NPS Reading List

Twentieth Century Building Materials: 1900-1950

U.S Department of the Interior National Park Service Preservation Assistance Division

U.S Department of Defense
Legacy Resource Management Program

The National Council
for Preservation Education

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

U.S. Department of the Interior
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Cover photo: The Motohome -- the result of a collaboration between architect Robert W. McLaughlin, Jr., and promoter Foster Gunnison -- was a prefabricated house framed in steel and clad with modular wall panels composed of fiber insulating boards faced on each side with asbestos cement. A mechanical core, the "moto-unit" gave the house its name and made it different from other steel-frame, prefabricated houses of the period. Approximately 150 Motohomes were built between 1934 and 1936. Photo: F.S. Lincoln.

Twentieth Century Building Materials: 1900-1950

An Annotated Bibliography

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U.S. Department of the Interior
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Joan Janicki, an architect and graduate student in Historic Preservation at the University of Georgia, prepared the Reading List for publication by providing technical and editorial review, as well as bibliographic, archival and photographic research. Anne Grimmer, Preservation Assistance Division, National Park Service, served as general editor of the Reading List.

Reading lists have been published by the National Park Service, Preservation Assistance Division, since 1975. Most are selected bibliographies rather than a comprehensive overview of a particular subject. Some of the reading lists are annotated. Comments or suggestions for additions to the Reading List should be sent to: Preservation Assistance Division, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.

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Introduction

The purpose of this bibliography is to provide information on building materials introduced or significantly developed during the first half of the twentieth century. The material fabric of twentieth-century buildings is often complicated or very interdependent in composition. Therefore, it is imperative that reading lists such as this be compiled and disseminated as means to insure the continued evaluation and proper maintenance of early twentieth century architecture.

The extraordinary, and often violent, economic and political changes from 1900 to 1950 produced marked changes in the way Americans lived. The invention of new materials resulted in new patterns and techniques in American building practices. Because of an expanding industrial output, as well as rising building costs, it became necessary to replace traditional materials and building conventions with new materials and practices. A readily seen example is gypsum wallboard, a material that significantly replaced the labor-intensive practice of lath and plaster by 1950.

Entries in this Reading List were assembled from books, periodicals, government documents, and preservation-related publications. Architectural journals were especially useful in providing an understanding of the development and availability of particular materials. Many architectural journals from the first half of the century not only had technology columns, but also provided information on new products each month. For example, *Architectural Forum* featured "Building Reporter" while *Architectural Record* had "Better Building Products." *Pencil Points* ran "Products Progress" which became "Products" and "Materials and Methods" when the journal changed its name to *Progressive Architecture.* Advertisements are also a significant source of information. While advertisers' claims are always suspect, many took measures to provide the reader with abundant information about their product through sample specifications, descriptions of available sizes or colors, photographs, and/or drawings.

The bibliography is organized into four major sections. The first, General Building Materials, provides sources that cover all (or many) building materials. Citations for specific materials are located under Classifications of Materials. This section is divided into the major types of materials (e.g. wood, masonry, concrete), some of which are further subdivided. The third section, Construction Systems, includes entries that focus on the assembly or construction of new materials. Finally, the section titled Additional Resources is intended to guide the reader to other organizations or research centers for further information.

General Building Materials: Background Information

Historical Information

Condit, Carl W. *American Building Art: The Twentieth Century.* New York, NY: Oxford University Press, 1961.

This book surveys building technology and materials of the first half of the twentieth century. It is particularly valuable for locating dates, names of people, and specific buildings relevant to the development of new materials and construction systems.

Elliott, Cecil D. *Technics and Architecture: The Development of Materials and Systems for Buildings.* Cambridge, MA: MIT Press, 1992.

The first half of this book provides a history of materials development from the Industrial Revolution through the first half of the twentieth century. Exceptional illustrations are provided.

Guedes, Pedro, editor. *Encyclopedia of Architectural Technology.* New York, NY: McGraw-Hill Book Company, 1979.

Section Five of this book presents concise information on a wide range of building materials supplemented with ample illustrations and photographs. Particular attention is given to wood, concrete, iron, and steel. Section Six discusses tools, techniques, joints, and fixings for particular materials. Other sections cover stylistic periods, building types, structural design and environmental systems.

Guise, David. *Design and Technology in Architecture.* New York, NY: Van Nostrand Reinhold Company, 1991.

The author provides an overview of the history of material and structural technology incorporating a discussion of physical forces, building materials, structural systems, life safety and code issues, and various case studies of steel-framed and concrete-framed buildings (mainly late 1950s and 1960s.) The book is well illustrated with diverse historical highlights.

Jennings, Jan, and Herbert Gottfried. *American Vernacular Interior Architecture 1870-1940.* New York, NY: Van Nostrand Reinhold Company, 1988.

This general book on the elements, spatial configurations, support systems, and building types of vernacular interior architecture offers information on materials that were used between 1870 and 1940. Specific names of products (e.g. Masonite, Carrara glass) are mentioned along with contemporary sources of information.

Primary Sources and Early Investigations

"Contributions of Science and Technology to Building Design 1891-1941." *Architectural Record.* Vol. 89, No. 1 (January 1941), pp. 42-57.

The product of a symposium, this brief article covers the development of building materials such as metals, concrete, wood, glass and plastics. It provides an overview of progress from the last decade of the nineteenth century to the first forty decades of the twentieth century.

Creighton, Thomas H. "Pearl Harbor to Nagasaki: A Review of Architectural Progress During the War Years." *Progressive Architecture*. Vol. 27, No. 1 (January 1946), pp. 42-81.

This extensive article summarizes the changes in American architecture during World War II. The development of building materials, construction methods, and building types such as military and industrial structures, schools, hospitals, and houses are discussed.

Dietz, Albert G. *Materials of Construction: Wood, Plastics, Fabrics*. New York, NY: D. Van Nostrand Company, Inc., 1949.

This popular reference book of its time deals with the identification, characteristics, details, and problems associated with wood construction with both sawn and re-manufactured wood materials. It also covers a variety of plastics and both natural and artificial fabrics. This relatively early description of the chemistry of plastics and resins includes information on their manufacture and properties.

Emerson, David B. "Floors and Flooring Materials," Parts I and II. *Pencil Points*. Vol. 14, Nos. 1 and 2 (January and February 1933), pp. 55-58; 101-104

Emerson describes the composition, uses, and qualities of various flooring materials in this article, including examples of installations of wood floors, cork tile, rubber tile, mastic, asphalt tile, linoleum, burnt clay tile, terrazzo, mosaic tile, marble, soapstone, slate, flagstone, and magnesite.

_____. "The Specification Desk: Roofs and Roofing Materials." *Pencil Points*. Vol. 11, No. 3 (March 1930), pp. 229-231.

This article presents a brief history of roofing materials and applications. Topics include the comparatively recent development of concrete tile used over theaters and industrial buildings.

Graf, Don. *Basic Building Data: 10,000 Timeless Construction Facts*. New York, NY: Van Nostrand Reinhold Company, 1975.

A reprint of the 1949 second edition, this handbook is a compilation of "Data Sheets" produced by the author and printed in *Pencil Points* from 1932 to 1942. Each page provides line drawings and/or text on a particular subject. In addition to properties of and construction details for materials, Graf covers such items as furnishings, architectural systems, log cabins, elevators, and design data for building types.

Hoke, John Ray, Jr., editor. *Architectural Graphic Standards*. New York, NY: John Wiley & Sons, 1988.

Known as "the architects' bible," this book provides design data, definitions, charts, dimensions, and extensive line drawings for everything from building materials to sitework to environmental systems. It was first published in 1932 and was followed by subsequent editions in 1936, 1941, 1951, 1956, 1970, 1981, and 1988. New to the eighth edition is a section on historic preservation that includes information on materials, structural systems, the Classical orders, the Historic American Buildings Survey, and interiors.

Kellog, Lester S. "Messages In Materials Price Trends: A Charting of Post War Price Trends." *Architectural Record*. Vol. 99, No. 1 (January 1946), pp. 51-55.

This article gives an overview of price trends during and immediately after World War I and assesses the situation after World War II. After discussing the effect of the relative unavailability of lumber, bricks, insulation board, lath, and soil pipe, Kellog makes predictions about the supply and demand for particular building materials during the post-war period.

Lopez, Frank G. "Taking Stock for the Future." *Pencil Points*. Vol. 26, No. 1 (January 1945), pp. 69-84.

The result of a survey of materials and equipment manufacturers, this article addresses aspects of product design and development, including competition, the public attitude, labor, building codes, uses, and innovations. Charts describe advances in materials and equipment. Trade names, a list of manufacturers, photographs, and drawings of new products are included.

_____. "What Can We Use?" *Pencil Points*. Vol. 23, Nos. 4 and 5 (April and May 1942), pp. 195-197; 261-264.

This article includes charts of approved wartime building materials and makes recommendations for substitutions for materials such as metal, rubber, and cork, which were not available during World War II.

The exterior of the "White Palace Cafe" features pigmented structural glass and neon signs - two uniquely 20th century building materials. *Photo:* Richard Wagner.

Lowenthal, Milton. "Trends in the Development of Building Materials." *Architectural Record*. Vol. 85, No. 5 (May 1939), pp. 78-83.

The increased ability to manipulate building materials and control specific properties are cited as reasons for the current trend in materials development. This trend -- the integration of structural, insulating, and surfacing requirements into a single system -- has led to the development of products such as Masonite, Vinylite panels, and Solex glass.

"Products for Better Building." *Architectural Record*. Vol. 106, No. 1 (July 1949), pp. 146, 174-184.

After a brief introduction to laminated sheetrock wallboard, this article discusses other new materials. Included are Allied Synthetic's Alsynite fiberglass sheets for skylights and windows, aluminum trim used in place of wood trim, Plytex plywood decorative panels, and Neo-Matte Alumilite finish.

"Products for Postwar Plans." *Architectural Record*. Vol. 96, No. 6 (December 1944), pp. 58-67.

This is a comprehensive listing of materials and products available from 255 manufacturers. Products vary from structural materials and systems to finishes. Each manufacturer gives a brief statement of what they have available.

Reed, J. Ronald. *The Craftsmanship Revival in Interior Design*. New York, NY: Henry Holt & Company, 1989.

After a brief introduction to craftsmanship, this book covers eight sections, each on a different material: metal, paint, stone and marble, tile,

brick, wood, plaster, and glass. Each section includes a brief history of the material's use, gives a profile of one craftsman, and gives restoration guidelines. There is also an extensive list of sources of associations, artisans and suppliers.

Savage, Bernard A. "Post-War Expectations in New Materials and Methods of Construction." *AIA Journal.* Vol. 1, No. 5 (May 1944), pp. 215-221.

The article cautions readers not to be overly impressed with the wealth of materials marketed in post World War II America. Savage critiques many new materials, including plastics, light-gauge metals, tempered glass, Portland cement, improvements in precast blocks, and prefabricated houses, giving a brief explanation of their strengths and weaknesses.

Shute, M.A. *Modern Building Materials.* Edited by F.E. Drury. London, England: Sir Isaac Pitman & Sons, Ltd., 1947.

This book is divided into chapters that discuss the history, composition, and properties of timber, iron and steel, non-ferrous metals, alloys, stone, clay, lime and cement, reinforced concrete, asphalt, asbestos, glass and paint.

Spurr, H. V. "Structural Progress." *Architectural Forum.* Vol. 60, No. 6 (June 1934), pp. 405-422.

This guide illustrates, with photographs and detail drawings, the structural and finish materials available in 1934. Materials such as Formica, Micarta, Flexboard, prefabricated laminated wood arches, gypsum plank, and synthetic stone are included.

Sweet's Catalog. Published annually by McGraw-Hill Information Systems Company.

The *Sweet's Catalogs* are a compilation of product information by American building suppliers. The first catalog was published by Clinton W. Sweet, owner of *The Architectural Record,* in 1906 and was entitled *Sweet's Indexed Catalogue of Building Construction.* Reprints of the catalogs dating from 1906 to 1949 are available on microfiche and are available at The Library of Congress. Columbia University's Avery Library has microfiche for the years 1909 through 1949.

Walsh, H. Vandervoort. "House Building Materials Reappraised." *Architectural Record.* Vol. 102, No. 5 (November 1947), pp. 115-120.

Aluminum alloys, plastics, lightweight concrete, and steel house chassis are discussed in this article. Line drawings of building components such as aluminum roofing sheets, precast concrete slabs, and pressed sheet steel flooring accompany the text.

Withey, M.O., and G.W. Washa. *Materials of Construction.* New York, NY: John Wiley & Sons, Inc., 1954.

This book covers a wide variety of building materials from building stone to concrete aggregates to non-ferrous metals and their alloys. It looks at the structural properties and manufacture of these various materials.

Recent Publications

Belle, John, John Ray Hoke, Jr., and Stephen A. Kliment, editors. *Traditional Details for Building Restoration, Renovation, and Rehabilitation.* New York, NY: John Wiley and Sons, Inc., 1991.

This guidebook is a compilation of selected entries from the first four editions of *Architectural Graphic Standards* printed between 1932 and 1951. Entries were chosen by the editors for their value in the restoration, renovation, or rehabilitation of historic buildings. Sections on building materials include information on masonry, metals,

carpentry, thermal and moisture protection, glass, and finishes.

Brady, George S., and Henry R. Clauser. *Materials Handbook: An Encyclopedia for Purchasing Agents, Engineers, Executives, and Foremen.* 11th ed. New York, NY: McGraw-Hill Book Company, 1977.

Entries in this compact encyclopedia describe some 14,000 materials. The 70-page index is particularly helpful because it includes common and trade names as well as chemical names.

Cotton, J. Randall. "Traditional Countertops: 'Old Fashioned' Materials That Still Work." *Old House Journal.* Vol. 20, No. 5 (September/October 1992), pp. 36-41.

Special kitchen countertop finishes, including monel metal, carrara glass, enameled metal, plastic laminates and soapstone are discussed along with their advantages and disadvantages. A list of current suppliers is provided for some materials.

Hornbostel, Caleb. *Construction Materials: Types, Uses and Applications.* New York, NY: John Wiley & Sons, 1978.

Each entry of this encyclopedia has the following subheadings: Physical and Chemical Properties, Types and Uses, Application, Condensed Checklist, Conditions Favorable, Conditions Unfavorable, History and Manufacture. Although some trade names are provided in the index, they are only given for the more commonly known products.

Jandl, H. Ward. *Preservation Briefs No. 11: Rehabilitating Historic Storefronts.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1982.

New products such as prismatic glass, aluminum, stainless steel, pigmented structural glass, tinted and mirrored glass, glass block, and neon were utilized for 1920s and 1930s storefronts. Determining the physical condition, appropriate treatments, and replacement procedures for deteriorating examples of these materials is the focus of this well-documented brief.

_____. *Yesterday's Houses of Tomorrow: Innovative American Homes, 1850-1950.* Additional essays by John A. Burns, AIA, and Michael J. Auer. Washington, DC: The Preservation Press, 1991.

This book focuses on 12 unique designs for American houses that were consciously created and publicized as being prototypes for the future. Some of the designs discussed here include a variety of concrete houses, Orson Fowler's octagon, Buckminster Fuller's Dymaxion house, Frank Lloyd Wright's Usonian House, and prefabricated houses such as Motohomes, and Lustron houses.

Knofel, Dietbert. *Corrosion of Building Materials.* Translated by R. M. E. Diamant. New York, NY: Van Nostrand Reinhold Company, 1978.

This book concisely presents information on corrosion and corrosion protection of a wide range of materials including hydraulic mortar, concrete, ceramic building materials, glass, stone, gypsum, metals, timber, and plastics. It is organized in a format that is easily referenced.

Moavenzadeh, Fred, Robert W. Cahn, and Michael B. Bever, editors. *Concise Encyclopedia of Building and Construction Materials.* 1st ed. Oxford, England: Pergamon Press, 1990.

This encyclopedia is a collection of articles grouped into eight categories including General Building Materials, Glass, Polymers, Plastics and Composites, Metals, and Wood. Extensive bibliographies are provided with each article.

Myers, John H. *Preservation Briefs No. 8: Aluminum and Vinyl Siding on Historic Buildings: The Appropriateness of Substitute Materials for Resurfacing Historic Wood Frame Buildings.* Revised by Gary L. Hume. Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1984.

While this brief emphasizes the potentially destructive effects of aluminum and vinyl siding on the integrity of historic buildings, it is nonetheless valuable for its information on the manufacture, installation, durability, cost, and energy efficiency of these mid-twentieth century cladding products.

O'Donnell, Bill. "Restoration Health Hazards." *Old House Journal.* Vol. 16, No. 1 (January/February 1988), pp. 44-49.

