ENCYCLOPEDIA OF AMERICAN ARCHITECTURE

Encyclopedia of American Architecture

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McGRAW-HILL BOOK COMPANY

New York St. Louis San Francisco Auckland Bogotá
Hamburg Johannesburg London Madrid Mexico
Montreal New Delhi Panama Paris São Paulo
Singapore Sydney Tokyo Toronto

Library of Congress Cataloging in Publication Data

Hunt, William Dudley.
Encyclopedia of American architecture.

Includes index.
1. Architecture—United States—Dictionaries.
I. Title.
NA705.H86 720'.973 80-11589
ISBN 0-07-031299-0

1234567890 HDHD 89876543210

The editors for this book were Thomas H. Quinn and Margaret Lamb, the designer was Naomi Auerbach, and the production supervisor was Paul A. Malchow. It was set in Optima Medium by The Clarinda Company.

Printed and bound by Halliday Lithograph.

Contents

Preface

This book presents, in words and pictures, the vast breadth of American architecture. It is intended to be of interest and use to people who want to know about the culture and the environment in which they live and how it came to be that way. Students of all ages, people who own or will some day own buildings, those who occupy and use buildings, those interested in history or the contemporary scene all should find information of interest and value. The book is also intended for those who must know about architecture: architects, landscape architects, engineers, interior designers, city planners, building owners and developers, real estate people, artists, contractors, construction financiers, conservationists, furniture designers, product manufacturers, government officials, and building managers. For such people, the articles on their own specialties may seem elementary, but those on the many other subjects should be useful.

In any work of this sort, there are obvious limitations. A whole library would be required to contain relatively complete information on all the elements involved in American architecture. In a single book, choices and compromises must be made, and this is certainly true of the present volume. The professional language of architecture also presents problems. The semantics are dealt with by using the proper specialized terms, but always defining them at the same time in everyday language.

In this book, an attempt has been made to discuss all the major elements of American architecture in enough depth to explain the general facts and principles of each, but not to become so complete or technical that only experts would require or understand so much information. The purpose is to inform the reader, not to be obscure.

Another important decision about the organization of this book involved methods for handling the participation in architecture of women, as well as minority and other special groups of people. Serious consideration was given to some special groups of people. Serious consideration was given to some special emphasis in the book, for example, a separate article on women in architecture. The final decision was based on the simple conviction that accomplishment in architecture today is not limited by sex, skin color, place of birth or aspects of that sort. The real limits are those of talent, training, knowledge, skills, and the will to work, and are therefore applicable to all people, regardless of sex, color, or other such attributes.

Therefore women and members of minority and special groups have been included in articles of this book wherever they have been found to have made notable accomplishments in architecture. That their numbers included here are relatively small reflects social conditions of the past. In the future, their numbers can confidently be expected to increase radically.

Although an attempt has been made to make the book as complete, interesting, and useful as possible, it is a foregone conclusion that such a broad, large, general work will have imperfections. For example, while the work of a very large number of architects and other environmental designers is discussed or illustrated, major articles are included on the lives and work of only about 50 architects, considered the most important in American history. Only a few living architects are the subjects of individual articles, most of them retired or nearing the end of their careers. The major deterrent to the selection of other living architects was the extreme difficulty of understanding and evaluating current work. To have the proper perspective of current architecture, while standing so close to it, seems to be almost impossible for most people, the author included. Another author might have handled this problem differently and might have selected some architects not included here.

Other articles in this book discuss various major aspects of architecture, including building types, systems, materials, structures, and the like; periods or movements in American architecture; the environment design professions and the building industry; and architectural practice. Another author might have chosen to eliminate some of the articles included here, substitute others, shorten or lengthen still others. The articles that are included were selected and their lengths and depths of coverage determined, only after many hours of thought, discussion, and study of their appropriateness to understanding American architecture and their value to those who want or need to know about it. The articles are as factual, straightforward, and objective as it was possible to make them.

The overall organization of the book was chosen to make it as useful as possible to readers. There are 202 articles, arranged alphabetically. The articles are as broad in scope as seemed feasible and their titles are as generic as possible. Articles may be classified into seven major categories: individual architects and firms; the building industry; building types; components and systems of buildings; history of architec-

ture; materials of construction; and practice of architecture. A large number of miscellaneous articles are also included that do not fit neatly in such categories.

Generally, each article begins with a definition of its title, discusses principles of the subject and other important aspects, and then proceeds to the history or biography of the subject. Technical or professional terms are defined at the places at which they are first used. The articles also include cross-references to others that are closely related.

At the end of articles, guidelines to further related information are included: other articles in this book; other books containing information on the subjects; magazines and other publications; and associations, organizations, or other sources. A large number of photographs, drawings, tables, and charts contribute to the understanding of the text of the articles. The very complete and detailed index is an important and useful guide to information contained in the book on thousands of architectural and related subjects.

This book took six years to research and write. In the course of the work, some 8,000 architectural and related terms were collected and analyzed and over 1,000 books were consulted, along with a great many magazine articles and other data. Perhaps the most important source of information and inspiration was the great number of friends, acquaintances, and other people who gave their time, talents, and knowledge in order to help the book become a reality. While a list of all of them is not possible, some must be mentioned, including Allen Freeman, managing editor of the *AIA Journal;* Harold Hauf, FAIA, architect and educator; Blake Hughes, publisher of *Architectural Record;* Douglas Haskell, FAIA, former editor of *Architectural Forum;* Robert Packard, AIA, architect and editor of the seventh edition of the AIA/Ramsey and Sleeper *Architectural Graphic Standards;* and architects Hugh Stubbins, FAIA, Merle Westlake, AIA, and Stephen Jacobs, AIA. All helped a great deal.

Then there are a number of people without whom the book could not have been written, even in six years. They include Susan Cosgrove Holton and Stephanie C. Byrnes of the AIA Library; Mary E. Fenelon, who did a masterful job of reading and typing the final manuscript; and my wife, Gwen Munson Hunt, who not only was able to live with the typing of an intermediate draft from an incredibly marked-up earlier draft, but also has managed to stay on speaking terms with the author.

The photographers' credits in the book comprise a blue-ribbon list of a great many of the best architectural photographers in the United States. Their help is appreciated and special mention must be made for that of Jack Hedrich of Hedrich-Blessing.

Credit must also be given to editor Thomas H. Quinn, editing supervisor Margaret Lamb, production supervisor Paul Malchow, and designer Naomi Auerbach for talented and efficient editing, design, and production of the book.

Finally, there is a small group of people whose help was absolutely essential in the preparation of this book, the consulting editors, who did research, gave counsel, read manuscripts, and did other invaluable services. They are Mary E. Osman, senior editor, the *AIA Journal;* Caleb Hornbostel, architect and educator; and Joseph W. Molitor, architectural photographer and architect.

