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A World of Art 6e Ch15

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chapter 15

Architecture

Fig. 450 **Philip Johnson and John Burgee,** *College of Architecture, University of Houston,* 1983–85.
Photo: Richard Payne, FAIA

The building that houses the College of Architecture at the University of Houston (**Fig. 450**), designed by architects Philip Johnson and John Burgee, is a sort of history of Western architecture from the Greeks to the present. Resting on its top is a model of a Greek temple. The main building below is reminiscent of Italian country villas of the Renaissance. The entire building was inspired by an eighteenth-century plan for a House of Education designed by Claude-Nicolas Ledoux (**Fig. 451**) for a proposed utopian community at Chaux, France, that never came into being. And the building itself is distinctly postmodern in spirit—it revels in a sense of discontinuity between its parts. One has the feeling that the Greek temple fits on the building's roof about as well as a maraschino cherry would on a scoop of potato salad.

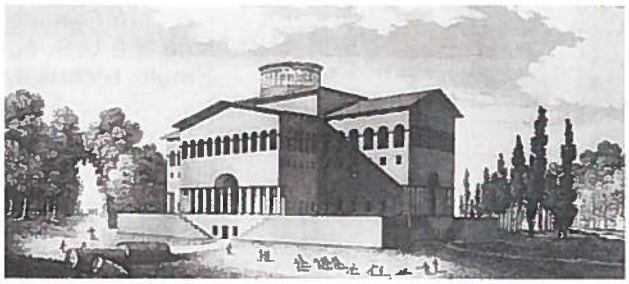

Fig. 451 **Claude-Nicolas Ledoux,** *House of Education,* 1773–79.
Courtesy of The Library of Congress.

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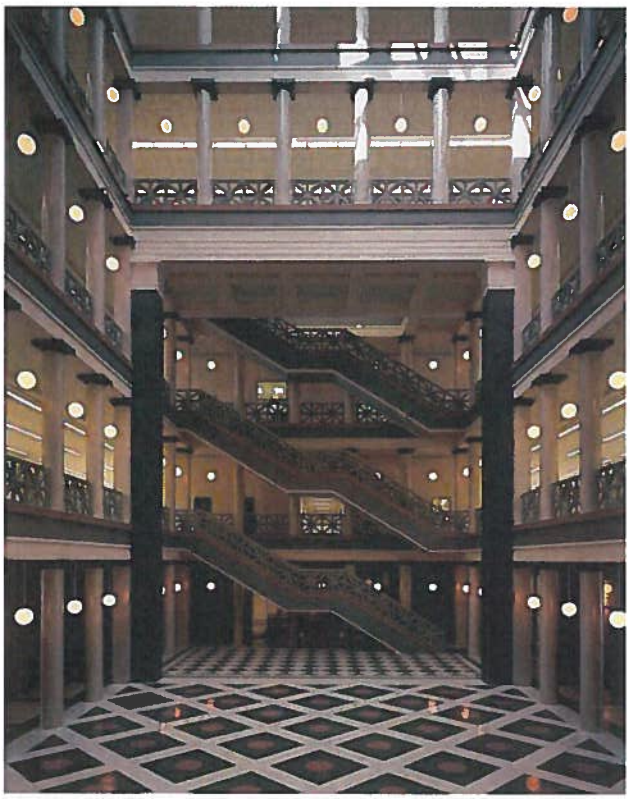

Fig. 452 Philip Johnson and John Burgee, *College of Architecture, University of Houston, interior,* 1983–85.
Photo: Richard Payne, FAIA.

In this chapter, we will consider how our built environment has developed—how we have traveled, in effect, from Greek temples and Anasazi cliff dwellings to skyscrapers and postmodernist designs. We will see that the "look" of our buildings and our communities depends on two different factors and their interrelation— **environment**, or the distinct landscape characteristics of the local site, including its climatic features, and **technology**, the materials and methods available to a given culture. Johnson and Burgee's design for the College of Architecture at the University of Houston takes advantage of many of the technologies developed over the centuries, but at first glance, it seems to ignore the local environment altogether. However, when we consider its interior (**Fig. 452**), we can see that the cool atrium space that lies under the colonnade on the roof offers a respite from the hot Texas sun. The site has had a considerable influence on the design. Thus, the key to understanding and appreciating architecture always involves both technology and environment. We will consider environment first.

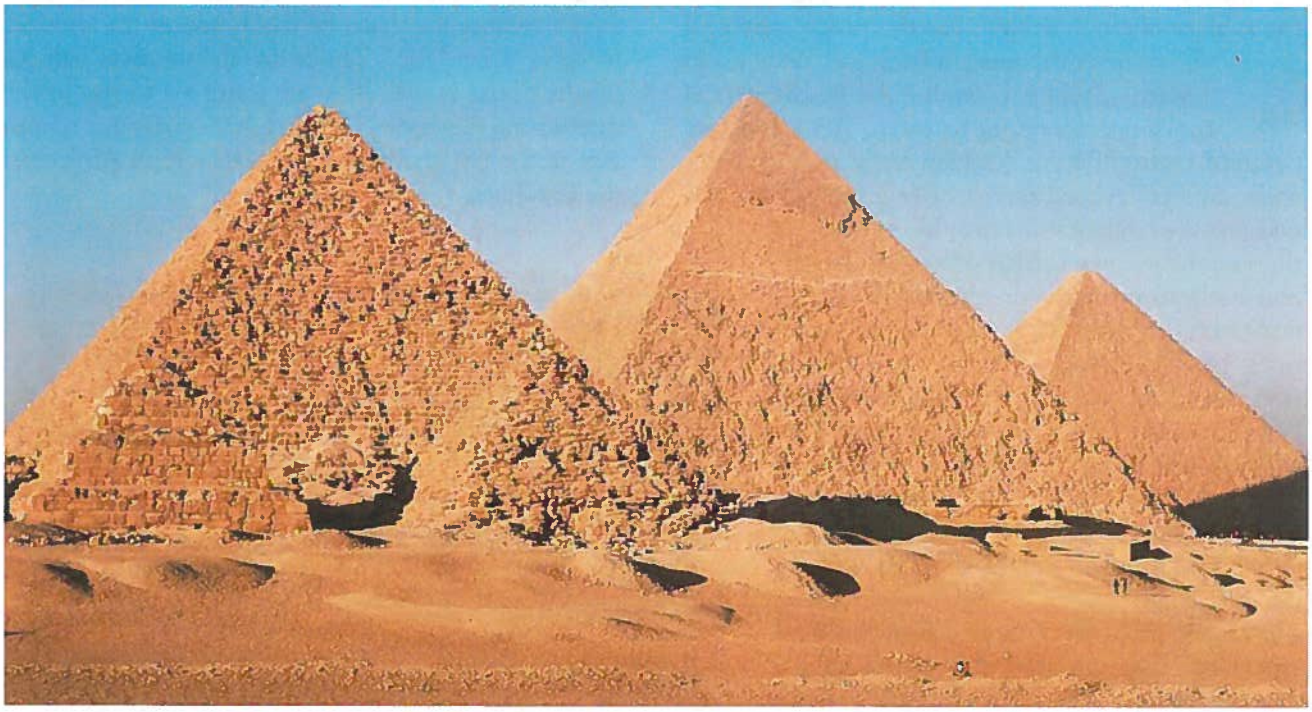

Fig. 453 *Pyramids of Menkaure* (c. 2470 BCE), *Khafre* (c. 2500 BCE), and *Khufu* (c. 2530 BCE).
Original height of Pyramid of Khufu 480 ft., length of each side at base 755 ft.
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Fig. 454 *Ziggurat, Ur,* c. 2100 BCE.
Fired brick over mud brick core, 210 × 150 ft. at base.
Corbis / Bettman.

ENVIRONMENT

The built environment reflects the natural world and the conception of the people who inhabit it of their place within the natural scheme of things. A building's form might echo the world around it, or it might contrast with it. It also might respond to the climate of the place. In each case, the choices builders make reveal their attitudes toward the world around them.

The architecture of the vast majority of early civilizations was designed to imitate natural forms. The significance of the pyramids of Egypt (**Fig. 453**) is the subject of much debate, but their form may well derive from the image of the god Re, who in ancient Egypt was symbolized by the rays of the sun descending to earth. A text in one pyramid reads: "I have trodden these rays as ramps under my feet." As one approached the mammoth pyramids, covered in limestone to reflect the light of the sun, the eye was carried skyward to Re, the Sun itself, who was, in the desert, the central fact of life. In contrast, the pyramidlike structures of Mesopotamia, known as *ziggurats* (**Fig. 454**), are flatter and wider than their Egyptian counterparts, as if imitating the shape of the foothills that lead up to the mountains. The Sumerians believed that the mountaintops were not only the source of precious water, but also the dwelling place of the gods. The ziggurat was constructed as an artificial mountain in which a god could reside. Some researchers have speculated that the platforms of the temple were originally covered with soil and planted with trees. The rainwater used to irrigate these trees would have flowed into the interior of the ziggurat and exited through a series of venting ducts loosely filled with broken pottery in the side of the ziggurat. Such an arrangement would have cooled the building even as, as water flowed from it, it symbolized the source of life itself.

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The designs of many buildings, in fact, reflect the climatic conditions of environments. When African slaves arrived in the Americas in the eighteenth century, they found themselves living in a climate very much like that they had left in Africa. A late eighteenth-century painting of the Mulberry Plantation in South Carolina (**Fig. 455**) depicts slave houses with steeply pitched roofs similar to the thatched-roof houses of the same era found in West Africa. The roof comprises over half the height of the house, allowing warm air to rise in the interior and trap cooler air beneath it—a distinct advantage in the hot and humid climates of both Africa and the Carolinas.

Fig. 455 **Thomas Coram,** *View of Mulberry House and Street,* c. 1800.
Oil on paper. Gibbes Museum of Art, Charleston, SC. Carolina Art Association, 1968.1968.18.01.

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Fig. 456 **Mesa Verde**, *Spruce Tree House*, c. 1200–1300 CE.
Courtyard formed by restoration of the roofs over two underground kivas.
Photo: John Deeks / Photo Researchers, Inc.

The Anasazi cliff dwelling known as Spruce Tree House (**Fig. 456**) at Mesa Verde National Park in southwestern Colorado reflects a similar relation between humans and their environment. The Anasazi lived in these cliffside caves for hundreds, perhaps thousands, of years. The cave not only provided security, but also to live there was to be closer to the people's origin and, therefore, to the source of their strength. For unknown reasons, the Anasazi abandoned their cliff dwellings in about 1300 CE. One possible cause was a severe drought that lasted from 1276 to 1299. It is also possible that disease, a shortened growing season, or war with Apache and Shoshone tribes caused the Anasazi to leave the highland mesas and migrate south into Arizona and New Mexico.

At the heart of the Anasazi culture was the **kiva**, a round, covered hole in the center of the communal plaza in which all ceremonial life took place. The roofs of two underground kivas on the north end of the ruin have been restored. They are constructed of horizontally laid logs built up to form a dome with an access hole (**Fig. 457**). The people utilized these roofs as a common area. Down below, in the enclosed kiva floor, was a *sipapu*, a small, round hole symbolic of the Anasazi creation myth, which told of the emergence of the Anasazi's ancestors from the depths of the earth. In the parched Southwestern desert country it is equally true that water, like life itself, also seeps out of small fissures in the earth. Thus, it is as if the entire Anasazi community, and everything necessary to its survival, emerges from mother earth.

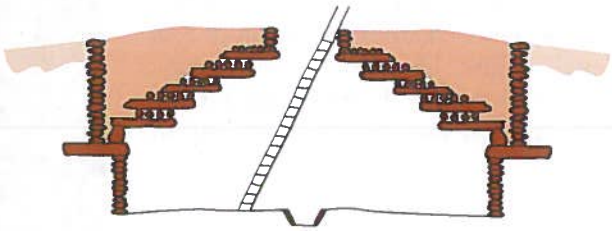

Fig. 457 Cribbed roof construction of a kiva.
After a National Park Service pamphlet.

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TECHNOLOGY

The structure of the kiva's roof represents a technological innovation of the Anasazi culture. Thus, while it responds directly to the environment of the place, it also reflects the *technology* available to the builder. The basic technological challenge faced by architecture is to construct upright walls and put a roof over the empty space they enclose. Walls may employ one of two basic structural systems: the **shell system**, in which one basic material provides both the structural support and the outside covering of the building, and the **skeleton-and-skin system**, which consists of a basic interior frame, the skeleton, that supports the more fragile outer covering, the skin.

In a building that is several stories tall, the walls or frame of the lower floors must also support the weight of the upper floors. The ability of a given building material to support weight is thus a determining factor in how high the building can be. The walls or frame also support the roof. The span between the elements of the supporting structure—between, for instance, stone walls, columns, or steel beams—is determined by the tensile strength of the roof material. **Tensile strength** is the ability of a building material to span horizontal distances without support and without buckling in the middle. The greater the tensile strength of a material, the wider its potential span. Almost all technological advances in the history of architecture depend on either the invention of new ways to distribute weight or the discovery of new materials with greater tensile strength. We begin our survey with the most basic technology and move forward to the most advanced.

Load-Bearing Construction

The simplest method of making a building is to make the walls **load-bearing**—make the walls themselves bear the weight of the roof. One does this by piling and stacking any material—stones, bricks, mud and straw—right up to roof level. Many load-bearing structures, such as the pyramids or the ziggurats we have already seen, are solid almost all the way through, with only small open chambers inside them. Though the Anasazi cliff dwelling contains more livable space than a pyramid or a ziggurat, it too is a load-bearing construction. The kiva is built of adobe bricks—bricks made of dried clay—piled on top of one another, and the roof is built of wood. The complex roof of the kiva spans a greater circumference than would be possible with just wood, and it supports the weight of the community in the plaza above. This is achieved by the downward pressure exerted on the wooden beams by the stones and fill on top of them above the outside wall, which counters the tendency of the roof to buckle.

Post-and-Lintel

The walls surrounding the Lion Gate at Mycenae in Greece (**Fig. 458**) are load-bearing construction. But the gate itself represents another form of construction: post-and-lintel. **Post-and-lintel construction** consists of a horizontal beam supported at each end by a vertical post or a wall. In essence, the downward force of the horizontal bridge holds the vertical posts in an upright position, and, conversely, the posts support the stone above in a give-and-take of directional force and balance. So large are the stones used to build this gate—both the length of the lintel and the total height of the post-and-lintel structure are roughly 13 feet—that later Greeks believed it could only have been built by the mythological race of one-eyed giants, the Cyclops.

Fig. 458 *The Lion Gate*, Mycenae, Greece, 1250 BCE.
Studio Kontos Photostock.

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Fig. 459 Corner of the First Temple of Hera, Paestum, Italy, c. 550 BCE.
Canali Photobank

Post-and-lintel construction is fundamental to all Greek architecture. As can be seen in the First Temple of Hera, at Paestum, Italy (**Fig. 459**), the columns, or posts, supporting the structure were placed relatively close together. This was done for a practical reason: If stone lintels, especially of marble, were required to span too great a distance, they were likely to crack and eventually collapse. Each of the columns in the temple is made of several pieces of stone, called **drums**. Grooves carved in the stone, called **fluting**, run the length of the column and unite the individual drums into a single unit. Each column tapers dramatically toward the top and slightly toward the bottom, an architectural feature known as **entasis**. Entasis deceives the eye and makes the column look absolutely vertical.

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It also gives the column a sense of almost human musculature and strength. The columns suggest the bodies of human beings, holding up the roof like miniature versions of the giant Atlas, who carried the world on his shoulders.

The values of the Greek city-state were embodied in its temples. The temple was usually situated on an elevated site above the city—an **acropolis**, from *akros*, meaning "top," of the *polis*, "city"—and was conceived as the center of civic life. Its **colonnade**, or row of columns set at regular intervals around the building and supporting the base of the roof, was constructed according to the rules of geometry and embodied cultural values of equality and proportion. So consistent were the Greeks in developing a generalized architectural type for their temples that it is possible to speak of them in terms of three distinct architectural types—the Doric, the Ionic, and the Corinthian, the last of which was rarely used by the Greeks themselves but later became the standard order in Roman architecture (**Fig. 460**). In ancient times, the heavier Doric order was considered masculine, and the more graceful Ionic order feminine. It is true that the Ionic order is slimmer and much lighter in feeling than the Doric.

