skyscrapers

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A Design for the 20th Century

Ever since the late nineteenth century when skyscrapers first appeared in the United States, they have shaped the public's perception of architecture. With their increasing proliferation since the Second World War, they have changed the face of most major cities worldwide. Skyscrapers have replaced church spires as peaks on the skyline and have become new topographical reference points. Economic interests and town-planning issues are usually the main factors behind proposals for their construction. But above and beyond rational economic considerations, skyscrapers have also long been associated with dreams, hopes and utopias that have lead them to aspire to new heights. From the Woolworth Building to the Empire State Building and the World Trade Center, skyscrapers have become a symbol for the seemingly limitless possibilities of architecture, a constantly renewable promise for the future. The numerous record projects that were announced before the dawn of the new millennium point to our enduring faith in the capacity of this design typology to continue to develop. On the other hand, skyscrapers are also associated with all kinds of anxieties, resistance and risks. In the negative mythology of the urban Moloch, the skyscraper became the most important symbol for the loss of individuality and of life on a human scale. In popular culture—from *Metropolis* to Gotham City in *Batman* to *Blade Runner*—skyscrapers always provide the backdrop to the developments threatening our future.

Like the progress in air travel and space exploration in the twentieth century, the evolution of the skyscraper has led to huge advances in technology and engineering, but has also opened up new hitherto unforeseen risks. As in the case of all man-made structures, the greatest danger is, and always has been, the possibility of collapse due to structural defects or natural causes, particularly earthquakes. Our fear of such events goes back a long way. In the Old Testament, the story of the failed Tower of Babel warned against the human hubris of building high into the sky and ignoring the heavenly boundary. For many years, as construction methods and calculations grew ever more precise, the danger of an actual collapse seemed to be an irrational, purely theoretical premise. Yet on September 11th, 2001, with the attacks planned and executed by terrorists, this danger became a harsh reality. The attack on the World Trade Center in New York was also an assault on a built symbol and on the thousands of people from all over the world who were in it at the time. It also naturally raised the question as to whether such tall skyscrapers should ever be built again in the future. For these structures can never guarantee the occupants absolute security in the face of attacks of this kind. Yet, in just the same way that a single plane crash does not hold back the continuation and expansion of global air traffic, the attack on the World Trade Center has not fundamentally called into question this particular building design. In an age when more than half of the world's population is already living in large towns and cities, the increasing density of the way we work and live in urban centers makes the continued construction of

Pieter Bruegel the Elder, *The Building of the Tower of Babel*, 1563, Kunsthistorisches Museum, Vienna

Erich Kettelhut, scenery for the film *Metropolis* by Fritz Lang, 1927

skyscrapers inevitable. In fact, the nature and location of most of the plans for new skyscrapers since September 2001—new and existing projects throughout the world—rob any possible future attacks of the supposed ideological justification of 9/11.

The extent to which the skyscraper is not purely functional, beholden to the demands of the economy, but is also a symbolic structure, was widely known long before 9/11. Yet, it was only this catastrophe that showed just how much it was the repository of the central tenets and values of a culture that was viewed as a threat by those who either did not or did not want to share the same values. Even so, it was already becoming clear before 2001 that the hitherto virtually unlimited hegemony of the American skyscraper was rapidly being ousted by new record-breaking projects in the countries of Asia. Of the twenty tallest buildings in the world, there are now only six in the United States; the majority are currently in Asia and were constructed within the last ten years.

History

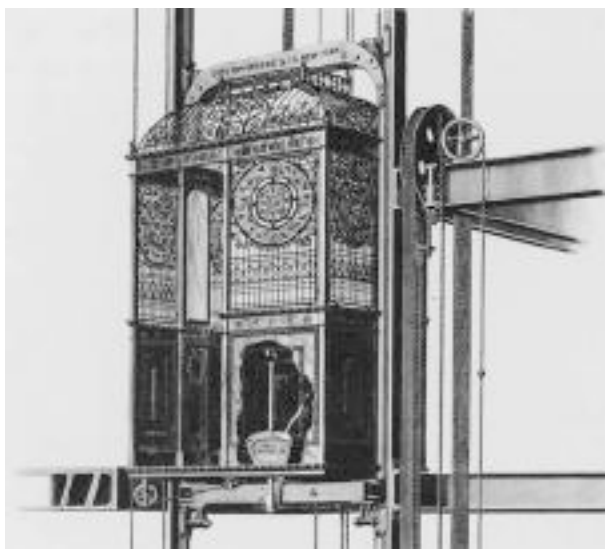
The development of the skyscraper was crucially influenced by two seemingly independent factors. The indispensable given was the free-standing, load-bearing iron skeleton, which was later replaced by an even stronger steel frame. The self-supporting iron frame, already developed in England in the first half of the nineteenth century, was further advanced in France after 1850, by the French engineer Gustave Eiffel, amongst others. His ground-breaking invention of a riveted iron construction reached the United States in 1885 with his design for the internal support structure for the Statue of Liberty. And news of his plans for a 984-foot (300-meter) tower for the 1889 World Exhibition in Paris was seen as a direct challenge by American engineers. By 1888 the architect Leroy S. Buffington from Minneapolis had patented a skeleton construction—called the "Cloudscraper"—which could accommodate up to twenty-eight floors.

Since it was practically impossible to find tenants for offices and apartments above the fourth or the fifth floor because of the tedious climb up the stairs to the higher floors, the invention of the elevator was the second factor underpinning the establishment of the skyscraper. Mechanical elevators as such had been known long before the nineteenth century, but it was only in 1853 when Elisha Graves Otis presented a passenger elevator guaranteed not to plunge suddenly downwards, that it became possible for people to travel upwards in

safety and comfort. In 1857 the first passenger elevator was built into a five-story New York office building. However, the hydraulic system used to power these elevators—still being used in the Flatiron Building as late as 1903—could only achieve very slow speeds. In 1880 Werner von Siemens in Germany demonstrated the first electrically powered elevator. In 1889 the first electric elevator system was installed in an office block in New York. Improvements in the technology soon opened the way to the ever faster vertical conquest.