The hazards of various historic materials and the products used in restorations are discussed. Topics include paint stripping, paint application, demolition, wood repair and preservation, and construction. A list of sources for safety equipment is also provided.

Poore, Jonathan. "Maintaining the Kitchen from Copper to Corian, Linoleum to Laminate." *Old House Journal.* Vol. 27, No. 4 (July/August 1989), pp. 20-23.

The author explores a variety of materials that are likely to be found in an old house kitchen and makes recommendations for each material's maintenance. Wood floors, wood cabinets, wood trim, wood counters, linoleum, tile, stone, porcelain, enameled metal, copper and brass, chrome and other plate, plastic laminates and glass are all covered.

Rosenstiel, Helene Von, and Gail Caskey Winkler. *Floor Coverings for Historic Buildings: A Guide to Selecting Reproductions.* Washington, DC: The Preservation Press, 1988.

After a brief history of floor coverings and a survey of techniques, floorcovering examples are given along with their names, descriptions, date of origin, fiber content, etc. The 1900 to 1930 section includes wood, brick, tile and resilient flooring, matting, rag, list and handmade rugs, braided and hooked rugs, flatwoven and pile carpeting, and oriental rugs. A list of suppliers is provided.

Simmons, H. Leslie. *Repairing and Extending Doors and Windows.* New York, NY: Van Nostrand Reinhold Company, 1991.

The author thoroughly covers the common problems associated with renovating doors and windows and makes recommendations about materials and repair. Chapters outline support systems, finishes, metal and wood materials, sliding glass doors, curtain walls and glazing. Important information on manufacturers, standards setting bodies, government agencies, trade associations, books and periodicals is also included.

Simpson, John W., and Peter J. Horrobin, editors. *The Weathering and Performance of Building Materials.* New York, NY: Wiley-Interscience, 1970.

Chapters of this book address the major material categories (concrete, clay products, timber, metals, and plastics) in terms of weathering and performance. Reasons for various types of deterioration or failure are provided, along with recommendationss for treatment. Each chapter is supplemented by ample illustrations and a bibliography.

Weber, Anne E. "Twentieth Century Interior Materials: New Wall and Ceiling Finishes." In *Interiors Handbook for Historic Buildings, Volume 2.* Edited by Michael J. Auer, Charles E. Fisher, Thomas C. Jester, and Marilyn E. Kaplan. Washington, DC: Historic Preservation Education Foundation, 1993, pp. 4-29 to 4-33.

Zenitherm, Absorbege, and Cushocel, which were found in the New Jersey State House Annex, are investigated. Zenitherm is a cast imitation stone product. Absorbege is a paper mache material and Cushocel a carpet pad. Descriptions of the three materials are given based on examination of remaining materials including laboratory tests, and research conducted in historic documents such as Sweets Catalogs.

Wilkes, Joseph A. editor. *Encyclopedia of Architecture: Design, Engineering & Construction.* New York, NY: John Wiley & Sons, 1988.

The entries in this five-volume set provide extensive information on all topics related to architecture. Although most of the information for building materials pertains to current applications, a historical background is usually included. A bibliography at the end of each entry and an index are also provided.

Wilson, Forrest. *Building Materials Evaluation Handbook.* New York, NY: Van Nostrand Reinhold Company, 1984.

Intended as a guide for the investigation and evaluation of building materials in existing buildings, this book discusses applications, problems, and diagnostic methods. The concise descriptions, photographs, drawings and references to other publications provide vital information pertaining to the preservation, rehabilitation, or restoration of the built environment.

Neon sign in Tulsa, Oklahoma. *Photo:* Richard Wagner.

Classifications of Materials

Wood

While wood construction is not unique to the twentieth century, the staggering amount of innovation in its use is a hallmark of the age. Advancements in glues and connectors during the first half of this century led to major changes. As in previous eras, wood remained the staple of residential construction, but as technology increased, this traditional product took on new shapes and characteristics. Laminated timbers provided strength and versatility never before realized. Plywood production was improved, facilitating the introduction of new building components such as plywood box beams and prefabricated panels. The following entries provide information and insight regarding some of these recent aspects of wood building products.

Allison, David. "Wood Moves Out of the Woods." *Architectural Forum.* Vol. 111, No. 2 (August 1959), pp. 138-145.

This valuable article provides insight into the massive changes that took place in twentieth century wood construction. The resulting increase in research brought the development of box-beams, glue-laminated timbers and related products. These technological advances, and a growing aversion among architects to a machine aesthetic, helped wood remain an important building material to the present.

"Bibliography on Structural Wood." *Bulletin of the American Institute of Architects.* Vol. 3, No. 1 (January 1949), pp. 27-30.

This is a listing of many of the printed materials available to architects, engineers, and builders in the 1940s.

Bienert, John D. "Products and Practice: Plywood." *Architectural Forum.* Vol. 74, No. 3 (March 1941), pp. 197-206.

The wonders and versatility of plywood are revealed in Beinert's discussion of this laminated product. He discusses recent developments that improved production and explains the incredible strength of plywood as well as its varied uses. The article includes photographs, and details of interior and exterior plywood construction.

Browne, F.L. "Water-Repellent Preservatives for Wood." *Architectural Record.* Vol. 105, No. 3 (March 1949), pp. 131-132.

This is a short but detailed explanation of wood preservatives of the time. The article provides general considerations regarding wood preservatives and explains the differences between repellents, preservatives, water-repellant preservatives, and sealers.

Dietz, Albert G. *Engineering Laminates.* New York, NY: John Wiley & Sons, 1949.

This book describes many of the applications of lamination that arose in the early twentieth century. It deals with strengths of laminates and sandwich structural elements, adhesives, plywood, plastic, and metal laminates.

_____. "Glued Timbers Tailored to Fit." *Architectural Record.* Vol. 106, No. 6 (December 1949), pp. 139-141.

Patented in Weimar, Germany in 1904, glue-laminated members became versatile and widely used in the United States. Through photographs of buildings and an explanation of production techniques, the article explains uses for this product.

Dietz, Albert G. "Wartime Innovations in Timber Design." *Engineering News-Record.* Vol. 135, No. 16 (October 18, 1945), pp. 514-517.

Dietz discusses design based on stress-graded wood improvements in wood glue, the use of connectors, glue-laminated members, and the special considerations involved in the use of those members. The article includes a bibliography.

Fisher, Oscar. "Construction with Plywood." *Pencil Points.* Vol. 20, No. 11 (November 1939), pp. 751-760.

This article provides information on the strength of plywood and the qualities of plywood that surpass solid wood. It provides advice for concrete construction with details on both structural and finish work.

Jay, B. Alwyn. "Development in Timber." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 1 (1945), pp. 375-379.

This short article explains some of the advances in wood technology which were spurred on by World War II. Improved methods of lamination and plywood technology are discussed, along with timber connectors and the grading and seasoning of lumber.

"New Process for Fireproofing Plywood." *California Arts and Architecture.* Vol. 61, No. 1 (January 1944), p. 36.

This article explains the American Lumber and Treating Company's minalith process, by which phosphate, sulphate and boron chemicals were used to fireproof plywood. This short entry hails the new process and gives details for its use.

Ottinger, Lawrence. "Plywood's Future Has Just Begun." *Pencil Points.* Vol. 25, No. 5 (May 1944), pp. 79-84.

The author, the president of the United States Plywood Corporation, describes the future of plywood in the building industry in postwar America. Products such as wall and floor panels, molded one-piece closets, and columns and tubes are discussed, as well as the important role that plywood would play in prefabricated buildings. Included are many diagrams showing joints and connections, as well as many photographs. Production methods and resin compositions are also given.

Taylor, Don. "Revival of Wood as a Building Material." *Architectural Record.* Vol. 86, No. 6 (December 1939), pp. 63-72.

This discussion of trends in wood processing of the previous twenty-five years looks at plywood, super-pressed plywood, laminated beams, and veneers of other types of materials and addresses the use of chemicals to resist bacteria, water, and fire. The article also reviews the revival of wood in structural applications, the development of timber connectors, plywood panels, and plank flooring.

Masonry

Although masonry products such as brick, terra cotta, concrete, tile and simulated stone were developed prior to the twentieth century, after 1900 these products went through many technological advances in terms of manufacturing processes that resulted in the availability of many product types. Terra cotta, for example, is an ancient building material, but between 1910 and 1930 the material dominated public and commercial architecture. During this time many specifications and methods of attachment were developed, as well as advancements made in polychrome terra cotta.

Nearly every building constructed between 1900 and 1950 contains some type of masonry, and it is important for the restorer/researcher to know how it was used in terms of twentieth century building practices. This section is divided into several types of masonry: Brick, Clay Tile, Hollow Clay Tile, Terra Cotta, Concrete Block, Gypsum Masonry, Cast Stone and Simulated Stone. These are followed by sources of Related Information.

Brick

"5000 Years to Make a Double Brick." *California Arts and Architecture.* Vol. 57, No. 6 (June 1940), p. 44.

A new brick produced by Gladding, McBean & Company in Northern California is described. This double brick consists of two 2-1/2" x 8-3/8" x 3-1/4" bricks.

Hansen, J. H. "Brick Plus Hy-Rib Metal Lath Makes Strong, Cheap Floors." *Brick and Clay Record.* Vol. 87, No. 6 (December 1935), pp. 194-195.

This article describes a new process to make strong, inexpensive floors by laying one course of brick with metal lath, resulting in a dramatically strong floor able to withstand heavy loading. It includes photographs and specifications, complete with load charts.

"More on Insul-Cla-Blok." *Brick and Clay Record.* Vol. 106, No. 2 (February 1945), p. 38.

This article discusses Insul-Cla-Blok, an insulated clay block product made of clay and sawdust. Included are diagrams and comparisons of heat transfer values to other wall systems.

"New Type of Brick Wall Construction Will Help Sell Products." *Brick and Clay Record.* Vol. 80, No. 2. (February 1932), pp. 89-90.

The article describes the development of a new type of wall construction using clay block, which is more watertight, stronger, and cheaper than concrete block. The Dubl-Wall and the Pittsburgh Wall are explained. Specifications, dimensions, and building procedures are included along with illustrations and photographs.

"Opportunities for Clay Industry in Insulation." *Brick and Clay Record.* Vol. 106, No. 1 (January 1945), pp. 31-33.

The article focusses on the use of Insul-Cla-Blok, a clay block developed for wartime production furnaces, as used in residential and cold storage applications. Specifications are given for the low-cost insulation of homes. Ample detailed drawings and comparisons to conventional masonry walls are also provided.

"Products and Practice." *Architectural Forum.* Vol. 71, No. 5 (November 1939), p. 367-370.

This article describes the resurgence of the use of reinforced brick masonry since 1922. It explains reinforced brick masonry in terms of its uses, advantages, design and materials. The Groutlock brick, designed to bond to the mortar, is also explained.

Zierer, A. "Closed End Clay Units of Less Weight and Easier Handling." *Brick and Clay Record.* Vol. 80, No. 3 (March 1932), pp. 153, 178.

Efforts by the United States clay industry to introduce lighter and stronger clay block are discussed. Included are descriptions and specifications for the Brick-tile and the Du-Brick, which is a block closed on five sides and open on one for tighter units and easier handling. Industry standards in clay block units are described.

Clay Tile

Bridgman, C. T. "Over 1,000,000 Square Feet of Tile Floor Installed in Midwest." *Brick and Clay Record.* Vol. 91, No. 1 (July 1937), pp. 34-36.

A new fire-resistant, low-cost clay tile floor system is described. Included are specifications, photographs, and notes about the flooring system used on numerous WPA and PWA buildings built in South Dakota, Nebraska, Minnesota, and Iowa.

"Build Tile Floor With New System." *Brick and Clay Record.* Vol. 95, No. 2. (August 1939), p. 41.

A new flooring system made of 16-inch clay tile is discussed. The tile is an integral part of the system and is load bearing. Installation procedures and photographs accompany the article.

"Natco Develops Tile for Low-Cost Housing." *Brick and Clay Record.* Vol. 87, No. 6 (December 1935), p. 172.

This article describes the Natco Speedwall tile and the Natco Junior Speedwall tile, as manufactured by the National Fire-proofing Company. This tile is a clay unit to be used in the rapid erection of walls in residential applications.

"New Reinforced Tile Construction Assembled on Building Site." *Brick and Clay Record.* Vol. 93, No. 2 (August 1938), p. 26.

This article describes Tilecrete, a fireproof, beveled, 16-inch tile set on lightweight steel trusses and covered with concrete. It includes specifications, photographs, and construction methods.

Stecich, Jack, and Jerry G. Stockbridge. "Turn-of-the-Century Floor Construction." *Association for Preservation Technology Bulletin.* Vol. XIX, No. 3 (1987), pp. 7-9.

This article discusses the use of brick or clay tile spans between structural steel beams in floor systems. Also covered is flat tile architecture and the conditions survey approach for determining the use of this system. The authors address such issues as structural capacity, how masonry and steel work together, testing deflection, and strain.

Hollow Clay Tile

Cosgrove, J. J. *Hollow Tile Construction.* New York, NY: UPC Book Company Inc., 1921.

This practical construction guide was the first book on the subject of hollow tile construction. It provides guidelines, rules, and tables for masons, along with drawings and photographs, explaining the different types of hollow tile and construction techniques.

"A Hollow Tile Cottage." *The Pacific Coast Architect.* Vol. 1, No. 5. (August 1911), p. 173.

This article examines a cottage in Tacoma, Washington, built entirely of hollow clay tile. The use of hollow clay tile in residential construction is presented as an innovative and cost-efficient way to build sanitary and moisture-proof houses.

Plummer, Harry C., and Edwin F. Wanner. *Principles of Tile Engineering.* Washington, DC: Structural Clay Products Institute, 1947.

This book is an intensive discussion of structural tile, beginning with the history of clay tile, and covering properties, design, construction, and details. It contains detailed drawings, specifications, and many brand names such as Joistile, Kalex, Tilecrete, and Natcoflor. Detailed discussions are supplemented with descriptions and installation procedures.

_____. *Tile Engineering Handbook of Design.* Washington, DC: Structural Clay Products Institute, 1947.

This book traces the development of structural tile from its invention in 1875 to 1946. It provides clear explanations and diagrams of different types of tile and their uses in walls, foundations, details, floors and roofs. The book includes an index and construction specifications.

"Reinforced Hollow Clay Tile Panels Open Market for Floors and Roofs." *Brick and Clay Record.* Vol. 90, No. 1 (January 1937), pp. 50-53.

Kalex reinforced tile panels are described. These structural clay tiles range in lengths from six to nine feet and are used for roofing and flooring. The article includes photographs and construction and structural specifications.

White, Charles E. *Hollow Tile Construction.* Philadelphia, PA: David McKay Company, 1924.

This book describes different types of hollow tile and explains the advantages, limitations, and applications of each. It also includes manufacturers' recommendations for wall, arch and lintel design in hollow tile construction. Photographs provide examples of houses built using the fireproof material.

Terra Cotta

Croly, Herbert D. "Advantages of Terra Cotta." *Architectural Record.* Vol. 18, No. 4 (October 1905), pp. 315-323.

In this article, the second part of a three-part series, the author explores the advantages of twentieth century terra cotta as a lightweight, low-cost, fireproof material. While the other two parts focus primarily on design issues, this part concentrates on terra cotta as a modern twentieth century building material.

Croly, Herbert D. "Glazed and Colored Terra Cotta." *Architectural Record.* Vol. 19, No. 4, (April 1906), pp. 313-323.

Croly writes a comprehensive overview of early twentieth century conventions in glazed and colored terra cotta and their manufacture. After the turn of the century, new production methods, a greater selection of colors, and modern techniques of fixing the terra cotta to the building were developed. These aspects are discussed in the article and documented with many photos.

Daniels, Mark. "The Why of Ceramic Veneer -- Streamlining an Ancient Building Material." *Architect and Engineer.* Vol. 159, No. 6 (December 1944), pp. 14-18.

Daniels discusses the transition from architectural terra cotta to ceramic veneer. While still made of the same material, ceramic veneer was machine made and mass produced. Illustrations are included.

"Illustrating the Perfection of Terra Cotta Ceramic Veneer. " *Architect and Engineer.* Vol. 145, No. 4 (April 1941), pp. 40-51.

By the end of the 1930s, most terra cotta manufacturers were making ceramic veneer, a faster and cheaper method of terra cotta production. The manufacture and popularity of this machine-made product are discussed, as well as methods of attachment. Illustrations are included.

Morrow, Irving F. "Clay Products Modernize." *Architect and Engineer.* Vol. 145, No. 4 (April 1941), pp. 25-34.

