louis I. Kahn
Center for the British Arts and Studies, New Haven, Connecticut
Kimbell Art Museum, Houston, Texas
Phillips Exeter Library, Exeter, New Hampshire

Luis Barragan
Capuchinas Sacramentarias del Purismo Corazon de Maria Chapel, Tlalpán, Mexico

Maki and Associates
Tokyo Church of Christ, Tokyo, Japan

Matsuzaki Wright Architects
C. K. Choi Building for the Institute of Asian Research, University of British Columbia, Vancouver, British Columbia

McDonough + Partners
Oberlin College Environmental Studies Center, Oberlin, Ohio

Meyer, Scherer & Rockcastle
MS&R Office, Minneapolis, Minnesota
Sahara West Library and Fine Arts Museum, Las Vegas, Nevada
SEI Headquarters, Oaks, Pennsylvania

Michael Maltzan Architecture and Marmol & Radziner Architecture
Mark Taper Center, Los Angeles, California

Thompson & Rose Architects
Atlantic Center for the Arts, New Smyrna Beach, Florida

T. R. Hamzah & Yeang
Menara Mesiniaga (IBM) Tower, Selangor, Malaysia

Vince James Associates
Type/Variant House, Hayward, Wisconsin

Vince James and Julie Snow
Children's Museum, St. Paul, Minnesota

Wells Woodburn O'Neil
Center for Energy and Environmental Education, Cedar Falls, Iowa

William Bruder
Theuer Residence, Phoenix, Arizona
Phoenix Central Library, Phoenix, Arizona

Foreword

In a few pages you're going to read that a 1981 book of mine played a part in shaping Mary Guzowski's environmental thinking. If it did, I now have reason to consider myself a success, for she has assembled in this book an array of information that can only be called vast.

Her vision is worldwide and her palette is rich: Light. Architecture. Color. Health. Design. Plants. Energy. Time. Reflection. Shading. Comfort. Form. Economy. Weather. Nature. Heat. Seasons. . . . Here we find all the ways that art and technology are learning to acknowledge, respect, and echo what the natural world long since perfected.

As I read *Daylighting for Sustainable Design* it struck me as appropriate that much of what the book is based upon is one of the earth's most common materials: sand . . . silicon. We learned to cook sand in order to get glass, and through that crystal we opened up for ourselves the hugely varied world of daylighting.

Still we go ahead, most of us, merrily trashing the planet, cheered on by all who stand to profit from our consumerism and waste. The world today presents a terribly depressing picture. But it's only half the picture. The other half can be seen in the book you now hold in your hands. Mary Guzowski is showing us the way back to an appropriate, balanced, and beautiful world.

She brings light into our lives.

Malcolm Wells

Acknowledgments

I would like to extend my sincere thanks and appreciation to the many colleagues, professional associates, friends, and family members who have helped, contributed, and supported in various ways the realization of this project. I want to thank the Department of Architecture and the College of Architecture and Landscape Architecture at the University of Minnesota for their support during the past several years. My special thanks to Michelle Juneau, whose thoughtful and thorough research assistance was invaluable. Although too numerous to list, I greatly appreciate the kindness and generosity of those individuals, firms, and photographers who made accessible their beautiful photographs and drawings—on which this book is so dependent. For their support and encouragement, I especially thank James, Bert, and my dear family and friends. Finally, I want to thank my editor, Wendy Lochner, and her associates at McGraw-Hill, and Christine Furry and the designers at North Market Street Graphics.

Introduction

In the early 1980s, I came across a small but significant book called *Gentle Architecture* by Malcolm Wells. Wells had no idea that the juxtaposition of those two words—*gentle* and *architecture*—would open for me (and undoubtedly for others) a new way of envisioning the built environment. What was significant about this modest book? Many other environmental and ecological writings and projects preceded its publication. The 1960s and 1970s were known for experimentation and explorations in passive solar, earth-sheltered, and energy-efficient architecture. It was Wells's distinction between the means and the end that was eye-opening for me. The book suggested to me that these approaches to design (passive solar, earth-sheltered, energy-efficient design, and other environmental concepts) are only ways of achieving larger architectural goals, which Malcolm Wells characterizes as "gentle architecture."

The term *gentle* added a new dimension—a new intention—to architectural design. What is an architecture that is gentle, and why is it desirable? By definition gentle is considerate, kind, patient, graceful, and even noble (from the Latin *gentilis,* "of noble birth"). The suggestion that architecture could embody these characteristics—gentleness, kindness, and grace—endows architecture with a life and spirit, and maybe even a soul. It is not enough to save energy, conserve resources, and minimize environmental impacts; it is equally important to create environments that are meaningful, humane, and worth living in. This intriguing juxtaposition of the words *gentle* and *architecture* has stayed with me through the years and is a quiet reminder that the end is about more than saving energy and important natural resources. Gentle architecture also expresses a point of view, a perspective, and an ethical way of thinking and acting in relation to the environment.