The writing involved a long and arduous struggle to achieve a book that, though inevitably imperfect, will be of interest and value to its readers and bring with it some degree of understanding the culture and architecture of America. If so, the book will have served its intended purpose.

The writing of the book has been an interesting and gratifying experience, accomplished in spite of the need for carrying on other editorial work at the same time and in spite of the fact that the window in front of the author, when seated at his typewriter, overlooks the North River leading to the Chesapeake Bay, in Tidewater Virginia, and then to all the seas and oceans of the world.

William Dudley Hunt, Jr.

A

AIRPORT An architectural complex consisting of runways, buildings, and related facilities for the takeoff, landing, and handling of airplanes and other aircraft and their crews, passengers, and cargoes.

Types There are three major types of airports: air carrier, general aviation, and military. Air carrier airports are designed for use by scheduled airlines. General aviation airports are for all types of civilian aircraft, except those of the airlines. Business, pleasure, and charter aircraft use general aviation airports, as do air taxis that fly to air carrier airports and between small towns. Facilities for general aviation are also provided at air carrier airports, often in buildings separated from the passenger terminals. Military airports are for the armed services, including the U.S. Air Force, Army, Navy, and Marines. They are also used by Reserve and National Guard units of the services. The major military airports are operated by the armed services, but facilities at commercial airports are sometimes used.

Air carrier airports serve various kinds of airlines, classified according to the areas served. Regional airlines serve regions such as the Southeastern or Northeastern United States. Trunk airlines serve larger areas, such as all the Eastern states. International airlines fly between countries.

General aviation airports are classified into basic utility for small airplanes, general utility for larger propeller airplanes, basic transport for small jets, and general transport for larger jets. Special types of general aviation airports are heliports for helicopters, which can land in small areas, including the tops of buildings; and the seaplane bases for seaplanes and amphibians, which can land on both land and water. In later years, short takeoff and landing (STOL) aircraft and vertical takeoff and landing (VTOL) aircraft have been developed. If they should come into widespread use, special airports may be provided for them.

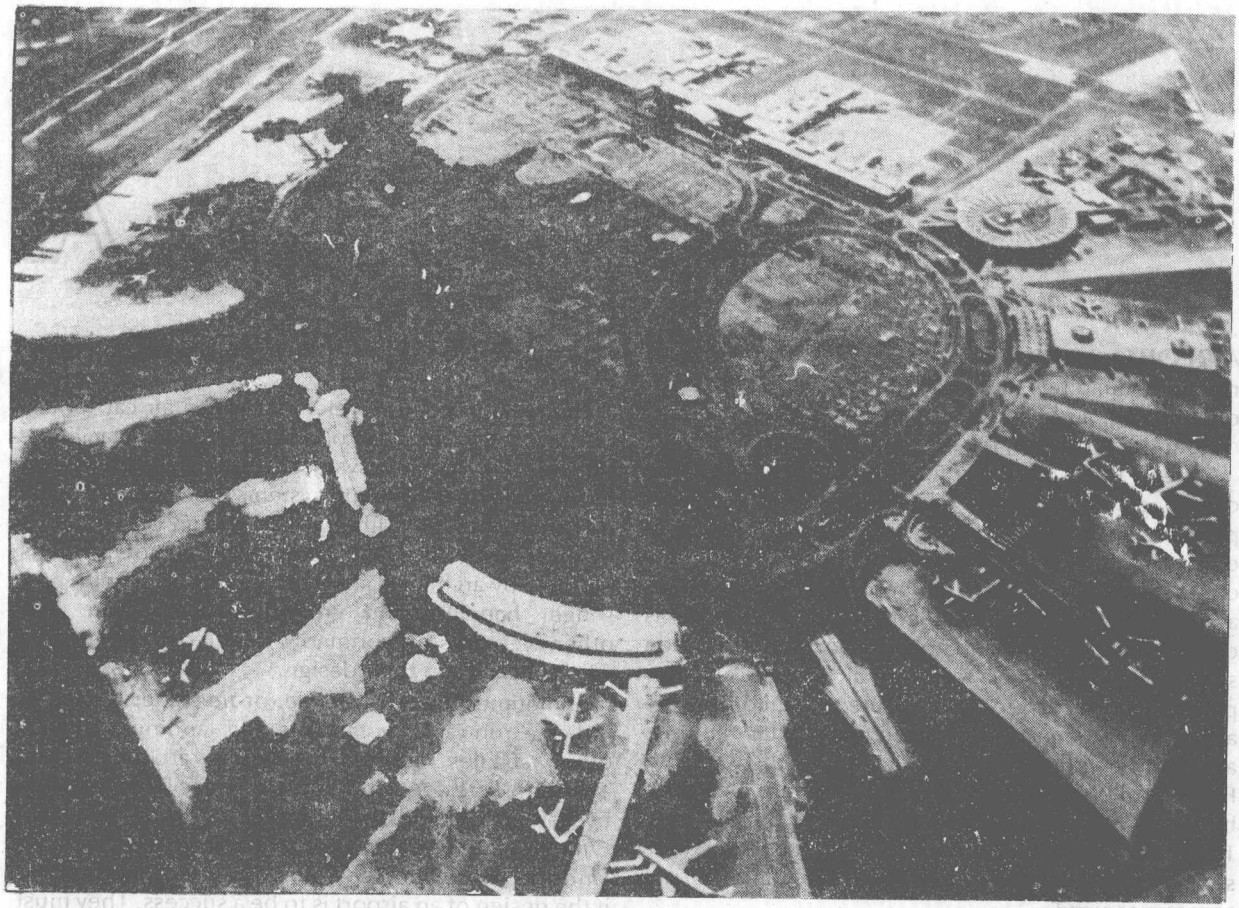
In the United States, there are over 12,000 airports, most of which are relatively small. Only about 1,000 can be used by aircraft that carry 20 or more passengers. And only slightly over 500 are used by scheduled airlines. While very few new airports are being built, continuing changes in aircraft and increases in their size, range, speed, and numbers cause existing airports to become obsolescent much faster than most other building types. Their modernization and replacement, therefore, and the design of a few new ones make airports not only an important building type but one that is interesting and challenging to architects.

Elements The major elements of an air carrier airport are air-traffic control and navigational facilities, runway and taxiway system, ground handling systems, passenger handling systems, and ground transportation systems. Although the design of airports is involved with all these systems, the major portions handled by architects are those having to do with passenger handling and ground transportation. The other elements are primarily handled by engineers who specialize in their design.