Morrow discusses the modernization of terra cotta, from a hand-packed, hand-fired product, to a machine-made, mass-produced product. Ceramic veneer is covered, as well as other "modern" clay products, in terms of modern production and design.

National Terra Cotta Society. "Standard Specifications for the Manufacture, Furnishing and Setting of Terra Cotta." *Pencil Points.* Vol. 4, No. 10 (October 1923), pp. 73-76.

This article, a series of specifications compiled by the National Terra Cotta Society, gives detailed specifications on quality, testing, modeling, design, structure (including weeps

and flashing), transportation, storage, erection and anchoring. A detailed glossary of terra cotta terms is also included.

Putnam, Edward H., "Architectural Terra Cotta Construction," Part I. *American Architect and Building News*. Vol. 100, No. 1873 (November 15, 1911), pp. 193-197; Part II, pp. 201-207; Part III, pp. 257-261. (Parts II and III appear in consecutive issues of Vol. 100.)

In the first part, Putnam discusses early twentieth century terra cotta in terms of manufacture and application. He describes shrinkage, color variances, tolerances, anchors and hangers, and proper drainage and ventilation practices.

Part II focuses on terra cotta column and cornice construction, including detailed descriptions of proper connections and joints.

Part III discusses the marriage of terra cotta and concrete. Concrete frameworks covered with a terra cotta cladding, with both metal and mortar connections, are included, as well as recipes for both concrete backing and mortar for the setting and bedding of the terra cotta. Specification drawings and photographs are included in all of the articles.

Prudon, Theodore H. M. "Architectural Terra Cotta and Ceramic Veneer in the United States Prior to World War II." Ph.D. diss., Columbia University, 1981.

This in-depth dissertation includes sections on definitions, history, manufacturers' processes, deterioration, inspection, testing and evaluation, restoration and repair, and a bibliography.

Thrall, Charles. "Terra Cotta: Its Character and Construction." *The Brickbuilder*. Vol. 18 (1909), pp. 204-207, 231-235, 249-253.

Thrall writes a comprehensive three-part article on early twentieth century techniques for the application of terra cotta. Because of better manufacturing and application methods developed in the early twentieth century, the terra cotta pieces were larger than previously used. Thrall describes in detail these new larger pieces and new types of fasteners used to affix them to the building. Also included are photographs of buildings using terra cotta, as well as many construction drawings.

Tiller, de Teel Patterson. *Preservation Briefs 7: The Preservation of Historic Glazed Architectural Terra-Cotta.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1979.

Tiller discusses the four types of manufactured terra cotta available after the mid-nineteenth century with special emphasis on ceramic veneer (developed during the 1930s) and glazed architectural units (predominant during the first third of the twentieth century). His examination details the material's composition and its structural anchoring system, as well as identifies deterioration problems such as crazing, spalling, mortar and metal anchoring failure, and material fatigue. He also outlines techniques for inspection, maintenance, repair and replacement of damaged or lost terra cotta units.

Tindall, Susan M. "How to Prepare Project-Specific Terra Cotta Specifications." *Association for Preservation Technology Bulletin.* Vol. 21, No. 1 (1989), 26-36.

The author describes the evolution of terra cotta standards as well as the critical numbers needed to specify new terra cotta or substitute materials. Tindall notes that there are no standard specifications for the replacement of terra cotta work, and the article is aimed at helping restorers prepare their own project specification. Numerous tables and diagrams are included.

Warren, Charles P. "Notes on Standard Forms of Specifications for Architectural Terra Cotta." *The Brickbuilder.* Vol. 14, No. 1 (January 1905), pp. 8-16.

This detailed article describes architectural terra cotta, both ornamental and structural. Each step in the manufacture and installation of terra cotta is described, including the responsibilities of the worker in each step. Detailed drawings and specifications are included.

Wilson, Hewitt. "Polychrome Decoration of Terra Cotta With Soluble Metallic Salts." *Technology & Conservation.* Vol. 11, No. 1 (Spring 1992), pp. 16-17. Excerpted from *The Journal of the American Ceramic Society.* Vol. 1, No. 5 (May 1915), pp. 353-366.

Four methods of applying colored glazesare described, with the most attention given to painting with soluble metallic salts. Mediums, experimental solutions, and firing processes are explained, along with the proportional measurements of mineral elements used to create the colors blue, green, and pink. The article concludes by mentioning the vitreous skin "K" colors and methods used by the Denver Terra Cotta Company.

Concrete Block

Cotton, J. Randall. "Ornamental Concrete Block Houses." *Old House Journal.* Vol. 12, No. 8 (October 1984), pp. 165, 180-183.

Ornamental concrete block, also called decorative or cast block and imitation or artificial stone, was promoted in the 1910s by the Sears Roebuck Company as a cheap, quick, and practical building material. The height of its use occured in the late 1800s until about the 1930s. This article provides photographs of the various faces available during that period as well as a description of the blockmaking process.

_____. "Repairing Ornamental Concrete Block." *Old House Journal.* Vol. 12, No. 9 (November 1984), pp. 201-204.

After explaining the importance of preventive maintenance, the author makes recommendations on the cleaning, painting, repair, and replacement of ornamental blocks. In reference to replacement, he provides directions for making a mold to produce new concrete blocks that will match existing units.

Gillespie, Ann. "Early Development of the Artistic Concrete Block: The Case of the Boyd Brothers." *Association for Preservation Technology Bulletin.* Vol. XI, No. 2 (1979), pp. 30-52.

Gillespie traces the history of the imitation concrete block from 1870 to 1920. Rock-face and stone-face block are discussed, as well as the Jarvis and Wizard concrete block machines. Production methods and the various imitation rock faces available are included, along with photos and illustrations.

"Products and Practice: Facade Blocks." *Architectural Forum.* Vol. 58, No. 6 (June 1933), p. 38.

This article describes a new product by the National Facade Corporation. Concrete blocks are cast with facade material such as brick, limestone, terra cotta, marble, granite, sandstone, or glass block, creating a single-unit masonry block with both the exterior wall surface and its backing. A diagram of a corner detail with different types of facade blocks is included.

Rice, Harmon, and William M. Torrance. *The Manufacture of Concrete Blocks and Their Use in Building Construction.* New York, NY: The Engineering News Publishing Company, 1906.

This is a collection of papers written for a competition held by *Cement Age* and *Engineering News*, covering the manufacture

and use of concrete block. The papers discuss topics ranging from materials and manufacturing machinery to production methods and block design. Illustrations are also included.

"Selection and Use of Concrete Block." *Pencil Points.* Vol. 26, No. 12 (December 1945), pp. 87-91.

This discussion of using concrete block in an architecturally aesthetic manner addresses its various properties such as texture, color, and size. Specifications of various blocks are given, along with photographs and detailed drawings. Case study buildings are also shown.

Simpson, Pamela H. "Cheap, Quick, and Easy: The Early History of Rockfaced Concrete Block Building." In *Perspectives in Vernacular Architecture III.* Columbia, MO: University of Missouri Press, 1989.

Due to its low cost and ease of production, Rock-faced concrete block became very popular in the early twentieth century. With period advertisements and photographs of buildings constructed of this material, the article chronicles its early history.

Gypsum Masonry

Lenhart, Walter B. "Gypsum Industry on the Pacific Coast." *Rock Products.* Vol. 33, No. 1 (January 1930), pp. 33-39.

This article discusses the newest product from the gypsum industry: gypsum hollow tiles. Manufacturing descriptions, specifications, and applications are included.

"Low Cost Construction." *California Arts and Architecture.* Vol. 57, No. 10 (November 1940), p. 34.

Of particular interest in this article about several Los Angeles buildings are the descriptions of a structural gypsum floor, gypsum tile partitions, and a roof constructed of steel beams and structural gypsum.

"Novel Building Method Utilizes Precast Gypsum Units." *Rock Products.* Vol. 51, No. 8 (August 1931), pp. 62-64.

This article presents the use of precast gypsum units as a new building material for walls, both exterior and interior, and for floors. Specifications and details are included.

Cast Stone

Walker, C. G. "Recent Developments in the Manufacture and Use of Cast Stone." *Journal of the American Concrete Institute.* Vol. 7, No. 4 (March/April 1936), pp. 473-484.

Walker relays improvements in the manufacturing and use of cast stone. By treating it as a concrete product, many of the problems associated with cast stone can be eliminated. Finishes, manufacturing processes, seasoning and curing are also discussed. Illustrations are included.

Warner, Henry P. "Cut Cast Stone." *Proceedings of the American Concrete Institute.* Vol. 23 (February 1927), pp. 206-212.

Warner, who was the president of the Onondaga Litholite Company, discusses the low cost and other advantages of using cast stone, and gives a detailed description of the manufacturing process.

Simulated Stone

Pilling, Ron. "Removing Formstone and Other Indignities." *Old House Journal.* Vol. 10, No. 9 (September 1982), pp. 179-182.

Formstone, patented in 1937, was a system of lath and mortar that was rolled with a stone

pattern and sprayed with mica chips or marble dust. The author addresses the methods and problems that may be encountered in removing this material, which was also known as Permastone, Dixie Stone, and Fieldstone.

Prudon, Theodore H. M. "Simulating Stone, 1860-1940: Artificial Marble, Artificial Stone, and Cast Stone." *Association for Preservation Technology Bulletin.* Vol. XXI, No. 3-4 (1989), pp. 79-91.

Prudon traces the history and manufacture of simulated and cast stone, including specifications and improvements in the technology of these products as they moved into the twentieth century. Manufacturers such as the Pacific Stone and Concrete Company are discussed. Photographs are included.

Ritchie, T. "Roman Stone and Other Decorative Artificial Stones." *Association for Preservation Technology Bulletin.* Vol. X, No. 1 (1979), pp. 20-34.

Roman Stone, an artificial stone produced by the Roman Stone Company of Canada, is the focus of Ritchie's article, along with a discussion of other manufactured simulated stone in Canada and the United States. Illustrations are included.

"Rostone, A New Building Material." *Rock Products.* Vol. 36 (May, 1933), pp. 44-46.

The development of Rostone, an artificial stone made of particles of shale, lime and stone, was a result of the research of several inventors, including H.C. Ross. The manufacture, chemical composition, and use are several of the issues addressed in this article.

Spencer, Clifford Wayne. "Artificial Marble and Scagliola." *Architectural Forum.* Vol. 51, No. 5, Part 2 (November 1929), p. 557.

The art of artificial marble, first practiced by Florentine monks around the fifteenth century, allowed the production of large monolithic pieces in the 1930s that would otherwise have been difficult to produce in real marble. The modern process of making artificial marble from a mixture of superfine Keene's cement and mineral colorings is described in detail.

Related Information

Emerson, David B. "The Specification Desk: Burnt Clay." *Pencil Points.* Vol. 10, No. 12 (December 1929), pp. 881-886.

In the first of this two-part article, Emerson describes brick and terra cotta. This comprehensive article begins with the history of these materials and then describes modern production methods. Product specifications are discussed, from roman brick to polychrome terra cotta and terra cotta hollow block.

_____. "The Specification Desk: Burnt Clay." *Pencil Points.* Vol. 11, No. 1 (January 1930), pp. 65-68.

Part two of Emerson's article focuses on clay tile. A historical overview is given, followed by a discussion of modern specifications and production methods. Various types of floor, wall, finish, and roofing tiles are covered and manufacturers are listed.

Hendry, Arnold W., editor. *Reinforced and Prestressed Masonry.* New York, NY: Longman Scientific and Technical, 1991.

This book provides a history of reinforced and prestressed masonry and explains material properties and uses.

Masonry Research Foundation. *Masonry Bibliography; 1830 - 1982.* Washington, DC: Masonry Research Foundation, 1985.

This extensive bibliography addresses all areas of masonry products and construction from 1830 to 1982. It contains subject and author indexes but is not organized chronologically.

"New Products, New Markets Point to Bigger Clay Industry." *Brick and Clay Record.* Vol. 80, No. 1 (January 1932), pp. 25-26.

Industry standards in products such as reinforced brick and clay block, tile, glazed products and face brick are discussed. Products listed include the Pittsburgh Wall and Du-Brick. Data by the Common Brick Manufacturer's Association and the Structural Clay Tile Association is also provided.

"New Walls, More Business." *Brick and Clay Record.* Vol. 93, No. 5 (November 1938), pp. 20-25.

A number of new clay products and systems, including various methods for tying brick veneer, precast tile beams, interlocking brick, and hollow wall construction are discussed. Brand names include Tilecrete, Farren Wall, Claycraft Hollow Unit, Speedwall Tile, Dek-Tile, Fabrick, Munlock Dry Wall, Speedtile, and Kalex Tile.

"Products." *Brick and Clay Record.* Vol. 105, No. 4 (October 1944), pp. 38-45.

This explains unit masonry products including: Bricon tile, Handi-Grip tile, Tex-Dri Wall, Acoustile, speed tile, flashing tile block, Korok tile, precast beams, Belden Brick, Dek-Tile, utility block and interlocking Nail Tile. Numerous photographs and construction details are provided.

"These Are Your Products." *Brick and Clay Record.* Vol. 105, No. 4 (October 1944), pp. 34-37.

This article covers ten "new" clay tile and block products used in residential construction. Products such as modular masonry, roman tile, ceramic veneer, precast lintels, and unglazed terra cotta are listed, complete with manufacturers' names, photographs, and construction details of each product.

Warland, E. G. *Modern Practical Masonry.* New York, NY: Pitman Publishing Company, 1953.

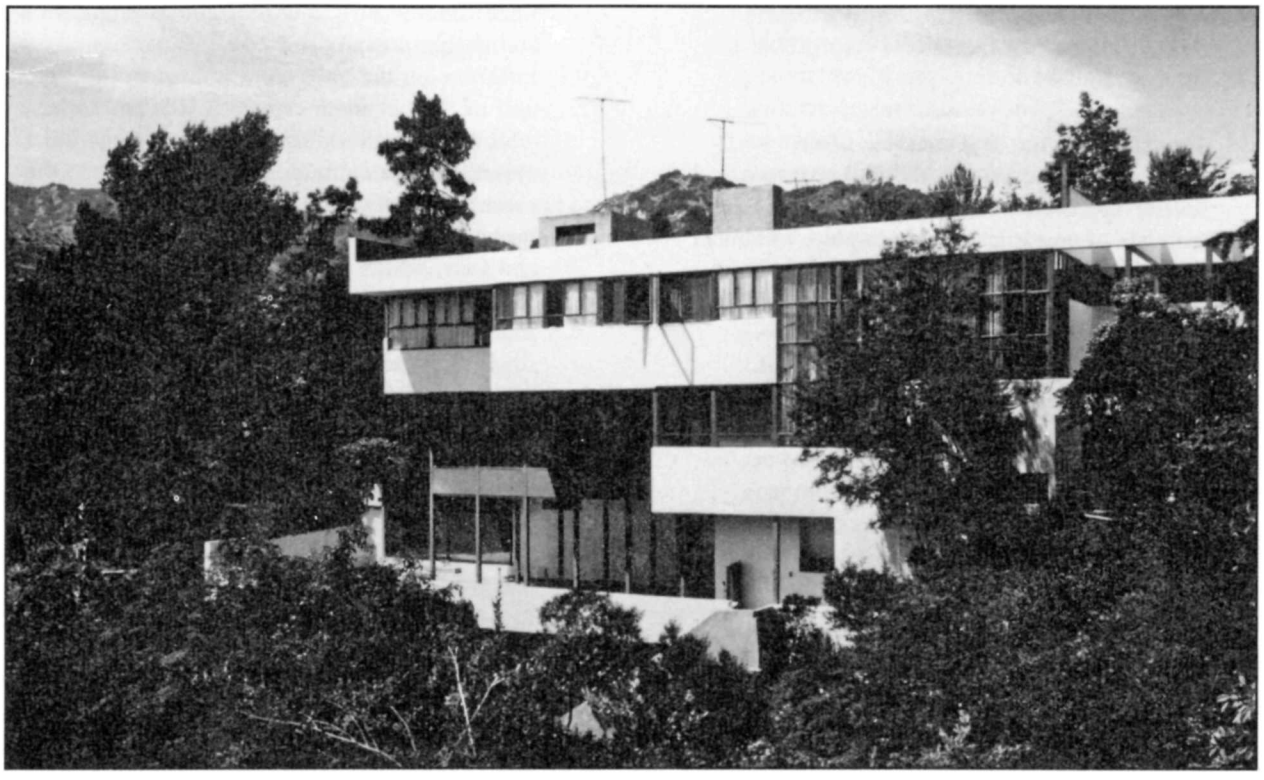
This practical guide to methods of masonry construction provides insight into masonry building practices up to the mid-twentieth century. It includes diagrams for details and construction methods. A well-documented glossary, index and bibliography are also included.