However, besides these important technical and structural factors, there was a third (economic) catalyst. After the devastating fire of 1871 in the center of Chicago, there was a surge in the demand for office space. Sites in the city center were expensive, and investors expected maximum usage. Increasing the number of floors meant a higher return on investments. It was only the building boom in Chicago in the 1880 combined with the intense financial pressures and the exploitation of the new construction methods that made it possible for the skyscraper to evolve so quickly.

The Home Insurance Building in Chicago (1885), designed by the architect William Le Baron Jenney, is generally regarded as the first tall building of this kind. Its crucial difference lies in its construction. Iron constructions had already been used in walls to reinforce the load-bearing brick walls. Jenney went a step further and now used the steel frame to support the masonry walls, although this decisive step in construction methods was not yet visible from the outside. The building looked like a Renaissance palace that had been extended in all directions. But from now on, buildings could rise ever higher without increasing the thickness of the walls. The ten-story Home Insurance Building was soon overtaken in 1889 by the fourteen-story Tacoma Building, also in Chicago. Freed of its load-bearing function, the facade—with its dynamic design and tall windows breaking up the wall surface—points very clearly to the new possibilities. By 1892 the Masonic Temple in Chicago, with its twenty-two floors and 302 feet (92 meters) height, was the tallest building of its time and the first to be publicly known as such. In 1895 the Reliance Building (p. 30) went even further in this same direction.



Passenger elevator by Otis Brothers & Co., New York, around 1900

William Le Baron Jenney, Home Insurance Building, Chicago, 1885, demolished 1931

Burnham and Root, Masonic Temple, Chicago, 1891–92, demolished 1939

Louis Sullivan, Dankmar Adler, Wainwright Building, St. Louis, 1890–91

While the unstoppable structural and technical advances saw tall buildings reaching ever greater heights, the teaching and theory of architecture were not prepared for the arrival of this new structural design. Initially, the designs conformed to the conventional patterns of palace architecture. In other words, skyscrapers were already quite tall, but without their height becoming a feature of the design. Similarly, in the early days the new possibilities of construction—above all the liberation of the facade from its load-bearing requirement—had virtually no influence on the overall appearance. When it first started to evolve, there were as yet no theories relating to this new structural design. Accordingly, Louis Sullivan started to formulate a theory to match the architectural potential of the skyscraper. He wrote: "It must be tall, every inch of it tall. The force and power of altitude must be in it, the glory and pride of exaltation must be in it. It must be every inch a proud and soaring thing, rising in sheer exultation that from bottom to top is a unit without a single dissenting line."[1] To this day Sullivan's exhortations are still relevant in terms of the intended effect of a skyscraper. And it was Sullivan who recognized—as early as 1891—the need for tall buildings to narrow (by means of set-backs) as they rise, in order to allow enough light into the street and into the buildings themselves, which were growing ever taller and more tightly packed.

Together with his partner Dankmar Adler, Sullivan created two important tall buildings: the Wainwright Building in St. Louis (1891) and the Guaranty Building in Buffalo (1895). He simplified the overall shape and accentuated the verticals by virtue of continuous columns running between the windows for ten stories. Despite their much more successful total design, making a special point of their height, these buildings still seem solid and closed, and fail to take advantage of the possibilities of the curtain wall. In his thinking on skyscrapers, Sullivan also suggested that a tall building should be divided into three sections like a column, with a base, a shaft and a capital. For some time this view held sway. With the onset of modernism this principle gave way temporarily to the uniform box-shape, before making a comeback in postmodernist designs.

Tallest Buildings

At the time of the construction of the first skyscraper in Chicago, the question as to which was the tallest building in the world soon began to play an increasingly prominent part in public discussions. This accolade became a sought-after, prestigious trophy, which every building, client or city wanted to earn. Gustave Eiffel's tower for the World Exhibition in Paris set a breath-taking record in 1889 with its height of 984 feet (300 meters). Worldwide, it was the tallest man-made structure and even if it could not count as a building because it contained no usable surfaces, it could not have done more to excite fantasies of the coming architectural conquest of the skies. With the construction of the American Surety Building in 1896, designed by Bruce Price, New York claimed the title for tallest building and took the lead in the construction of skyscrapers. In contrast to generally closed, block-like structures, in New York there was initially a preference for "towers" such as the Singer Tower completed in 1908 (p. 36) or the Metropolitan Life Insurance Tower (1909). For the external look of a building, the architects—many of them having studied at the École des Beaux-Arts in Paris—drew heavily on European models. Thus, the tip of the Singer Tower echoes the corner turrets of the Louvre, the Metropolitan Life Insurance Tower follows the example of the Campanile of San Marco in Venice and the top of the tower of the Bankers Trust Company Building is a reference to the Mausoleum of Halikarnass. This historicizing stylistic pluralism in the design of skyscrapers continued with the Woolworth Building (p. 38) of 1913 through to the Chicago Tribune Tower (p. 40) of 1925, the exterior of which is influenced by examples of Gothic architecture in Europe.