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The vertical design, or **elevation**, of the Greek temple is composed of three elements—the **platform**, the **column**, and the **entablature**. The relationship among these three units is referred to as its **order**. The Doric, the earliest and plainest of the three, is used in the temple at Paestum. The Ionic is later, more elaborate, and organic, while the Corinthian is more organic and decorative still. The elevation of each order begins with its floor, the **stylobate**, or the top step of the platform on which the building rests. The column in the Doric order consists of two parts, the **shaft** and the **capital**, to which both the Ionic and Corinthian orders add a base. The orders are most quickly distinguished by their capitals. The Doric capital is plain, marked only by a subtle outward curve. The Ionic capital is much more elaborate and is distinguished by its scroll. The Corinthian capital is decorated with stylized acanthus leaves. The entablature consists of three parts: the **architrave**, or weight-bearing and weight-distributing element; the **frieze**, the horizontal band just above the architrave that is generally decorated with relief sculptural elements; and the **cornice**, the horizontal molded projection that crowns or completes the wall.

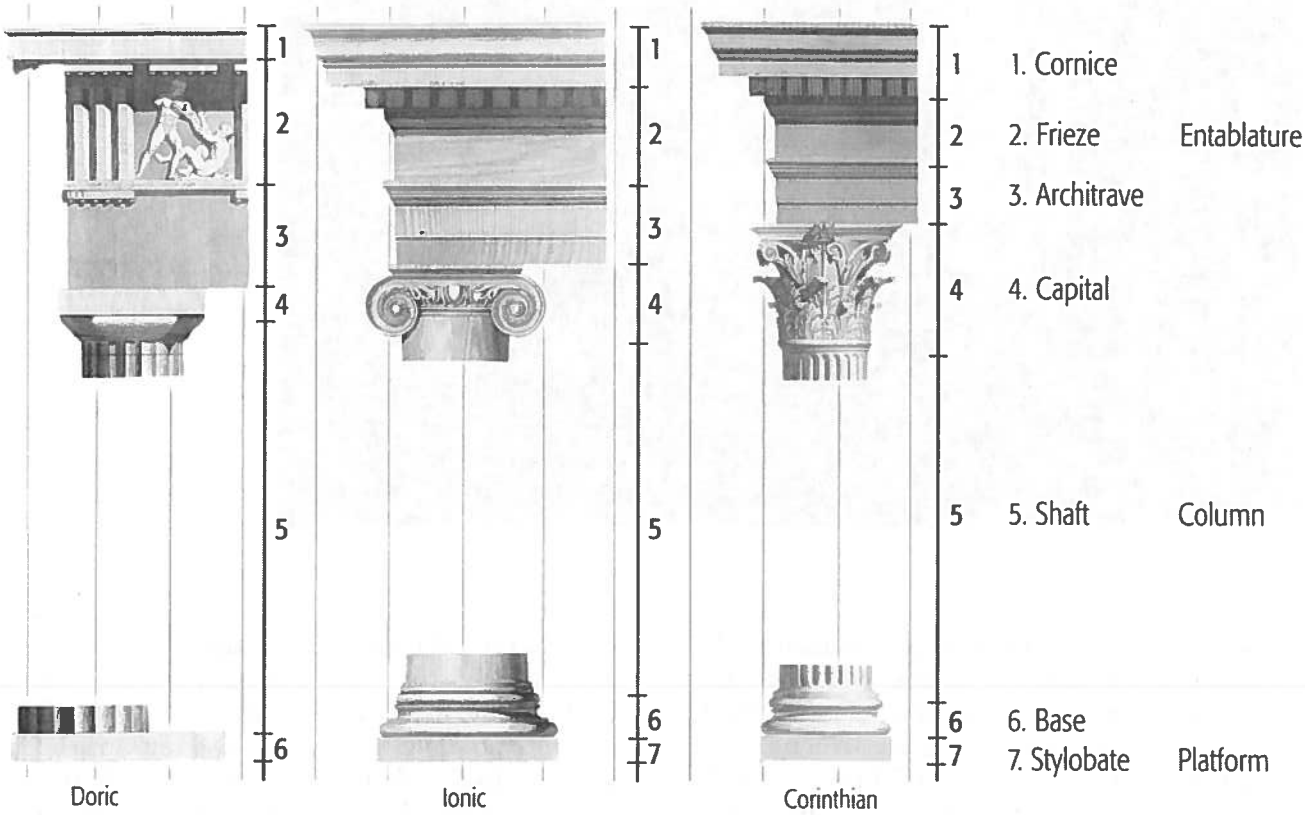

Fig. 460 *The Greek orders,* from James Stuart, *The Antiquities of Athens,* London, 1794.
Courtesy of The Library of Congress

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Arches, Vaults, and Domes

The geometrical order of the Greek temple suggests a conscious desire to control the natural world. So strong was this impulse that Greek architecture seems defiant in its belief that the intellect is superior to the irrational forces of nature. We can read this same impulse in Roman architecture—the will to dominate the site. Though the Romans made considerable use of colonnades—rows of columns—they also perfected the use of the **arch** (**Fig. 461**), an innovation that revolutionized the built environment. The Romans recognized that the arch would allow them to make structures with a much larger span than was possible with post-and-lintel construction. Made of wedge-shaped stones, called **voussoirs**, each cut to fit into the semicircular form, an arch is not stable until the **keystone**, the stone at the very top, has been put into place. At this point, equal pressure is exerted by each stone on its neighbors, and the scaffolding that is necessary to support the arch while it is under construction can be removed. The arch supports itself, with the weight of the whole transferred downward to the posts. A series of arches could be made to span a wide canyon with relative ease. One of the most successful Roman structures is the Pont du Gard (**Fig. 462**), an aqueduct used to carry water from the distant hills to the Roman compound in Nîmes, France. Still intact today, it is an engineering feat remarkable not only for its durability, but also, like most examples of Roman architecture, for its incredible size.

With the development of the **barrel vault**, or **tunnel vault** (**Fig. 463** top), which is essentially an extension in depth of the single arch by lining up one arch behind another, the Romans were able to create large, uninterrupted interior spaces. The strength of the vaulting structure of the Roman Colosseum (**Figs. 464** and **465**) allowed more than 50,000 spectators to be seated in it. The Colosseum is an example of an **amphitheater** (literally meaning a "double theater"), in which two semicircular theaters are brought face to face, a building type invented by the Romans to accommodate large crowds. Built for gladiatorial games and other "sporting" events, including mock naval battles and fights to the death between humans and animals, the Colosseum is constructed both with barrel vaults and with **groined vaults** (**Fig. 463**, bottom), the latter created when two barrel vaults are made to meet at right angles. These vaults were made possible by the Roman invention of concrete. The Romans discovered that if they added volcanic aggregate, such as that found near Naples and Pompeii, to the concrete mixture, it would both set faster and be stronger. The Colosseum is constructed of these concrete blocks, held together by metal cramps and dowels. They were originally covered with stone and elaborate stucco decorations.

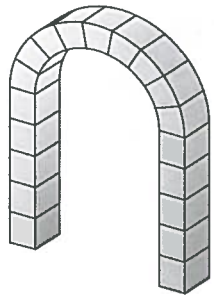

Fig. 461 Arch.

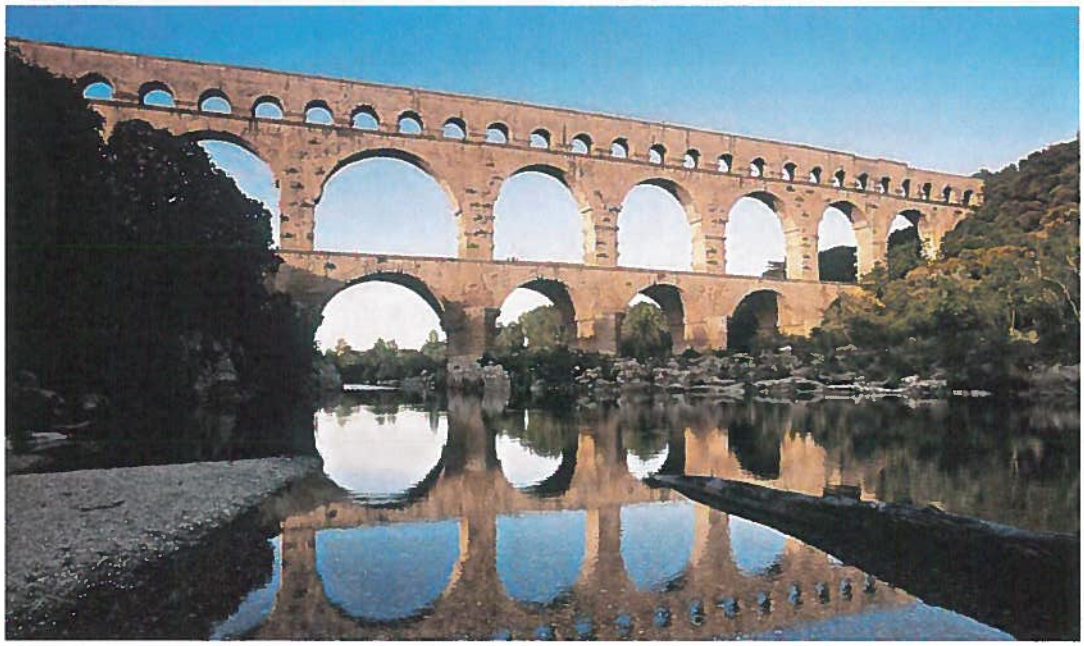

Fig. 462 *Pont du Gard,* near Nîmes, France. Late first century BCE. Danita Delimont Photography

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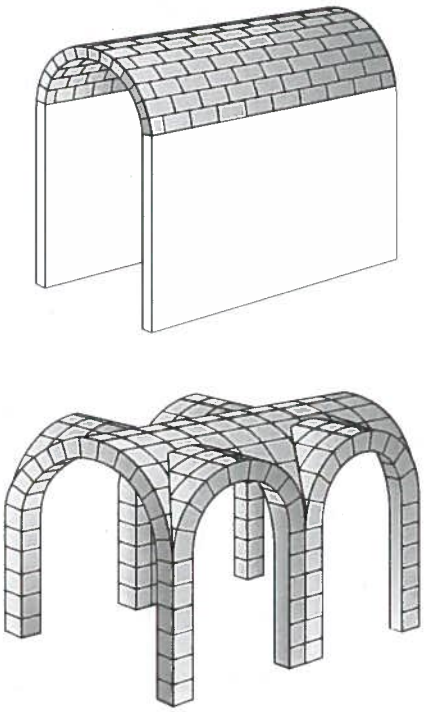

Fig. 463 Barrel vault (top) and groined vault (bottom) construction.

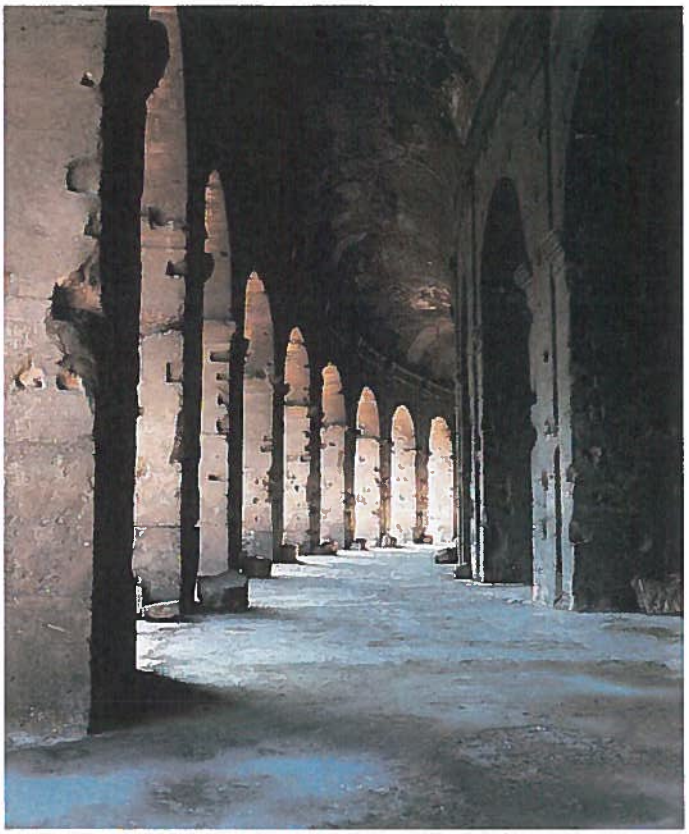

Fig. 464 Barrel-vaulted gallery, ground floor of the Colosseum, Rome.
Scala / Art Resource, NY.

Fig. 465 *The Colosseum* (aerial view), Rome, 72–80 CE.
Publi Aer Foto.

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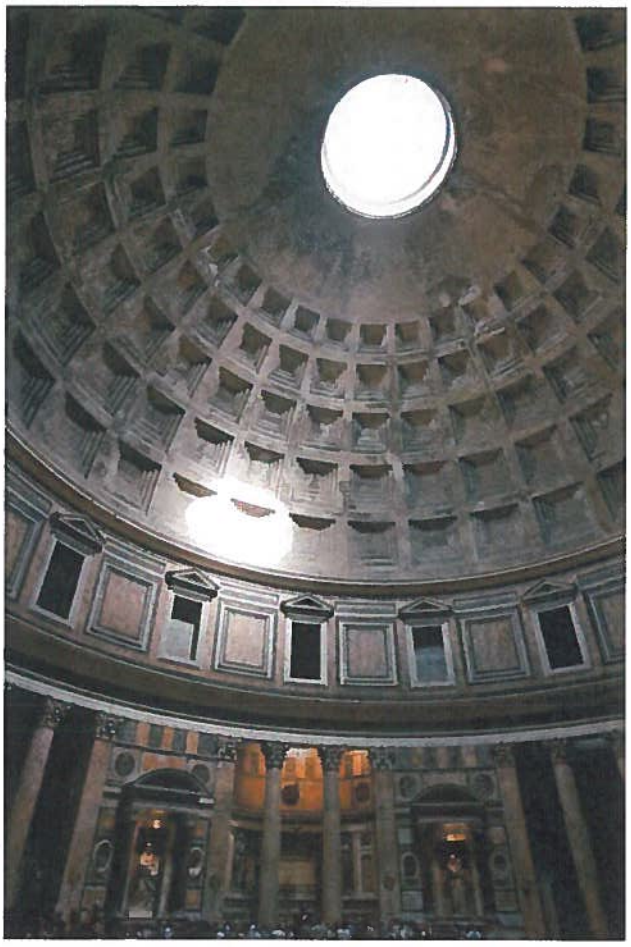

Fig. 466 Interior, *Pantheon,* 117–125 CE.
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The Romans were also the first to perfect the **dome**, which takes the shape of a hemisphere, sometimes defined as a continuous arch rotated 360 degrees on its axis. Conceived as a temple to celebrate all their gods, the Roman Pantheon (**Fig. 466**)—from the Greek words *pan* ("every") and *theos* ("god")—consists of a 142-foot-high dome set on a cylindrical wall 140 feet in diameter. Every interior dimension appears equal and proportionate, even as its scale overwhelms the viewer. The dome is concrete, which was poured in sections over a huge mold supported by a complex scaffolding. Over 20 feet thick where it meets the walls—the **springing**, or the point where an arch or dome rises from its support—the dome thins to only 6 feet at the circular opening, 30 feet in diameter, at the dome's top. Through this **oculus** (Latin for "eye"), the building's only source of illumination, worshippers could make contact with the heavens. As the sun shone through it, casting a round spotlight into the interior, it seemed as if the eye of Jupiter, king of the gods, shone upon the Pantheon walls. Seen from the street (**Fig. 467**), where it was originally approached between parallel colonnades that culminated in a podium now lost to the rise of the area's street level, its interior space could only be intuited. Instead, the viewer was confronted by a portico composed of eight mammoth Corinthian columns made of polished granite rising to a pediment some 121 feet wide.