Concrete

When considering the enormous changes in the material environment, the most significant innovations that can be regarded as products of this time period came largely in concrete construction. New societal demands arising from mechanical inventions, technical developments, building code requirements, and changes in taste as well as material wants, led to construction for which concrete was ideally suited. The result is that from 1900 to 1950, and beyond, the quantity of concrete used in all construction expanded far more rapidly than that of all other building materials. The European inventions of prestressing and ferro-concrete thin shells gave the designers and builders the means of exploiting the flexibility in form and solid rigidity of concrete in structures.

Comparatively, the United States lagged behind Europe in technological development, largely because the ruling corporate economic institutions of business and labor resisted change and exploration. Hence, it was early in this century before American literature began promoting and providing technical assistance on emerging concrete systems.

This section is divided into three principle parts based on construction methodology or systems introduced during the twentieth century. These sections are Cast-In-Place, Precast, and Prestressed with Related Information as a fourth. The two sections, Concrete Masonry and Cast Stone, located under the main heading of Masonry, should be referenced for additional citations regarding concrete products.



One of the first examples of the International Style in the United States, the Lovell House, 1929, Los Angeles, Richard Neutra, architect, was constructed from a steel frame and sprayed with gunite, a thin concrete shot from pneumatic hoses, and an early 20th century exterior finish. *Photo:* Marvin Rand, HABS Collection.

Cast-in-place

Embury, Aymar, II. "Aesthetics of Concrete." *Pencil Points.* Vol. 19, No. 5 (May 1938), pp. 267-279.

The author addresses concerns about the design and finishing of concrete. He discusses textures produced by formwork, washing, or bushhammering and the treatment of pour joints with particular attention given to civil engineering structures.

Gemeny, Albin L., and C. B. McCullough. "The Freyssinet Method of Arch Construction Applied to the Rogue River Bridge in Oregon." *Journal of the American Concrete Institute.* Vol. 29, No. 3 (October 1932), pp. 57-79.

This is a paper co-authored by Oregon State highway engineer, C. B. McCullough, whose remaining depression-era concrete highway bridges are now on the National Register. The Freyssinet method of arch construction had not been attempted in this country until introduced in the construction of the Rogue River bridge in Oregon in 1932. The method is described in detail.

Hill, George. "Reinforced Concrete Construction: American Methods." *The Architectural Record.* Vol. 12, No. 4 (September 1902), pp. 393-412.

This early account was intended to familiarize designers with concrete as a modern material. After explaining the structural concepts of reinforced concrete, the author reviews applications, fireproofing qualities, wood formwork, and aggregates.

Murray, Robert Dennis. "Concrete Virtues." *Pencil Points.* Vol. 20, No. 4 (April 1939), pp. 213-226.

The author argues that concrete is an economical building material and proposes several approaches to finishing. He discusses methods of constructing cast-in-place ornament including pneumatically placed Gunite.

Newlon, Howard, Jr., editor. *A Selection of Historic American Papers on Concrete, 1876-1926.* Publication SP-52. Detroit, MI: American Concrete Institute, 1976.

This collection of important papers starts with a reprint of "A Brief History of Lime, Cement, Concrete and Reinforced Concrete," written by Jasper O. Draffin. Part II outlines the development of concrete as a building material through a series of landmark papers by the following pioneers in cement and concrete: Thaddeus Hyatt, William Evans Ward, Arthur Newell Talbot, Arthur Russell Lord, C. A. P. Turner, Ernest Leslie Ransome, and Duff Andrew Abrams. A concise biography precedes each individual paper.

Onderdonk, Francis S., Jr. *The Ferro-Concrete Style.* New York, NY: Architectural Book Publishing Co., Inc., 1928.

The author, an advocate of reinforced concrete, relies on many photographs and drawings to illustrate the potential of this building material. Chapter One covers formwork (metal, composition) and methods of placement, while Chapter Two discusses surface treatment, aggregate, and color. Tracery, parabolic arches, and architectural design are presented in following chapters.

Raafat, Aly Ahmad. *Reinforced Concrete in Architecture.* New York, NY: Reinhold Publishing Co., 1958.

A summary of the history and development of concrete from a global perspective, this book traces the history, technological development and design potentials of concrete and its influence on the built environment of the first half of the twentieth century. It is particularly well suited to describe the range of concrete systems and construction methodologies to the preservationist who has no architectural background. Of importance are chapters three and four, which deal with "Progress in Materials and Methods" and "Technical Design Innovations" respectively. The text is fully illustrated and there is an extensive bibliography.

Ransome, Ernest L., and Alexis Saurbrey. *Reinforced Concrete Buildings: A Treatise on the History, Patents, Design and Erection of the Principal Parts Entering into a Modern Reinforced Concrete Building.* New York, NY: McGraw-Hill Company, 1912.

The first part of this treatise, which was reprinted in *A Selection of Historic American Papers on Concrete, 1876-1926* (see above), discusses the history of reinforced concrete with a focus on patents. In Part Two, Ransome writes a "Personal Reminiscence" while Saurbrey contributes "Basic Patents and a Short Survey of the Early History of the Art."

Shand, P. Morton. "Steel and Concrete: A Historical Survey." *Architectural Review.* Vol. 72, No. 432 (November 1932), pp. 169-179.

This informative historical survey of concrete and steel gives a contemporary view of the comparative advantages and disadvantages of these two prominent structural materials. The companion article following, "The Evolution of Design in Steel and Concrete," by Walter Goldsmith, is a very specific technical history in a volume of *Architectural Review* devoted totally to concrete and steel.

Stern, Sylvan P. *Elements of Reinforced Concrete.* Englewood Cliffs, NJ: Prentice-Hall Inc., 1959.

This textbook focuses on the structural design of concrete and its reinforcement. Chapter topics include Anchorage, Embedment, Anchor Bolts, Reinforced Concrete Columns, and Retaining Walls.

Turner, C.A.P. *Concrete Steel Construction: Part I Buildings, A Practical Treatise for the Constructor and Those Commercially Engaged in the Industry.* Minneapolis, MN: Farnham Printing and Stationery Co., 1909. Also, Chapter 8, "Systems of Reinforced Concrete Construction." Reprinted in *A Selection of Historic American Papers on Concrete, 1876-1926.* Detroit, MI: American Concrete Institute, 1976. pp. 245-284.

This volume, written by the American who pioneered (along with Maillart) the twentieth century development of the flat slab system, focuses on Turner's patented flat slab system reinforced in two orthogonal directions. The reprint gives descriptions of the various systems in common usage.

Wyatt, Brummitt. "The Art of Concrete Flooring." *Pencil Points.* Vol. 11, No. 11 (November 1930), pp. 879-882.

Concrete flooring's various uses are discussed and exhibited through photographs in this article. Staining, painting, and integral coloring of concrete floors is included, as well as a discussion on terrazzo floors. A table with commercial names of colors for use in cement with the ratio of color to cement is also included.

Precast

Billig, Kurt. *Precast Concrete.* New York, NY: D. Van Nostrand Company, Inc., 1955.

This four-part volume thoroughly covers the twentieth century developments in the field of precast concrete. Included in the text are: design methodology, the processes of production, transportation and erection, along with treatment of units and the joinery between members. The last part is a survey of structures erected from precast members or a combination of such members with cast-in-place concrete.

Childe, H. L. *Concrete Products and Cast Stone.* London, England: Concrete Publications Limited, 1st edition, 1929, 9th edition, 1961.

This is a summary of the materials and methods used in making most types of precast concrete with a significant emphasis upon the manufacture of cast stone ornamentation and detailing. The text is generously supported with details and illustrations.

"Prefabrication." *Architectural Forum.* Vol. 82, No. 5 (May 1945), pp. 186, 188, 192, 196.

This article is important for the method of manufacture and uses of an early form of precast lightweight concrete, used in American housing. While this type of heat treated or autoclaved aerated concrete is commonplace in Europe, it has been minimally used in the United States. There are photographs and details amplifying the text.

Prestressed

Billig, Kurt. *Prestressed Concrete.* New York, NY: D. Van Nostrand Company, Inc., 1953.

This is a highly regarded early volume on prestressed concrete design that was intended to comprehensively cover the accumulated information on this relatively new subject. The first section is focused on the history, development, and fundamental concepts of prestressed concrete. The second part covers the design of prestressed concrete structures, and the third section addresses the design problems. Though technical, it offers the reader an informative text on prestressed concrete issues.

Dobell, Curzon. "Design Progress in Prestressed Concrete." *Progressive Architecture.* Vol. 30, No. 10 (October 1949), pp. 84-87.

This is a short history of prestressed concrete. The article concludes with information about buildings in the United States that were under construction or being designed at the time. The Guggenheim Museum by Frank Lloyd Wright is among them.

Holley, Myle J. "Prestressed Concrete." *Bulletin of the American Institute of Architects.* Vol. 6, No. 5 (September/October 1952), pp. 7-10.

This technical article describes issues related to prestressed concrete and is complete with comparative diagrams and loading charts. It relates a summary of developments in an emerging system.

Nasser, George D., editor. *Reflections on the Beginnings of Prestressed Concrete in America.* Chicago, IL: Prestressed Concrete Institute, 1981. Reprinted from the *Journal of the Prestressed Concrete Institute.* Vol. 23, No. 3 (May/June 1978) and successive issues through Vol. 25, No. 3 (May/June, 1980).

This series of papers illustrates the early history of prestressed and precast concrete in North America. Part One, by Charles C. Zollman, traces the events that led to the construction of Walnut Lane Bridge in Pennsylvania, the first major linear prestressed concrete structure in the United States. Additional articles describe innovators in prestressed concrete. The text finishes with a chronology called "Milestones of Events and Developments in North American Prestressed Concrete Industry."

Walsh, H. Vandervoort, and Anselm Cefola. "Prestressed Concrete Exploits Virtues of Steel and Concrete." *Architectural Record.* Vol. 106, No. 2 (August 1949), pp. 136-142.

A concise history of prestressed concrete is presented in this article as well as present and future applications in the United States. It is well illustrated with works by Magnel and Freyssinet.

Related Information

"Asbestos for Fire Protection." *The Architect.* Vol. 12, No. 2 (August 1916), pp. 122, 126.

This article describes the characteristics and production of fireproof shingles and panels made of Portland cement with asbestos fibers used as a binder. The panels were used as ceilings, partitions, and wainscoting.

Cadwalader, Burns, and Chris D. Poland. "Rehabilitation of the Kaiser Convention." *Association for Preservation Technology Bulletin.* Vol. XX, No. 2 (1968), pp. 21-27.

The rehabilitation of the historic Oakland Auditorium c. 1916 for life-safety requirements of California's seismic code is the focus of this article. An analysis of the concrete's condition, the seismic resistance and structural modifications are included. A program for strengthening seismic deficiencies and arresting the deterioration of concrete is provided.

Campbell-Allen, Denison, and Harold Roper. *Concrete Structures: Materials, Maintenance, and Repair.* New York, NY: John Wiley and Sons, Inc., 1991.

Of particular interest to the preservationist are Chapter Six, "Maintenance and Repair Strategies" and Chapter Seven, "Materials and Processes for Repair." Chapter Eight provides case studies. A thorough list of references is provided after each chapter.

Coney, William B., AIA. *Preservation Briefs 15: Preservation of Historic Concrete: Problems and General Approaches.* Washington, DC: Rocky Mountain Regional Office, Division of Cultural Resources, National Park Service, US Department of the Interior (no date).

Both reinforced and unreinforced concrete systems are discussed in terms of deterioration,

examination, and repair. Structural design defects, spalling, document review, and deflection repair are presented. Especially helpful are photographs used to illustrate the step-by-step repair procedure for a 1941 reinforced concrete industrial building.

" 'High Early' Portland Cement." *Progressive Architecture.* Vol. 29, No. 7 (July 1948) pp. 68-72.

This article traces the history and reports the progress that was made in the twenty years following the first use of "high-early" strength Portland cement in the 1927 Moffat tunnnel project. It has charts comparing "high-early" to ordinary concrete, as well as contempory uses.

Huxtable, Ada Louise. "Concrete Technology in the U.S.A.: Historical Survey." *Progressive Architecture.* Vol. 41, No. 10 (October 1960), pp. 143-149.

The major developments in the history of concrete construction in the United States are related in this article. As a historical survey, it is well researched and includes photographs of 18 prominent concrete buildings.

Kemp. E. L., editor. American Concrete Institute, ACI Committee 120. *History of Concrete: 30 B.C. to 1926 A.D., Annotated.* Bibliography No. 14. Detroit, MI: American Concrete Institute, 1982.

As one of the most comprehensive annotated bibliographies on the history, development and manufacture of concrete, this book has a wealth of information on early twentieth century research and reporting on precasting, prestressing, and evolving concrete chemistry. Many of the 413 alphabetically organized entries are very important to early standardization of the concrete industry during this century. The work contains a comprehensive index.

Lesley, Robert W., John B. Lober, and George S. Bartlett. *History of the Portland Cement Industry in the United States with Appendices Covering Progress of the Industry by Years and an Outline of the Organization and Activities of the Portland Cement Association.* Chicago, IL: International Trade Press, Inc., 1924. Reprinted by the International Trade Press, Inc., 1972.

This early work provides a comprehensive review of the Portland cement industry including manufacturers, development, and promoters. The four appendices provide useful historical information regarding the industry and manufacturers.

"Lightweight Aggregates Win New Attention." *Architectural Record.* Vol. 104, No. 1 (July 1948), pp. 143-145.

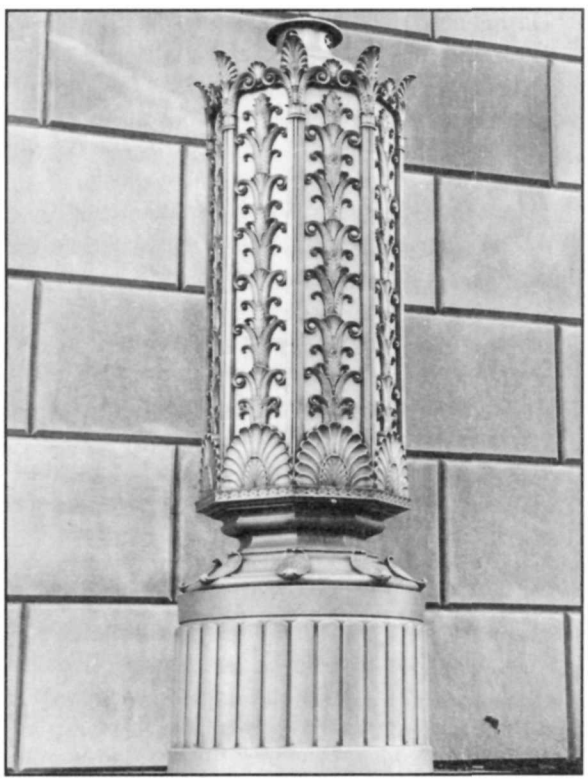
This article reports on post-war research on lightweight aggregates. Available aggregates are classified into four groups: volcanic (perlite, pumice); nicaceous mineral (vermiculite); clay and shale (Airox, Rocklite); and by-products (slag, cinders).

Sabnis, Gajanan, editor. *Rehabilitation, Renovation, and Preservation of Concrete and Masonry Structures.* Detroit, MI: American Concrete Institute, 1985.

This volume presents papers from three symposia held in 1981 and 1982 and sponsored by the Technical Activities Committee of the American Concrete Institute. Many of the papers are devoted to early twentieth century building rehabilitation case studies. The first two papers, "Essential Steps in Adaptation of Old Buildings" and "Non-Destructive Evaluation in Rehabilitation and Preservation of Concrete and Masonry Materials," are especially useful.

Wiedyke, Robert G., and Mary K. Hurd. *American Concrete Institute: A 55 Year Index 1905-1959.* Detroit, MI: American Concrete Institute, 1960.

This comprehensive index of all the papers published in the *Proceedings* of the American Concrete Institute facilitates research on a wide variety of topics relating to concrete. Synopses are provided for volumes 26-55 of *Proceedings* which corresponds to the first volumes of the *Journal of the American Concrete Institute.*



By the 1930s, aluminum was in wide use for exterior, weather-resistant architectural elements, such as this exterior lantern outside the U.S. Custom House, Philadelphia, PA. Ritter and Shay, architects, Edward Ardolino, sculptor. *Photo:* Esther Mipaas.

Metals

The period between 1900 and 1950 was a time of rapid development in the metallurgy and structural theory. With the increased technology resulting from industrialization, alloys such as monel metal and stainless steel were developed and utilized for structural and ornamental applications. Although aluminum was developed in 1897, it was not until the early 1930s that it was viewed as a building material.