With the rapidly growing number of skyscrapers, particularly in Manhattan, questions soon arose concerning their relationship to each other as part of a cityscape. Initially driven purely by commercial considerations, the advent of skyscrapers soon began to change the look of the modern city by leaps and bounds. The idea of the skyline as a composition incorporating a series of skyscrapers took hold, but this continued drive upwards brought about problems. If a new building outstripped its neighbors, the latter would now be in shadow

Gustave Eiffel, Eiffel Tower, Paris, 1887–89

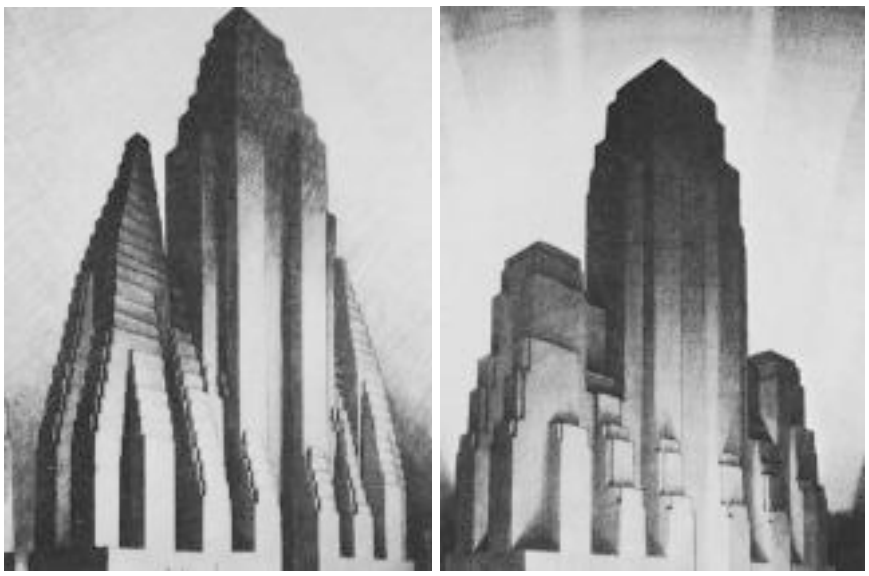
Napoleon LeBrun & Sons, Metropolitan Life Insurance Tower, New York, 1907–09

Ernest Graham, Equitable Building, New York, 1912–15

and its offices would by definition receive less light. This led to a decline in property values, rental rates and ultimately a decrease in tax revenues.

In 1908 Ernest Flagg, the architect of the Singer Tower, pointed to the urban problems that come with a rising number of tall buildings. In addition to the matter of one building overshadowing another, he already foresaw the ensuing increased volume of car traffic and problems that any fire would pose. But it was not until the construction of the Equitable Building in New York (1915) that changes were made in building regulations. With the construction of this building—the largest structure in the world in terms of its floor space—the limits to what could be tolerated were finally reached, since it overshadowed all its neighbors. As a result, in 1916 the City of New York passed its Zoning Law, which linked the heights of buildings to precisely prescribed set-backs. This law stated that the more a building receded towards the top, the higher that building could be. And if, after a certain height, its dimensions are no more than a quarter of the ground level floor plan, then its height is entirely unrestricted. This law crucially altered the aesthetics of subsequent new skyscraper projects and hence the shaping of the skyline too. Taking the terms of the Zoning Law as his guide, Hugh Ferriss (known for his visionary drawing of buildings and architecture) created his own influential visions of the next generation of skyscrapers.

One advantage not to be underestimated for the subsequent record-breaking projects in New York was the city's geological situation. Since the bedrock in Manhattan is not far beneath surface, foundations were easier to anchor than in the sandy earth of Chicago. Thus the next record heights could soon be set, quickly passing from one building to the next but remaining in New York for over sixty years. In 1908 the Singer Building held the record, only to be deposed the following year by the Metropolitan Life Insurance Tower. In 1913 the record was broken yet again with the completion of the Woolworth Building.

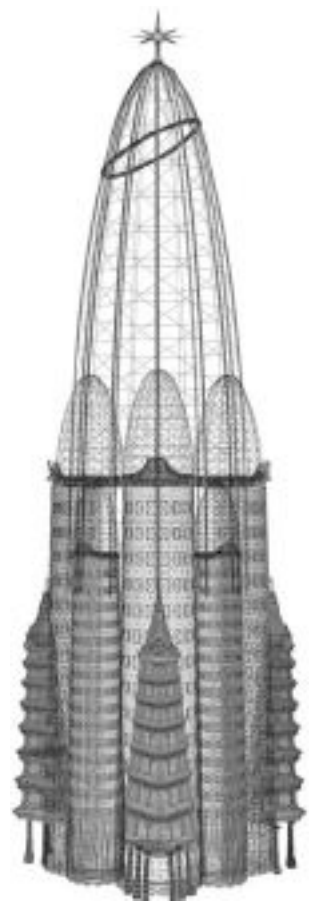


Hugh Ferriss, studies for the maximum mass permitted by the 1916 New York zoning law, 1922