Even though their use of concrete had been forgotten, the architectural inventions of the Romans provided the basis for building construction in the Western world for nearly 2,000 years. The idealism, even mysticism, of the Pantheon's vast interior space, with its evocation of the symbolic presence of Jupiter, found its way into churches as the Christian religion came to dominate the West. Large congregations could gather beneath the high barrel vaults of churches, which were constructed on Roman architectural principles. Vault construction in stone was employed especially in Romanesque architecture—so called because it used so many Roman methods and architectural forms. The barrel vault at St. Sernin, in Toulouse, France (**Fig. 468**), is a magnificent example of Romanesque architecture. The plan of this church is one of great symmetry and geometric simplicity

Fig. 467 Exterior, *Pantheon,* 117–125 CE.
Canali Photobank.

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Fig. 468 Interior view of nave, St. Sernin, Toulouse, France, c. 1080–1120.
Alamy Images

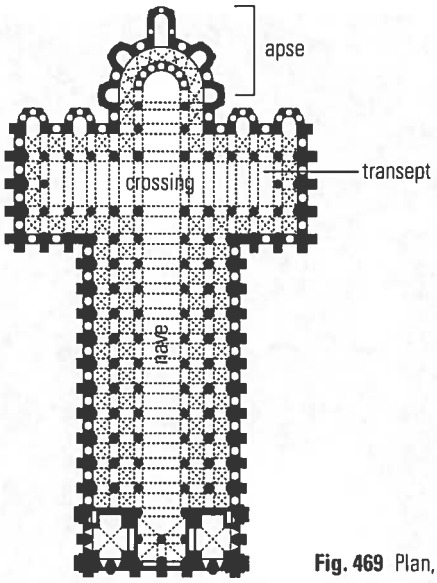

Fig. 469 Plan, St. Sernin.

(**Fig. 469**). It reflects the Romanesque preference for rational order and logical development. Every measurement is based on the central square at the **crossing**, where the two **transepts**, or side wings, cross the length of the **nave**, the central aisle of the church used by the congregation, and the **apse**, the semicircular projection at the end of the church that is topped by a Roman half-dome. Each square in the aisles, for instance, is one-quarter the size of the crossing square. Each transept extends two full squares from the center. The tower that rises over the crossing, incidentally, was completed in later times and is taller than it was originally intended to be.

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The immense interior space of the great Gothic cathedrals, which arose throughout Europe beginning in about 1150 CE, culminates this direction in architecture. A building such as the Pantheon, with a 30-foot hole in its roof, was simply impractical in the severe climates of northern Europe. As if in response to the dark and dreary climate outside, the interior of the Gothic cathedral rises to an incredible height, lit by stained-glass windows that transform a dull day with a warm and richly radiant light. The enormous interior space of Amiens Cathedral (**Fig. 470**), with an interior height of 142 feet and a total interior surface of more than 26,000 square feet, leaves any viewer in awe. At the center of the nave is a complex maze, laid down in 1288, praising the three master masons who built the complex, Robert de Luzarches, and Thomas and Renaud de Cormont, who succeeded in creating the largest Gothic cathedral ever built in Northern Europe.

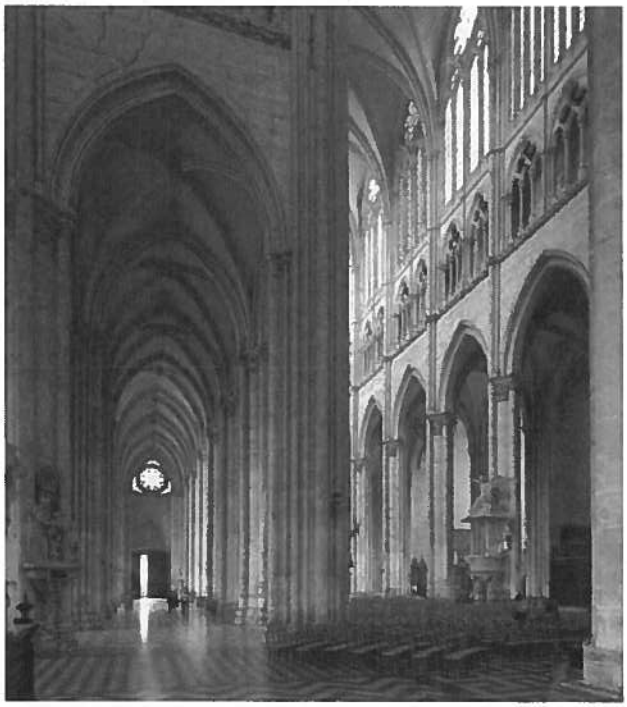

Fig. 470 *Amiens Cathedral,* begun 1220.
Photo © Achim Bednorz, Kohn.

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The great height of the Gothic cathedral's interior space is achieved by means of a system of pointed, rather than round, arches. The height of a rounded arch is determined by its width, but the height of a **pointed arch (Fig. 471)** can readily be extended by straightening the curve of the sides upward to a point, the weight descending much more directly down the wall (see Fig. 470). By using the pointed arch in a scheme of groined vaults, the almost ethereal space of the Gothic cathedral, soaring upward as if toward God, is realized.

All arches tend to spread outward, creating a risk of collapse, and, early on, the Romans learned to support the sides of the arch to counteract this lateral thrust. In the great French cathedrals, the support was provided by building a series of arches on the outside whose thrusts would counteract the outward force of the interior arches. Extending inward from a series of columns or piers, these **flying buttresses (Figs. 472 and 473)**, so named because they lend to the massive stone architecture a sense of lightness and flight, are an aesthetic response to a practical problem. Together with the stunning height of the nave allowed by the pointed arch, the flying buttresses reveal the desire of the builder to elevate the cathedral above the humdrum daily life in the medieval world. The cathedral became a symbol not only of the divine, but also of the human ability to exceed, in art and in imagination, our own limitations and circumstances.

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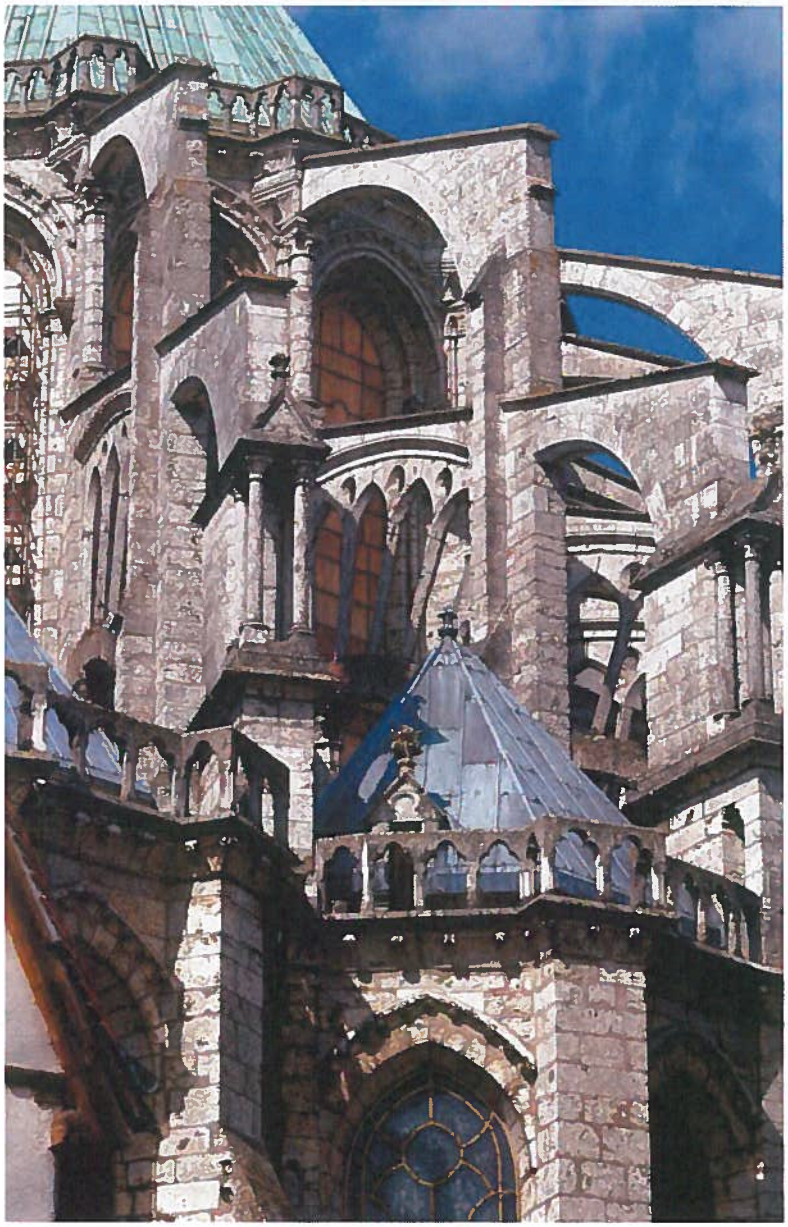

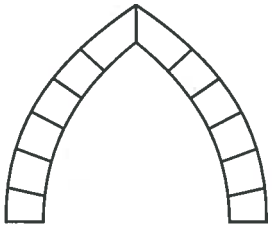

Fig. 471 Pointed arch.

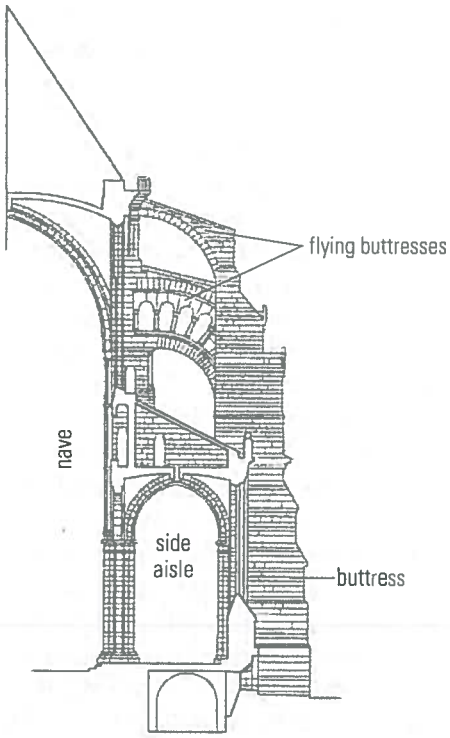

Fig. 472 and 473 Flying buttresses, Cathedral of Notre-Dame, Chartres, and diagram (after Acland).
Achim Bednorz, Koln.

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Cast-Iron Construction

Until the nineteenth century, the history of architecture was determined by innovations in the ways the same materials—mostly stone—could be employed. In the nineteenth century, iron, a material that had been known for thousands of years, but never employed in architecture, absolutely transformed the built environment. Wrought iron was soft and flexible, and, when heated, it could be easily turned and twisted into a variety of forms. But engineers discovered that, by adding carbon to iron, they could create a much more rigid and strong material—**cast iron**. The French engineer Gustave Eiffel used cast iron in his new lattice-beam construction technique, which produces structures of the maximum rigidity with the minimum weight by exploiting the way in which girders can be used to brace one another in three dimensions.

Fig. 474 **Gustave Eiffel**, *Eiffel Tower*, 1887–89.
Seen from Champs de Mars. Height of tower 1,051 ft.
Alain Evrard / Globe Press. Photo Researchers, Inc.

The most influential result was the Eiffel Tower (**Fig. 474**), designed as a monument to industry and the centerpiece of the international Paris Exposition of 1889. Over 1,000 feet high, and at that time by far the tallest structure in the world, the tower posed a particular problem—how to build a structure of such a height, yet one that could resist the wind. Eiffel's solution was simple but brilliant: Construct a skeleton, an open lattice-beam framework that would allow the wind to pass through it. Though it served for many years as a radio tower—on July 1, 1913, the first signal transmitted around the world was broadcast from its top, inaugurating the global electronic network—the tower was essentially useless, nothing more than a monument. Many Parisians hated it at first, feeling that it was a blight on the skyline. Newspapers jokingly held contests to "clothe" it. The French writer Guy de Maupassant often took his lunch at the restaurant in the tower, despite the fact that the food was not particularly appealing: "It's the only place in Paris," he said, "where I don't have to see it." But by the early years of the twentieth century the tower had become the symbol of Paris itself, probably the most famous structure in the world. But most important, it demonstrated the possibility of building to very great height without load-bearing walls. The tower gave birth to the skeleton-and-skin system of building. And the idea of designing "clothes" to cover such a structure soon became a reality.

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Frame Construction

The role of iron and steel in changing the course of architecture in the nineteenth century cannot be underestimated—and we will consider steel in even more detail in a moment—but two more humble technological innovations had almost as significant an impact, determining the look of our built environment down to the present day. The mass production of the common nail, together with improved methods and standardization in the process of milling lumber, led to a revolution in home building techniques.

Lumber cannot easily support structures of great height, but it is perfect for domestic architecture. In 1833, in Chicago, the common **wood-frame** construction (**Fig. 475**), a true skeleton-and-skin building method, was introduced. Sometimes called **balloon-frame** construction, because early skeptics believed houses built in this manner would explode like balloons, the method is both inexpensive and relatively easy. A framework skeleton of, generally, 2- × 4-inch beams is nailed together. Windows and doors are placed in the wall using basic post-and-lintel design principles, and the whole is sheathed with planks, clapboard, shingles, or any other suitable material. The roof is somewhat more complex, but as early as the construction of Old St. Peter's Basilica in Rome in the fourth century CE (**Fig. 477**), the basic principles were in use. The walls of St. Peter's were composed of columns and arches made of stone and brick, but the

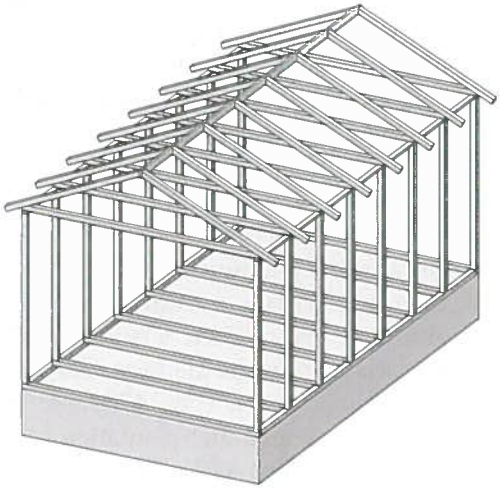

Fig. 475 Wood-frame construction.

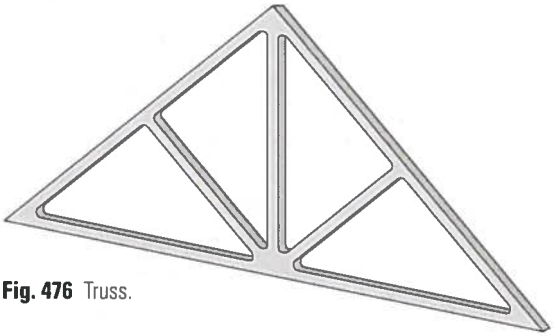

Fig. 476 Truss.

