

TWENTIETH-CENTURY BUILDING MATERIALS

HISTORY AND CONSERVATION

EDITED WITH A NEW PREFACE BY THOMAS C. JESTER

GETTY CONSERVATION INSTITUTE, LOS ANGELES

THIS BOOK IS DEDICATED TO THE MEMORY OF HENRY WARD JANDL. 1946-1995

The Getty Conservation Institute
Timothy P. Whalen, *Director*Jeanne Marie Teutonico. *Associate Director, Programs*

The Getty Conservation Institute works to advance conservation practice in the visual arts, broadly interpreted to include objects, collections, architecture, and sites. It serves the conservation community through scientific research, education and training, model field projects, and the broad dissemination of the results of both its own work and the work of others in the field. And in all its endeavors, it focuses on the creation and dissemination of knowledge that will benefit professionals and organizations responsible for the conservation of the world's cultural heritage.

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Front cover: The Alcoa Building, Pittsburgh, Pa. See fig. 1.3.

Page i: Standard-sized building materials with established properties, such as Celotex's 4-by-8-foot fiberboard, became a hallmark of the construction industry in the twentieth century. *Celotex Manual for Architects*, The Celotex Corporation, 1937.

Page ii: The Kresge Auditorium at the Massachusetts Institute of Technology, Cambridge, Mass. See plate 8.

Page viii: Cast aluminum elevator doors and a stepped over door grace the Cities Services Building (1932, Clinton and Russell, George and Holdon), New York City.

Back cover: The Salk Institute (Louis I. Kahn, architect), San Diego, Calif. Detail.

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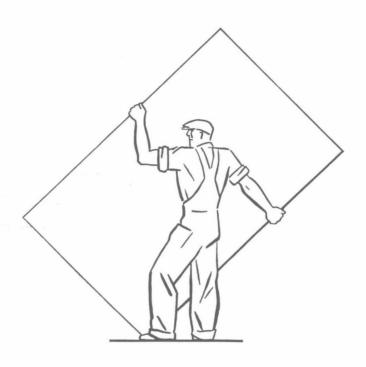
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FOREWORD TO THE 2014 EDITION

Over the past few decades it has become increasingly apparent that modern buildings present a unique series of conservation challenges. Many of these buildings have not aged well, and conservation efforts have been hampered by a lack of information about the materials and technologies used in their construction.

The Getty Conservation Institute launched its Conserving Modern Architecture Initiative in 2012 with the goal of advancing the practice of conserving twentieth-century heritage, with a focus on modern architecture. The Initiative is intended to help address the needs of the field through research and investigation, including the development of practical conservation solutions, and the creation and distribution of information through training programs and publications.

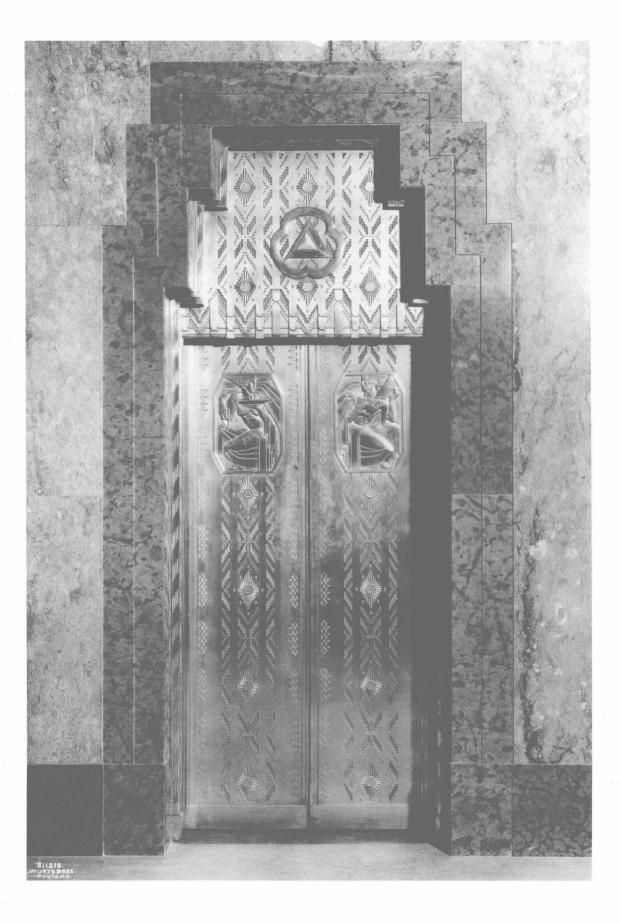
In our early discussions about publications and the dissemination of critical literature, Thomas Jester, the original editor of *Twentieth-Century Building Materials*, suggested we revise or re-issue this landmark volume, which had been out of print for several years. Originally published under the aegis of the United States Department of the Interior's National Park Service's Preservation Assistance Division, *Twentieth-Century Building Materials* is considered the first in-depth survey of important construction materials used primarily in North America since 1900. Highly regarded by architects, architectural historians, and conservation professionals, it is still a relevant and valuable resource for professionals from various disciplines working in the field of modern heritage.