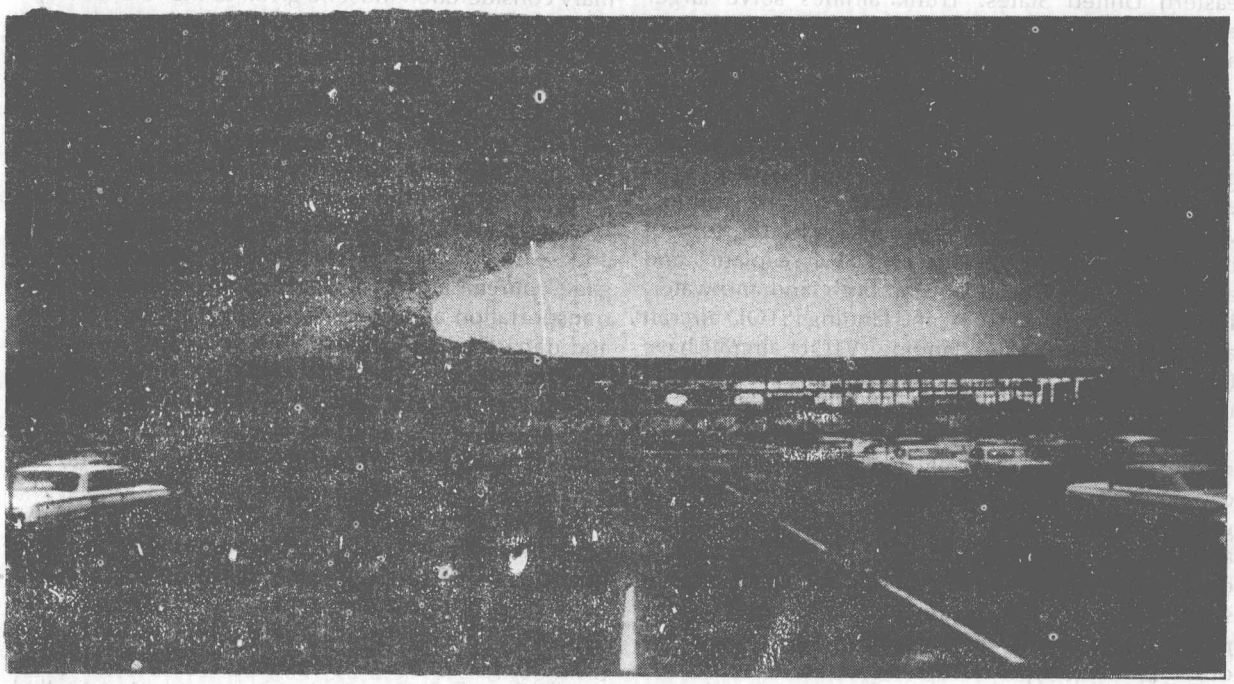
Sometimes the term *airside,* or *fieldside,* is used to indicate runways for takeoffs and landings, and for other facilities required by the aircraft themselves. The term *landside* is often used for facilities required by passengers and their luggage, freight, and mail. Often engineers design the airside and architects the landside. However, they must work closely together if the design of an airport is to be a success. They must also work with the airlines, often called the carriers, and with those who will operate the airport.

Design In the design of an air carrier airport, primary consideration must be given to the relationships between the apron, the terminal, and ground transportation. The apron is the area between the airside, or runway-taxiway, part of the airport and the terminal, the building in which the requirements of passengers and other functions are handled. On the apron, aircraft arrive and depart, load and unload, at connections with the terminal called gates, and here the aircraft are serviced with fuel, passenger meals, and so on. In the terminal, passengers check baggage, purchase tickets, and so on. In the ground transportation area, provisions are made for arriving and departing passengers, sometimes called *deplaning* and *enplaning* passengers, to reach the terminal by automobile, limousine, bus, taxicab, or on foot. Parking lots and sometimes garages are provided for short-term and long-term parking by passengers, visitors, and employees.

At the junction of the apron with the terminal, the gates allow passengers to *enplane* or *deplane,* or to board or depart from the aircraft. There are four major methods of providing gates. The simplest, used at small terminals, is the linear method in which the gates are placed on the side of the terminal facing the apron. For larger terminals, piers, sometimes called fingers, project from the terminal proper and aircraft



AIRPORT Separate Terminal Buildings, John F. Kennedy International (1942–62, with some buildings later), New York, N.Y. [*Consulting architect: Wallace K. Harrison. Architects of terminals: International Arrivals Building (1957), Skidmore, Owings and Merrill; Pan American (1961), Tibbetts, Abbett, McCarthy and Stratton; Trans World (1960), Eero Saarinen; Domestic Arrivals (1969), I. M. Pei; Northwest (1962), White and Mariani; Eastern (1959), Chester L. Churchill; American (1960), Kahn and Jacobs; United (1961), Skidmore, Owings, and Merrill.*]



AIRPORT Centralized Terminal Buildings, O'Hare International (1963), Chicago, Ill. [*Architects: C. F. Murphy Assoc. (Hedrich-Blessing)*]