In addition to new alloys, new construction systems evolved with the advancement of the technology of metal. Conventional construction systems such as reinforced masonry and wood frame gave way to steel frame systems which allowed the evolution of the skyscraper.

This section is divided into Ferrous Metal Alloys (those containing iron in some form), Non-Ferrous Metal Alloys (those not containing iron), and Related Information for sources covering many types of metals.

Ferrous Metal Alloys

Block, Carl F. "New Developments: Steel in Building Construction." *Progressive Architecture.* Vol. 27, No. 1 (January 1946), pp. 87-89.

This article discusses the use of steel in housing. It provides a series of guidelines which include those for floor and wall construction, finishes, built-in equipment, radiant heating, adaptability, and light-gauge construction.

"Fireproofing Structural Steel with Vermiculite Plaster." *Progressive Architecture.* Vol. 30, No. 4 (April 1949), pp. 85-88.

Vermiculite plaster used with steel is the subject of this article. This combination results in a better fire rating, lighter weight, comparable tensile strength, and lower cost.

Gloag, John, and Derek Bridgwater. *A History of Cast Iron in Architecture.* London, England: George Allen and Unwin Ltd., 1948.

The majority of this book covers the use of cast iron prior to the turn of the twentieth century. However, the last section discusses, in a fairly indepth manner, the use of cast iron between 1900 and 1945 from the decorative (grilles) to the utilitarian (fuse box covers).

Grinter, Linton. *Design of Modern Steel Structures.* New York, NY: The MacMillan Company, 1941.

Grinter discusses connections, timber construction, tension and compression members, beams, girders, combined stress and flexure, stress and stability. The designs of plate girders, industrial roofs, low-truss highway bridges, office buildings, tall buildings and continuous beams are also reviewed.

Paret, Richard E. "Structural Applications of Stainless Steel." *Progressive Architecture.* Vol. 30 (October 1949), pp. 80-83.

This article encompasses a wide range of topics, including the types of stainless steel, curtain walls, mechanical properties, fabrication, cleaning, exterior and interior trim, roof drainage, and insect screening.

Park, Sharon C., AIA. *Preservation Briefs 13: The Repair and Thermal Upgrading of Historic Steel Windows.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, (no date).

In this examination of rolled steel windows, manufactured between 1890 and 1950, Park identifies the operational types of fire-resistant steel windows used in masonry and concrete pre-World War II industrial and commercial buildings. Evaluative criteria for both deterioration detection and treatment methods are discussed.

Pearsall, William Rice. "T-Flange Girders: A New Development in Heavy Steel Construction." *Pencil Points.* Vol. 13, No. 9 (September 1949), pp. 630-631.

Described as "the first radical departure in structural steel design since the introduction, about 20 years ago, of the rolled broad flange beam and column sections," the new composite section is reviewed in this article. It discusses structural integrity as well as implications on heavy steel construction.

Princeton University School of Architecture. *Curtain Walls of Stainless Steel.* Princeton, NJ: Committee of Stainless Steel Producers, American Iron and Steel Institute, 1955.

This book explores stainless steel and the new construction system of the curtain wall. It discusses design issues and examines specific buildings that utilize curtain wall systems.

Sivinski, Valerie. "Preserving Historic Materials: Ferrous Metals." *Architecture.* Vol. 75, No. 11 (November 1986), pp. 108-109.

This concise article on the preservation and maintenance of metals provides information on methods of preventing deterioration and repairing damage.

"Steel." *Architectural Record.* Vol. 87, No. 4 (April 1940), pp. 73-80.

This is the sixth in a series of articles on trends in building materials. It is an extensive review of steel and its structural properties, design possibilities, and range of application.

"Trend Notes on a Building World: Designing in Welded Steel." *Architectural Record.* Vol. 38, No. 3 (September 1938), p. 89.

Column beam construction and the Portal Truss are two systems of rigid frame design

discussed in this article. Designed by engineers in Chicago and Cleveland, these systems employ shallower, lighter beams with longer expanses and are welded rather than riveted.

Wood, B. L. "Research Report: Construction With Light Steel." *Progressive Architecture.* Vol. 30, No. 3 (March 1949), pp. 74-78.

A brief history of steel in building construction, from the skyscraper to the single-family dwelling, is provided. The focus is on light gauge steel and its advantages in design, fire safety, strength, quality, and design specifications.

Non-Ferrous Metal Alloys

Architectural Aluminum. Pittsburgh, PA: Aluminum Company of America, 1929.

This trade catalog focuses on the use of aluminum in architecture, from the capping of the Washington Monument to the finial at the top of the Standard Oil building, in order to show the range of capabilities aluminum has as a building material. The end of the catalog cites new uses for aluminum in building including rigid conduit for floodlight systems, "top-down" shingles, and complete roofing systems.

Copper Development Association. "The Use of Copper in Post-War Building." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 1 (1945), pp. 332-339.

Until the outbreak of World War II, the use of copper for construction in the United States was limited. In the post-war era, however, it became one of the most sought after materials for many applications. This article explains the importance and versatility of this material.

Coulter, Lane, and Maurice Dixon, Jr. *New Mexican Tinwork, 1840-1940.* Albuquerque: University of New Mexico Press, 1990.

This book delves into the tools, materials, processes, functional uses, methods for dating, and craftsmanship of Spanish New Mexican tinsmithing. Illustrated with color plates and black and white photographs, it provides insight into this lost art form. A glossary of terms and an appendix of hispanic tinsmiths are also included.

Howard-White, F. B. *Nickel, An Historical Review.* Princeton, NJ: Van Nostrand Press, 1963.

This book traces the development of the nickel metal industry. It is fairly specific about the nature of some of its alloys including Monel and nickel silver.

McMullen, A.L. *Architectural Metalwork in Copper and Its Alloys.* London, England: Copper Development Association, 1963.

This is an informative source on copper and its many alloys. Not only does it discuss the properties of the various alloys but it also looks at the issues of construction, finishes and maintenance. The text is well supported by photographs and architectural drawings.

Moore, R. L. "How and When to Use Aluminum Alloys." *Engineering News-Record.* Vol. 135, No. 16 (October 18, 1945), pp. 518-524.

R. L. Moore explains war-time performance tests on aluminum that show its importance as a building material. His article includes descriptions of aluminum and its alloys and it provides tables regarding properties, forms, and characteristics. He discusses available types, shapes, joints, connectors and finishes and supplies photos of experimental products and test results.

Peter, John. *Aluminum in Modern Architecture, Volume I.* Louisville, KY: Reynolds Metals Company, 1956.

This book is a source of specific examples of aluminum architecture. It contains photographs accompanied by brief discussions as well as indexes of architects, architecture, and aluminum products.

Practical Design in Monel Metal. New York, NY: International Nickel Company, 1931.

One of the more thorough resources on Monel Metal, this trade catalog covers Monel from its structural, chemical and material properties to its color, feel, texture, weathering, finish and design. Examples of its varied use are provided and supported by photographs and detail drawings.

Rosenberg, Samuel J. *Nickel and Its Alloys.* Washington, DC: Institute for Materials Research, National Bureau of Standards, May, 1968.

This monograph is a review of properties, production, and uses of nickel and its ferrous and nonferrous alloys. In addition to providing a list of trademarks and owners, it discusses the history of nickel as well as its recovery, production, consumption, uses, and the location of nickel ore. The publication provides a wealth of technical and chemical information.

Weidlinger, Paul. *Aluminum in Modern Architecture, Volume II.* Louisville, KY: Reynolds Metals Company, 1956.

Described as an engineering reference book, the second volume in this set is a comprehensive guide to aluminum. Its physical and mechanical properties, production and fabrication, joints and connections, potential and limitations, structural design, architectural design and detail, environmental control systems and use are all discussed. Included are charts and line drawings, as well as an index containing conversion tables, specifications, and designations.

Elevator doors, Chrysler Building, 1928-29, New York City. William Van Alen, architect. The first extensive use in America of chromium-nickel steel, commonly known as stainless steel, was displayed on the exterior of the Chrysler Building. Stainless steel was incorporated with rare woods as illustrated on these elevator doors. *Photo:* Cervin Robinson.

_____. Aluminum as a Structural Material." *Progressive Architecture.* Vol. 29, Nos. 9 and 10 (September and October 1948), pp. 77-84; 89-92.

This two-part article looks in depth at the application of aluminum as a structural material. The first part concentrates on aluminum and its alloys and on material properties, forming, fabrication and economics.

The second part examines shapes and connections when used structurally, citing examples of existing structures.

Welsh, Frank Sagendorph. "Architectural Metallic Finishes in the Late Nineteenth and Early Twentieth Centuries: The Great Imitators: Aluminum and Bronze." In *Interiors Handbook for Historic Buildings, Volume 2.* Edited by Michael J. Auer, Charles E. Fisher, Thomas C. Jester, and Marilyn E. Kaplan. Washington, DC: Historic Preservation Education Foundation, 1993, pp. 3-37 to 3-43.

This paper discusses the composition of aluminum and bronze, their manufacture, uses, application techniques, and characteristics. A brief description of microchemical analysis is given as well as a list of buildings where these metallic finishes were used.

Williams, Hugh R. "Monel Metal; Points of Superiority of this New Natural Alloy in All Fields for Non-Corroding Steel." *Scientific American Supplement.* Vol. 88, No. 2276 (August 16, 1919), pp. 98-99.

This article provides statistics on the structural properties of Monel metal and gives examples of its first applications such as propellers for the U.S.S. Dakota, sheet metal roofing for the Pennsylvania Railroad Terminal, and even golf clubs. Most of the cited examples attest to its superior performance in comparison with German silver and steel.

Related Information

Atchison, Leslie. *A History of Metals.* New York, NY: Interscience Publishers, Inc., 1960.

This historic overview of all metals covers development and application from the earliest use to the date of publication.

Chase, David, and Carolyn Laray. *Sheet Metal Craftsmanship: Progress in Building.* Washington DC: Publications Office, National Building Museum, 1988.

This catalog accompanied a National Building Museum exhibit on the 100 years of the Sheet Metal Industry in America. It gives a broad overview of sheet metal applications, and a history of its production. Included are paintings, photographs, and a bibliography.

Emerson, David B. "The Specification Desk: Metals and Alloys." *Pencil Points.* Vol. 12, No. 3 (March 1931), pp. 239-240.

Ferrous and non-ferrous alloys and their properties and applications are discussed in this article. This includes iron, bronze, copper, German silver, Monel metal, aluminum, yellow (Muntz) metal, tool-proof steel, and chrome-nickel steel.

Gayle, Margot, David W. Look, AIA, and John G. Waite, AIA. *Metals in America's Historic Buildings: Uses and Preservation Treatments.* Washington DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1980. Revised 1992.

This book charts the use of metal as a building material in America. The history of copper, nickel, iron, aluminum and their respective alloys is discussed as well as the processes of deterioration and preservation. Also included is an extensive bibliography.

Grimmer, Anne E. *Preservation Briefs 6: Dangers of Abrasive Cleaning to Historic Buildings.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1979.

This brief is valuable for its discussion of 1920s and 1930s metals such as chrome, nickel alloys, aluminum, and stainless steel. Suggested methods for cleaning, including

glass bead peening, crushed walnut shell pressure cleaning, and fine sand blasting, are examined for their potential in removing paint and corrosion from very plain to highly articulated metal features.

Lopez, Frank G. "Conserving Metals With Stone and Glass Veneers." *Architectural Record.* Vol. 90, No. 6 (December 1941), pp. 92-96.

This article suggests substitute materials, primarily stone and structural glass, for materials in short supply due to World War II. It is followed by time-saving standards which provide construction details for stone and glass.

Mitchell, Robert A. "What Ever Happened to Lustron Homes?" *Association for Preservation Technology Bulletin.* Vol. XXIII, No. 2 (1991), pp. 44-53.

The housing shortage following World War II prompted the Lustron Corporation to begin manufacturing a prefabricated house made of porcelain enameled steel panels. This article highlights the historical significance of these houses. It includes drawings and photographs of floor plans and various details along with suggestions for the preservation of Lustron Homes.

Ornamental Designs from Architectural Sheet Metal, The Complete Broschart & Braun, ca. 1900. New York, NY: The Athenaeum of Philadelphia and Dover Publications, Inc., 1992.

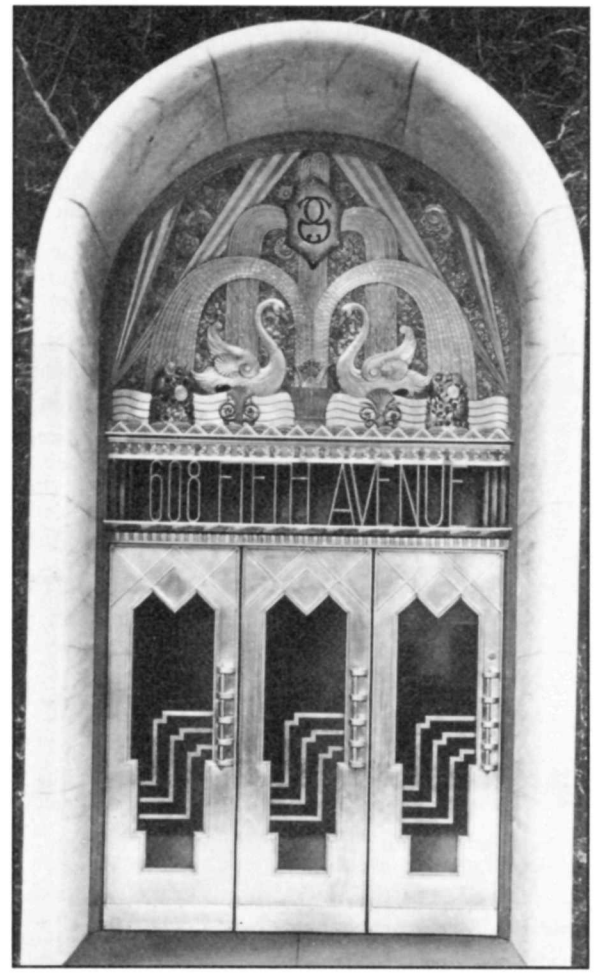
This catalog contains detail drawings, photographs, dimensions, and prices of the entire line of architectural sheet metal from the company of Broschart & Braun.

Ornamental Iron and Bronze. Chicago, IL: The Winslow Brothers Company, 1910.

This book consists of photographs of buildings that feature architectural iron and bronze work. Each building is identified and the architect is noted. The book also contains a listing of other buildings across the nation that have iron and bronze detailing.

Sivinski, Valerie. "Metals in Interiors: Repair and Replacement." In *The Interiors Handbook for Historic Buildings.* Edited by Charles E. Fisher, III, Michael Auer, and Anne Grimmer. Washington D.C.: Historic Preservation Education Foundation, 1988, pp. 2-15 to 2-17.

A general description of metals used for interior and exterior applications is given.



Goelet Building, 1932, New York City. E.H. Faile, architect, General Bronze Corp., foundry, Long Island, N.Y. Many 20th century metals such as copper, brass, nickel silver, and black enamel have been integrated into the design of this entranceway emphasizing the art-deco style common to the 1920's and 1930's. *Photo:* International Nickel Company.

Repair, replacement and maintenance recommendations are provided for iron, copper (and its alloys, including monel), aluminum, and metal leaf.

Small, Ben John. "Streamlined Specifications: Metals." *Progressive Architecture.* Vol. 30 (May 1949), pp. 92-95.

This concise guide to metals is organized in an outline form with the following headings: General Requirements, Materials, Gages, and Treatments.

Trelstad, Derek H. "Renovation: Stuyvesant Town and Peter Cooper Village." *Building Renovation.* (January/February 1993), pp. 28-33.

Thermal performance and operational problems associated with World War II era steel casement windows resulted in a search for sympathetic substitute windows for this 1947 public housing project in New York's Lower East Side. The selection of the new aluminum windows of a similar casement-hopper design, their specifications and methods of installation as well as the recycling of the original steel windows is discussed.

Glass

Although glass is an ancient building material, it has enjoyed extensive development in the twentieth century. Shatterproof, x-ray proof, wired, decorative, and opaque glass are only a few examples that were introduced and promoted under a variety of trade names. Two types, Structural Glass and Glass Block, were exploited for their capabilities as load-bearing materials. These, along with Decorative Glass, serve as the subheadings in this category.

Decorative Glass

Harbeson, John F. "Design in Modern Architecture: Stained Glass and Mosaic." *Pencil Points.* Vol. 11, No. 12 (December 1930), pp. 957-963.