We thank Thomas for editing the original 1995 edition of *Twentieth-Century Building Materials* and for his assistance in this re-issue. We are also grateful to the National Park Service for supporting the development of this important project, and to Susan Macdonald and Kyle Normandin, who through the Conserving Modern Architecture Initiative have helped give new life to this important publication.

We hope that this book will serve conservation professionals, including architects, engineers, conservators, and

material scientists, as well as students in those fields, as a resource for the conservation of building materials of the twentieth century—from everyday structures to iconic monumental architecture—and help ensure that these buildings are appropriately safeguarded in the future.

Timothy P. Whalen
Director
The Getty Conservation Institute



PREFACE TO THE 2014 EDITION

The importance of preserving both modern architecture and the recent past is today clearly acknowledged as part of the mainstream in the field of heritage conservation. That wasn't the case in 1995, however, when Twentieth-Century Building Materials: History and Conservation was first published. Twenty years ago very little information was available on the repair and conservation of modern building materials and assemblies. Twentieth-Century Building Materials was conceived and developed by the National Park Service's Technical Preservation Services Branch, which was an early leader in advancing the practice of historic preservation through its technical publications and national conferences. As an introduction to a conservation perspective on the world of modern building materials, the book was groundbreaking for its time. It brought attention to this emerging area of preservation practice and effected a sea change in the understanding of midcentury construction. A tremendous collaborative undertaking, Twentieth-Century Building Materials would not have been possible without the significant contributions made by more than forty authors and the commitment of the National Park Service.

Extensive literature has been published over the past twenty-five years about the conservation and repair challenges associated with modern materials and assemblies. Beginning in the mid-1990s, the literature on preservation technology shifted from theoretical discussion about conservation issues to project-specific case studies, as buildings from the modern era began to undergo interventions. The Getty Conservation Institute's bibliography Conserving Twentieth-Century Built Heritage, A Bibliography, Second Edition is testimony to the worldwide interest in this specialty area of conservation practice, an interest that continues today. The Association for Preservation Technology International and DOCOMOMO International have been at the forefront of efforts to advance the technical understanding of modern heritage through conferences, training workshops, and publications, which have addressed topics ranging from exposed reinforced

concrete and curtain walls to stone cladding, modern wood, and glass.

Despite the real advances in our ability to address the unique technical and philosophical challenges associated with modern building materials and components. there is still a great need for more advanced information on modes of deterioration, diagnostics, and repair and conservation treatments. Advanced and widely accepted technical solutions still do not exist for many of the most common materials, including reinforced and precast concrete, curtain wall systems, glass, and metals. Although the number of modern preservation projects continues to grow-and with it the associated knowledge base-decisions about specific materials are most frequently based on unique circumstances and conditions rather than on application of time-tested conservation approaches and methods. In part this is explained by the sheer number of proprietary materials and assemblies used in the twentieth century, but it is also because we simply do not know as much as we should about modern materials.

Put simply, not enough advanced information is available to conservation professionals. More conservation research is needed, including more partnerships among industry, academia, and government agencies. One could look for inspiration at the related fields of museum and objects conservation. Objects conservators have embraced the challenges of modern materials in their collections with research programs on topics such as modern metals, paints, and plastics. Similar research programs are needed for the most important conservation issues associated with immovable cultural property.

So, if preservation technology for modern buildings has advanced in the past twenty years, why republish Twentieth-Century Building Materials?

First, there is still a great need for basic information, and no other reference provides readers with an introduction to the history of modern materials and associated repair and conservation issues. The book was intended as a primer, and readers needing more detailed historical and repair information were then—and are now—encouraged to consult additional sources. Since its publication in 1995, more detailed technical literature has been published on many of the materials. In many other cases, however, the history sections of these essays are as current today as they were twenty years ago, because no additional scholarship has advanced our understanding of the history of a particular building technology.