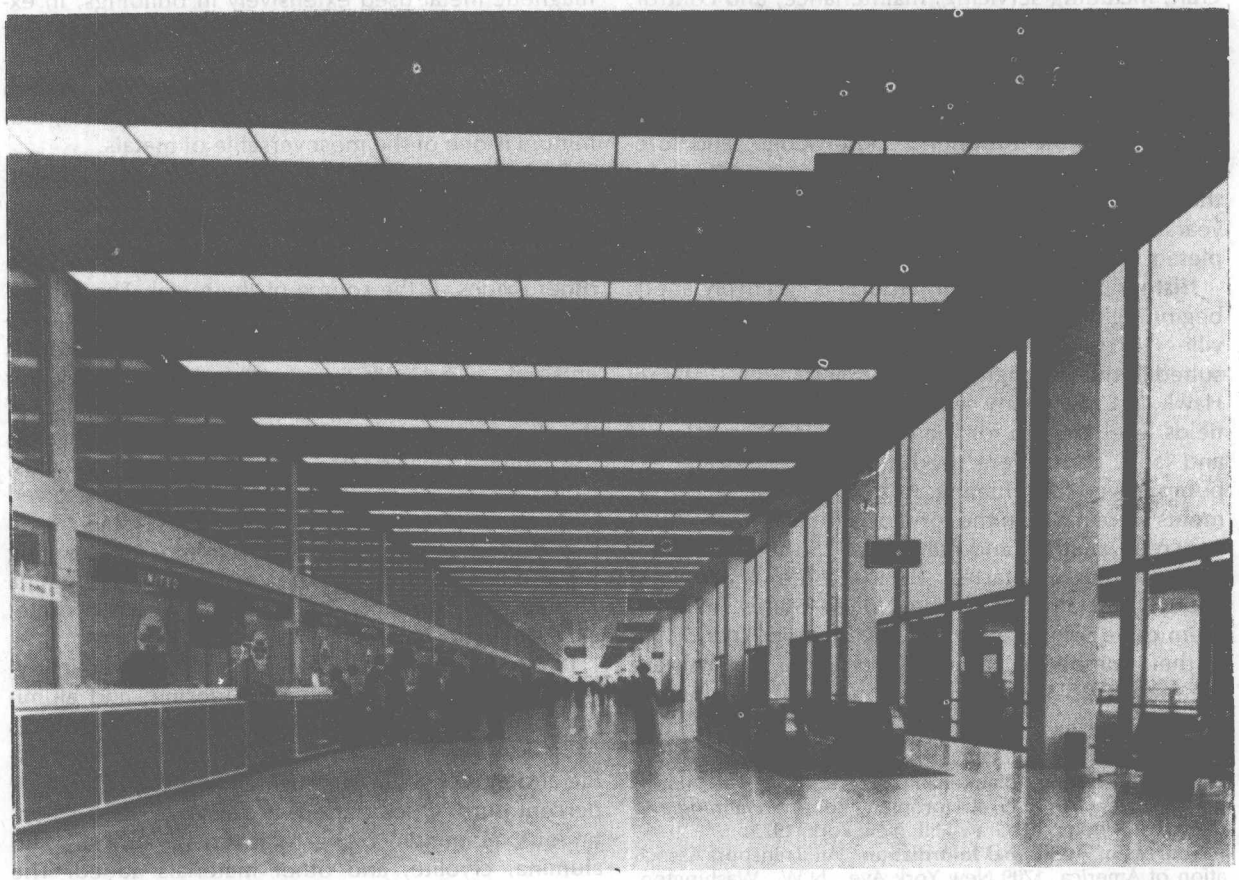
are parked alongside; the third method uses satellite buildings which are smaller elements located away from the main terminal and connected to it with corridors or concourses. The fourth type, not used to any great extent so far, is the transporter method, which utilizes mobile lounges. In this case, aircraft are parked at some distance from the terminal and passengers transported to and from them in vehicles that resemble buses, which can be driven in either direction and have special provisions for connecting with both the aircraft and the terminal building.

The Terminal In some air carrier airports, a single terminal building is used by all the airlines. In other airports, there may be a group of terminal buildings, each used by one or more airlines. In any terminal, there are several kinds of space: passenger and public areas; management offices; areas used by the airlines; special facilities such as the control tower, from which aircraft air and ground traffic are directed, a weather station, and, for international airports, customs, health, and immigration services.

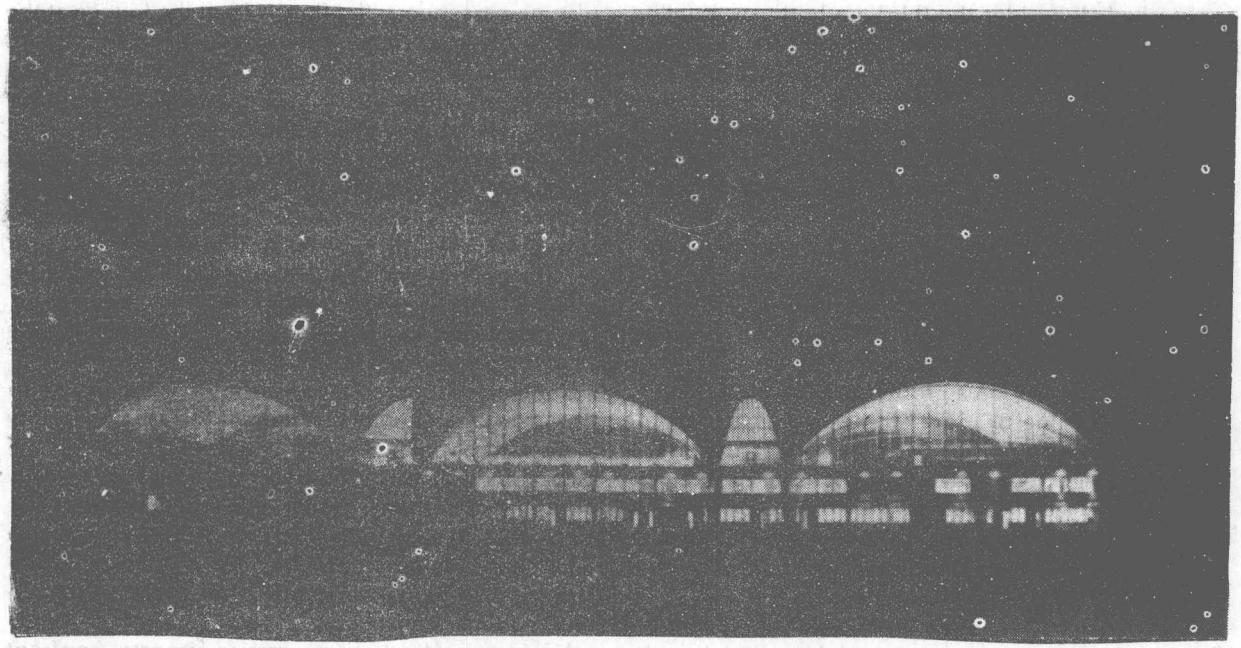
In any terminal, an important design problem is the flow of passengers from ground transportation to baggage check-in to ticket counters to the departure lounge at the gate. In recent years, this flow has become even more complicated by the need for security checks to prevent hijacking and other threats. For *deplaning* passengers, the flow is from the lounge at the gate to baggage claim and to ground transportation. In addition, most airports make provisions for many other needs and wishes of passengers and visitors, including rest rooms, newsstands, restaurants, bars and lounges, banks, shops, and in some cases even hotels and motion picture houses. Freight, or air cargo, including mail, is often handled along with passenger luggage at small airports. In larger ones, special provisions must be made, including separate terminals designed specifically for freight. At almost all airports, except the very smallest, hangars are provided for the maintenance of aircraft.

General aviation, whether located at an air carrier airport or at a general aviation airport, utilizes many of the same elements as the air carriers, runways, taxiways, and so on. However, runways are usually shorter and terminal provisions much simpler. For these purposes, an individual or organization called a "fixed base operator" provides flight and weather information, fuel, hangars and tie-down space for aircraft, and maintenance.

Airports, particularly air carrier airports, confront architects and engineers with very complex design problems. Because of the interrelationships between the complicated requirements of the airlines, management, passengers, and visitors; and the extremely



AIRPORT Interior, O'Hare International Airport (1963), Chicago, Ill. [*Architects: C. F. Murphy Assoc. (Hedrich-Blessing)*]



AIRPORT Centralized Terminal Building, Lambert–St. Louis (1956), with later additions), St. Louis, Mo. [*Architects: Hellmuth, Yamasaki and Leinweber; additions: Hellmuth, Obata and Kassabaum. (Hedrich-Blessing)*]

high degree of technological requirements of the aircraft, including servicing, maintenance, and control; the need for safety and security; and the great and growing number of people using airlines; the design of airports has become highly specialized. Most airport design is therefore handled by architects and engineers with the experience, knowledge, and foresight to design facilities that will function properly for the aircraft and the people who will use them some 10 years later, when their construction has been completed.