The author discusses modern approaches to stained glass. These include the use of machine-made commercial glass (chipped, rippled, pressed-lens, etched and ground) and designs that require minimal divisions.

Harrison, Martin. "Twentieth-Century Stained Glass." In *Architectural Stained Glass.* New York: Architectural Record Books, 1979, pp. 65-80.

An analysis of modern stained glass history, this essay begins with the work of the Berlin expressionists (in particular the Glass Pavilion of 1914). Other significant architects discussed in connection with the use of stained glass include Auguste Perret, Charles Rennie Mackintosh, Frank Lloyd Wright, Henry Ven de Velde, and Peter Behrens. The contribution of the Bauhaus school is also noted.

Glass Block

"Announce Building Unit of Glass and Haydite." *Brick and Clay Record.* Vol. 94, No. 5 (May 1939), p. 33.

This short article details the development of Gladstone, a load-bearing glass unit made by bonding Vitrolite with Haydite, as manufactured by the Libbey-Owens-Ford Glass Company. This article notes that many buildings under construction in Detroit were using the product. It includes a photograph and cross-section of a Gladstone slab.

Clute, Eugene. "Designing for Construction in Glass." *Pencil Points.* Vol. 13, No. 11 (November, 1932), pp. 741-748.

This article discusses design possibilities for glass block, tiles and relief panels.

Versailles Apartment Building, 1936, Brooklyn, N.Y. Kavy and Kavovitt, Inc., architects. These entrance doors were fabricated from sheets of stainless steel with etched glass in the window. Both the stainless steel frame, produced from rolled sections and the inset glass blocks at the top and sides, are uniquely 20th century building materials. *Photo:* David W. Look, AIA.

Applications using these products are discussed, and several photographs showing contemporary designs are included.

"Demountable Glass Block Partitions for Stores, Offices, Homes." *American Builder*. Vol. 64, No. 11 (November 1942), p. 44.

This article describes a war-time method of building internal glass block walls without the use of metal or mortar by using prefabricated wood strips and wedges as produced by the Insulux Division of the Owens-Illinois Glass Company.

"Luxfer Glass Prism Constructions." *Architectural Record*. Vol. 69, No. 1 (January 1931), pp. 59-62.

The Luxfer Glass Prism tile unit and its application in roof and wall construction is discussed. The diamond or modeled surface of this product is compared with flat glass. Included are photographs of Luxfer Glass in buildings in Germany.

"New Method of Glass Block Construction." *American Builder*. Vol. 62, No. 2 (February 1940), p. 106.

This article describes the Revere System, a new method for using prefabricated and

interlocking metal members for glass block construction. Installation procedures are explained and a diagram of the product is shown.

"Products and Practice: Glass Block." *Architectural Forum.* Vol. 72, No. 5 (May 1940), pp. 327-330.

This article explains glass block in terms of three categories: residential, institutional/ commercial, and industrial. It ends with a paragraph on new products. Explanations are given regarding directional glass block, diffusing blocks, and a new system for demountable glass block wall systems. Diagrams and many photographs are included.

"Vacu-lite Glass Blocks." *American Builder.* Vol. 62, No. 6 (June 1940), p. 84.

A new patented form of insulated glass roof and ceiling construction using Alglas aluminum frames and Vacu-lite partial-vacuum glass blocks is announced. The description of the product includes specifications and small illustrations.

Structural Glass

Kendrick, Gregory D., editor. *Preservation Briefs 12: The Preservation of Historic Pigmented Structural Glass (Vitrolite and Carrara Glass).* Washington, DC: Rocky Mountain Regional Office, Cultural Resources Division, National Park Service, US Department of the Interior, 1984.

Popular with the Art Deco, Streamline, and Moderne designs of the 1920s and 1930s, pigmented structural glass (commonly known by the trade names Carrara, Sani Onyx, Rox, and Vitrolite) emerged in the first decade of the twentieth century as a substitute for marble. This brief discusses the aesthetic appeal, technical composition, application methods, deterioration processes, maintenance, repair, and replacement strategies for this material and its panel system of construction.

"Manufacture of Structural Glass." *Glass Industry.* Vol. 20, No. 6 (June 1939), pp. 215-219.

Works No. 6 of the Pittsburgh Glass Company goes through a complex process to produce Carrara glass and Herculite. The plant and the production process are described in this article and brief references to applications of these materials are included.

Polivka, Jaroslav. "Glass: Structural Material of Tomorrow." *Architectural Record.* Vol. 85, No. 2 (February 1939), pp. 66-72.

In this article, the author proposes the use of glass as a load-bearing material. He examines uses where glass is treated not as a surfacing material but as a structural component capable of carrying compressive and tensile loads.

Yorke, Douglas A., Jr., AIA. "Material Conservation for the Twentieth Century: The Case for Structural Glass." *Association for Preservation Technology Bulletin.* Vol. XIII, No. 3 (1981), pp. 18-29.

Yorke provides standard sizes, physical descriptions, and properties for structural glass, with particular attention given to Vitrolite and Carrara Glass. A chart of colors includes the Munsell notation and decade of availability. After discussing the three types of failure, recommendations are made for replacement and repair.

Related Information

Byrne, Richard O. "Conservation of Historic Window Glass." *Association for Preservation Technology Bulletin.* Vol. XIII, No. 3 (1981), pp. 3-9.

The three types of deterioration (decolorization, scratching and etching, and breakage) are described in this article. Recommendations for treatment and a list of reproduction glass suppliers are provided.

de Tailly, M. "Thermolux Glass - Insulating, Translucid, Light Diffusing." *Glass Industry.* Vol. 20, No. 7 (July 1939), pp. 265-268.

A layer of very fine glass thread called Vetroflex is fixed between two layers of glass to form Thermolux. This article describes the make-up of Thermolux as well as its thermal, diffusive, and sound-insulating qualities.

Emerson, David B. "Glass and Glazing," Parts I and II. *Pencil Points.* Vol. 12, Nos. 9 and 10 (September and October 1931), pp. 713-716; 789-791.

This first part of this article traces the general history of glass, focusing on the more recently developed types such as plate, obscured, wire, ultraviolet transmission, x-ray proof, and shatterproof glass. The second part addresses prism glass, mirrors, setting of glass and appropriate materials and sizes of frames.

Lopez, Frank G. "Glass in House Design." *Pencil Points.* Vol. 26, No. 5 (May 1945), pp. 93-100.

The properties, applications, and forms of recently developed glass products are examined. The types of glass available (e.g. Lustraglass, Pyrex, Herculite) are listed by trade name and manufacturer.

McGrath, Raymond, and A. L. Frost. *Glass in Architecture and Decoration.* London, England: The Architectural Press, 1937, revised 1961.

Extensive histories of all types of glass are provided in this thorough book. Numerous black and white photographs, line drawings, and an extensive bibliography are included.

Sheet and Plate-Glass Manufacturers' Association. "Glass." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 1 (1945), pp. 353-354.

Explaining advances in twentieth century glass production, this article distinguishes older types of blown glass from more recent types such as plate glass, wire glass, hollow glass bricks, and early fiberglass. In addition to clarifying the attributes of these materials, the article provides insight into the overwhelming effect that World War II had on building technology.

Plastics, Rubber, and Asphalt

Asphalt was first used thousands of years ago, but it has enjoyed widespread use in the twentieth century. While it is generally thought of as a paving material, it has been commonly utilized in other applications such as roofing and flooring. Another material that has seen further scientific developments is rubber. Since the patent for vulcanization was received in 1844, the manufacturing processes advanced significantly. The shortage of natural rubber during World War II led to the further development of synthetic rubber which was first produced in the late nineteenth century.

Plastic is another material that was also researched and developed extensively as a result of the two World Wars. Advancements in plastics technology affected many building materials. These include flooring, walls, roofing, waterproofing, paint, and adhesives, as well as electrical and mechanical equipment. While there are many types of plastics, they can be classified into two major categories: thermoplastics (can be reheated and remolded) and thermo-setting plastics (can only be molded once).

The following entries address these three materials which played a significant role in the first half of this century.

The Asphalt Institute. *The Asphalt Handbook.* College Park, MD: The Asphalt Institute, 1947.

This thorough handbook provides information regarding various aspects of asphalt. It defines terminology, specifications, paving equipment, construction requirements, various applications, and erosion control. The book also includes lists of Asphalt Institute offices and member companies.

"Bakelite, a Growing Factor in the Trend of Modern Decoration." *Dun's International Review.* Vol. 57, No. 4 (June 1931), pp. 32-33.

This brief article discusses the development of Bakelite phenol-laminated resinoids and their applications in furniture and interior design.

Carr, J. Gordon. "Plastics: Characteristics and Applications." *Architectural Record.* Vol. 95, No. 6 (June 1944), pp. 105-108.

This group of charts was collected to inform designers about types of plastics, their applications, trade names and manufacturers. They also include information regarding chemical composition and the physical and chemical properties of plastics.

"Construction Units Appear." *Modern Plastics.* Vol. 18 (February 1940), pp. 30-31, 70-72.

A plastic block designed by Alden B. Dow is presented in this article. The 12" x 12" x 1/8" units can be transparent, translucent, or opaque and offer extensive building opportunities.

Dawson, T.R., and E. Sopher. "Applications of Rubber in Building." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 2 (1947), pp. 239-242.

The authors list and describe new uses for rubber in building applications. Products such as sound insulation, wall panels, coverings, rubber flooring and rubber-coated sheet metal are discussed. Also included is a description of Ebonite, a hard rubber wall panel. Construction details are provided for the products discussed.

"The House of Plastic Blocks." *California Arts & Architecture.* Vol. 51, No. 1 (January 1940), pp. 10, 32.

Alden Dow envisioned houses made almost completely of plastic. He invented the plastic block described in this article, which was to be an integral part of plastic construction.

Koehler, Charles R. *Plastics in Building.* Washington, DC: Government Printing Office, April 1955.

This book is the result of a conference conducted by the Building Research Institute in October of 1954. It discusses the plastics industry, and the standards, codes and present and future uses of plastics. "Surfacing and Decorative Uses of Plastics in Building," by *Plastics* editor Hiram McCann, evaluates vinyl flooring (e.g. Corlon, Plastile, Terraflex), decorative laminates (e.g. Formica, Naugatop, Conolite) and styrene wall tile.

Lougee, E. F. "Plastics for Architecture." *Pencil Points.* Vol. 20, No. 6 (June 1939), pp. 395-403.

Different types of plastics are explained and identified by trade names. For example, Lumarith, Masuron, and Nixonite are cellulose acetate materials; Plexiglas, Crystalite, and Lucite are acrylic resins; while Durite, MakaLot, Resinox and Textolite are phenolic

materials. The manufacture and application of laminated plastics and translucent laminates are also discussed.

Lusty, H. H. "Plastics and Their Place in Post-War Building." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 1 (1945), pp. 364-372.

Lusty concisely describes the difference between thermo-plastics (i.e. polyvinyl-chloride) and thermo-setting plastics (i.e. Bakelite). The manufacture of molded and laminated sheet plastics is reviewed in addition to their possible applications as windows, wall and floor tiles, plumbing, and interior decoration.

Marshall, Robert F. "Plastics... Practically Speaking." *Architectural Record.* Vol. 93, No. 4 (April 1943), pp. 54-59, 86.

Marshall provides an overview of plastics and their manufacturing processes. The organization of the plastics industry is explained.

"Plastics." *Architectural Record.* Vol. 69, No. 4 (April 1931), pp. 321-322.

This article outlines three types of plastic materials available in 1931 including phenolic resins (e.g. Bakelite), cellulose acetate (e.g. Lumarith), and urea formaldehyde resins (e.g. Beetle). A chart of architectural uses, trade names, forms, principal characteristics, suitable uses, colors, transparency and effects of various compounds is included.

"Plastics in Architecture." *Architectural Forum.* Vol. 66, No. 2 (February 1937), pp. 147-149.

This brief article lists the characteristics of different types of synthetic resin plastics as well as the manufacturers and trade names of these products.

Progressive Architecture. Vol. 41 (June 1960).

This issue contains eleven articles about plastics, including "Chemistry's Man Made Plastics" by William Demarest, "Structural Considerations" by Frederick J. McGarry, and "Residential Research" by Lee Frankl.

Progressive Architecture. Vol. 51 (October 1970).

This issue is devoted to plastics in architecture. An introductory review by Albert Dietz is followed by articles discussing properties, building codes, applications, and case studies. Although much of the information pertains specifically to the 1970s, the issue is helpful in understanding the development of plastics in the twentieth century.

Quarmby, Arthur. *Plastics and Architecture.* New York, NY: Praeger Publishers, 1974.

Although most of this book focuses on contemporary design, Chapter Five, "Historical Applications," summarizes developments in early architectural applications. Photographs illustrate pre-fabrication systems and component housing systems such as the 1957 Monsanto House of the Future.

Rosato, Dominick V. *Rosato's Plastics Encyclopedia and Dictionary.* Munich, Germany: Hanser Publishers, 1993.

Over 11,000 entries are defined in this book by an expert in the plastics field. It is supplemented with illustrations, a 24-page chronology (beginning with 1800 B.C.), and a list of 186 references.

Sanders, Morris. "Plastics and Architecture." *Architectural Record.* Vol. 88, No. 1 (July 1940), pp. 66-76.

Supplemented with numerous photographs, this article describes the different types of thermoplastics and thermo-setting plastics. A

time line of the evolution of plastics, beginning with the discovery of urea in 1773, and ending with developments in 1938, is provided.

Singer, Joseph B. *Plastics In Building*. London, England: The Architectural Press, 1952.

In addition to explaining the manufacturing process of plastics, their advantages and disadvantages, and historical applications, this book provides extensive information on exterior and interior uses. Particular subjects include Corroplast roofing, Perspex glazing and wall panels, Holoplast panels, and Prespine wall coverings. A glossary of trade names (e.g. Accotile, Durite, Kalistron, Luxorite, Plastrim), a bibliography, and advertisements are also provided.

Tetzlaff, Frederick W., and Robert R. Rorke. "Acrylic Plastics in Architecture." *Progressive Architecture*. Vol. 30, No. 6 (June 1949), pp. 75-78.

The authors discuss the various applications of acrylic plastics (marketed under the trade names Lucite and Plexiglass), including partitions, corrugated panels, storefronts, lighting and skylights. Recommendations are made for optical considerations, safety, machining, and installation.

Composites and Laminates

During the first half of the twentieth century, many innovative composite materials were developed, especially in the 1930s and 1940s. These materials were often either substitute materials such as Formica, a replacement for tile and wood countertops, or labor-saving prefabricated materials, such as Celotex siding, an asphalt-based material with a backing and finished surface. While laminates and composites are often thought of as building materials of the latter part of the twentieth century, they did play an important role in construction during the first half.

Building Boards Joint Committee. "Fibre Building Boards." *Architects' Year Book*. Edited by Jane B. Drew. Vol. 1 (1945), pp. 345-348.

This short but informative article defines and explains the use of each class of wood fiber building boards. It includes a table with specifics regarding composition, sizes, appearance, fasteners and finishes for this material.

Dietz, Albert G. H., editor. *Composite Engineering Laminates*. Cambridge, MA: The MIT Press, 1969.

Although this books focuses on the development of composite laminates since 1949, it is helpful in providing some historical background. Particularly useful are Chapter 3, "Structural Glued Laminated Timber," Chapter 4, "Plywood," Chapter 7, "Composite-Glass Structures," and Chapter 12, "Stainless-Steel-Clad Metal."

Lewin, Susan Grant, editor. *Formica & Design: From the Counter-Top to High Art*. New York, NY: Rizzoli, 1991.

This book, which describes the evolution of Formica laminate and its pervasive presence in American society, grew out of the celebration of Formica Corporation's 75th anniversary. It provides ample photographs, many historical, and includes chapters specifically on Formica use in the fifties and in diners.

"Products and Practice." *Architectural Forum*. Vol. 72, No. 6 (June 1940), pp. 413-418.

This article discusses the role of plastics in building, especially when used as a laminate and combined with wood. It covers decorative laminates, resin bonded plywoods and molded products. Trade names and manufacturers (e.g. Bakelite by the Bakelite Corporation, Vinylite by the Carbide and Carbon Chemicals Corporation) are also included.

"Rose Hill Courts." *California Arts & Architecture.* Vol. 59 (August 1942), p. 32.

The construction of a World War II housing project by the Housing Authority of Los Angeles is the topic of this article. It describes, among other techniques, the integration of plastics and masonite-tempered Presdwood.

"Sandwich Panels Tested for Small House." *Architectural Record.* Vol. 103, No. 4 (April 1948), pp. 150-151.

The panels discussed in this article were developed during World War II for high-speed aircraft. The honeycomb paper core panel, which can be faced with sheet materials such as plywood or metal, was being tested for strength and resistance to decay.