Second, more and more modern buildings are at an age when renewal is required, and practitioners are faced with decisions about repair and replacement. Some modern materials were experimental; others simply lack the durability of more traditional materials or do not meet today's performance requirements. The need to replace certain materials and assemblies, most prominently curtain walls, for example, has become more widely accepted than in the past. Addressing this kind of technical obsolescence nonetheless remains a challenge for practitioners, who must find a balance between the need for performance and respect for historic values in significant buildings. Indeed, the starting point for designing an intervention should be not what must be replaced but rather what can be preserved. This requires a thorough understanding of the materials from a historical and conservation perspective. Finally, the book contains valuable bibliographic references and resource information that remain useful to students of the history of building technology as well as to conservation professionals.

For all these reasons, Twentieth-Century Building Materials remains a valuable introduction to its subject. It is also hoped that republication of this book will once again emphasize the importance of understanding the history of modern materials and associated conservation and repair challenges and serve as a bridge until more advanced technical literature becomes available. The preface to the 1995 edition noted that the book was intended to identify many of the conservation challenges that lie ahead and "sound a call" for more research into such subjects as the failure mechanisms afflicting modern materials. Despite the advances made in the past twenty years, those points remain valid today. The Getty's Conserving Modern Architecture Initiative (CMAI) has assumed a leadership role in much the same way that the National Park Service did in the 1990s. We hope that the CMAI will spur, conduct, and support research on the most ubiquitous modern materials and facilitate advances both in our understanding of how modern materials deteriorate and in the development of new conservation approaches and repair techniques. While this important

work is being done, for anyone wishing to understand the most widely used construction materials of the last century, *Twentieth-Century Building Materials* is once again available as both resource and reference.

Thomas C. Jester, AIA, FAPT January 2014

PREFACE TO THE FIRST EDITION

Twentieth-Century Building Materials explores the history of many of the materials used to build modern America. Some of these materials, such as reinforced concrete and terra cotta, were nineteenth-century materials that found new uses after the turn of the century. Others, such as glass block, stainless steel, porcelain enamel, and decorative plastic laminates, did not appear until after 1900. Still others were not widely used until after World War II. Such materials can be found in buildings on Main Streets and in cities across the country.

Building materials not only make possible the structure and form of a building; they also reflect the industries that defined the machine age. Curved structural glass, extruded aluminum, glass block, and linoleum are examples of mass-produced materials that gave buildings a distinctively modern appearance. Building products from this century are also reminders of improvements in construction technology—prismatic glass, for example, improved lighting in buildings, and acoustical materials provided sound control. Other products, like gypsum board, signified the growing trend toward simplified drywall construction. Regardless of importance, building materials have shaped both architectural masterworks as well as vernacular buildings.

This book was inspired in part by two earlier books that focused on historic building materials and technology and underscored the importance of understanding materials and technology as the basis of sound historic preservation practice. More than twenty years ago Charles F. Peterson, then with the National Park Service, organized a symposium to celebrate the 250th anniversary of the Carpenters Company of the City and County of Philadelphia and focus attention on building practices before 1860. Until then the subject of building technology had largely been ignored by historians. The culmination of this effort was the publication of *Building Early America*, edited by Peterson. The symposium's success led the Association for Preservation Technology to undertake a research program nearly ten years later. Under the

direction of Hugh Miller and Lee H. Nelson, both historical architects at the National Park Service, the association's foundation compiled and in 1983 published a collection of essays on late-nineteenth-century building technology and materials. H. Ward Jandl served as editor of this volume, entitled *The Technology of Historic American Buildings. Twentieth-Century Building Materials*, likewise, is the culmination of a tremendous collaborative effort, involving professionals and scholars.

The National Park Service is directed by Congress to conduct a range of activities to assist states and territories, federal agencies, and the general public in the treatment and long-term protection of historic properties listed in the National Register of Historic Places. The Preservation Assistance Division, one of the National Park Service's cultural divisions, sets professional standards and guidelines for conservation and rehabilitation work, sponsors and carries out training workshops and conferences, and produces and distributes technical information through a variety of formats, including the well-known Preservation Briefs series, Preservation Tech Notes, and copublished works, such as this book.