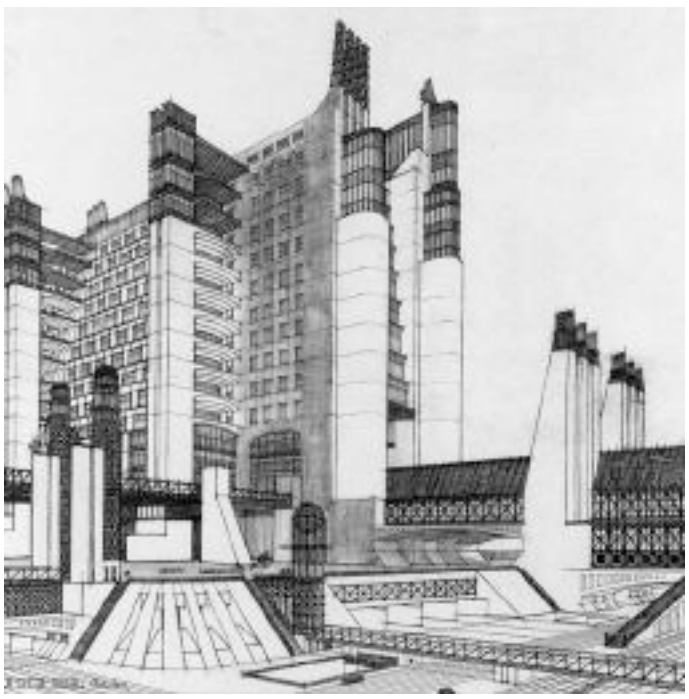
With viewing platforms now available in various buildings, the public could participate directly in the breakneck upwards thrust, and cast their astonished gaze downwards on the skyline that was now rising faster and faster. On the 40th floor of the Singer Tower there was a viewing terrace, open to paying visitors. Similar arrangements also existed on the 46th floor of the Metropolitan Life Insurance Building and on the 55th floor of the Woolworth Building. While human beings used to look down from mountains—and then church towers—on the town below them, at these viewing points an increasing number of equally high or even higher structures would loom into view. From this elevated vantage point one could experience the skyline in a different way. The Woolworth Building not only claimed a new record height, it also set a completely new agenda with its fastest elevators of that time and its nocturnal illumination by floodlights. Exactly as the client had wished, it became a symbol of the commercial success of the company, and by association, a symbol of the city itself. The mythical character traits that the twentieth century skyscraper soon acquired have their roots in this building.

Visions in Europe

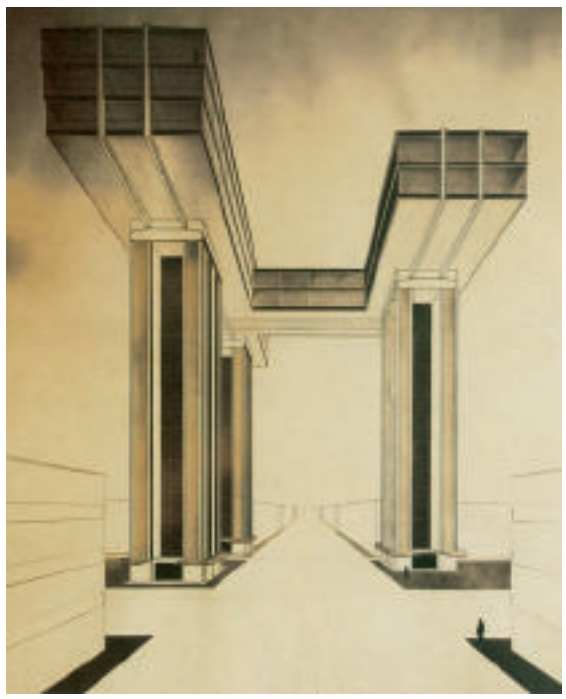
The first flowering of the skyscraper in Chicago and New York preceded the First World War and was watched with interest in Europe. It kindled the imaginations of architects dreaming of ever taller buildings. As early as 1908, Antoni Gaudí was already sketching a 1,181-foot (360-meter) hotel for New York. Although there were intense discussions on the construction of tall buildings in Europe around 1920, developments on the scale of what was happening in the United States were above all stalled by the conservative attitudes of European building regulators. Their intention was to prevent the traditional townscapes of historic inner cities from being destroyed. In the absence of tall buildings as a practical possibility, all over Europe—especially after the First World War—theoretical design solutions started to emerge. Auguste Perret, for instance, designed a visionary city with towers, and in Italy the futurists Antonio Sant'Elia and Marco Chiattone were dreaming of tall, machine-like structures. In Russia Constructivist architects designed skyscrapers as symbols of revolutionary progress. El Lissitzky's Cloud-Iron (1924–25)—a horizontal skyscraper—was amongst the most audacious fantasy structures.



A rendition of Antoni Gaudí's original drawing of Hotel Attraction, New York, project, 1908



Antonio Sant'Elia, La Città nuova, project, 1914



El Lissitzky, Cloud-Iron, Moscow, project, 1924–25

Ludwig Mies van der Rohe, model of glass skyscraper, project, 1922

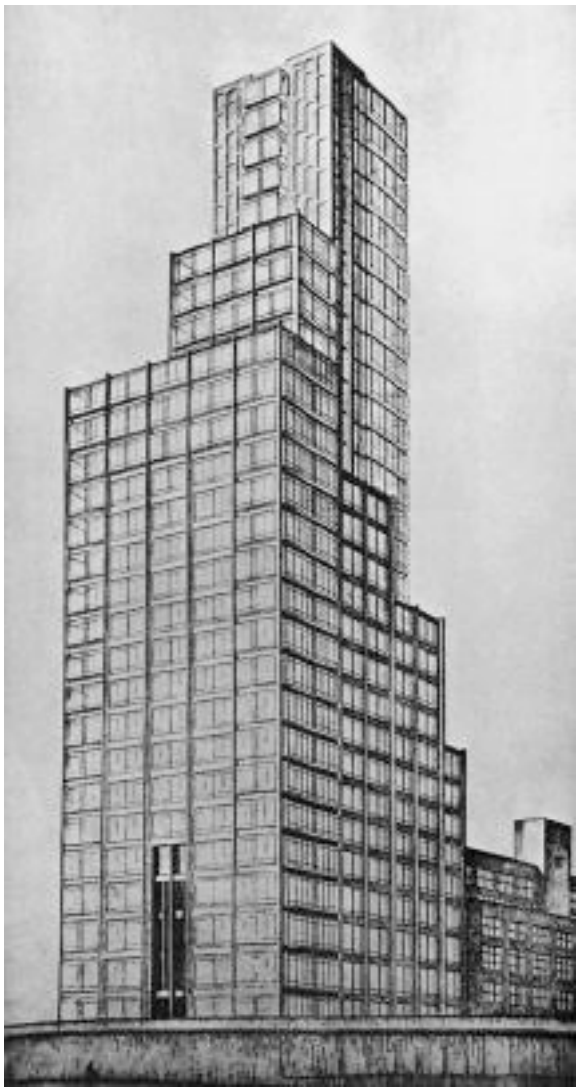
One of the most influential contributions to the European debate on tall buildings came from Ludwig Mies van der Rohe. In the competition for a tower block at the Friedrichstrasse station in Berlin, he submitted a design for a glass-skinned, crystalline skyscraper. With glass as the emphatically dominant design feature, Mies was echoing the utopian ideas of the German architects and artists' group *Gläserne Kette* (Glass Chain). Mies's approach was far ahead of his time and still a long way from being technically possible. Nevertheless, Mies continued to work on his concept of a glass skyscraper, on paper and with a model. The publication and exhibition of his designs aroused a high degree of interest in his architectural visions. Beyond this, Mies also drew his colleagues' attention to the sheer beauty of the steel frame construction: "Only skyscrapers under construction manifest their bold structural thinking and one is overwhelmed by the impression of this towering steel skeleton. The cladding of the facades completely destroys this impression."[2]