History The history of airports is relatively short, beginning with the work of the Wright brothers, Orville (1871–1948) and Wilbur (1867–1912), that resulted in the first flight on December 17, 1903, at Kitty Hawk, N.C. For many years, airports were pastures or fields level enough for the early airplanes to take off and land. Barns were used as hangars and any gas pump served for refueling. As time went on, improvements were made in the form of dirt (later asphalt and concrete) airstrips and mats. In 1925 the first scheduled airline was started. By that time, there were about 1,000 airports in the United States, most of them quite primitive. By the beginning of World War II, their number had more than doubled. Today there are more than 12,000 U.S. airports and their number is still growing.

Related Articles GARAGE; ROAD AND TRAFFIC DESIGN.

Further Reading Blankenship, Edward G.: *The Aiport,* Praeger, New York, 1974, Horonjeff, Robert: *Planning and Design of Aiports,* McGraw-Hill, New York, 1975.

Sources of Additional Information Air Transport Association of America, 1709 New York Ave., N.W., Washington, D.C. 20006; Aircraft Owners and Pilots Assoc., 7315 Wisconsin Ave., Bethesda, Md. 20014

ALUMINUM A lightweight, silvery-colored, nonmagnetic metal used extensively in buildings, in extruded, forged, stamped, rolled, and cast form, for windows, doors, roofing, wall covering, wiring, hardware, and a host of other purposes. Called aluminium in England, Canada, and some other countries, aluminum is one of the most versatile of metals.

Extraction Aluminum is a very abundant element, occurring in almost all soils and rocks, but only in compounds, not as a native metal. Bauxite ore, composed primarily of alumina, or aluminum oxide, and other oxides, is the source of the metal. The separation of aluminum from the other materials in bauxite ore is a two-stage process. In the first stage, bauxite is crushed, mixed with lime, soda ash, and hot water and pumped into digester tanks. There the action of the chemicals and the introduction of steam dissolves the alumina, leaving the other materials as solids, which are filtered out. In a precipitator, the dissolved alumina cools and precipitates into crystals, from which the water is removed in a rotary kiln, leaving pure alumina. During the process the alumina changes into sodium aluminate, aluminum hydrate, and back into alumina.

In the second stage, the alumina is dissolved in cryolite, a compound of sodium, fluorine, and aluminum, in an electrolytic cell, through which current is passed to break down the alumina into carbon dioxide and molten aluminum, which is approximately 99 percent pure. Once started, the second stage is continuous, aluminum being removed periodically and alumina, cryolite, and other materials added. The molten aluminum is siphoned off into large ladles and either poured directly into molds to form pigs weigh-

ing 50 pounds each or fluxed, skimmed, and cast into ingots. For most architectural uses, pig or ingot aluminum is remelted and alloyed before further processing into various products.

Properties Among the properties of aluminum that make it so important in architecture are its lightness, about one-third that of other common metals, and its easy workability by most methods, including, most importantly, extrusion, a process involving drawing the metal through dies to produce shapes. Other properties include resistance to corrosion through the formation of aluminum oxide on the surface which then resists further deterioration, relatively high conduction of both heat and electricity, and reflection qualities. Aluminum is nonpoisonous and nonflammable, though it does have a relatively low melting point. While pure aluminum is soft and has relatively low strength, both properties may be improved considerably by proper alloying and various metalworking techniques.

Aluminum for use in architecture may be obtained in bars, rods, wire, cable, plate, sheet, foil, pipe, and structural shapes, and in complete products such as nails, rivets, hardware, windows, doors, and many others. Such products may be made by all the major production methods: forging, casting, extrusion, pressing, molding, stamping, cold or hot rolling, and so on. Aluminum may be fastened in many ways such as nailing, riveting, welding, brazing, and soldering, and adhesion with glues or other adhesives.

Alloys Aluminum alloys are available in great variety. Among the major metals with which aluminum is alloyed are copper, manganese, silicon, magnesium, and zinc. Among the large number of alloys are types suitable for a host of architectural purposes. Special alloys are available for producing plate, sheet, and other shapes by rolling—forcing hot metal between rollers; others are for extrusion—forcing hot metal through dies; others are made for casting—pouring the molten metal into molds made of sand, cast iron, or steel; and still others for forging—utilizing forging presses or hammers to form the metal. The choice of an alloy for a specific architectural purpose is heavily dependent on the forming method to be used.

The choice of an alloy for a specific architectural purpose is also dependent on the function to be served. For example, the alloys used most often for structural members are usually quite different from those used for other purposes. Aluminum structural members are often alloys with copper or with a combination of magnesium and silicon, while hardware is often made of alloys with magnesium alone. Aluminum manufacturers and suppliers furnish information on the various alloys and their uses.

Aluminum is widely used without the addition of finishes, other than various surface textures. Many people find the natural color pleasing and, under most conditions other than near bodies of salt water, the metal is resistant to corrosion. However, aluminum may also be finished with a number of materials, including wax, plastic coating, paint, plating of other metals, and porcelain enamel. By making a selection from the types of finishes available, it is possible to obtain aluminum in plain, textured, highly polished, or matte finishes, exposing the color of the natural metal or in a variety of colors. A most important aluminum finishing method is called anodizing. This is an electrolytic process which builds up a clear protective coating of aluminum oxide on the surface of the metal. The color of anodized aluminum depends on the alloy used and includes a range of grays. Color anodizing produces a range of colors in the aluminum oxide coating by means of dyes or by adding various metals in small quantities.

Architectural Products Any list of architectural products made of aluminum would be a very long one. Among the major products are structural members, including beams, tees, angles, channels, zees, and square, rectangular, and round pipe; roofing and siding, including flat, corrugated, and other shapes; roofing, including crimped, shingles, and others; flashing, copings, gravel stops, gutters, and downspouts, or leaders; windows and doors; curtain walls and storefronts; railings, grilles, stair treads, and fences; insect screens; ceiling products; movable partitions; heating and air-conditioning ducts; hardware; and others. Such products come in a great variety of sizes, alloys, finishes, and colors. Aluminum is also used for wiring and, in the form of foil, for insulation and vapor barriers and under plastic laminated materials for countertops to make them resistant to heat, including damage from cigarettes. Powdered aluminum, actually miniscule flakes, is sometimes used in paints.