"Translucent Laminated Plastics Open New Vistas to Architects and Industrial Designers." *Modern Plastics.* Vol. 13 (January 1935), pp. 29-31.

This short article promotes the use of urea formaldehyde laminations in exterior and interior applications. It cites translucence, ease of cutting, heat resistance, and minimal weight as some of the advantages of this material.

"Wood Wool Building Slabs." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 2 (1947), pp. 262-263.

This article praises the versatility of this fire-resistant sound-deadening material. It explains the types of wood wool slabs, their uses, and the process of producing them from wood fiber.

Prefabricated modular panels ready for assembly on site. Photo courtesy H. Ward Jandl.

Wallboard, Stucco, and Plaster

Although gypsum is one of the oldest building materials, particularly as in its use in plaster, it was not until the 1940s that it was used in sheet form for wall and ceiling systems. The speed of erection and cost placed it in competition with conventional plaster. Although gypsum board, plaster, and stucco may be considered finish materials, they played important roles in the twentieth century construction industry. The development and treatment of these materials are addressed in the following entries.

Allan, W.D.M. "The Functions of Modern Stucco." *Pencil Points.* Vol. 12, No. 2 (February 1931), pp. 159-160.

A general description of stucco, its composition, characteristics, and application as well as a brief history is given. Proper mixing techniques are also included.

"Buttonlath: An Improved Lathing Material." *The Architect.* Vol. 11, No. 2 (February 1916), pp. 120, 124.

This article describes a new material produced by Buttonlath Manufacturing Company, Buttonlath, which was used as a special lath system for the application of plaster. It was made with a plastic base and waterproof paper and was thought to work well for soundproofing, heat insulation, and fire resistance.

Denivelle, Paul E. "Sgraffito." *The Architect.* Vol. 14, No. 5 (November 1917), pp. 287-292, 337.

The various methods of sgraffitoare described, first as practiced in Italy with a special lime putty; then as used at the 1915 Panama Pacific Exposition, with a gypsum base; and then as used with more contemporary Portland cement varieties. Photographs show examples of sgraffito from Renaissance Italy and John Galen Howard's Hilgard Hall at the University of California, Berkeley. The author ponders problems and the fate of sgraffito in future architectural endeavors.

Emerson, David B. "The Specification Desk: Lime, Cement, and Plaster." *Pencil Points.* Vol. 10, No. 9 (September 1929), pp. 657-659, 664.

This article briefly describes and outlines the principal uses of lime, cement and plaster. Specific areas include hydrated lime, lime stucco, hydraulic lime, Portland cement, white cement, Lumnite, brick cement, slag cement, and LaFarge cement.

Grimmer, Anne. *Preservation Briefs 22: The Preservation and Repair of Historic Stucco.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1990.

The exterior finishing of stone, brick, log, and wood frame buildings with a two- or three-part plaster coat is the focus of this brief. Attention is paid to uses of stucco that began in the late 1890s with the Prairie style, continued through the 1920s Art Deco period, and were greatly popularized during the 1930s and 1940s with the various Revival styles.

Ladygo, Andrew C. "New Techniques for Restoring Decorative Plasterwork." *The Construction Specifier.* Vol. 41, No. 7 (July 1988), pp. 104-112.

Modern methods used to save plasterwork are outlined in this article, and include adhesion systems and stabilization methods. One section is devoted to Akoustolith Plaster. This material's history and composition are described as determined through experiments and information found in patents.

"Lath and Plaster." *Architectural Forum.* Vol. 63, No. 12 (December 1935), p. 607.

This article provides definitions and descriptions of terms and accessories relating to plastering as encountered in the 1930s.

Lefebure, Major V. "Some Notes on Plasterboard." *Architects' Year Book.* Edited by Jane B. Drew. Vol. 1 (1945), pp. 362-364.

In 1945 North America and Great Britain were using 200,000,000 square yards of gypsum plasterboard each year. This material became a staple of the twentieth century building industry. Lefebure explains the incredible ingenuity entailed in plasterboard production and the numerous qualities of the product.

MacDonald, Marylee. *Preservation Briefs 21: Repairing Historic Flat Plaster Walls and Ceilings.* Washington, DC: Preservation Assistance Division, National Park Service, US Department of the Interior, 1989.

With the late nineteenth century substitution of gypsum for lime as a base material, plaster

evolved into a twentieth-century wall coating. Combined with rock lath, a paper-faced compressed gypsum board lath, gypsum plaster proved an economical finish product for residential work through the 1930s. This Brief provides information on deterioration problems associated with structural failure, poor workmanship, improper curing and moisture problems. It also discusses the repair of cracks, replacement of lath, patching of holes, removal, and substitution.

Phillips, Morgan W. "Adhesives for the Reattachment of Loose Plaster." *Association for Preservation Technology Bulletin.* Vol. XII, No. 2 (1980), pp. 37-63.

The problems encountered with reattaching plaster are discussed. The majority of the article provides a description of a recommended method of plaster reattachment. Sections include materials used, formulation, application, and the advantages of the method that is described.

Sleeper, Harold R. "Dry-Wall Construction, Part I: Fiber Board." *Architectural Record.* Vol. 94, No. 3 (September 1943), pp. 83-88.

The development of drywall is discussed in the first of this two-part article. It concentrates on the attributes of fiber board, explaining its uses, cost, and sizes, providing details for application. The article is meant to provide architects with information on the proper choice of materials.

_____. "Dry-Wall Construction, Part II: Gypsum Board, Plywood, Miscellaneous." *Architectural Record.* Vol. 94, No. 4 (October 1943), pp. 77-81.

Specifications, applications, and finishing details for gypsum board, plywood and other materials are supplied in this article. The different types and grades of these materials are explained, and their appropriate uses are discussed.

Wall Coverings and Coatings

The search for protective coatings for a variety of applications during the two World Wars led to significant developments in paint technology. The composition of paint was particularly influenced by the use of synthetic ingredients. The following entries address paint and another finish material, wallcoverings, in a twentieth century context.

Ackerman, Phyllis. *Wallpaper: Its History, Design and Use.* New York, NY: Frederick A. Stokes Company, 1923.

The author of this book gives a history of wallpaper and describes its use in early American homes. The rest of the book is devoted to wallpapers from the time around the publication of this book, in 1923. The manufacture of wallpaper and the problems of designing with wallpaper, including color problems, texture, and the light and scale of patterns are discussed.

Alderson, Caroline. "Re-Creating a 19th Century Paint Palette." *Association for Preservation Technology Bulletin.* Vol. XVI, No. 1 (1984), pp. 47-56.

Despite the title, this article provides useful information on house paint colors popular up until 1924. The color palette produced by the author is based on early manuals and textbooks for painters.

Long, J.S., Henry A. Gardner, R. L. Hallett, and John Marshall. "Post-War Paint." *Architectural Record.* Vol. 96, No. 4 (October 1944), pp. 68-70, 134-136.

New paints (1944) and their chemical compositions are discussed in comparison to existing paints. Guidelines for specifications and applications (including the *Kinatron* tube) for paints such as lead, enamel, casein products, varnishes, and aluminum are given.

Discussion also includes products that are not available due to the war; and the pros and cons of painter-mixed versus manufacturer-mixed paints.

Lynn, Catherine. *Wallpaper in America from the 17th Century to World War I.* New York, NY: W. W. Norton, 1980.

The chapter that deals with wall coverings between 1890 and 1915 includes many photographs of period wall coverings. The influence of wallpaper design, the colors used, the types and locations of wallpaper, and the influence of style are discussed.

"New Materials: Rubber Derived Coatings Protect Materials from Corrosion." *Architectural Record.* Vol. 84, No. 1 (July 1938), p. 55.

A rubber-based coating produced by Goodyear Tire and Rubber Company is introduced as a corrosion preventative for application to wood, metal, or concrete. Light reflection, density and hardness of Aluminum Plicote and Whitel Plicote are discussed.

Nylander, Richard C. *Wallpapers for Historic Buildings.* Washington, DC: The Preservation Press, 1983. Revised 1992.

The latter part of this book includes reproductions of wallpapers from the twentieth century. Each catalog entry includes useful information such as the manufacturer's name, country, as well as date and method of manufacture of the original paper. A list of manufacturers of reproduction papers is included.

"Paints for Masonry Walls." *Architectural Record.* Vol. 102, No. 6 (December 1947), pp. 115-116.

This article discusses the results of a six-year test in Washington, D.C. on the durability of various masonry paints. Walls of stone and cinder-concrete block, lightweight-aggregate block, new and used common brick, and cast concrete slabs were painted with cement water, resin emulsion, oil-base and rubber solution paints. Recommendations are made based on the study and are clearly illustrated with a chart.

Price, Burr. "Paints: Present and Post War." *Architectural Record.* Vol. 93, No. 6 (June 1943), pp. 81-84.

The new paint technologies that were developed due to war and war-time shortages are discussed. Many types of paint and

The interior of the Johnson Wax Corporation Building, 1936, Racine Wisconsin, designed by Frank Lloyd Wright, features several uniquely 20th century building materials such as linoleum, stainless steel, and tube-glass walls. *Photo:* Jack E. Boucher, HABS Collection.

materials are included, such as pigments, oils, water-mixed paints, cement-based paints, casein, synthetic resin, metallic paints, rust-resistors, fire retarders and fluorescent paints.

Resilient Flooring

The search for sanitary and attractive resilient flooring in the nineteenth century resulted in Frederick Walton's development of Linoleum in England in 1863. The overwhelmingly prominent use of this product in later years makes Linoleum an integral part of any discussion of early twentieth century flooring.

As with most building materials of the twentieth century, the two World Wars resulted in new developments, bringing various vinyls and poured resilient floors to the fore. The entries below include information regarding the development of some of these products, their characteristics, and preservation.

Blackman, Leo, and Deborah Dietsch. "Linoleum: How to Repair It, Install It, and Clean It." *Old House Journal.* Vol. 10, No. 2 (February 1982), pp. 36-38.

The recommended methods for installing, cleaning, and repairing historic linoleum are given in this article. Once the initial work is completed, methods for cleaning and maintaining this floor covering are outlined. The installation that is described is based on a 1920s method.

_____. "A New Look at Linoleum, Preservation's Rejected Floor Covering." *Old House Journal.* Vol. 10, No. 1 (January 1982), pp. 9-11.

The history of linoleum and its manufacture is traced in this article. The article also describes various types of linoleum, such as inlaid, Jaspe, and Coranite linoleum.

Carroll, Orville W. "Linoleum Used in Restoration Work." *Association for Preservation Technology Bulletin.* Vol. I, No. 3 (December 1969), pp. 8-11.

This article describes linoleum found in National Park Service properties. The problems and solutions to replacing linoleum in one house are briefly discussed. A photograph of an 1899 linoleum, a brief history, and a few manufacturers at the time of publication of this article are included.

Kahn, Eve. "Finding Linoleum." *Old House Journal.* Vol. 14, No. 12 (December 1986), pp. 478-481.

This article provides a list of sources with descriptions of the type of linoleum produced, styles, and average prices. Photographs are included.

Maxwell, Shirley, and James C. Massey. "Before Vinyl, There Was Linoleum." *Old House Journal.* Vol. 20, No. 5 (September/October 1992), pp. 44-50.

The authors provide an overview of the history of linoleum including its popularity after World War I, the manufacturing process, types (Battleship, Plain, Jaspe, etc.), patterns, and colors. They also make recommendations on its conservation, repair, care, and removal of linoleum adhesive. A list of suppliers is provided.

Parks, Bonnie W. "Floorcloths to Linoleum: The Development of Resilient Flooring." In *Interiors Handbook for Historic Buildings, Volume 2.* Edited by Michael J. Auer, Charles E. Fisher, Thomas C. Jester, and Marilyn E. Kaplan. Washington, DC: Historic Preservation Education Foundation, 1993, pp. 3-37 to 3-43.

A comprehensive history of the development and manufacturing techniques of floor cloths and linoleum is presented. Recommendations

for the repair, cleaning and restoration of linoleum are included.

"Poured Resilient Flooring for Houses." *Architectural Record.* Vol. 103, No. 1 (January 1948), pp. 115-116.

Three types of resilient flooring are discussed in this article, specifically plastic floorings that can be poured in place over concrete, wood or steel subfloors. Included in the article are descriptions of Silvacon, Oaktred and Dex-O-Tex brands, along with installation procedures, specifications, and product compositions. Photographs are also included.

Construction Systems

During the first half of the twentieth century, many innovative construction systems were developed for both housing stock and commercial buildings. Spurred on by the need for economical and speedy construction systems and new building materials, many manufacturers developed prefabricated and mass-produced buildings. These products ranged from partial systems such as honeycomb-laminated panels and insulated plywood wall panels, to complete structures such as the Lustron House and the Stran Steel Quonset Hut.

Another popular system, particularly through the 1930s, was Guastavino vaulting. The materials used in this system evolved as new building materials, such as Akoustalith acoustic tiles, became available. Because of their relationship to new building materials of the twentieth century, sources addressing construction systems have been included.

Concrete Systems

De Huff, Paul. "Precastructural Concrete." *The Architectural Forum.* Vol. 95, No. 3 (September 1951), pp. 194-195, 236, 242, 248, 254.

This is an early report of tilt-up construction as it was being implemented in the years immediately following World War II. The article contains contemporary costs, usual materials and details, a limited history of the system, with patent information and techniques of construction.

Ford, O'Neil. "Lift-Slab." *Bulletin of the American Institute of Architects.* Vol. 6, No. 5 (September/October 1952), pp. 3-6.

This article discusses early techniques and strategies for the implementing of the lift-slab system of reinforced concrete slab floors.

"New Systems: Walls Built in Horizontal Forms and Raised to Position." *Architectural Record.* Vol. 84, No. 6. (December 1938), p. 58.

A tilt-up stone-faced concrete system developed by Form-U-Lay Homes of Cleveland, this system allows for the construction of a concrete wall on the ground after which it is tilted vertically into position.

Severud, Fred N. "Forecasting a New Era for Concrete." *Architectural Record.* Vol. 106, No. 6 (December 1949), pp. 134-138.

This article discusses tilt-up and lift-up construction systems for concrete slabs. The author advocates the application of gentle pressure to the concrete during the early curing stages, or "densing," as a means to insure against cracks in the slabs.

Guastavino Vaulting

Collins, George R. "The Transfer of Thin Masonry Vaulting from Spain to America." *Journal of the Society of Architectural Historians.* Vol. 27, No. 3 (October 1968), pp. 176-201.

This article describes the historical origins and advantages of thin masonry vaulting that was popular in the United States from the 1880s to the 1940s. The contributions of Rafael Guastavino, Sr., who brought this construction technique to the United States from Spain, are also discussed.

Prudon, Theodore H. M. "Guastevino [sic] Tile Construction." *Progressive Architecture.* Vol. 70, No. 9 (September 1989), pp. 137-138.

After providing a concise history of Rafael Guastavino, Sr. and his company, Prudon describes the materials and construction of thin-shelled vault construction. He provides information on Rumford and Akoustilith tiles (introduced in 1914 and 1916 respectively), reasons for structural failure, and recommendations for restoration.

Wight, Peter B. "The Works of Rafael Guastavino." *The Brickbuilder.* Vol. 27, Nos. 4, 5, 9, and 10 (April, May, September, and October 1901), pp. 79-81; 100-102; 184-188; 211-214.

Part One (April) discusses the life and early works of Rafael Guastavino, Sr. The materials (hard-burned, flat clay tiles, Portland cement, and plaster), construction techniques, and structural characteristics of Guastavino vaults are discussed in Part Two (May). The last two parts (September and October) focus on the works of the Guastavino Fireproof Construction Company, established in 1889.

Prefabrication Systems

Bemis, Albert Farwell. *The Evolving House.* Vol. 3. Cambridge, MA: The Technology Press, Massachusetts Institute of Technology, 1933.

This volume describes a range of innovative construction systems for houses. Each system is explained in detail and also well illustrated with line drawings. Examples include the Armastone wall system, the Century House, the Fer-O-Con system, and the Masonite house.

Buell, Temple Hoyne. "Community Planning With Transportable Housing." *Architectural Record.* Vol. 75, No. 1 (January 1934), pp. 11-36.

Various prefabricated houses (complete with plans, details and illustrations) are described in this article. Included are the Buell Fabricated House System, the Stran Steel System, the Ferro Enamel House, the House of Tomorrow by George Keck, the Rostone House, the Vinylite House, and the One-Plus-Two Diatom House by Richard Neutra and Peter Pfisterer.

Davison, Robert L. "The Better Wall is Coming." *Architectural Record.* Vol. 100, No. 4 (October 1946), pp. 119-123.