There is now an urgent need to address the relative dearth of historical and practical conservation information on twentieth-century building materials. Many buildings constructed in the first half of the century are now being designated as historic landmarks, and they are being rehabilitated and restored or are prime candidates for renewal. This volume is intended to promote awareness of the history of a range of building materials that can be found in twentieth-century buildings. The conservation sections will help readers identify common materials, explain how they deteriorate, and suggest conservation, repair, and replacement approaches.

Mass-produced materials used in this century are already beginning to pose conservation challenges for the current generation of architectural conservators, architects, and engineers involved in historic preservation. Contrary to popular perception, modern building mate-

rials are neither maintenance free nor more durable than traditional materials, from brick and timber to iron and stone. Just like handcrafted materials, modern materials are subject to environmental degradation and the effects of human use.

Building materials from this century are in some respects more complex than their predecessors, and for this reason we need to expand our understanding of historic manufacturing processes, standards, and testing methods. Many twentieth-century products are typically manufactured using large-scale and mechanized processes; in addition, they are often composite materials. Intricate alloys, materials based on patented formulas, complex plastics, and laminated materials are only a few examples of composite materials. Learning more about how materials in composites behave and interact will be a challenging task for historic preservation professionals in the coming years.

Even though few time-tested conservation techniques exist for many twentieth-century materials, the amount of current technical literature on the performance and durability of these materials is far larger than that for materials of earlier centuries. To avoid outdated, potentially damaging approaches to materials evaluation, testing, and repair and replication, preservationists must study the historical record documenting the development and early testing of these building materials. Research into early technical documents will be useful—if not essential—in guarding the integrity of twentieth-century architecture and limiting insensitive material repairs and replacement.

The introductory essay by Michael A. Tomlan, director of the Historic Preservation Planning Program at Cornell University, provides a historical overview of building material developments between the late nineteenth and mid-twentieth centuries. Subsequent sections cover specific materials in the following general categories: metals; concrete; wood and plastics; masonry; glass; flooring; and roofing, siding, and walls. Entries on materials, written by more than forty contributors, begin with the name of the author or authors. When multiple authors are listed and separated by a semicolon, the first author or authors listed prepared the history section, while those listed second prepared the conservation section. Dates of production refer specifically to U.S. production and principally to architectural applications. The decision to include trade names also deserves explanation. A broad definition of the term trade name has been adopted for this book to include the names of both trademarked and proprietary products, as well as names commonly used in the construction industry.

This book is intended to sound a call for more investigation into the deterioration and conservation of twentieth-century materials. For a few materials discussed in this volume, no conservation section has been included. Further research is necessary on these topics and others.

The sheer number of materials used in this century suggests that research should focus on prevalent products or specific companies' product lines. A positive beginning using this approach is a National Center for Preservation Technology and Training grant made to the National Council for Preservation Education in 1994 to support master's thesis research on the history and conservation of twentieth-century materials. This grant will, for example, enable a graduate student studying Formica to develop state-of-the-art techniques for conserving this well-known decorative plastic laminate.

Other topics that deserve immediate study include asbestos products, paint coatings and other finishes, ceramic veneers and clay tile panels, more recent flat glass products, modern woods, such as plywood, and a host of products made of laminated sandwich construction. Research on these and other topics can be developed with assistance from professionals in related fields, including conservators facing similar challenges with twentieth-century artifacts made of plastics, metal alloys, and laminated woods. Materials scientists at universities and private laboratories are another relatively untapped source, as indicated in the appendix.

With the publication of this introduction to the subject of twentieth-century building materials, the National Park Service seeks to promote awareness of the history of building materials from this century, present current information on known repair techniques, and identify many of the conservation challenges that lie ahead.

Thomas C. Jester Editor

ACKNOWLEDGMENTS

Edited works are by their very nature collaborative efforts. Thus, this book would not have been possible without the invaluable assistance of many people.

Shortly after joining the National Park Service's Preservation Assistance Division in 1991, H. Ward Jandl shared with me a conceptual outline for a guide to twentieth-century building materials. Aside from his interest in modern buildings, Ward recognized the importance of this subject to the future of historic preservation. Ward's support of my efforts to make this book a reality was unwavering, and I am deeply saddened that his death in March 1995 prevented him from seeing its completion.