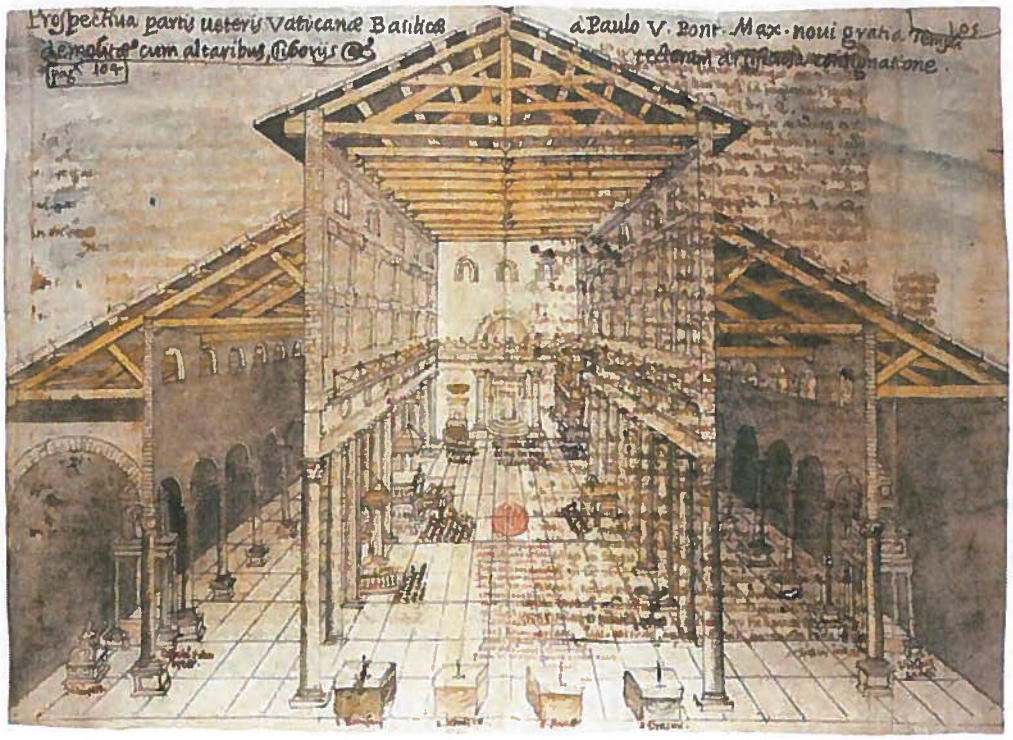

Fig. 477 Drawing of Old St. Peter's Basilica, Rome, c. 320–27.
Vatican Museums, Rome, Italy.

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roof was wood. And notice the angled beams supporting the roof over the aisles. These are elementary forms of the truss, prefabricated versions of which most home builders today use for the roofs of their houses. One of the most rigid structural forms in architecture, the **truss** (**Fig. 476**) is a triangular framework that, because of its rigidity, can span much wider areas than a single wooden beam.

Wood-frame construction is, of course, the foundation of American domestic architecture, and it is versatile enough to accommodate a variety of styles. Compare, for instance, two residences built near the end of the eighteenth century, the Harrison Gray Otis House in Boston, Massachusetts (**Fig. 478**) and the Parlange Mansion, built on an indigo plantation north of Baton Rouge, Louisiana (**Fig. 479**). The Otis House was designed by Charles Bulfinch, America's first native-born professional architect, and its simple, clearly articulated exterior brick-clad facade with its five window bays set a stylistic standard for the city. Brick was chosen to cover the wood-frame construction beneath to provide insulation and protection against New England's severe winter weather. The Parlange mansion likewise uses brick, made in this case by the plantation's slaves. The upper floor rests above a half-buried brick basement with brick pillars supporting the open-air gallery which surrounds the second story. The walls, both inside and out, are plastered with a mixture of mud, sand, Spanish moss and deer hair, and painted white, providing cooling insulation in the hot and humid Louisiana summers. The upper level contains the main living quarters. Each room in the house, on both the upper and lower levels, opens on to the surrounding galleries, which serve as hallways for the house, protecting the inner rooms from direct sunlight.

Fig. 478 **Charles Bulfinch**, Harrison Gray Otis House, Boston, Massachusetts, 1795–96.
Photo courtesy of Historic New England.

Fig. 479 Architect unknown, **Mansion at Parlange Plantation, New Roads,** Louisiana. c. 1785–95.
© Philip Gould / Corbis.

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Fig. 480 Christian Gladu, *The Birch,* The Bungalow Company, North Town Woods, Bainbridge Island, Washington, 1998.
Photo courtesy of The Bungalow Company.

Early in the twentieth century, wood-frame construction formed the basis of a widespread "bungalow" style of architecture, which has enjoyed a revival in the last decade (**Fig. 480**). It became popular when furniture designer Gustav Stickley began publishing bungalow designs in his magazine *The Craftsman*. From the beginning, the bungalow was conceived as a form of domestic architecture available to everyone. Like Stickley's furniture, which he thought of as "made" for bungalows, it was democratic. It embodied, from Stickley's point of view, "that plainness which is beauty." The hand-hewn local materials—stone and shingles—employed in the construction tied the home to its natural environment. And so did its porches, which tied the interior to the world outside, and which, with their sturdy, wide-set pillars, bespoke functional solidity. By the late 1920s, as many as 100,000 stock plans had been sold by both national architectural companies and local lumber and building firms, and, across America, bungalows popped up everywhere. In the popular imagination, the word "bungalow" was synonymous with "quality."

Steel-and-Reinforced-Concrete Construction

It was in Chicago that frame construction began, and it was Chicago that most impressed C. R. Ashbee, a representative of the British National Trust, when he visited America in 1900: "Chicago is the only American city I have seen where something absolutely distinctive in the aesthetic handling of material has been evolved out of the Industrial system." A young architect named Frank Lloyd Wright impressed him most, but it was Wright's mentor, Louis Sullivan, who was perhaps most responsible for the sense of vitality to which Ashbee was responding.

For Sullivan, the foremost problem that the modern architect had to address was how the building might transcend the "sinister" urban conditions out of which, of necessity, it had to rise. The development of steel construction techniques, combined with what Sullivan called "a system of ornament," offered him a way to mitigate the urban malaise. A fireproof steel skeletal frame, suggested by wood-frame construction, freed the wall of load-bearing necessity and opened it both to ornament and to large numbers of exterior windows. The vertical emphasis of the building's exterior lines echoed the upward sweep of the steel skeleton. As a result, the exterior of the tall building no longer seemed massive; rather, it might rise with an almost organic lightness into the skies.

The building's real identity depended on the ornamentation that could now be freely distributed across its facade. Ornament was, according to Sullivan, "spirit." The inorganic, rigid, and geometric lines of the steel frame would flow, through the ornamental

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detail that covered it, into "graceful curves," and angularities would "disappear in a mystical blending of surface." Thus, at the top of Sullivan's Bayard Building (**Figs. 481** and **482**)—a New York, rather than a Chicago, building—the vertical columns that rise between the windows blossom in an explosion of floral decoration.

Such ornamentation might seem to contradict completely the dictum for which Sullivan is most famous—"Form follows function." If the function of the urban building is to provide a well-lighted and ventilated place in which to work, then the steel-frame structure and the abundance of windows on the building's facade make sense. But what about the ornamentation? How does it follow from the structure's function? Isn't it simply an example of purposeless excess?

Down through the twentieth century, Sullivan's original meaning has largely been forgotten. He was not promoting a notion of design akin to the sense of practical utility that can be discovered in, for instance, a Model T Ford. For Sullivan, "The function of all functions is the Infinite Creative Spirit," and this spirit could be revealed in the rhythm of growth and decay that we find in nature. Thus, the elaborate, organic forms that cover his buildings were intended to evoke the Infinite. For Sullivan, the primary function of a building was to elevate the spirit of those who worked in it.

Almost all of Sullivan's ornamental exuberance seems to have disappeared in the architecture of Frank Lloyd Wright, whom many consider the first truly modern architect. But from 1888 to 1893, Wright worked as chief draftsman in Sullivan's Chicago firm, and Sullivan's belief in the unity of design and nature can still be understood as instrumental to Wright's work. In an article written for the *Architectural Record* in 1908, Wright emphasized that "a sense of the organic is indispensable to an architect," and as early as the 1890s, he was routinely "translating" the natural and the organic into what he called "the terms of building stone."

Fig. 481 Louis H. Sullivan, *Bayard (Condict) Building,* New York, 1897–98.
© Angelo Hornak / Corbis.

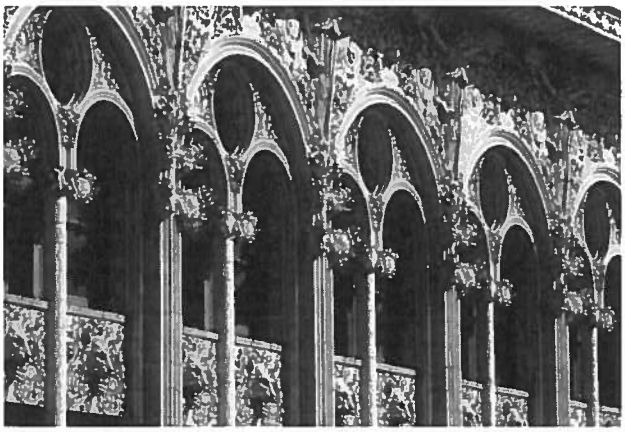

Fig. 482 Louis H. Sullivan, *Bayard (Condict) Building,* exterior detailing, New York, 1897–98.
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Fig. 483 Frank Lloyd Wright, *Robie House,* South Woodlawn, Chicago, Illinois, 1909.
Heidrich Blessing / Chicago Historical Society.

The ultimate expression of Wright's intentions is the so-called Prairie House, the most notable example of which is the Robie House in Chicago, designed in 1906 and built in 1909 (**Figs. 483** and **484**). Although the house is contemporary in feeling—with its wide overhanging roof extending out into space, its fluid, open interiors, and its rigidly geometric lines—it was, from Wright's point of view, purely "organic" in conception.

Wright spoke of the Prairie House as "of" the land, not "on" it, and the horizontal sweep of the roof and the open interior space reflect the flat expanses of the Midwestern prairie landscape. Alternatively, in a different environment, a house might reflect the cliffs of a Pennsylvania ravine (see *Works in Progress*, on p. 366). The **cantilever**, a horizontal form supported on one end and jutting out into space on the other, was made possible by newly invented steel-and-reinforced-concrete construction techniques. Under a cantilevered roof, one could be simultaneously outside and protected. The roof thus ties together the interior space of the house and the natural world outside. Furthermore, the house itself was built of materials—brick, stone, and wood, especially oak—native to its surroundings.

The architectural innovations of Wright's teacher, Louis Sullivan, led directly to the skyscraper. It is the sheer strength of steel that makes the modern skyscraper a reality. Structures with stone walls require thicker walls on the ground floor as they rise higher. A 16-story building, for instance, would require ground-floor walls approximately 6 feet thick. But the steel cage, connected by floors made of **reinforced concrete**—concrete in which steel reinforcement bars, or **rebars**, are placed to both strengthen and make concrete less brittle—overcomes this necessity.

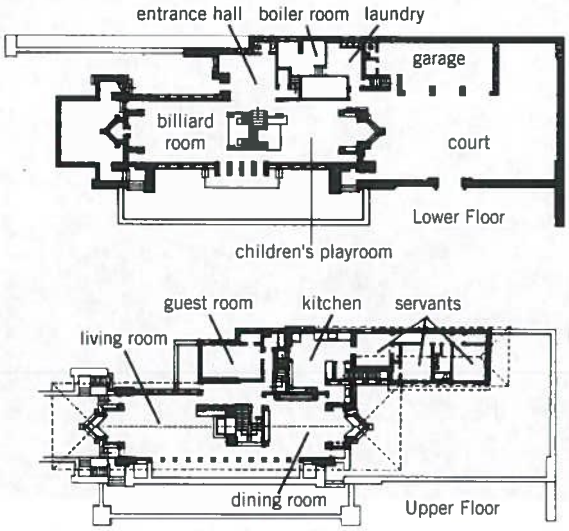

Fig. 484 Frank Lloyd Wright, Plan of the Robie House.

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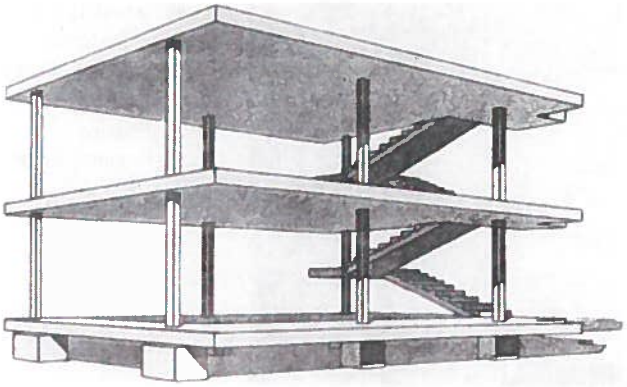

Fig. 485 Le Corbusier, Perspective drawing for Domino Housing Project, 1914. French Embassy.

The simplicity of the resulting structure can be seen clearly in French architect Le Corbusier's 1914 drawing for the Domino Housing Project (**Fig. 485**). The design is almost infinitely expandable, both sideways and upward. Any combination of windows and walls can be hung on the frame. Internal divisions can be freely designed in an endless variety of ways, or, indeed, the space can be left entirely open. Even the stairwell can be moved to any location within the structural frame.

In 1932, Alfred H. Barr, Jr., a young curator at the Museum of Modern Art in New York City, who would later become one of the most influential historians of modern art, identified Le Corbusier as one of the founders of a new "International Style." In an exhibition on "Modern Architecture," Barr wrote:

> *Slender steel posts and beams, and concrete reinforced by steel have made possible structures of skeletonlike strength and lightness. The modern architect working in the new style conceives of his building . . . as a skeleton enclosed by a thin light shell. He thinks in terms of volume—of space enclosed by planes and surfaces—as opposed to mass and solidity. This principle of volume leads him to make his walls seem thin flat surfaces by eliminating moldings and by making his windows and doors flush with the surface.*

Taking advantage of the strength of concrete-and-steel construction, Le Corbusier lifted his houses on stilts (**Fig. 486**), thus creating, out of the heaviest of materials, a sense of lightness, even flight. The entire structure is composed of primary forms (that is, rectangles, circles, and so on). Writing in his first book, *Towards a New Architecture*, translated into English in 1925, Le Corbusier put it this way: "Primary forms are beautiful forms because they can be clearly appreciated." "A house," he said, "is a machine for living in!"—functional and precise, with no redundant parts.

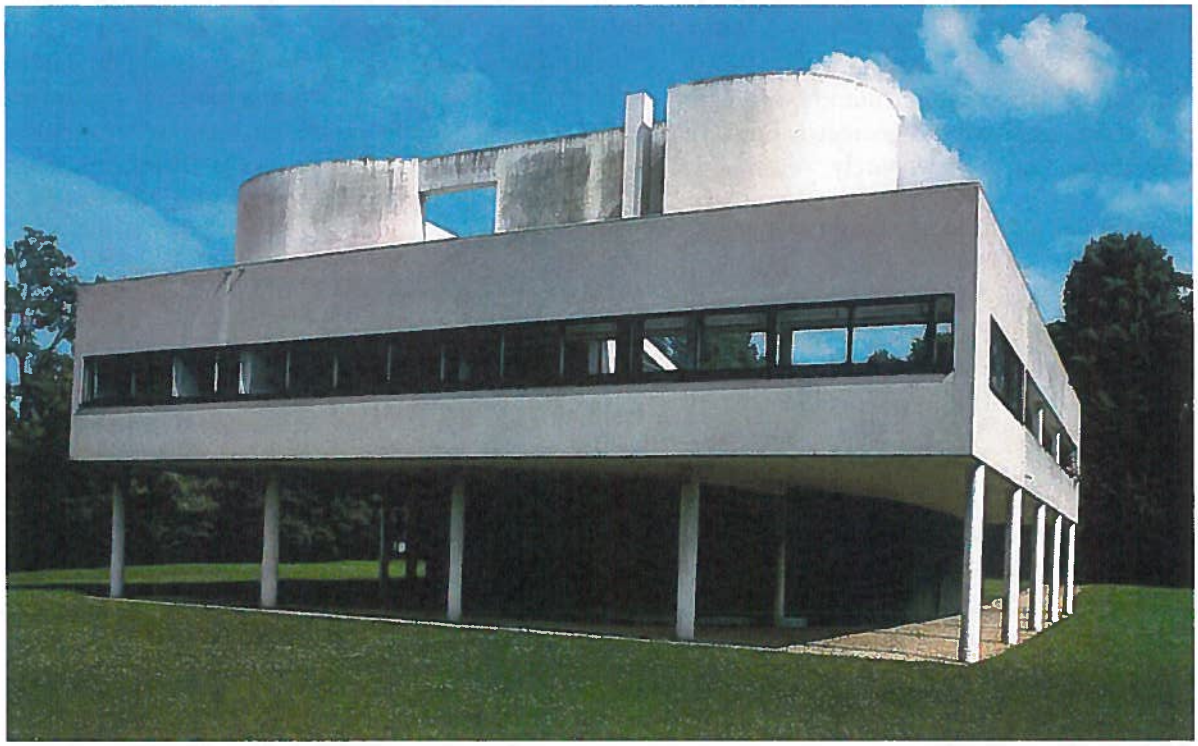

Fig. 486 Le Corbusier and Jeanneret, *Villa Savoye*, Poissy-sur-Seine, France, 1928–30.
© Anthony Scibilia Solidus. Art Resource, NY. © 2007 Artists Rights Society (ARS), New York / ADAGP, Paris / FLC.