In response to the need for economy of materials and construction, manufacturers developed new wall systems. The potential of materials such as Santocel, Cemesto board, honeycomb laminated panels, foam plastics, and metal panels is explored here.

"Door Manufacturers' Prefab House." *California Arts & Architecture.* Vol. 59, No. 11 (November 1942), p. 43.

The "speed-built" system, developed by Kim Weber of Los Angeles, was used in the construction of prefabricated houses in Washington. This article describes the process which includes the integration of plywood panels and stressed skin sheets. It uses prefabricated panels for the roof, floor, and walls.

"Factory-Produced Houses in the News." *Architectural Record.* Vol. 101, No. 1 (January 1947), pp. 103-104.

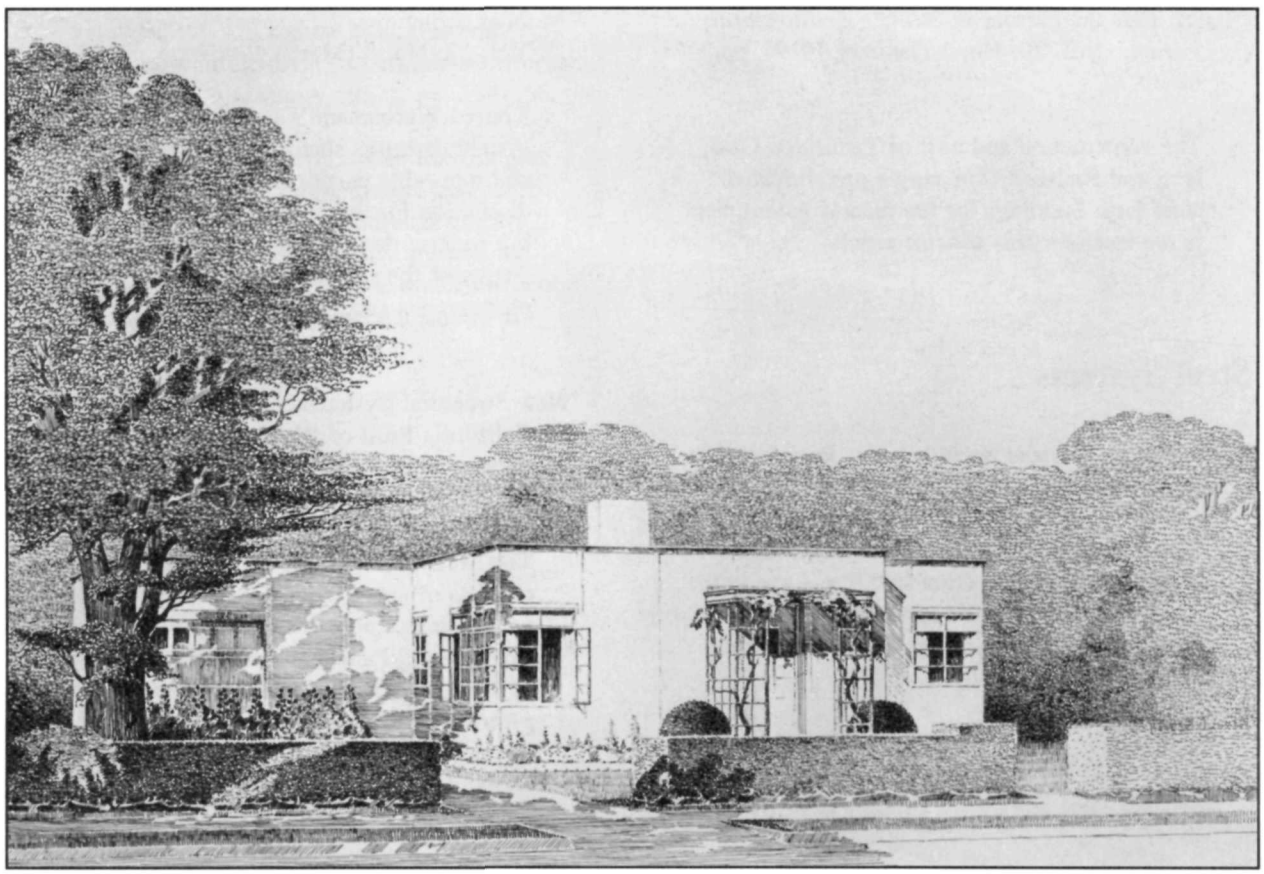
This article briefly reports on prefabricated and mass-produced houses such as the Lustron House, the B-16 House (insulated plywood panels), the Vultee House (aluminum and plastic), the Harman House (steel frame), and the HomeOla House (stressed-skin panels).

"Fifty Plywood-Panel Houses Built at the Rate of One a Day." *Architectural Record.* Vol. 85, No. 3 (March 1939), pp. 38-40.

This article describes a Federal Housing Administration project in Fort Wayne, Indiana involving plywood box beam panelled houses. The construction system is discussed and illustrated from its preliminary stages to roof installation.

Fouilhoux, J. Andre. "Prefabricated Units for the Home." *Architectural Forum.* Vol. 63, No. 6 (December 1935), pp. 544-576.

Drawings and explanations for a variety of prefabricated components, such as walls and



Rendering of a model home by General Houses, Inc. The company was founded in 1932 by architect/engineer Howard T. Fisher whose concept for prefabricated housing utilized a production process based on the production of automobiles. Standardized building elements such as four foot wide exterior wall panels comprised of sheet steel and rock wool bat insulation; full-length double-glazed windows; interior partitions; and floor, ceiling and roof panels were fabricated in various factories and bolted together on site in a variety of designs. Photo courtesy H. Ward Jandl.

floors, are given in this article. It concludes with a summary of the current and future uses of synthetic finishes, wood, steel, and concrete.

Luce, Albert W. "Pre-fabricated Brick Slabs Offer House for $5,000 Cost Level." *Brick and Clay Record.* Vol. 90, No. 5 (May 1937), pp. 284-286.

Luce describes a residential building system that uses a reinforced brick slab, four-inch load-bearing walls and brick partition walls built into prefabricated panels on site. Construction instructions and specifications are included, as well as many photographs. The system was first introduced at the Chicago "Century of Progress" exhibition in 1937.

"Steel-Panel Prefabricated Farm Buildings Erected in the South." *Architectural Record.* Vol. 85, No. 1 (January 1939), pp. 38-39.

This article describes and illustrates Farm Security Administration prefabricated steel farmstead units. Each building's foundation, frame, sides, roof, exterior door, window trim, and fireplace is composed of steel. The article concludes with a discussion of labor and costs. This work serves as a introduction to pre-war prefabrication.

"T.C.I. Puts the Farmer in Steel." *Architectural Forum.* Vol. 70, No. 1 (January 1939), pp. 68-69.

The construction and cost of Tennessee Coal, Iron and Railroad Company's prefabricated steel farm buildings for the federal government is the basis for this concise article.

Steel Systems

Drew, Philip. *Tensile Architecture.* Boulder, CO: Westview Press, 1979.

This book covers the history and development of tensile structures, from traditional use in the suspension bridge to its application in modern architecture. Photographs, drawings, and a bibliography are included.

"A House With No Bearing Walls." *Architectural Record.* Vol. 93, No. 3 (March 1943), pp. 46-47.

An experimental system consisting of pipe columns and steel beams provides an opportunity for flexibility of interior space and a curtain wall exterior. This system is characterized by a reduced initial cost, low maintenance, ease and speed of erection, and possibilities for prefabrication. Photographs, floor plans, and construction details are included.

Lopez, Frank. "Mass Production + Light Steel: The Quonset Hut, a Working Example." *Progressive Architecture.* Vol. 28, No. 3 (September 1947), pp. 71-75.

Lopez describes the manufacturing of the quonset hut by the Stran-Steel Company. The use of the Quonset as housing and factory stock is discussed, and model specifications are given. Many detailed construction diagrams and photographs are included.

"Mobilar Structures." *Progressive Architecture.* Vol. 27, No. 3 (March 1946), pp. 87-99.

Konrad Wachsmann's invention of a structural system that uses standardized tubular members and moveable partitions is the basis of discussion for this article. This is an extensive but concise description of the construction and design of the system complete with photographs and line drawings.

"New Structural Systems: Church in Southern California Built of Welded Steel Rods." *Architectural Record.* Vol. 84, No. 5 (November 1938), p. 60.

The McLellan steel frame construction system consists of small, round steel rods which are welded into a network creating walls, roof and floor joists. Panels are electric welded as a covering and metal lath is stitched to the frame prior to the application of concrete. The structure is claimed to be resistant to fires, earthquakes, and termites.

"Quonset Huts Are Back from the War." *Architectural Record.* Vol. 101, No. 1 (January 1947), p. 102.

This brief article on the varied uses of Quonset Huts with reference to the Great Lakes Steel Corporation is accompanied by black and white photographs.

"Quonsets Turn to Civilian Life." *Interiors.* Vol. 105, No. 2 (February 1946), pp. 92-93.

When the Quonset hut returned to America after World War II, it rapidly gained acceptance as building stock. Its prefabricated modular system made it easy to build at a low cost. This article describes the use of this building system in post-war America. Construction details and photographs are included.

"Wartime Quonset to Produce Factories and Warehouses in a Hurry." *Architectural Forum.* Vol. 96, No. 1 (January 1952), pp. 154-156.

This article discusses the use of the Quonset hut as a modular building system that can be combined to create large buildings quickly. These buildings can be rapidly erected and used as factories and warehouses. Construction diagrams, photographs and case studies are included.

Additional Resources

Centers of Research

American Institute of Architects
AIA Archives
1735 New York Avenue, NW
Washington, DC 20006

Avery Architectural and Fine Arts Library
200 Avery
Columbia University
New York NY 10027

Library of Congress
101 Independence Avenue, S.E.
Washington, DC 20540

National Trust for Historic Preservation Library
McKeldin Library
University of Maryland
Architecture Building
College Park, MD 20742

Periodicals

Architectural Record
McGraw-Hill Information Systems Company
1221 Avenue of the Americas
New York, NY 10020

Architectural Technology
1130 Connecticut Avenue, N.W., Suite 625
Washington, DC 20036

Architecture
BPI Communications
1515 Broadway
New York, NY 10036

Building Design and Construction
Cahners Publishing
1350 East Touhy Avenue
P.O. Box 5080
Des Plaines, IL 60018

The Bulletin
Association for Preservation Technology
International
P. O. Box 8178
Fredericksburg, VA 22404

The Construction Specifier
Construction Specifications Institute
601 Madison Street
Alexandria, VA 22314-1791

CRM Bulletin
US Department of the Interior
National Park Service
Cultural Resources
P. O. Box 37127
Washington, DC 20013-7127

Historic Preservation
National Trust for Historic Preservation
1785 Massachusetts Avenue, N.W.
Washington, DC 20036

Journal of the Society of Architectural Historians
1232 Pine Street
Philadelpia, PA 19107

Metal Architecture
7450 North Skokie Boulevard
Skokie, IL 60077

Modern Metals
Trend Publishing
625 North Michigan Avenue, Suite 2500
Chicago, IL 60611

The Old House Journal and
The Old House Journal Catalog
2 Main Street
Gloucester, MA 01930

Preservation News
National Trust for Historic Preservation
1785 Massachusetts Avenue, N.W.
Washington, DC 20036

Progressive Architecture
600 Summer Street
P.O. Box 1361
Stamford CT 06904

Preservation Organizations

Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, Suite 809
Washington, DC 20004

American Association for State and Local History
530 Church Street, Suite 600
Nashville, TN 37219

Association for Preservation Technology International
P. O. Box 8178
Fredericksburg, VA 22404

Council on America's Military Past
P. O. Box 1151
Fort Myer, VA 22211

Friends of Terra Cotta
c/o Susan Tunick
771 West End Avenue, 10E
New York, NY 10025

National Trust for Historic Preservation
1785 Massachusetts Avenue, N.W.
Washington, DC 20036

Society of Architectural Historians
1232 Pine Street
Philadelpia, PA 19107

Vernacular Architecture Forum
c/o Michael Ann Williams
Programs in Folk Studies/MLIS
Western Kentucky University
Bowling Green, KY 42101

Professional and Trade Organizations

General

American Architectural Manufacturers Association
1540 E. Dundee Road, Suite 310
Palatine, IL 60067

American Council of Independent Laboratories
1629 K Street, N.W., Suite 400
Washington, DC 20006

American Institute of Architects
1735 New York Avenue, N.W.
Washington, DC 20006

American National Standards Institute
11 W. 42nd Street
New York, NY 10036

Associated Builders and Contractors
1300 N. 17th Street, 8th Floor
Rosslyn, VA 22209

Associated General Contractors of America
1957 E Street, N.W.
Washington, DC 20006

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103-1187

Construction Industry Manufacturers Association
111 E. Wisconsin Avenue, Suite 940
Milwaukee, WI 53202

Materials and Methods Standards Association
614 Monroe Street
Grand Haven, MI 49417

Wood

American Institute of Timber Construction
11818 S.E. Mill Plain Boulevard, Suite 407
Vancouver, WA 98684

American Plywood Association
P.O. Box 11700
Tacoma, WA 98411

American Wood Preservers' Institute
1945 Old Gallows Road, Suite 150
Vienna, VA 22182

Architectural Woodwork Institute
P.O. Box 1550
Centreville, VA 22020

Forest Products Laboratory
U.S. Department of Agriculture
1 Gifford Pinchot Drive
Madison, WI 53705-2398

National Forest Products Association
1250 Connecticut Avenue, N.W., Suite 200
Washington, DC 20036

Western Wood Products Association
522 S.W. 5th Avenue
Yeon Building
Portland, OR 97204

Masonry

Brick Institute of America
11490 Commerce Park Drive
Reston, VA 22091

Advertisement for *Flexglass*, an early 20th century real-glass material that was easily glued to any surface, and came in four types: opaque, rolled pattern mirror, metallic, and flat mirror.

Masonry Institute of America
2550 Beverly Boulevard
Los Angeles, CA 90057

Tile Heritage Foundation
P.O. Box 1850
Healdsburg, CA 95448

Concrete

American Concrete Institute
P. O. Box 19150
22400 Seven Mile
Detroit, MI 48219

Concrete Reinforcing Steel Institute
933 N. Plum Grove Road
Chaunburk, IL 60173-4758

National Precast Concrete Association
10333 N. Meridian, Suite 272
Indianapolis, IN 46290

Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077-1083

Prestressed Concrete Institute
175 W. Jackson Boulevard
Chicago, IL 60604

Metal

Aluminum Association
900 19th Street, N.W., Suite 300
Washington, DC 20006

American Institute of Steel Construction
1 E. Wacker Drive, Suite 3100
Chicago, IL 60601-2001

American Iron and Steel Institute
1101 17th N.W., Suite 1300
Washington, DC 20036-4700

American Society for Metals
Materials Park, OH 44073

Copper Development Association
260 Madison Avenue, 16th Floor
New York, NY 10016

Ferroalloys Association
900 2nd Street, N.E., Suite 306
Washington, DC 20002

Lead Industries Association
295 Madison Avenue
New York, NY 10017

Metal Construction Association
1101 14th Street, N.W., Suite 1100
Washington, DC 20005

National Association of Architectural Metal Manufacturers
600 S. Federal Street, Suite 400
Chicago, IL 60605

Glass

Flat Glass Marketing Association
3310 SW. Harrison Street
Topeka, KS 66611-2279

Glass Tempering Association
3310 SW. Harrison Street
Topeka, KS 66611-2279

Insulating Glass Certification Council
3933 U.S. Route 11
Cortland, NY 13045

National Glass Association
8200 Greensboro Drive
McLean, VA 22102-3881

Asphalt Institute
Asphalt Institute Building
College Park, MD 20740

Rubber Manufacturers' Association
1400 K Street, N.W.
Washington, DC 20005

Society of Plastics Industry
355 Lexington Avenue
New York, NY 10017

Wallboard, Stucco, and Plaster

Plastering Information Bureau
21243 Ventura Boulevard, Suite 115
Woodland Hills, CA 91364

United States Gypsum Association
125 S. Franklin St.
Chicago, IL 60606

Wall Coverings and Coatings

National Paint and Coatings
1500 Rhode Island Avenue, N.W.
Washington, DC 20005

Government Agencies

Federal Housing Administration
U.S. Department of Housing and Urban Development
451 7th Street, S.W., Room 915B
Washington, DC 20410

General Services Administration
General Services Building
18th and F Streets, N.W.
Washington, DC 20405

U.S. Department of the Interior
National Park Service
Preservation Assistance Division
P.O. Box 37127
Washington, DC 20013-7127

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