Aluminum appeals to architects as a material because of its inherent characteristics and properties and for its versatility. Particularly appealing is the ease of extrusion of the metal, using low-cost dies that make special applications economically feasible that might not be if other metals were used. Also of appeal is the variety of surface textures, as well as the great number of colors, available through color anodizing at relatively low costs.

When selecting products of aluminum, architects and other environmental designers should make sure the proper alloys, forming methods, and finishes are used for the specific purposes intended. Designing special products or usages of aluminum requires considerable knowledge of its properties and characteristics, and those of its alloys, and its fabrication and finishing. When designing structures of aluminum, careful attention must be paid to the properties and characteristics of aluminum that are quite different from those of other structural materials.

History Although natural compounds containing aluminum were used for various purposes in ancient times, the metal itself was not separated from the compounds until the 19th century. And aluminum did not make its appearance in architecture until the late 19th century, making it one of the very few really

ALUMINUM Alcoa Building (1952), Pittsburgh, Pa. [*Architects: Harrison and Abramovitz, in association with Mitchell and Ritchey and Altenhof and Brown.*] (*Richard Wurts*)

modern building materials. The discovery of aluminum and its later extraction and development was an international effort.

In 1809 the English chemist Sir Humphry Davy (1778–1829) first demonstrated that alum contained an unknown metal, which he named aluminum. The Danish physicist Hans Christian Oersted (1777–1851) produced the first aluminum powder in 1825. A German chemist, Friedrich Wöhler (1800–82), made the first aluminum particles in 1845 and discovered the properties of the metal, including its light weight. In 1854 a French chemist, Henri Étienne Sainte-Claire Deville (1818–81), developed a method for melting the particles to produce bars of the metal. In the same year a German chemist, Robert Wilhelm Bunsen (1811–99), accomplished the same feat. The new metal was then more costly than gold. Emperor Napoleon III (1808–73) of France had a set of aluminum tableware made for his most honored guests; his less important guests dined with gold and silver tableware.

In 1884 the first aluminum to be used in architecture was the 6-pound cap of the Washington Monument, Washington, D.C., designed by Robert Mills (1781–1855). The price of aluminum had come down from that of the time of Napoleon III, when it was about $550 per pound, to about $12, which was still too expensive for most uses. In 1886 the American chemist Charles Martin Hall (1863–1914) and the French metallurgist Paul Louis Toussaint Héroult (1863–1914) independently developed methods for the electrolytic production of aluminum, the basis of the methods still used today. Within six years, the price per pound had dropped to about 60 cents and the future of aluminum as a material for architectural and other purposes was ensured.

The major uses of aluminum in the early 20th century were for such purposes as cooking pots and pans and other small utensils and devices. The first structural uses were in dirigibles and these were followed by widespread uses in the aircraft industry. By the beginning of the second quarter of the 20th century, aluminum began to be used in buildings, on a somewhat tentative basis at first. As time went by, its use spread rapidly, not only to a great number of architectural elements, including curtain walls, but also to many other industries, including aircraft, automobiles, bridges, and others. Today aluminum is used in many ways in architecture and has become one of the most important materials.

Related Articles Various articles on structures, components, and systems in architecture.

Further Reading Peter, John: *Aluminum in Modern Architecture*, vol. 1, Reynolds Metals Company (distributed by Reinhold), Louisville, Ky., 1956; Weidlinger, Paul: *Aluminum in Modern Architecture—Engineering Design and Details*, vol. 2, Reynolds Metal Company (distributed by Reinhold), Louisville, Ky., 1956.

Sources of Additional Information Aluminum Assoc., 750 Third Ave., New York, N.Y. 10017; Architectural Aluminum Manufacturers Assoc., 35 E. Wacker Dr., Chicago, Ill. 60601.

APARTMENT Originally a dwelling room, now usually a group of rooms used as a dwelling, or an apartment building or apartment house which contains a number of such groups of rooms. Apartment buildings assumed importance in the United States as cities became more crowded, causing land values to increase and available land to decrease. Apartment buildings are enjoying increasing acceptance by those who choose to live in close proximity to other people, shops and stores, and often jobs and recreational facilities, with relative safety and ease of maintenance. An apartment often provides increased living space and more amenities than a single-family house that costs the same amount of money. Because of their popularity and increasing numbers in suburbs as well as in urban areas, apartment buildings have become one of the major building types in architecture today.

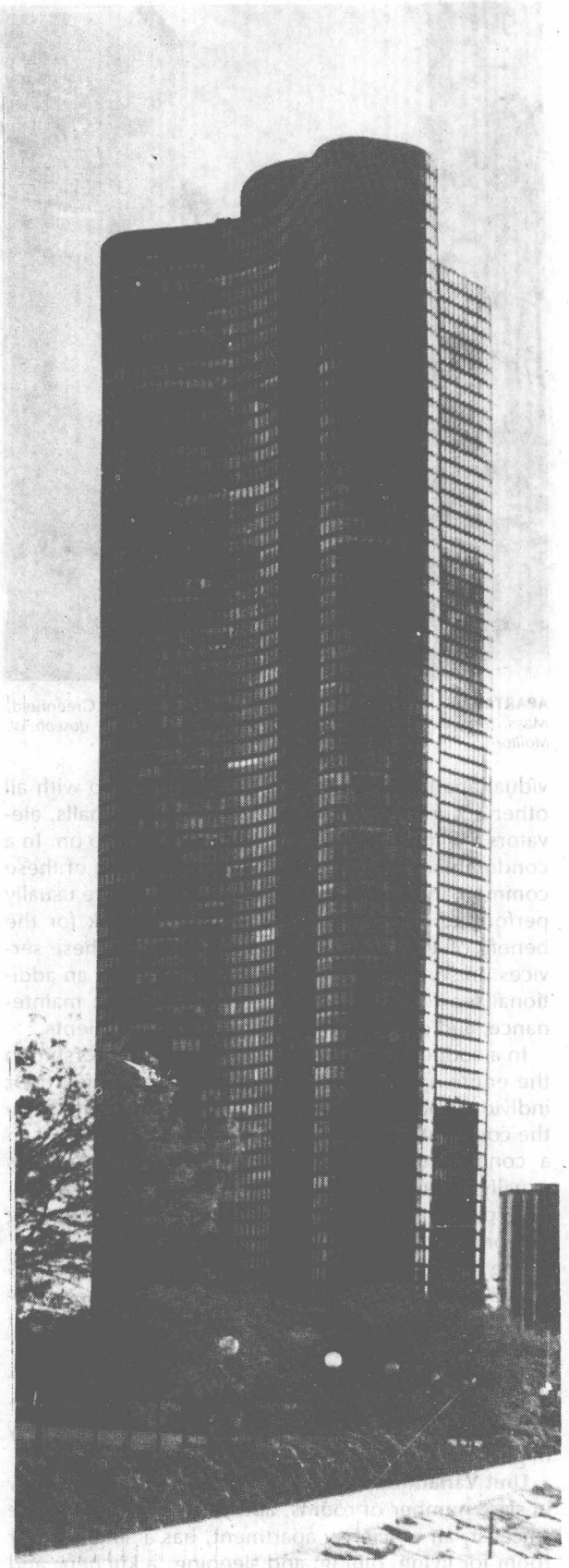
Types There are several different kinds of apartment buildings. A garden apartment, usually found in the suburbs and one to three stories in height, is an apartment building in which some or all of the individual units have private gardens of limited size or share an outdoor garden area. In some cases, each garden apartment unit occupies only a single floor, but in others the units have two stories. When similar apartment buildings are located in more highly populated areas, as in cities, they are frequently called townhouses.