The USA and Modernism

The triumphal arrival of modernism in Europe began in the 1920s, yet still no skyscrapers were being built there. European architects would travel to the United States to study the rationalization of construction methods and the latest technological advances. Yet, until well into the 1930s, the United States remained largely untouched by modernism, above all in the ongoing construction of skyscrapers. Although clients enthusiastically embraced technological innovation in the construction methods, in the provision of elevators and lighting, when it came to the outward appearance of their buildings they still clung to traditional design formulas. Ayn Rand's 1943 novel *The Fountainhead* revolves around exactly this conflict. And after traveling through the United States for two months in 1928, Walter Gropius remarked that, "There is no true American architecture yet."[3]

The first real contact with developments in Europe came with the competition for the Chicago Tribune Tower in 1922. Of the 204 proposals, over a third were from European entrants. Above all, the designs submitted by Adolf Loos and Walter Gropius seem to have been pointing to future developments. On one hand there was the clearly constructed, well proportioned modernist "box," and on the other hand their designs already used the expressive forms that postmodernism was later to rediscover in tall buildings. With the touring exhibition of competition entries, modernist European architects became known across the United States, far beyond Chicago. The first clearly identifiable reaction to the European submissions in this famous competition can be seen in the American Radiator Building in New York (p. 44). Although Raymond Hood, the winner of the competition, went on to realize his neo-Gothic tower in Chicago, at the same time in New York he was clearly inspired by the much more modern design proposed by the winner of the second prize, Eliel Saarinen. Hood learned from Saarinen how to give a building a coherent form and simultaneously to accentuate its height by carefully composed set-backs. With his Radiator Building, Hood set in motion a wave of Art Deco buildings in the 1920s which were to form a high point in the evolution of the skyscraper. The Barclay-Vesey Building (1926), the Fuller Building (1929) and the Daily News Building (1930) subsequently became the most important skyscrapers of that time, until Raymond Hood's McGraw-Hill Building set a new course leading away from Art Deco towards modernism.

The Chrysler Building (p. 46) and the Empire State Building (p. 50) mark the second flowering of the skyscraper. Both entered the race to become the tallest building, which was now a publicly celebrated event. The Chrysler Building became the first building to outstrip the Eiffel Tower, but was soon overtaken by the Empire State Building with its docking mast for zeppelins—although this never fulfilled that function. Nevertheless, it was the first time that



Max Taut's entry for the Chicago Tribune Tower competition, 1922

Raymond Hood, Godley & Fouilhoux, McGraw-Hill Building, New York, 1930–31

the futurist notion of accessing skyscrapers from the air at least became a concrete intention. Both of these buildings still basically adhered to Sullivan's concept of a three-part structure and to the typology of tall buildings specific to New York. Both the Chrysler Building and the Empire State Building had public viewing terraces. In the case of the Empire State Building, which was completed during the Depression, the admission fees charged to the many visitors at least provided a small income while the offices remained largely vacant. In terms of skyscraper design, the Empire State Building marked the end of the traditional steel frame construction, and it remained unchallenged until the 1970s because this type of construction was simply too expensive upwards of a certain height.

The record height of the Empire State Building was and still is, very special for a variety of reasons. It stood unchallenged for over forty years, the longest reign of any skyscraper. Yet it also marked the stylistic finale of the Art Deco skyscraper. The Rockefeller Center (p. 56) soon signaled the arrival of a new concept: the idea of a comprehensively composed group of skyscrapers as a "city within a city." With its newly created open areas and roof gardens, with its plaza and concert halls, the Rockefeller Center really did become a skyscraper city. It showed how a clever mix of functions and the planned integration of skyscrapers into their setting could create completely new urban spaces. Not long afterwards, William Lescaze's PSFS Building in Philadelphia (p. 54)—with its flat roof, powerfully defined verticals and asymmetric sub-sections—marked a crucial stage in the stylistic progress of the skyscraper towards modernism. This and Hood's McGraw-Hill Building were the only tall buildings to be included in the 1932 exhibition *Modern Architecture: International Exhibition* at the Museum of Modern Art, New York, organized by Philip Johnson and Henry-Russell Hitchcock. The accompanying

Frank Lloyd Wright, One-Mile-High Skyscraper, project, 1956

publication, *The International Style: Architecture since 1922*, constitutes the first triumph of the skyscraper in the literature and in the reception history of architectural styles.