Though we may use the terms *environmental design, ecological design, sustainable design,* or even *green design* instead of "gentle architecture," all of these approaches strive to define and create more respectful relationships between humans and all of life—to create ecological relationships. Perhaps the term *ecological design* most clearly embodies the spirit of recent design efforts; however, I also find the term *sustainable design* useful because it adds the dimension of time. Although I will use both terms in this book, I suggest that the role of time and the promise of the future are explicit in the term *sustainable design* and implicit in the term *ecological design.* Sustainable design is ecological design with our responsibility to the future made apparent. The definition of the word *sustainable* is to "keep in existence, prolong, and maintain." When the word *sustainable* is combined with the word *design,* a dimension of time and its future implications are overlaid on the making of the built environment. We can no longer view architecture as disposable or something that can be thrown away as though it has little material, cultural, or emotional value. We have a responsibility to keep, maintain, and nurture environments through time. Yet the use of the term *sustainable design* upsets some people because they know full well that today it is impossible to achieve sustainability and that the term is perhaps even an oxymoron. Despite its complexities and ambiguities, I still appreciate the term *sustainable design* because of its promise for a new future.

Although we could spend significant effort exploring definitions of sustainable design (and their distinctions from environmental and ecological design), it is helpful to consider a definition found in *From One Earth to One World,* an overview of sustainable development by the World Commission on Environmental Development. Although the commission is speaking of sustainable development, I find their definition relevant and compelling because it is simple and open-ended. The commission suggests that sustainable development involves ". . . meeting the needs of the present without compromising the ability of future generations to meet their own needs."* Here the element of time is made explicit. Surely we need to make things better for today, but we also have to address tomorrow, and the next day, and on into the

* World Commission on Environmental Development, *From One Earth to One World* (Oxford, England: Oxford University Press, 1987), 8.

future. Yet, even in this simple definition, the use of the words "without compromising" lets us off too easily. We certainly should not compromise the future, but are we not responsible for more than that? Are we not responsible for meeting the needs of the present while also *enriching and enhancing* the ability for future generations to meet their own needs? Should we prepare a path that helps those in the future go beyond where we are today or even tomorrow? I use the term *sustainable design* despite these unanswered questions and despite its inherent complexities and contradictions; I'm also fully aware that we are nowhere near its realization—that it will probably be generations before we approach such a dream. Despite these conditions, the term is useful because it embodies a desire to go beyond where we are today. The term *sustainable design* holds a vision of the future, a hope of where we might go. As a result, the term itself becomes a reminder that we have important work to do today and tomorrow.

While there is some debate about what types of issues are included under the topic of sustainable design, a discussion by the American Institute of Architects (AIA) and the International Union of Architects (IUA) is helpful in suggesting its scope and breadth: ". . . sustainable design integrates considerations of resource and energy efficiency, healthy buildings and materials, ecologically and socially sensitive land-use, and an aesthetic sensitivity that inspires, affirms, and ennobles. . . ."* I find it encouraging that the AIA and IUA include the phrase "aesthetic sensitivity that inspires, affirms, and ennobles" in their discussion. This clearly distinguishes sustainable design from the emphasis on energy and natural resources in the 1960s and 1970s. It is this distinction that I find so compelling and so promising. It suggests to me that we need to create environments that sustain all of life—including humans and their seemingly unique aesthetic, physiological, psychological, and spiritual needs. Aesthetics, beauty, health, well-being, and quality of life are as important to sustainable design as are reducing waste, energy consumption, and environmental impacts. Yet some people are apprehensive about these nonquantifiable aspects of sustainable design. When pressed, a surprising number of people

* Susan Maxman and Olufemi Majekodunmi, "Declaration of Interdependence for a Sustainable Future," in *A Primer on Sustainable Building* (Snowmass, Colo.: Rocky Mountain Institute, 1995), 119.

view sustainable design as just another incarnation of energy-efficient and resource-efficient design.

Daylighting is an intriguing aspect of design in which these environmental, aesthetic, and human factors come together. Daylighting design (which can be viewed as just one topic under sustainable design) can be explored from various perspectives. It is not uncommon for different aspects of the daylighting design to be addressed by different people during the design process. In extreme cases, "building scientists" study the energy and environmental impacts of daylighting, "designers" explore its formal and aesthetic implications, and "behaviorists" address the human implications of daylighting. The problem is to synthesize and integrate seemingly disparate daylighting issues when so many considerations (and perhaps people) may be involved. Most would agree that daylighting design includes environmental, architectonic, and human factors. Yet, the emphasis on daylighting within the context of sustainable design still tends to focus on a particular set of environmental issues related to energy and natural resources. This book suggests that this triad—environmental, architectonic, and human considerations—need to be woven together in an ecological or sustainable approach to design. The inclusion of environmental factors, energy, and natural resources is critical; however, without architectonic and human considerations the vision of sustainable design is incomplete. We are well aware of the pragmatic aspects of sustainable design, but what are its poetic and experiential implications?

This book is organized into three parts: environmental, architectonic, and human considerations. Each part includes several chapters that are presented as design principles. Each chapter in turn explores related design concepts, strategies, and precedents.

Part I, Environmental Considerations, includes three chapters that focus on how external environmental factors influence an ecological approach to daylighting design. External factors include environmental forces such as sun and wind as well as environmental resources such as energy, materials, and the related issue of waste. *Chapter 1, Take a Bioregional Approach,* considers how the environmental forces of sun and wind shape daylighting and how these forces interact with climate and site. *Chapter 2, Do More with Less,* addresses how daylighting can be coupled with other design issues to reduce the consumption of energy and natural resources. *Chapter 3, Design for Evolution,* explores how day-