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Works in Progress

Fallingwater (**Fig. 488**), Frank Lloyd Wright's name for the house he designed for Edgar and Lillian Kaufmann in 1935, is arguably the most famous modern house in the world. Edgar Kaufmann was owner of Kaufmann's Store in Pittsburgh, the largest ready-made men's clothing store in the country, and his son had begun to study with Wright in 1934. In November of that year, Wright first visited the site. There are no known design drawings until the following September. Writing a few years before about his own design process, Wright stated that the architect should "conceive the building in the imagination, not on paper but in the mind, thoroughly—before touching paper. Let it live there—gradually taking more definite form before committing it to the draughting board. When the thing lives for you, start to plan it with tools. Not before. . . . It is best to cultivate the imagination to construct and complete the building before working on it with T-square and triangle."

The first drawings were done in two hours when Kaufmann made a surprise call to Wright and told him he was in the neighborhood and would like to see something. Using a different colored pencil for each of the house's three floors on the site plan, Wright completed not only a floor plan, but a north-south cross-section and a view of the exterior from across the stream (**Fig. 487**). The drawings were remarkably close to the final house.

Wright thought of the house as entirely consistent with his earlier Prairie Houses. It was, like them, wedded to its site, only the site was markedly different. The reinforced concrete cantilevers mirrored the natural cliffs of the hillside down and over which the stream, Bear Run, cascades. By the end of 1935, Wright had opened a quarry on the site to extract local stone for the house's construction.

Meanwhile, the radical style of the house had made Kaufmann nervous. He hired engineers to

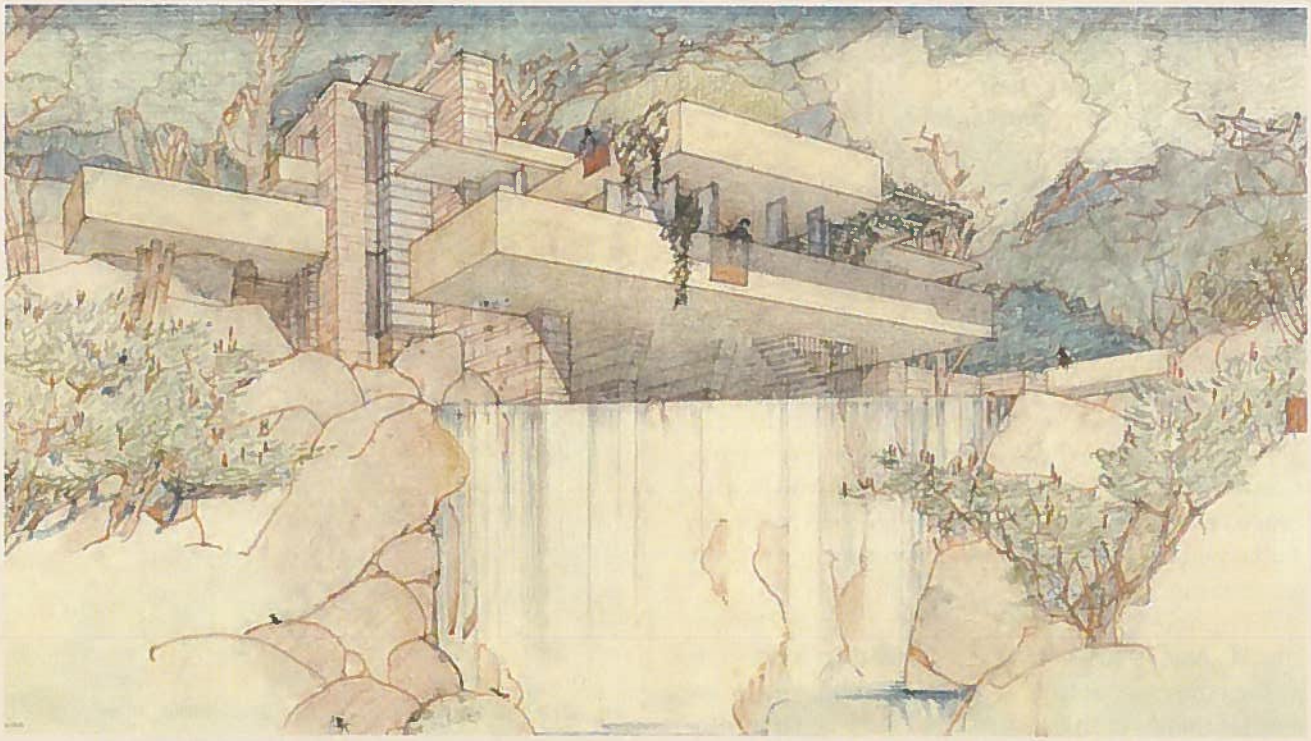

Fig. 487 **Frank Lloyd Wright**, drawing for *Fallingwater*, Kaufmann House, Bear Run, Pennsylvania, 1936. 15⅜ × 27¼ in. The Frank Lloyd Wright Archives.

Frank Lloyd Wright drawings are © 1959, 1994, 1997, 2004 The Frank Lloyd Wright Foundation, Scottsdale, Arizona.

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Frank Lloyd Wright's *Fallingwater*

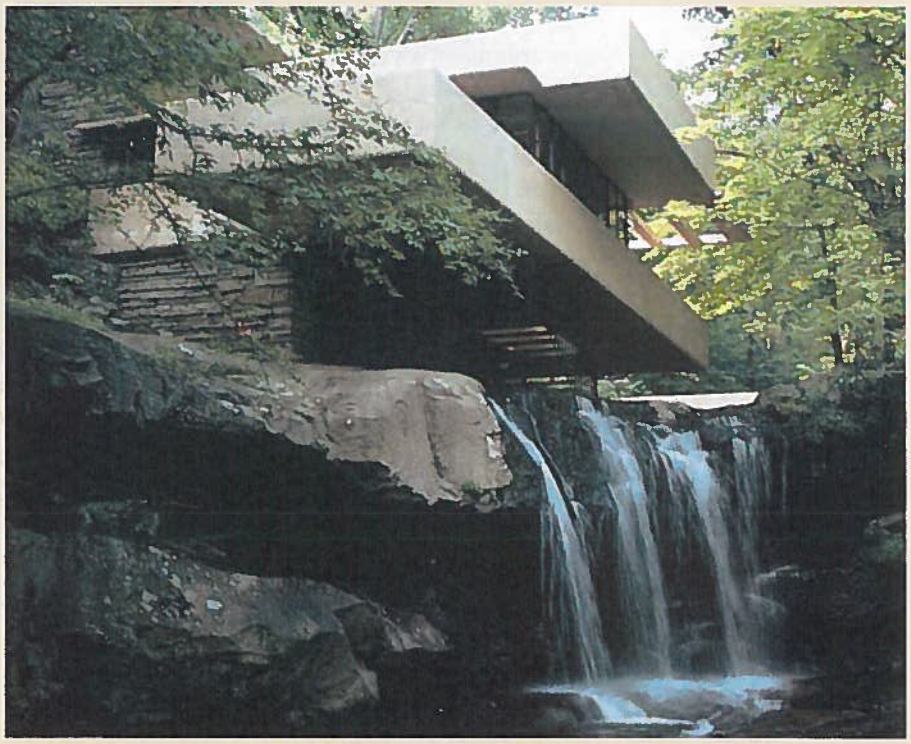

Fig. 488 Frank Lloyd Wright, *Fallingwater,* Kaufmann House, Bear Run, Pennsylvania, 1936.
Western Pennsylvania Conservancy / Art Resource, NY.

review Wright's plan, and they were doubtful that reinforced concrete could sustain the 18-foot cantilevers that Wright proposed. When Kaufmann sent the engineers' reports to Wright, Wright told him to return the plans to him "since he did not deserve the house." Kaufmann apologized for his lack of faith, and work on the house proceeded.

Still, the contractor and engineer didn't trust Wright's plans for reinforcing the concrete for the cantilevers, and before the first slab was poured, they put in nearly twice as much steel as Wright had called for. As a result, the main cantilever droops to this day. Wright was incensed that no one trusted his calculations. After the first slab was set, but still heavily braced with wooden framing (**Fig. 489**), Wright walked under the house and kicked a number of the wooden braces out.

The house, finally, is in complete harmony with its site. "I came to see a building," Wright wrote in 1936, as the house was nearing completion, "primarily . . . as a broad shelter in the open, related to vista; vista without and vista within. You may see in these various feelings, all taking the same direction, that I was born an American, child of the ground and of space."

Fig. 489 Frank Lloyd Wright, *Fallingwater scaffolding,* from the Fallingwater Collection at the Avery Architectural and Fine Arts Library, Columbia University, New York.
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Fig. 490 **Ludvig Miës van der Rohe**, *Farnsworth House*, Fox River, Plano, Illinois, 1950.
© 2007 Artists Rights Society (ARS), New York / VG Bild-Kunst, Bonn.

Fig. 491 **Miës van der Rohe and Philip Johnson**, *Seagram Building*, New York City, 1958.
Photo: Ezra Stoller. © Esto. All rights reserved. Esto Photographics, Inc. © 2007 Artists Rights Society (ARS), New York / VG Bild-Kunst, Bonn.

For Barr, Ludvig Miës van der Rohe was the other great innovator of the International Style. His Farnsworth House (**Fig. 490**), which was built in 1950, opens itself to its surroundings. An homage to Le Corbusier's Villa Savoye, the house is virtually transparent—both opening itself out into the environment and inviting it in.

But the culmination of Le Corbusier's steel-and-reinforced-concrete Domino plan is the so-called International Style skyscraper, the most notable of which is the Seagram Building in New York City (**Fig. 491**), a collaboration between Miës van der Rohe and Philip Johnson. Johnson is the architect whose design for the College of Architecture at the University of Houston opened this chapter and who, in 1932, had written the foreword to Barr's "Modern Architecture" catalogue. The **International Style** is marked by its austere geometric simplicity, and the design solution presented by the Seagram Building is extremely elegant. The exposed structural I-beams (that is, steel beams that seen in cross-section look like the capital letter "I") are finished in bronze to match the amber-tinted glass sheath. At the base, these exterior beams drop, unsheathed, to the courtyard, creating an open-air steel colonnade around a recessed glass lobby. New York law requires that buildings must conform to a "setback" restriction: Buildings that at ground level occupy an entire site must stagger-step inward as they rise in order to avoid "walling-in" the city's inhabitants. But the Seagram Building occupies less than one-half its site, and as a result, it is free to rise vertically out of the plaza at its

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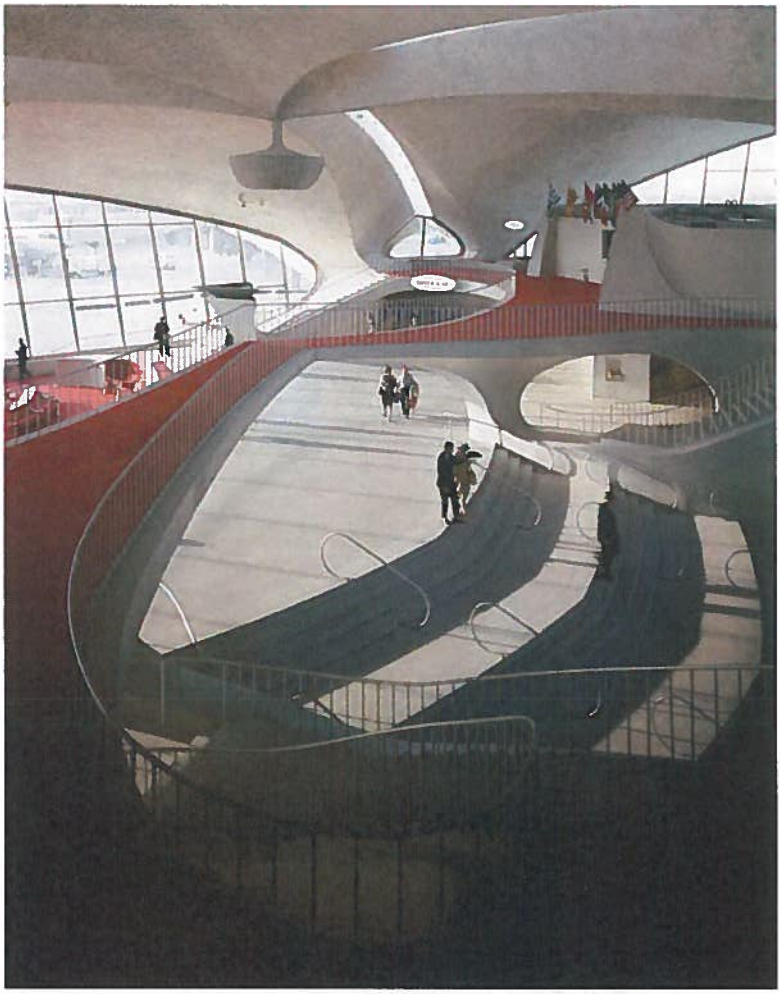

Fig. 492 **Eero Saarinen**, TWA Terminal, John F. Kennedy International Airport, New York, 1962.
Photo: Ezra Stoller. © Esto. All rights reserved. Esto Photographics, Inc.

base. At night, the lighted windows activate the building's exterior, and by day, the surface of the opaque glass reflects the changing world around the building.

Rejecting the International Style's emphasis on primary geometric forms, the architecture of Eero Saarinen demonstrates how steel and reinforced concrete construction can be utilized in other ways. One of his most successful buildings is the TWA Terminal at Kennedy International Airport in New York (**Figs. 492** and **493**), designed in 1956 and completed after his death in 1961. It is defined by a contrast between the openness provided by the broad expanses of window and the sculptural mass of the reinforced concrete walls and roof. What results is a constant play of light and shadow throughout the space. The exterior—two huge concrete wings that appear to hover above the runways—is a symbolic rendering of flight.

Increasingly, contemporary architecture has largely become a question of creating distinctive buildings that stand out in the vast sameness of the "world metropolis," the vast interconnected fabric of places where people "do business," and among which they travel, the hubs (all served by airports) of today's mobile society. It is also a question of creating buildings of distinction—contemporary architecture is highly competitive. Most major commissions are competitions, and most cities compete for the best, most distinctive architects.