Particularly after 1933, political developments in Europe drove an increasing number of modernist architects to seek refuge in the United States. In 1937 Walter Gropius accepted a chair at Harvard; in 1938 Ludwig Mies van der Rohe became director of the Illinois Institute of Technology in Chicago. Soon after the Second World War, Mies was able to realize his long-nurtured ideas on the construction of skyscrapers. His Promontory Apartment Building (1949), using concrete-frame construction, was soon followed by the Lake Shore Drive Apartments (p. 62). These represent the first modern apartment block and the earliest example of a double tower. By positioning the two towers neither symmetrically nor parallel to one another, but slightly apart, Mies created a dynamic design which still exerts a palpable influence today. This same idea was used for the World Trade Center and most recently a similar design was devised by Massimiliano Fuksas for his Vienna Twin Tower (Vienna, 2001).

By 1969 Mies had planned and realized a total of fourteen tall buildings. Early on, however, the design of the Seagram Building (p. 66) already achieved an architectural quality that could never be surpassed. Together with the Lever House (p. 64)—facing the Seagram Building and completed just a few years earlier—they became the two main archetypes for future developments in skyscraper construction. These two alternatives comprised a dark, glazed box with bronze braces, creating the impression of an elegant sculpture, or the bright, glazed transparent box, which revealed its internal structures. In both cases, the connection with the urban setting at street level is of particular importance. Lever House created a public open space underneath itself by being raised up on stilts, while the Seagram Building was set well back from the edge of the street, opening up a public space in the front. In fact, this marked the introduction of the public plaza which is still repeated the world over as the skyscraper's tribute to the city. This design solution was subsequently incorporated into the new building regulations passed in New York.

Both the Seagram Building and Lever House continued to use the tried and trusted steel frame, which long remained the standard construction method for

tall buildings. Meanwhile Frank Lloyd Wright was developing a different method. His Johnson Wax Research Tower (p. 60) was constructed in the shape of a tree, with the floors extending outwards from the central trunk like branches. This idea was only taken up by others much later, for instance by Bertrand Goldberg in his Marina City in 1964. Wright himself furthered this concept in the Price Tower in Bartlesville (1956). It would also have formed the structural basis of his visionary project for a One-Mile-High Skyscraper (1956). This super-skyscraper formed the center of his utopian vision of Broadacre City and was designed as a multi-functional structure. No doubt the presentation of this project was an attempt to give visual form to the dreams of the unlimited potential of the skyscraper of the future. But the idea of realizing a structure whose foundations would have to go as deep as the Empire State Building was tall, went far beyond was what conceivably possible. Yet the effect of this utopian project on the imaginations of many architects should not be underestimated.

In the years after the Second World War, in many places in Europe there was a shift in public attitudes to the construction of skyscrapers. With the Torre Pirelli in Milan (p. 70) and the Thyssenhaus design in Düsseldorf (p. 76) an early form of European skyscraper appeared on the scene. In the case of the Torre Pirelli, it was Pier Luigi Nervi's concrete construction that gave the building its elegant, yet highly dynamic look. The Thyssenhaus owed both its construction and its facade to existing American buildings. But the ground plan and the composition of the volumes have an elegance that also attracted attention in the United States. From the start, the formal design of skyscrapers in Europe was shaped by very different building regulations to those that applied in the United States. These included the stipulation that no workstation should be more than 23 feet (7 meters) from a window. Consequently, the ground plans for the floors could not be as generously laid out as in the United States, where a distance of up to 65 feet (20 meters) was allowed. European tower blocks therefore remained very narrow. The SAS Royal Hotel, built in Copenhagen in 1960 (p. 72), is relatively modest in terms of its height, but nevertheless stands as an important European design solution bearing some of the hallmarks of its American precursors. From its subtle connection to the city to its elegant resolution of the check-in area, to the restaurant and lamps on the bedside tables all of this contributed to the making of a hightly respected architectural *Gesamtkunstwerk*.

Initially, the 1960s saw no major innovations in the evolution of the skyscraper. Even the race to be tallest building seemed to have been forgotten. Now the modern skyscraper set the standard almost all over the world with between fifty and sixty floors on average. Mies's students disseminated his teachings without adding new perspectives that would have moved his ideas on. The Richard J. Daley Center in Chicago (1965) is one of a number of skyscrapers directly influenced by Mies, as is the Lake Point Tower (p. 84) of 1968. The only student to offer an interesting new impulse was Bertrand Goldberg with his Marina City (p. 78). His urban concept of reclaiming living space in the city by radically combining it with cultural provision even to the extent of including a private jetty was exemplary. However, his ideas fell largely on fallow ground. The rounded ground plan—with considerable advantages in terms of structural stability in the face of winds blowing against the facade—formed the basis of the first important skyscraper in Australia, Harry Seidler's Australia Square in Sydney (p. 82). A student of Gropius and Breuer, Seidler—with the help of Pier Luigi Nervi—created a structure that was both dynamic and elegant and graced by a lively public plaza. This paved the way for the development of a skyline in Sydney which has since become one of the most memorable worldwide.

New Records

The construction of the John Hancock Center in Chicago (p. 88) in 1969 marked a new phase in the evolution of the skyscraper. In the same year that a space mission landed on the moon, architecture was also striving to reach new heights. At that time belief in technological progress was almost limitless and the simultaneous development of the jumbo jet (Boeing 747) and of the supersonic passenger aircraft Concorde further testified to this. The new departure in skyscraper design was based on a new structural concept developed by the engineer Fazlur Khan. His braced frame tube system meant that the John Hancock Center came dangerously close to the record height of the Empire State Building while at the same time requiring significantly less steel. Meanwhile Minoru Yamasaki was using a rigid frame tube for the World Trade Center (p. 94). So in the early 1970s, the race for the world record was on again, and in 1972 the World Trade Center won it for New York for a short period of time. However, with the construction of the Sears Tower (p. 96) the title returned to Chicago for the next twenty-three years. The Sears Tower used another system devised by Fazlur Khan, namely the bundled tube; the architectural design was by Bruce Graham of Skidmore, Owings and Merrill.