Often the terms *high-rise* and *low-rise*, and sometimes *medium-rise*, are applied to apartment buildings. There is little agreement about the exact definitions of these terms. However, it is generally accepted that any apartment over three, or possibly four, stories in height must be served by elevators, while the lower buildings may be walk-up apartments. If low-rise apartments are defined as walk-ups, perhaps medium-rise might mean those from about five to nine stories; and high-rise, those more than nine. If an apartment building requires elevators, its design and construction will differ markedly from those that only require stairs.

An apartment hotel combines some of the qualities of both hotels and apartments. For example, it might have more or less permanent residents as in an apartment, but might provide public spaces for dining and other purposes and maid and maintenance service as in a hotel.

Formerly, all apartments were rented or leased by the occupants. Such apartment units are available furnished, with all major pieces of furniture and furnishings provided and sometimes with such things as dishes and linen. Unfurnished apartments usually have only the major kitchen equipment, the remainder of the furniture and furnishings to be supplied by the occupants. In later years, there has been a growing tendency toward ownership of some apartments by their occupants. Occupant-owned apartments may be condominiums or cooperatives.

Ownership A condominium is an apartment building, in which the occupants own their own indi-



APARTMENT High-Rise, Lake Point Tower (1968), Chicago, Ill. *[Architects: Schipporeit and Heinrich (Hedrich-Blessing)]*

APARTMENT Low-Rise, Greenfield Housing (1949), Greenfield, Mass. [*Architects: Sargent, Webster, Crenshaw and Folley. (Joseph W. Molitor)*]

vidual apartment units and share ownership with all other occupants of common areas, such as halls, elevators, swimming pool, outside areas, and so on. In a condominium, the maintenance and upkeep of these common areas and of the overall building are usually performed by people who handle the work for the benefit of all occupants, who pay a fee for these services. In some cases, the occupants also pay an additional fee for which they receive janitorial, maintenance, and other services within their apartments.

In a cooperative, the occupants share ownership in the entire apartment building, but do not own their individual apartment units, leasing their units from the cooperative in which they are stockholders. As in a condominium, cooperative apartment occupants usually pay a fee for upkeep, maintenance, and so on. Also property taxes are paid on the entire building and prorated among the owners.

The most obvious advantage of both condominiums and cooperatives is that of ownership as opposed to renting. With this comes the advantages that other homeowners have of acquiring equity and various tax advantages. Since cooperatives and condominiums are generally nonprofit, their occupant-owners can ordinarily afford nicer apartments than they might in a rental apartment building.

Unit Variations Apartment units vary considerably in size, number of rooms, and degree of luxury. The smallest, an efficiency apartment, has a single major room for living, dining, and sleeping; a kitchen; and a bathroom. Larger apartments, like single-family houses, may have any number of rooms, large or small. Apartments of all sizes may range from somewhat simple, utilitarian types to the utmost in luxury, with costs and rentals reflecting the various degrees between. Apartment units may occupy one floor, two floors, or sometimes more. If a unit occupies two floors, it is called a duplex apartment, not to be confused with a duplex house, which means a double house for two families. If the apartment unit occupies three floors, it is called a triplex.

Building Complexes At one time, the most usual apartment development consisted of a single building placed on a single site. Such a building might contain a few individual units or hundreds. Of increasing importance are complexes consisting of two or more apartment buildings on one site, with landscaped areas, automobile parking spaces, and sometimes recreational facilities, such as swimming pools and tennis courts, shared between them. In some cases, the development goes much further, providing on a single site a shopping center, a motion picture house, and other amenities. A further development is the multiuse center which not only contains elements of this kind but also may provide hotel or motel facilities, a convention center, and offices. In most cases, this multiplicity of usage is provided in a group of buildings, designed and constructed in such a way as to complement each other. In some cases, though, many of these uses may be combined into a single high-rise building.

In the last few years, another method for providing housing has been the planned unit development. Such developments provide open spaces, recreation facilities, churches, schools, and shops, as well as dwellings, for a relatively large number of families. A typical planned unit development might include multifamily residences, such as high-rise apartments and townhouses as well as single-family and two-family homes.

Elements The planning of apartment buildings involves three major elements: private areas, public areas, and administration-service areas. The private areas are the apartment units. These ordinarily contain rooms or spaces, as in a single-family house, for sleeping, dining, food preparation, and so on. The public area includes the lobby or vestibule, stairs and elevators, corridors, parking facilities, and sometimes a mailroom. Also often included are other shared facilities, such as laundry rooms, bulk storage for tenants, recreational facilities, and community rooms for games and dining. There may be shops and service establishments in the building. The administration-service area includes office space for the management, storage rooms, and space for mechanical equipment and sometimes maintenance shops.

American Development In colonial America, land was plentiful and inexpensive and most people lived in single-family houses. As land became less available and more expensive, construction of apartments began, first in New York City in the mid-19th century and

APARTMENT Low-Rise, Lake Shore Housing (1971), Buffalo, N.Y. [*Architect: Paul Rudolph. (Joseph W. Molitor)*]

later in other large cities. Prior to about 1870, these buildings were tenements, which originally simply meant apartments but which came to mean buildings for housing great numbers of poor families in large cities. Often shabbily built, overcrowded, unsafe, and unsanitary, the tenements were not desirable places to live. The conditions of the tenements and their eventual deterioration into slums slowed the development of more suitable forms of multiple housing for many years.

In spite of the bad reputation of tenements, the continuing growth of city populations gradually led to construction of better apartment buildings, beginning about 1875 in New York City and few years later in Chicago. The evolution of the modern apartment had begun. Technological developments, including steel-framed structural systems, electric lighting, and greatly improved elevators, helped speed the evolution. Better planning of apartment buildings and individual apartment units soon followed. Early in the 20th century, passage of laws protecting the safety and health of apartment dwellers gave a tremendous boost to the development of apartments. This led to a great boom in apartment construction in larger cities after 1921, a boom that spread to the smaller cities and towns and then to the suburbs. In most urban areas today, single-family houses have largely been supplanted by apartments. And apartment living has come to be very acceptable, even desirable, for a large number of people. With the continuing scarcity and high cost of land, the trend can be expected to continue.