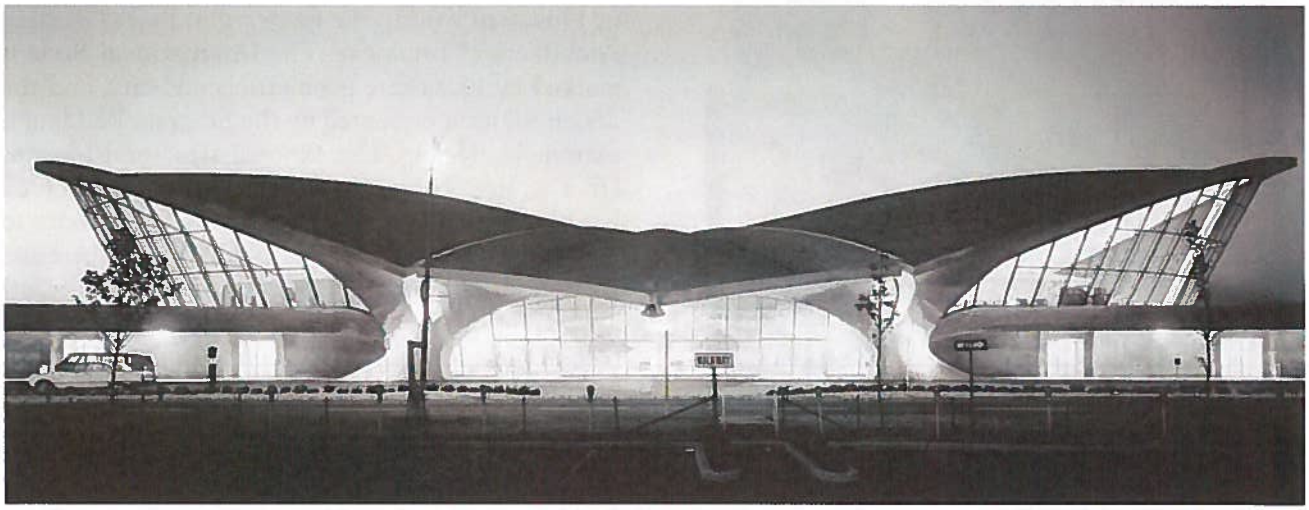

Fig. 493 **Eero Saarinen**, TWA Terminal, John F. Kennedy International Airport, New York, 1962.
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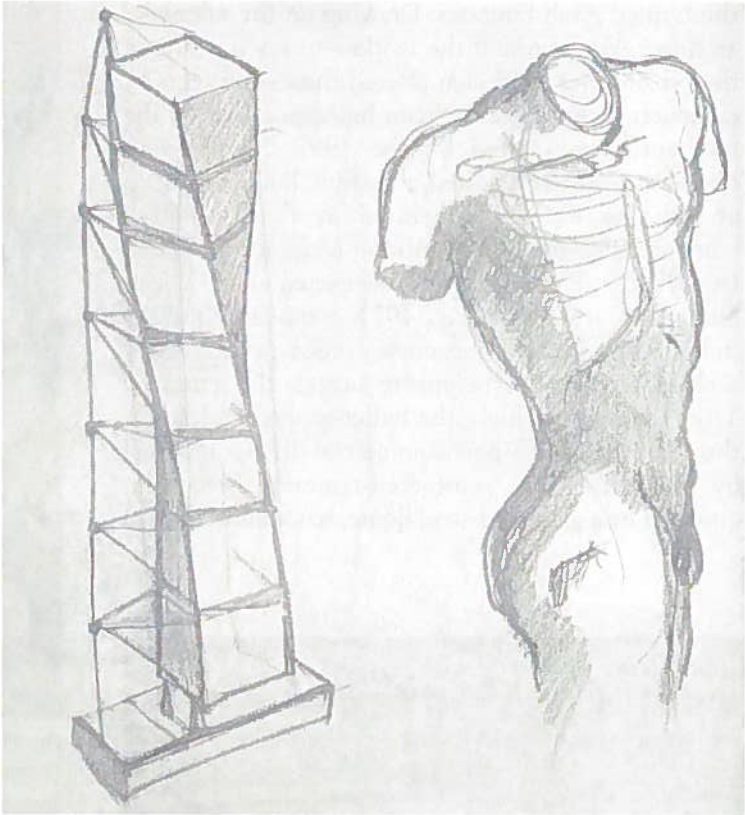

Fig. 494 and 495 Santiago Calatrava, *Turning Torso Residential Tower,* Malmø, Sweden, 2005, and drawing, © 2000.
Photo: Courtesy of Barbara Burg, Oliver Schuh / Palladium Photodesign. Drawing: © Santiago Calatrava.

One of the most successful architects in these international competitions has been Spaniard Santiago Calatrava. Known especially for the dynamic curves of his buildings and bridges, his commissions include the Athens Olympics Sports Complex (2001–2004), the extraordinary Tenerife Opera House (2003), and the equally extraordinary Turning Torso residential tower in Malmø, Sweden (**Fig. 494**). Based on the model of a twisting body (**Fig. 495**), it consists of nine cubes, twisting 90 degrees from bottom to top, and rising to a rooftop observation deck with vistas across the Øresund strait to Copenhagen. At 54 stories, it is the tallest building in Sweden.

The Asian city is particularly intriguing to postmodern architects because, much more than the American city, where, by and large, people don't live where they work, Asian cities possess a much greater "mix" of functions and scales, tall buildings that rise in the midst of jumbled smaller structures that seem to change rapidly almost from one day to the next. One of the most intriguing new projects in Asia is the work of the Rotterdam-based Office for Metropolitan Architecture (OMA), headed by Rem Koolhaas. Since 1995, Koolhaas has been a professor at Harvard University, where he is leading a series of research projects for Harvard's "Project on the City," a student-based research group whose recent projects include a study of five cities in the Pearl River Delta of China, and "Shopping," an analysis of the role of retail consumption in the contemporary city. His OMA firm's most recent work includes the new Museum of Modern Art in New York, the new Seattle Public Library, and Central China Television's headquarters (**Fig. 496**), completed for the Beijing Olympics in 2008. The CCTV tower is 750 feet high, an icon for the Olympics themselves. But, perhaps in keeping with the international spirit of the Games, it possesses many identities. As Koolhaas explained to an interviewer in 2008 just as the tower was coming to completion: "It looks different from every angle, no matter where you stand. Foreground and background are constantly shifting. We didn't create a single identity, but 400 identities. That was what we wanted: To create ambiguity and complexity, so as to escape the constraints of the explicit."

Probably no two countries in the world, however, have defined themselves more as centers of international architectural experimentation than Spain and

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the United Arab Emirates. Drawing on the talents of architects from around the world—to say nothing of the possibilities for design offered these architects by computer technologies—Spain has capitalized on the momentum generated by the 1992 Olympics in Barcelona, which required a massive building effort, and the excitement generated by Frank Gehry's computer-designed Guggenheim Museum in Bilbao (see *Works in Progress*, p. 372), completed in 1997. Jean Nouvel's Torre Agbar (**Fig. 497**), completed in 2005 in Barcelona, is just one example of the new innovative architecture that is erupting across the country. Thirty-one stories high, the bullet-shaped building is the centerpiece of a new commercial district planned by the city. The reinforced-concrete structure, crowned by a glass-and-steel dome, has a multicolored facade of aluminum panels, behind glass louvers, in 25 different colors. There are 4,400 windows and 56,619 transparent and translucent glass plates. The louvers are tilted at different angles calculated to deflect the direct sunlight. At night, 4,500 yellow, blue, pink, and red lights, placed over the facade, illuminate the entire tower.

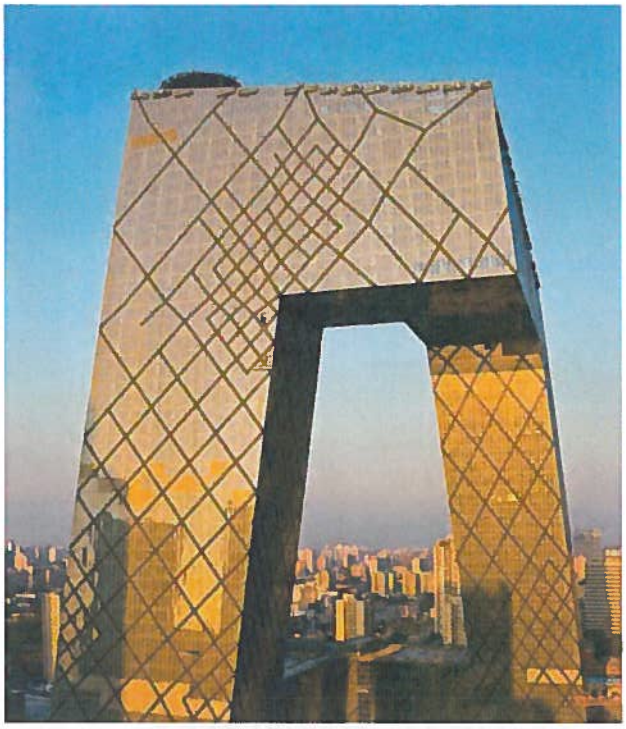

Fig. 496 Rem Koolhaas and Ole Scheeren, *OMA, New Headquarters, Central Chinese Television CCTV,* Beijing, China, 2008.
Photo courtesy of OMA / Ole Scheeren and Rem Koolhaas.

Fig. 497 Jean Nouvel/Ateliers, Jean Nouvel with b720 Arquitectos, *Torre Agbar,* Barcelona, 2005.
Lighting design by Yann Kersalé.
Photo © Roland Halbe.

Dubai, in the United Arab Emirates, is the most rapidly growing city in the world, so much so that in 2008 Rem Koolhaas was commissioned by a Dubai-based developer to propose a 1.5-billion-square-foot Waterfront City that would approximate the density of Manhattan on an artificial island surrounded by water from the Persian Gulf channeled into canals dug out of the desert. Koolhaas has conceived of the island as a perfect square, with the tallest towers concentrated along its southern edge to shield the interior blocks from the hot desert sun.

Koolhaas's extravagant project is in keeping with the architectural ambitions of Dubai itself. As of 2008, the city boasted 390 completed high-rise buildings, 313 more under construction, and yet another 445 approved for construction. The tallest of these—indeed the tallest free-standing structure in the world at 2,684 feet (more than twice as high

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Works in Progress

Frank Gehry's ***Guggenheim Museum Bilbao***

"I start drawing sometimes," architect Frank Gehry has said, "not knowing exactly where I am going. I use familiar strokes that evolve into the building. Sometimes it seems directionless, not going anywhere for sure. It's like feeling your way along in the dark, anticipating that something will come out usually. I become voyeur of my own thoughts as they develop, and wander about them. Sometimes I say 'boy, here it is, here it is, it's coming.' I understand it. I get all excited."

Gehry's early drawings of the north, riverfront facade for the Guggenheim Museum in Bilbao, Spain (**Fig. 498**), executed only three months after he had won the competition to design the building in 1991, reveal his process of searching for the form his buildings eventually take. These semiautomatic "doodles" are explorations that are surprisingly close to Gehry's finished building (**Fig. 500**). They capture the fluidity of its lines, the flowing movement of the building along the riverfront space.

Gehry moves quickly from such sketches to actual scale models. The models, for Gehry, are like sculpture: "You forget about it as architecture, because you're focused on this sculpting process." The models, finally, are transformed into actual buildings by means of Catia, a computer program originally developed for the French aerospace industry (**Fig. 499**). This program demonstrated to builders, contractors—and the client—that Gehry's plan was not only buildable, but affordably so.

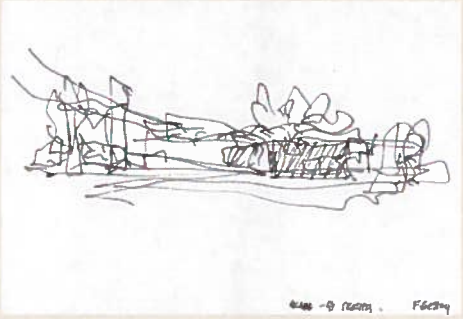

Fig. 498 Frank Gehry, *Guggenheim Museum Bilbao, north elevations, October 1991.*
Sketch by Frank Gehry, 1991.
© Frank O. Gehry & Associates.

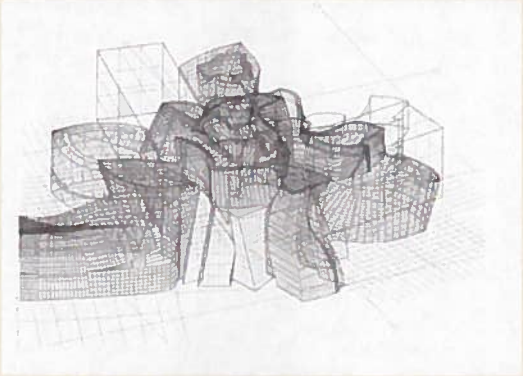

Fig. 499 Frank Gehry, *Guggenheim Museum Bilbao.*
© Gehry Partners, LLP.

Fig. 500 Frank Gehry, *Guggenheim Museum Bilbao,* 1997.
© The Solomon R. Guggenheim Foundation, New York.
Photo: David Heald.

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as the Empire State Building)—is the Burj Dubai (**Fig. 501**). *Burj* is Arabic for "tower," and this tower is the centerpiece of yet another real-estate development that will include 30,000 homes, 9 hotels, over 7 acres of parkland, at least 19 residential towers, the Dubai Mall, and a 30-acre man-made lake. Designed by Adrian Smith of the New York architecture firm Skidmore, Owings & Merrill, the structure is scheduled to open in the fall of 2009.

But perhaps the gem of Dubai is the Burj Al-Arab (**Fig. 502**), a luxury hotel perched on its own island like some enormous wind-filled sail in the blue waters of the Persian Gulf. Designed by British architect Tom Wills-Wright, the hotel rises over the Gulf some 1,053 feet. Its main lobby rises over 500 feet, high enough to accommodate the Statue of Liberty. Essentially a glass tower, its windows are covered by a double-knit Teflon fabric that reflects over 70 percent of the light and heat from the outside. A round cantilevered helipad, which also serves as the world highest tennis court, extends off the front of the building from the twenty-eighth floor.

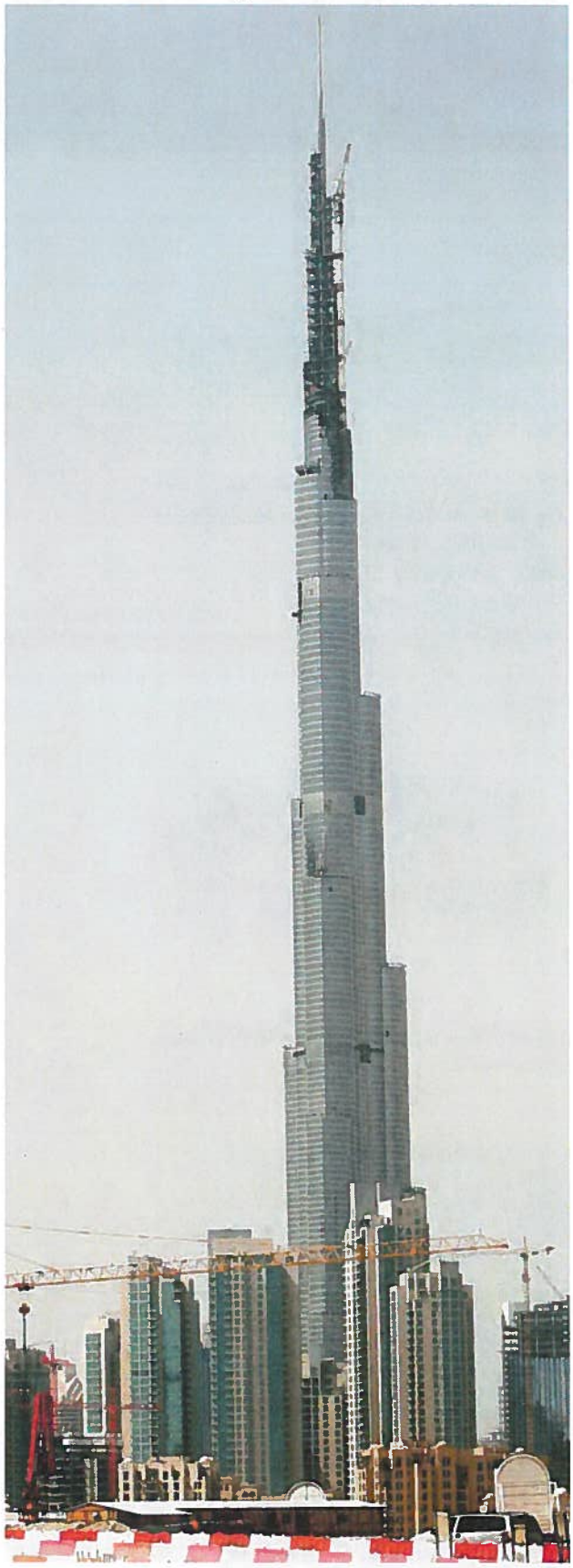

Fig. 501 **Adrian Smith, and Skidmore, Owings & Merrill,** Burj Dubai, Dubai, United Arab Emirates, under construction, October 26, 2008.