I would like to thank each contributor for participating in this project and for each's assistance and patience during the editorial process. Each author's passion for his or her topic was evident and exciting, even when that passion translated into longer essays that did not fit into the allotted space. Without the expertise of the contributors and the willingness of some individuals to research specific topics, this book would not have been possible. Thanks are due to Flora A. Calabrese; Irene J. Cohen; James D. Connolly: Adrienne B. Cowden: Carol J. Dyson: Susan M. Escherich: David C. Fischetti: Sidney Freedman: Rebecca Gallagher; Paul E. Gaudette; Edward A. Gerns; Carol S. Gould: Anne E. Grimmer: William G. Hime: Harry J. Hunderman: Mike Jackson: Walker C. Johnson; Bruce S. Kaskel; Stephen J. Kelley; Paul D. Kofoed; Kimberly A. Konrad: Ann Milkovich McKee: Robert W. McKinley: Andrew McNall: Kathleen Catalano Milley: Dietrich Neumann; Howard Newlon, Jr.; William J. Nugent; Sharon C. Park; Conrad Paulson; Michael J. Scheffler; Robert Score: John C. Scott: Carolyn L. Searls: Pamela H. Simpson; Amy E. Slaton; Deborah Slaton; Bonnie Wehle Parks Snyder; Jerry G. Stockbridge; Nicole L. Stull; Anne T. Sullivan; Michael A. Tomlan; Derek H. Trelstad; Anthony J. T. Walker; Anne E. Weber; David P. Wessel; and Kenneth M. Wilson.

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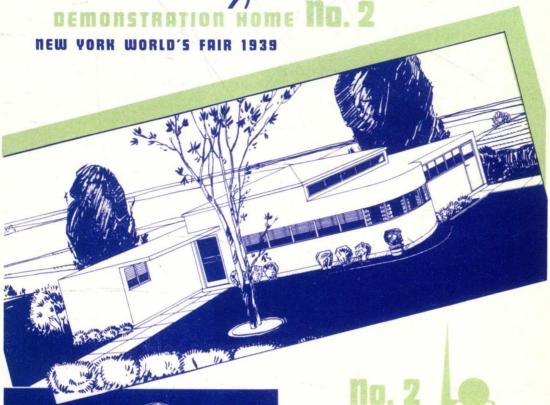
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The National Park Service permitted me to devote an extraordinary amount of time and resources to this book project, for which I am thankful. In addition to financial

TWENTIETH-CENTURY BUILDING MATERIALS: A PHOTOGRAPHIC ESSAY

Plate 1. Built for the 1939 New York World's Fair, Demonstration Home no. 2 (Lawrence Kocher) highlighted plywood's potential use in residential construction (opposite). Douglas fir plywood was used for the exterior walls, interior walls, and roof sheathing. Lithograph by Burland Printing Company, 1939.

The Town of Tomorrow DEMONSTRATION HOME NO. 2



PLYWOOD HOUSE LVING ROOM SHELVES LVING ROOM DEESS. T. DRESSER CLOSET LINEN DRESSER CLOSET LINEN DRESSER CLOSET DRESSER CLOSET DRESSER CLOSET DRESSER CLOSET DRESSER CLOSET DRESSER CLOSET LINEN DRESSER CLOSET DRESSER CLOS

THE HOUSE OF PLYWOOD

Sponsored by

Douglas Fir Plywood Association

Crane Co.
General Electric Company
Johns-Manville
Johnson Wax Products
National Better Light-Better Sight Bureau
New York Telephone Company
Orange Screen Company
Truscon Steel Company
Wall Paper Institute

Furnishings by Modernage



Architect: A. Lawrence Kocher, 4 Park End Place, Forest Hills, N. Y.



Plate 5. An intricate stainless steel sculpture, "Spirit of Light," adorns the Niagara-Hudson Building (1930, Clayton Frye and Albert Rumschik), Syracuse, N.Y. (left).

Plate 6. The cast metal door panels of the apartment building at 3 East 84th Street (1928, Howells and Hood), New York City, were made of Monel, a nickel-copper alloy manufactured by the International Nickel Company (bottom left).

Plate 7. Cast aluminum grilles with floral details were used for the entrance bay of the Seattle Art Museum (1932, Charles Bebb and Carl Gould) (bottom right).









Plate 8. Eero Saarinen's inventive use of modern materials—a thin reinforced concrete shell and aluminum-framed glass panels—contributes to the dramatic form of the Kresge Auditorium (1955) at the Massachusetts Institute of Technology, Cambridge, Mass.

Plate 9. Streamlined interior designs using modern materials were popular for restaurants during the 1930s. Metalwork was often featured prominently, as in this stainless steel bar front in Whitey's Cafe, East Grand Forks, Minn.