Although the new super-tall skyscrapers used revolutionary features in their construction methods and attracted worldwide attention with the records they set, nevertheless in terms of their aesthetics they provided little that the public could identify with. Moreover their connection with their urban surroundings was generally not carefully conceived. The Twin Towers of the World Trade Center stunned observers by their immense height combined with a minimalist design. Although they were sharply criticized on all sides for their monumentality, nevertheless with the viewing terrace on the South Tower and the "Windows of the World" restaurant they established themselves as one of the main sights of Manhattan. By contrast, the Sears Tower at least attempted to make design sense of its unimaginable height by the set-backs of its tower tubes. But it too—a dark sculptural form—proved to be an architectural monument that few could identify with.

However, the concurrent construction of the Transamerica Pyramid in San Francisco (p. 92) was the first expression of a newly awakened interest in eloquent forms, a legible vocabulary and references to architectural history. At first the 1970s were dominated by cuboid structures—usually with a flat glass skin and often reflective like mirrors—such as the United Nations Plaza in New York (1976), the John Hancock Center in Boston (1976) by Pei Cobb Freed & Partners or the Westin Peachtree Plaza Hotel in Atlanta (1976). While these crystalline sculptures often provided large internal public spaces in glazed atriums, as in the IDS Center in Minneapolis designed by Johnson/Burgee Architects in 1973, externally they looked at best like well-designed or not so well-designed boxes with no real connection to their urban setting. Only the Citicorp Center in New York (p. 98), with its sunken Plaza, departed from the usual schema because the neighboring parish expressly demanded that they should. With its slanting roof, in fact intended for solar panels, the building acquired almost by chance a profile that was readily identifiable on the skyline.

Proliferation

Since the 1970s, skyscrapers have increasingly appeared in other North American cities and in other countries. Thus, a major architectural practice like SOM Skidmore, Owings and Merrill could find a worldwide market for its specialist experience in the construction of tall buildings. Like other cutting-edge technological products, skyscrapers were increasingly regarded as symbols of a nation's economic prowess. The building of the National Commercial Bank in Jeddah (p. 100), designed by Gordon Bunshaft, who also created Lever House, is one of the

I. M. Pei, Oversea-Chinese Bank, Singapore, 1970–76

City in the Air, project, 1960–63 by Arata Isozaki, a member of the Metabolist movement in Japan

most important examples of this aspect of architecture. It was an answer to the particular climatic and cultural conditions of that region and, with a structure facing entirely towards the center, it established an important new approach.

In Asia, at the same time as current standards for tall buildings were being imported from abroad, new architectural concepts were being developed at home which had a growing influence on skyscraper design as a whole. Metabolism, for instance, was embodied by Kisho Kurokawa's Nakagin Capsule Tower (p. 90) which was finished in 1972. This building meets one of the central demands of Metabolism, namely that standardized living units should be slotted into the core. These units were to be interchangeable and variously connectable. The Chinese-American architect I. M. Pei's Oversea-Chinese Bank (OCBC Center) in Singapore (1976) was to be his first important skyscraper in Asia. The same location also saw the construction of Kenzo Tange's Overseas Union Bank (OUB) Center 1986, another equally important, powerfully sculpturally structure.

Beyond Modernism

By the mid-1960s, new theoretical and practical approaches were emerging which contributed to the demise of the principles of modernist architecture. This also had an effect on the design of tall buildings. Publications by Robert Venturi and Denise Scott Brown such as *Learning from Las Vegas* (1972) pointed the way to postmodernism. The right-angled, abstract box had served its time as the basic form for tall buildings and new, expressive forms were now returning to architecture. Mies van der Rohe's "less is more" was turned by Venturi into "less is a bore." A new complexity now took on aesthetic functionalism.

Philip Johnson, NationsBank Center, Houston, 1981–83

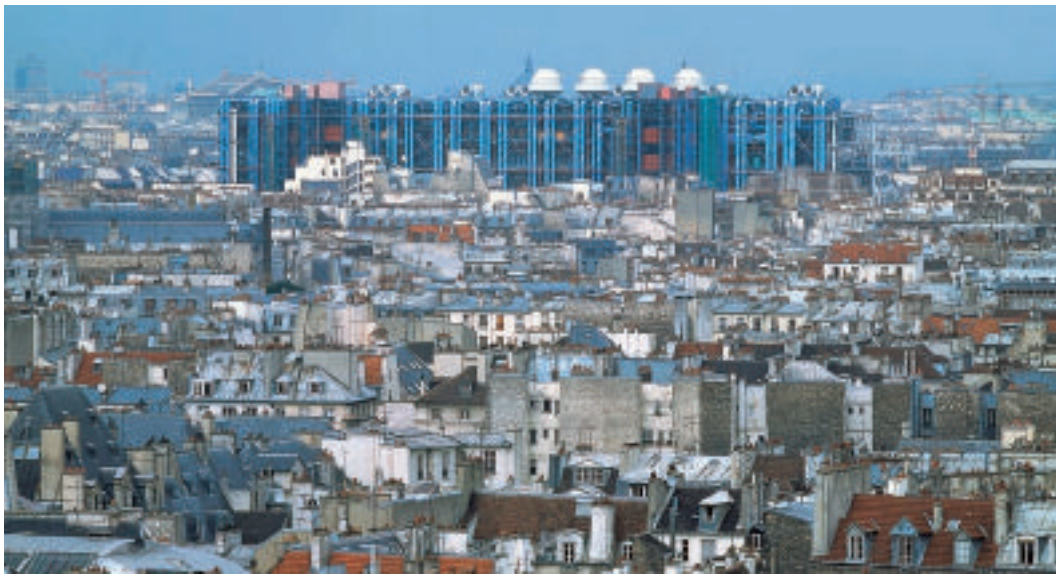
Philip Johnson's AT&T Headquarters (p. 102) of 1984 was the first significant tall building of the postmodernist era. Johnson, who had himself worked with Mies on the Seagram Building and occupied an office there for a long time, now made the definitive break with his teacher. The intentionally provocative feature of this building was its demonstrative return to the historical beginnings of the skyscraper. Instead of a glass curtain wall, once again there was a heavy stone facade, and Sullivan's three-part structure with base, shaft and capital reappeared along with a mixture of several architectural styles. In his subsequent designs, such as the NationsBank Center in Houston (1983) and the Pittsburgh Plate Glass Company (1984), Johnson took a similar approach, using historical quotation to individualize the form of the building as a whole and to anchor it in history. Yet just as surprisingly as Johnson had invented himself as a superstar postmodernist architect (much to the amazement of many of his admirers), he now changed directions again and, with his Lipstick Building (p. 108), set his sights on an abstract, dynamic expressivity.