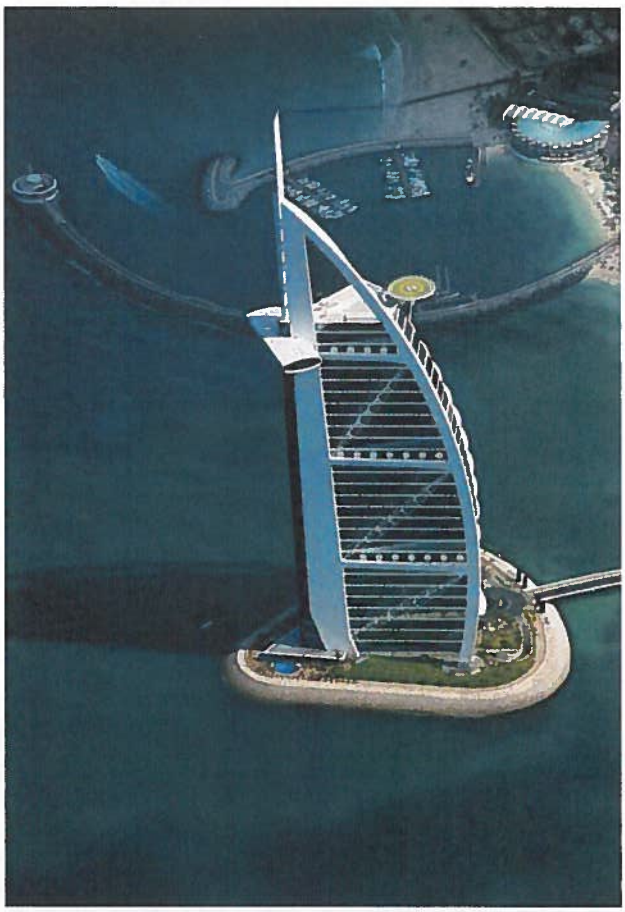

Fig. 502 **Tom Wills-Wright,** Burj Al-Arab, Dubai, United Arab Emirates, 1999.

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"GREEN" ARCHITECTURE

Aside from the fact that they take steps to allay, in some measure, the heat of the desert, and thus cut down on energy consumption, the high rises of Dubai are not just monumental, but monumentally at odds with the environment. It is not just that they embody a drive toward a density of population that their desert environs do not seem capable of sustaining, but, situated as they are in the oil-rich Arab world, they could be said to symbolize the unbridled consumption of fossil fuels that has contributed, in no small part, to global warming. In response to the direction in architecture that buildings such as the Dubai towers represent, a different practice, more environmentally friendly and sustainable, has developed—so-called **green architecture**.

One of the masterpieces of green architecture is Renzo Piano's Jean-Marie Tjibaou Cultural Center in New Caledonia (see Fig. 10). As Piano's design suggests, green architecture is characterized by a number of different principles, but usually only some of these principles are realized in a given project:

1) *Smaller buildings*. This represents an attitude that is the very opposite of the Dubai model, and it is no accident that residential architecture, such as the 2,800-square-foot Brunsell Residence designed by Obie Bowman at Sea Ranch, California (**Fig. 503**), has led the way in the development of sustainable, green architecture.
2) *Integration and compatibility with the natural environment*. Although only portions of Bowman's structure are 4 feet underground, he has created a rooftop meadow of the same grass species as the surrounding headlands, thus creating the feeling that the structure is almost entirely buried in the earth. As Bowman explains: "The places we make emphasize their connectedness to the character and quality of the setting and are designed as part of the landscape rather than as isolated objects placed down upon it."
3) *Energy efficiency and solar orientation*. The rooftop meadow on the Sea Ranch house helps to stabilize interior temperatures. In addition, solar collectors capture the sunlight to heat the residence's water, and it is sited specifically to protect the house from the prevailing winds. A south-facing solarium provides winter warmth.
4) *Use of recycled, reusable, and sustainable materials*. One of the contemporary architects most sensitive to the use of "green" materials in construction of new residences is James Cutler. His Bridge House is exemplary (**Fig. 504**). Faced with building a home on a difficult site on Bainbridge Island, Washington, across Puget Sound from Seattle, Cutler chose to build the house over the gully and stream bisecting the site, thus preserving all of the native trees. The house is built entirely of nontoxic materials and wood harvested locally, including pine and cedar. Cutler was even more innovative in his use of materials for Microsoft's Bill Gates at his enormous compound on nearby Lake Washington. The design incorporates sod roofs, vegetation-covered terraces, and solar collectors. When Gates insisted on using the highest-quality wood available, suggesting that Cutler

Fig. 503 Obie Bowman, Brunsell Residence, Sea Ranch, California, 1987.
© Obie Bowman Architect

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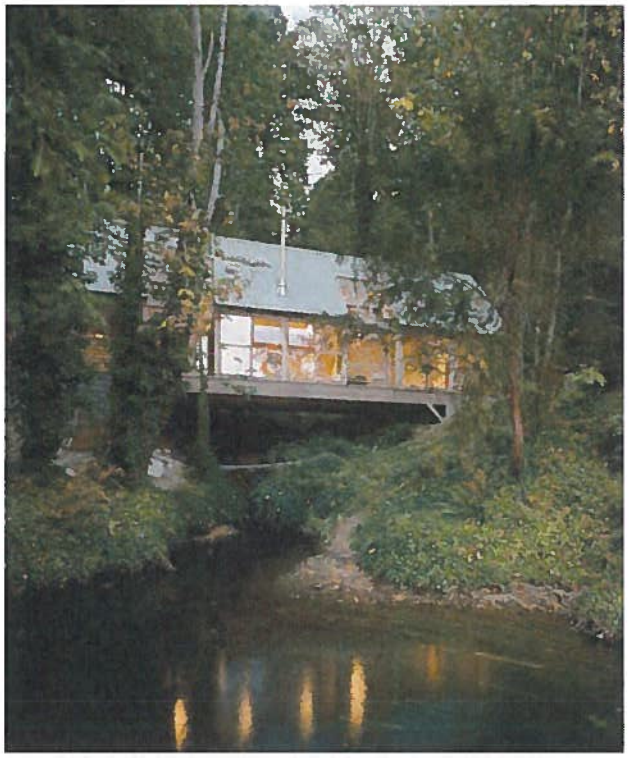

Fig. 504 **James Cutler,** Bridge House, Bainbridge Island, Washington, 1987.
© Peter Aaron / Esto.

look over a nearby forest for premium trees, the architect suggested instead that Gates use salvaged lumber. In response, Gates set up the first heavy-timber recycling sawmill in the world. But Cutler took things further. "If you look at the landscape on Gates's property," he told *Architectural Record*,

> *you'll see it's the first time anybody ever planted an emergent forest. We . . . bought about 100 truckloads of forest floor, before they burned it, and spread it over the property. Plus we planted more than 5,000 red elder you can dig out of ditches for free, and we planted an emergent forest. In about 50 years, this forest will have transformed itself from a big-leaf elder forest to a Douglas fir and cedar forest.*

These principles are, of course, harder to implement in densely populated urban environments. But when the city of Fukuoka, Japan, realized that the only space available for a much-needed government office building was a large two-block park that also happened to be the last remaining green space in the city center, Argentine-American architect Emilio Ambasz presented a plan that successfully maintained, even improved upon, the green space (**Fig. 505**). A heavily planted and pedestrian-friendly stepped terrace, reminiscent of what a Mesopotamian ziggurat might once have looked like (see Fig. 454), descends down the entire park side of the building. Reflecting pools on each level are connected by upwardly spraying jets of water, to create a ladder-like climbing waterfall, which also serves to mask the noise of the city streets beyond. Under the building's 14 terraces lie more than one million square feet of space, including a 2,000-seat theater, all cooled by the gardens on the outside. The building is not entirely green—it is constructed of steel-framed reinforced concrete—and its interior spaces are defined by an unremarkable and bland white that might be found in any modern high-rise office building. Still, the building suggests many new possibilities for reconceptualizing the urban environment in more environmentally friendly terms.

Fig. 505 **Emilio Ambasz,** ACROS Building (Fukuoka Prefecturial International Hall), Fukuoka, Japan, 1989–95.
© Emilio Ambasz & Associates.

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COMMUNITY LIFE

However lovely we find the Seagram Building, the uniformity of its grid-like facade, in the hands of less-skillful architects, came to represent, for many, the impersonality and anonymity of urban life. The skyscraper became, by the 1960s, the embodiment of conformity and mediocrity in the modern world. Rather than a symbol of community, it became a symbol of human anonymity and loneliness.

Nevertheless, the idea of community remains a driving impulse in American architecture and design. Richard Meier's Atheneum (**Fig. 506**), in New Harmony, Indiana, is a tribute to this spirit. New Harmony is the site of two of America's great utopian communities. The first, Harmonie on the Wabash (1814–24), was founded by the Harmony Society, a group of Separatists from the German Lutheran Church. In 1825, Robert Owen, Welsh-born industrialist and social philosopher, bought their Indiana town and the surrounding lands for his own utopian experiment. Owen's ambition was to create a more perfect society through free education and the abolition of social classes and personal wealth. World-renowned scientists and educators settled in New Harmony. With the help of William Maclure, the Scottish geologist and businessman, they introduced vocational education, kindergarten, and other educational reforms.

Meier's Atheneum serves as the Visitors Center and introduction to historic New Harmony. It is a building oriented, on the one hand, to the orderly grid of New Harmony itself, and, on the other, to the Wabash River, which swings at an angle to the city. Thus, the angular wall that the visitor sees on first approaching the building points to the river, and the uncontrollable forces of nature. The glass walls and the vistas they provide serve to connect the visitor to the surrounding landscape. But overall, the building's formal structure recalls Le Corbusier's Villa Savoye (see Fig. 486) and the International Style as a whole. It is this tension between man and nature upon which all "harmony" depends.

Since the middle of the nineteenth century, there have been numerous attempts to incorporate the natural world into the urban context. New York's Central Park (**Fig. 507**), designed by Frederick Law Olmsted and Calvert Vaux after the city of New York acquired the 840-acre tract of land in 1856, is an attempt to put city-dwelling humans back in touch with their roots in nature. Olmsted

Fig. 506 Richard Meier, *Atheneum,* New Harmony, Indiana, 1979.
Digital imaging project.
Photo © Mary Ann Sullivan, sullivanm@bluffton.edu

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Fig. 507 **Frederick Law Olmsted and Calvert Vaux,** *Central Park,* aerial view, New York City, 1857–87.
Steve Proehl / Getty Images, Inc.

developed a system of paths, fields, and wooded areas modeled after the eighteenth-century gardens of English country estates. These estate gardens *appeared* wholly natural, but they were in actuality extremely artificial, with man-made lakes, carefully planted forests, landscaped meadows, meandering paths, and fake Greek ruins.

Olmsted favored a park similarly conceived, with, in his words, "gracefully curved lines, generous spaces, and the absence of sharp corners, the idea being to suggest and imply leisure, contemplativeness and happy tranquility." In such places, the rational eighteenth-century mind had sought refuge from the trials of daily life. Likewise, in Central Park, Olmsted imagined the city dweller escaping the rush of urban life. "At every center of commerce," he wrote, "more and more business tends to come under each roof, and, in the progress of building, walls are carried higher and higher, and deeper and deeper, so that now 'vertical railways' [elevators] are coming in vogue." For Olmsted, both the city itself and neoclassical Greek and Roman architectural features in the English garden offer geometries—emblems of reason and practicality—to which the "gracefully curved" lines of the park and garden stand in counterpoint.

So successful was Olmsted's plan for Central Park that he was subsequently commissioned to design many other parks, including South Park in Chicago and the parkway system of the City of Boston, Mont Royal in Montreal, and the grounds at Stanford University and the University of California at Berkeley. But he perhaps showed the most foresight in his belief that the growing density of the city demanded the growth of what would later become known as the *suburb*, a residential community lying outside but within commuting distance of the city. "When not engaged in business," Olmsted wrote, the worker

> *has no occasion to be near his working place, but demands arrangements of a wholly different character. Families require to settle in certain localities which minister to their social and other wants, and yet are not willing to accept the conditions of town-life . . . but demand as much of the luxuries of free air, space, and abundant vegetation as, without loss of town-privileges, they can be enabled to secure.*

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As early as 1869, Olmsted laid out a general plan for the city of Riverside, Illinois, one of the first suburbs of Chicago (**Fig. 508**), which was situated along the Des Plaines River. The plan incorporated the railroad as the principle form of transportation into the city. Olmsted strived to create a communal spirit by subdividing the site into small "village" areas linked by drives and walks, all situated near common areas that were intended to have "the character of informal village greens, commons, and playgrounds."

Together with Forest Hills in New York, Llewellyn Park in New Jersey, and Lake Forest, also outside of Chicago, Olmsted's design for Riverside set the standard for suburban development in America. The pace of that development was steady but slow until the 1920s, when suburbia exploded. During that decade, the suburbs grew twice as fast as the central cities. Beverly Hills in Los Angeles grew by 2,500 percent, and Shaker Heights outside of Cleveland by 1,000 percent. The Great Depression and World War II slowed growth temporarily, but, by 1950, the suburbs were growing at a rate 10 times that of the cities. Between 1950 and 1960, American cities grew by 6 million people or 11.6 percent. In that same decade, the suburban population grew by 19 million, a rate of 45.6 percent. And, for the first time, some cities actually began to lose population: The populations of both Boston and St. Louis declined by 13 percent.

There were two great consequences of this suburban emigration: first, the development of the highway system, aided as well by the rise of the automobile as the primary means of transportation, and second, the collapse of the financial base of the urban center itself. As early as 1930, there were 800,000 automobiles in Los Angeles—two for every five people—and the city quite consciously decided not to spend public monies on mass transit but to support instead a giant freeway system (**Fig. 509**). The freeways essentially overlaid the rectilinear grid of the city's streets with continuous, streamlined ribbons of highway. Similarly, in 1940, Pennsylvania opened a turnpike that ran the length of the state. Public enthusiasm was enormous, and traffic volume far exceeded expectations. That same year, the first stretches of the Pasadena Freeway opened. Today it is estimated that roads and parking spaces for cars occupy between 60 and 70 percent of the total land area of Los Angeles.