Related Articles HOUSE; HOUSING.

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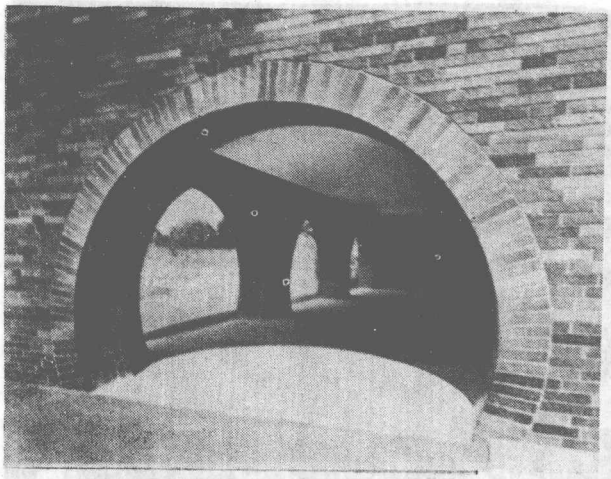
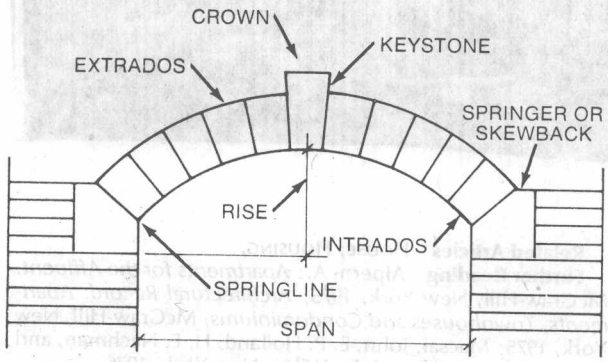
ARCH A structural element that usually supports the weight of a building or other structure above a door, window, or other opening in a wall. Originally, arches were constructed from a number of small wedge-shaped masonry units, of brick, stone, or tile called *voussoirs,* set in such a way as to form an opening that curved upward from the sides. Curved arches may take many forms, including semicircle, horseshoe, and lancet (pointed). Arches may also be flat.

Masonry arches derive their strength by transferring weight, or thrust, laterally from unit to unit starting at the crown in the top unit, the keystone, down the sides or haunches to the bottom of the arch to what is called the spring line. At the spring line, the weight, or thrust, is transferred from the arch to a wall or other structural element. This may be a pier, which is a heavy type of column designed to take the thrust. The pier may be assisted in this by a buttress, another structural element placed to help take the thrust. An arcade is a line of arches resting on columns, arranged so that the thrust at the bottom of each arch is resisted by the thrust from the arches on either side.

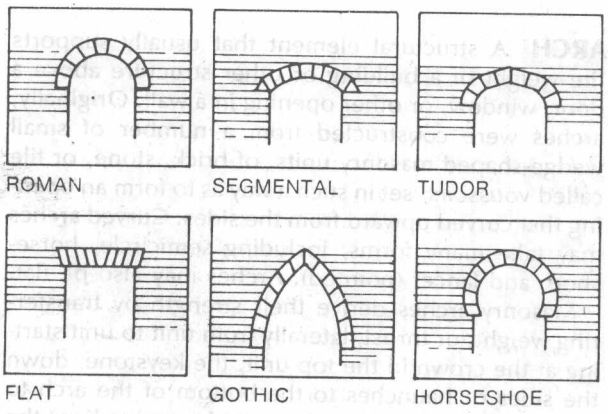
Elements of an Arch The rise of an arch is the height from the springer to the keystone and the span



ARCH Contemporary brick, Dutch Lane School (1974), Freehold, N.Y. [*Architect: Warren Ashley. (Joseph W. Molitor)*]



ARCH Components of masonry segmental type.



ARCH Masonry types.

is the width between springers. An archivolt is an ornamental molding on the face of an arch, and an extrados is the line or surface of the exterior of an arch at the outside edge of the units or voussoirs. This is the line which the archivolt follows. An intrados is the line or surface at the interior of an arch at the inside edge of the voussoirs. A springer, or skewback, is the unit at the bottom of the side of an arch.

Today arches are also made of wood, steel, and reinforced concrete, utilizing many of the same principles but with the lateral thrust at the spring line reduced to a minimum so that heavy piers or buttresses are not required.

History The principles of the arch were discovered in Mesopotamia at least 6,000 years ago. The ancient Babylonians and Egyptians used arches, as did the Greeks. The Romans developed arch design to a high level, especially in the semicircular form. In the Gothic architecture of the Middle Ages, the pointed arch was widely used and highly developed. In Renaissance buildings, there was a return to the round form.

American Development The Spanish began using masonry, including arches, in St. Augustine in 1565. Early in the 17th century, perhaps as early as 1610 at Jamestown, the manufacture of brick in the English colonies in America began, and stone quarrying soon followed. The masonry arch then followed and has been an important structural element of American architecture ever since. At first, masonry buildings and arches were relatively uncommon in the colonies. Later the use of stone and brick became widespread not only for large, important buildings but also for houses. Today arches of masonry are still used in buildings but arches of the newer materials of laminated wood, steel, and reinforced concrete are more prevalent.

Related Articles BRICK; CONCRETE: DOME; MASONRY STRUCTURE; STONE; TILE; VAULT; WOOD.

ARCHITECTURE The art and science of buildings, groups of buildings, and other structures that are functional, soundly constructed, economical, and esthetic. The term *architecture* can also be applied to buildings, groups of buildings, and other structures that fulfill these requirements. Although the word *architect* is sometimes used in a general sense, such as in speaking of God as the Architect of the Universe, the more specific meaning today denotes a person who has been educated and has gained experience in architecture and, having passed comprehensive examinations, is registered or licensed to practice architecture. In ancient Greece an architect was called *architekton,* arch technician or builder; in Rome this became *architectus.*

Attributes Marcus Vitruvius Pollio, usually called simply Vitruvius, a Roman architect and writer, who lived in the first century A.D., defined architecture in his famous book, *De architectura.* Vitruvius said architecture consisted of order, arrangement, proportion, symmetry, decor, and distribution. These dicta are still widely followed today and mean, in modern terms, that architecture must have its details adjusted properly, the details must be assembled together properly, the parts of a building must be of proper sizes and proportion in relation to other parts and to the building as a whole, the parts of the building must be in harmony with each other and balanced, all parts of a building must be assembled into an ensemble,