However, not only automobiles but also money—the wealth of the middle class—drove down these highways, out of the core city and into the burgeoning suburbs. The cities were faced with discouraging and destructive urban decline. Most discouraging of all was the demise of the **infrastructure**, the systems that deliver services to people—water supply and waste removal, energy, transportation, and communications. The infrastructure is what determines the quality of city life. If we think about many of the works of art we have studied in this chapter, we can recognize that they were initially conceived as part of the

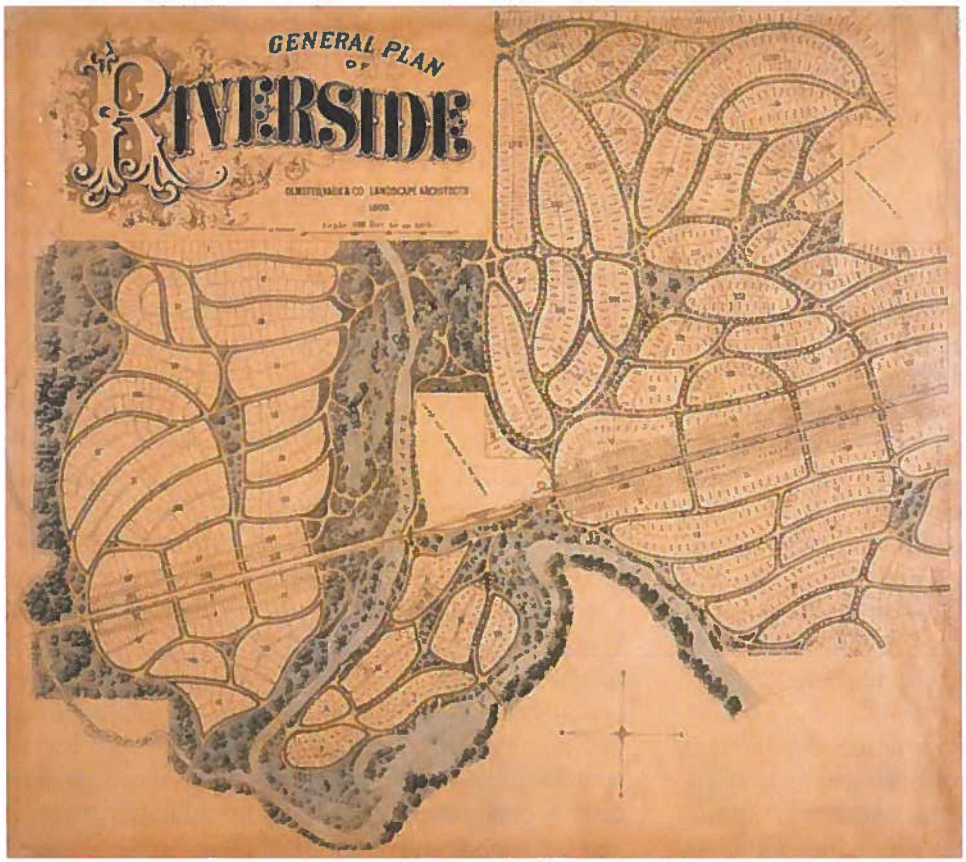

Fig. 508 Olmsted, Vaux & Co., landscape architects, general plan of Riverside, Illinois, 1869.
Frances Loeb Library, Graduate School of Design, Harvard University.

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Fig. 509 Los Angeles Freeway Interchange.
© Ron Chapple / Corbis.

infrastructure of their communities. For example, the Pont du Gard (see Fig. 462) is a water supply aqueduct. Public buildings such as temples, churches, and cathedrals provide places for people to congregate. Even skyscrapers are integral parts of the urban infrastructure, providing centralized places for people to work. As the infrastructure collapses, businesses close down, industries relocate, the built environment deteriorates rapidly, and even social upheaval can follow. To this day, downtown Detroit has never recovered from the 1967 riots and the subsequent loss of jobs in the auto industry in the mid-1970s. Block after block of buildings that once housed thriving businesses lie decayed and unused.

Perhaps one of the most devastating assaults on a city's infrastructure occurred on September 11, 2001, when terrorists brought down the twin towers of the World Trade Center in New York City. Officials needed to find a suitable site for collecting and sorting through the debris. Because it was both convenient to the disaster site and large enough to accommodate the vast amount of debris from the World Trade Center, they chose Fresh Kills Landfill, which had served for years as the city's primary waste disposal site but which was, by 2001, in the process of being reclaimed as park lands, a project directed by artist Mierle Ukeles (see *Works in Progress* on pp. 380–381). Almost immediately after the tragedy, plans were put in place to rebuild the site at Ground Zero, highlighted by an architectural competition. Problems of urban planning were paramount. Transportation issues involving the city's street and subway systems vied with retail and office commercial interests for consideration. But all designs had to address the heavy weight of the site's symbolic significance—the memory of the World Trade Center itself and the people who had worked there.

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Works in Progress

Maintenance has been one of the major themes of Mierle Ukeles's multidisciplinary art. Her seminal 1969 *Manifesto for Maintenance Art* announced her belief that art can reveal, even transform, the discontinuity between society's promise of freedom for all and the unequal effects arising from our need to survive. Survival, she argues, has for too long led to gender, class, and race-based disenfranchisements. If earth is to be our "common home," these inequities must be addressed. Her own personal situation fueled her thinking: "I am an artist. I am a woman. I am a wife. (Random order)," she wrote. "I do a hell of a lot of washing, cleaning, cooking, renewing, supporting, preserving, etc. Also (up to now separately) I 'do' Art. Now I will simply do these maintenance things, and flush them up to consciousness, exhibit them, as Art."

In the first place, Ukeles wanted to challenge the notion of service work—i.e., "women's work"—and make it public. In her 1973 piece *Wash*, she scrubbed the sidewalk in front of A. I. R. Gallery in SoHo, New York, on her hands and knees, with a bucket of water, soap, and rags. In taking personal responsibility for maintaining the "cleanliness" of the area for five hours, she immediately wiped out any tracks made by those innocently passing by, following them, rag in hand, erasing their footsteps right up to the point of brushing the backs of their heels. The often-unstated power-based "social contract" of maintenance was made visible.

The city, she realized, was the ideal site for investigating the idea of maintenance. Maintenance of the city's infrastructure is an invisible process that is absolutely vital, and bringing the invisible to light is one of the artist's primary roles. For her *I Make Maintenance Art One Hour Every Day*, a 1976 project for a branch of the Whitney Museum of American Art located in New York's Chemical Bank Building, Ukeles invited the 300-person maintenance staff in the building, most of whom work invisibly at night, to designate one hour of their normal activities on the job as art, while she inhabited the building for seven weeks documenting their selections and exhibiting them daily.

Soon after, Ukeles became the unsalaried artist-in-residence for the New York City Department of Sanitation. In New York, the collection, transportation, and disposal of waste occurs 24 hours a day, every day of the year but Christmas. Her first piece was *Touch Sanitation*, a performance artwork in which, after one and a half year's preparatory research, she spent 11 months creating a physical portrait of New York City as "a living entity" by facing and shaking the hand of each of the Department's 8,500

Fig. 510 **Mierle Laderman Ukeles,** *Fresh Kills Landfill,* daily operation.
Courtesy Ronald Feldman Fine Arts, Inc., New York.

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Mierle Laderman Ukeles's *Fresh Kills Landfill Project*

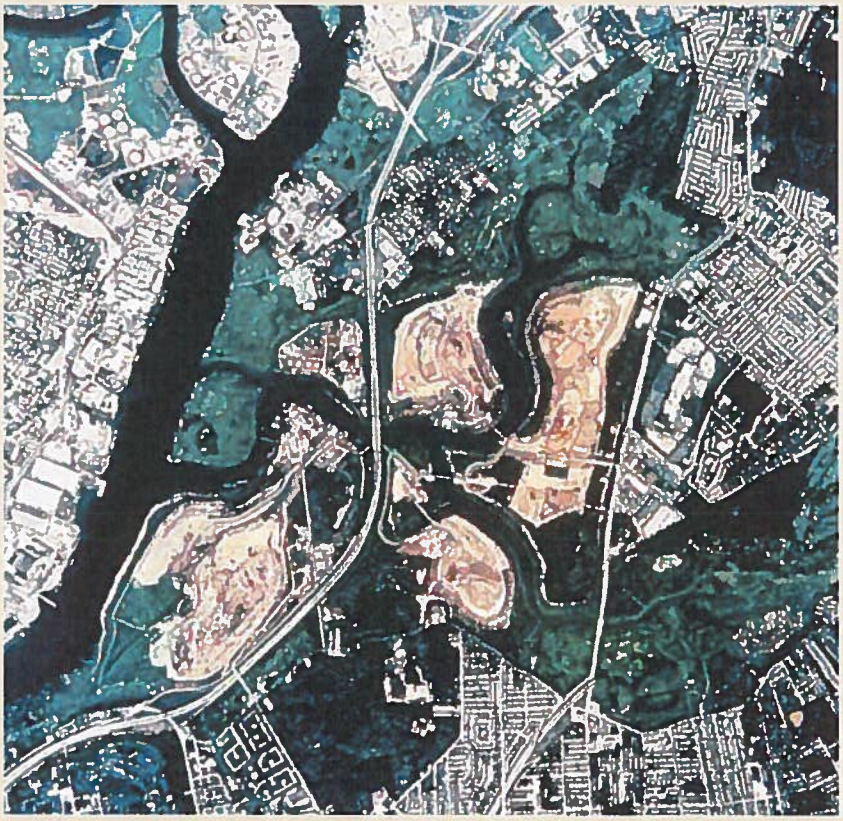

Fig. 511 Mierle Laderman Ukeles, *Fresh Kills Landfill,* aerial view.
Courtesy Ronald Feldman Fine Arts, Inc., New York

employees, saying, "Thank you for keeping New York City alive," and walking thousands of city miles with them. She spent four more years creating an exhibition documenting this journey.

Her most ambitious project for the department is as artist of the Fresh Kills Landfill on Staten Island (**Figs. 510** and **511**), an ongoing collaboration in redesign, begun in 1977, with no end in sight. Landfills, she points out, are the city's largest remaining open spaces, and the Fresh Kills Landfill, at 3,000 acres, is the largest in the United States. She was designated to be part of a team that was to remediate, reshape, transform, and recapture the landfill as healed public space after its closure in 2001. But the events of history intervened in 2002, when Fresh Kills reopened as the repository for the bulk of the material recovered from the World Trade Center disaster of 9/11.

One area of her mega-project is based on re-envisioning the four images of earth that have yielded four traditions of creation. In each, the earth is imaged as female, often as seen by males. Earth as ancient mother, seen in sacred earth mounds, forever nourishes us and sustains us, producing in us an attitude of reverence and devotion. Earth as virgin as seen in early American landscape painting as a virtually uninhabited boundless territory, is, she says, "forever fresh and young . . . available for the taking, producing in us (males) lust and acquisitiveness." Earth as wife is "enticingly wild and equally kempt . . . thoroughly domesticated because adequately husbanded." For her, the perfect image of earth as wife is the artificial wilderness of English landscape and Olmsted. Finally, there is the earth as old sick whore, once free and bountiful and endlessly available, then wasted, used up, dumped, and abandoned. To treat the earth as whore is to pretend that "one has no responsibility for one's actions." In Ukeles's plan for Fresh Kills Landfill, she asks,

> *Can we utilize the beauty of reverence, devotion, awe, craft, science, technology, and love that yielded the first three traditions while eliminating what has been essentially the obsession with domination and control that comes inevitably when one sex has rapacious power over the other, a power that pollutes all four traditions? Or can we simply un-gender our image of earth, so that we can re-invent our entire relationship, to create a new open interdependency in a more free and equal way?*

After 9/11, these questions resonate even more powerfully than before.

WATCH VIDEO Watch Mierle Ukeles as she develops the Fresh Kills Landfill project in the years just preceding 9/11 and considers its relation to her other work in the *Works in Progress* video series.

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Fig. 512 **Santiago Calatrava,** Port Authority Trans Hudson (PATH) station, World Trade Center site, 2004.
Courtesy Santiago Calatrava / Port Authority of New York.

One of the most successful designs submitted for the site is by Santiago Calatrava, the same architect who designed the Twisting Torso Residential Tower in Malmø, Sweden (see Fig. 494). His plan for the Port Authority Trans Hudson (PATH) train station (**Fig. 512**) is based on a sketch that he drew of a child's hands releasing a bird into the air. Calatrava said that the goal of his design was to "use light as a construction material." At ground level, the station's steel, concrete, and glass canopy functions as a skylight that allows daylight to penetrate 60 feet to the tracks below. On nice days, the canopy's roof retracts to create a dome of sky above the station. A total of 14 subway lines will be accessible from the station, and it will also connect to ferry service and airport transportation. The Port Authority sees it as the centerpiece of a new regional transportation infrastructure designed to rejuvenate lower Manhattan.

THE CRITICAL PROCESS

Thinking about Architecture

The attentive reader will have noticed that as this book has progressed it has become increasingly historical in its focus. Perhaps because developments in architecture are so closely tied to advances in technology, this chapter is perhaps the most historical of all, moving as it does from rudimentary post-and-lintel construction to advanced architectural accomplishments made possible by both computer technologies and the ability of architects themselves to move physically and communicate virtually on a global scale.

That said, it must be admitted, as the saying goes, that the more things change, the more things stay the same. The need of humans to dwell in suitable habitats and their desire to congregate in livable communities are timeless impulses. Consider, for instance, a kind of dwelling that has survived from prehistoric

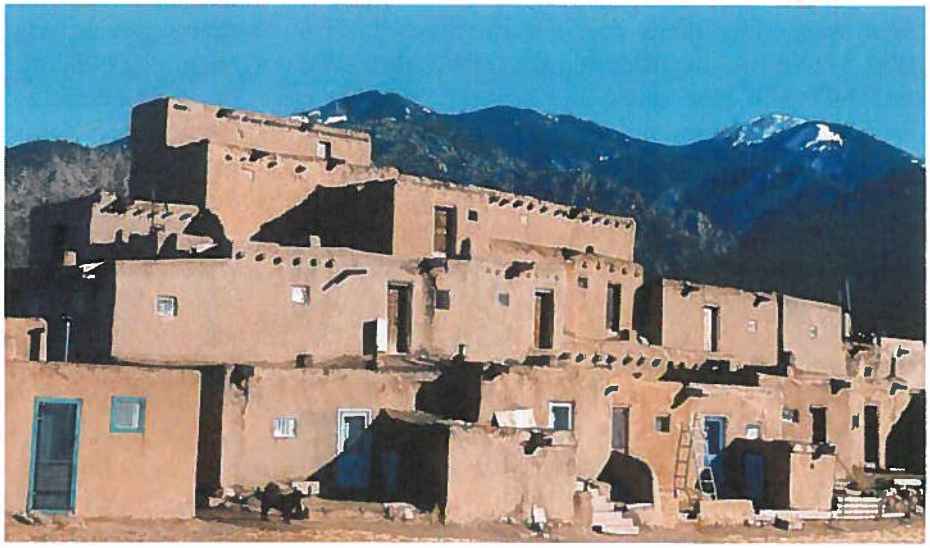

Fig. 513 Multi-story apartment block, Taos Pueblo, New Mexico, originally built 1000–1450.
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Fig. 514 **Moshe Safdie**, Habitat, Montreal, Canada, 1967.
Michael Harding—Arcaid / Corbis.

times to the present, the apartment block. By 7000 BCE, across the Middle East, houses consisting of mud brick and timber stood side by side with abutting walls, often terraced in ways that probably resembled the Native American pueblos of the American Southwest. The main parts of the Taos Pueblo (**Fig. 513**) were most likely constructed between 1000 and 1450 and look today much as they did when Spanish explorers and missionaries first arrived in the area in the sixteenth century. The Pueblo is divided into two apartment blocks, which rise on either side of a vast dance plaza bisected by a stream. The Pueblo's walls, which are several feet thick, are made of **adobe**, a mixture of earth, water, and straw formed into sun-dried mud bricks. The roofs are supported by large wooden beams which are topped by smaller pieces of wood, and the whole roof is then covered with packed dirt. Each of the five stories is set back from the one below, thus forming terraces which serve as patios and viewing areas for ceremonial activities in the dance plaza below.

Taos Pueblo has much in common with Israeli architect Moshe Safdie's Habitat (**Fig. 514**), designed as an experimental housing project for Expo 67, the Montreal World's Fair, but today still serving a community of content residents, most of whom think of themselves as living in Montreal's "most prestigious apartment building." Safdie's design is based on modular pre-fabricated concrete blocks stacked in what Safdie called "confused order" and connected by internal steel cables. Safdie used 354 uniform blocks to make up 158 apartments of from one to four bedrooms. Each apartment has an outdoor living space, generally on the roof of the apartment directly below. The stacks are arranged to maximize privacy, access to views of the St. Lawrence River, and protection from the weather.

In what ways does Safdie's design evoke Southwest Native American pueblos? How does it differ? In what ways is Safdie's design reminiscent of Le Corbusier's Domino Housing Project (see Fig. 485)? How does it differ?

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