Postmodernism saw the return of pictorial forms and historic motifs in skyscraper design. Yet the rapid expansion of the market for this type of building went hand in hand with an almost serial proliferation of a number of basic compositional patterns and details. In 1985 Cesar Pelli realized the World Financial Center in New York and virtually repeated this design for the Canary Wharf Tower in London (1991). Moreover his Key Tower (1991) in Cleveland and the Worldwide Plaza in New York (1989) by SOM in principle use the same scheme, with a mildly historicized square tower terminating in a pyramid-shaped peak. Purely decorative extended roof-crowns came into fashion despite having no connection with the urban setting of the building in question. Examples of this include the DG Bank Hochhaus in Frankfurt/Main (1993) by Kohn Pedersen Fox and the First Bank Place by Pei Cobb Freed & Partners in Minneapolis (1992). For One Liberty Place in Philadelphia (1987) the team at

Murphy / Jahn realized a much coarser, clumsy replica of the roof section of the Chrysler Building. And in 1991 Helmut Jahn returned to his native land with a postmodern-inspired tall building in the shape of the Messeturm in Frankfurt / Main (p. 114).

Alongside postmodernism, which quickly ran into the ground because it was far too intellectual a fashion, there were other new architectural approaches emerging which advanced the principles of modernism in other directions. Team 4, founded by Richard Rogers and Norman Foster in 1963, developed a style that turned the spotlight on architectural construction methods and technology. For the general public, the Centre Pompidou (1978)—designed by Richard Rogers and Renzo Piano working together—became the most important manifesto of this development. A brightly colored, monumental cultural machine was in effect dropped into the crowded center of a city densely populated by historic monuments. Rogers pursued the same principle in his Lloyd's Building (p. 104), this time demonstratively placing the services on the outside of a tall building. This wholly unconventional building came astonishingly close to the visions of the futurists.

In the mid-1980s another series of important tall buildings was realized in Asia. This included the new skyscrapers in Hong Kong, most notably Norman Foster's Hongkong and Shanghai Bank (p. 106). The outstanding significance of this building lies in its new aesthetic, the visible constructive concept and the new spatial structures in the interior. At the same



Renzo Piano, Richard Rogers, Centre Pompidou, Paris, 1971–77

time I. M. Pei's Bank of China (p. 110) marked another, very different new departure. The new construction of the diagonal spatial trusses which turn the exterior of the building in to a rigid tube, is shown by the diagonals on the facade. However, in view of possible negative consequences, according to the laws of feng shui, the horizontal braces were concealed behind the glass facade. With its slanting stepped set-backs, the building presents a different aspect on each side, always accentuating its own height. In 1991 in Japan, the New Tokyo City Hall (p. 116) by Kenzo Tange developed a new approach using the twin-tower motif from the history of European architecture. This complex of buildings also takes into account a highly differentiated urban structure. The national record for the highest building in Japan was claimed in 1993 by the Landmark Tower in Yokohama, designed by Stubbins Associates.

Ecological Issues

By definition, skyscrapers are not primarily ecological. The construction and running of any tall building can only be achieved at the cost of an extraordinary input of primary energies and raw materials. On the other hand, by providing a high density of quality workstations with good connections to public transport systems they ensure a highly efficient use of spatial resources. Since it has long been impossible to imagine our ever more densely built cities without their tall buildings and skyscrapers, the oil crisis in the late 1970s prompted a reevaluation of ways of improving the use of energy in the running of skyscrapers. Norman Foster had already arrived at some important solutions in his design for the Hongkong and Shanghai Bank: the building is cooled by sea water which is also used to flush the toilets. This has significantly reduced the consumption of pure drinking water. As well as this the use of natural light in the interiors has been improved, which has in turn created better quality workstations.

The theory of the "green" skyscraper has been notably shaped by the writing of Ken Yeang. In his theories he proposes interconnected measures concerning the use of energy, water and light, and further relates these to the local climate, the spatial conditions and the function of the building. The result is a complex series of demands affecting the planning and design of skyscrapers. His Menara Mesiniaga (p. 118), completed in 1992, was to become a much admired practical example of an ecological tall building. Norman Foster was pursuing similar ecological strategies in his Commerzbank in Frankfurt/Main (p. 120), built in 1997. This building also twists, like the Menara Mesiniaga, with four-story air shafts reaching upwards in the interior, creating a structure that allows natural light into all the workstations. At the same time the "conservatories" arising from the same construction serve as rest and relaxation zones for the staff working in the building. Every workstation has its own supply of fresh air; the building is cooled by a ceiling cooling system using circulating water.

The Race for the Millennium

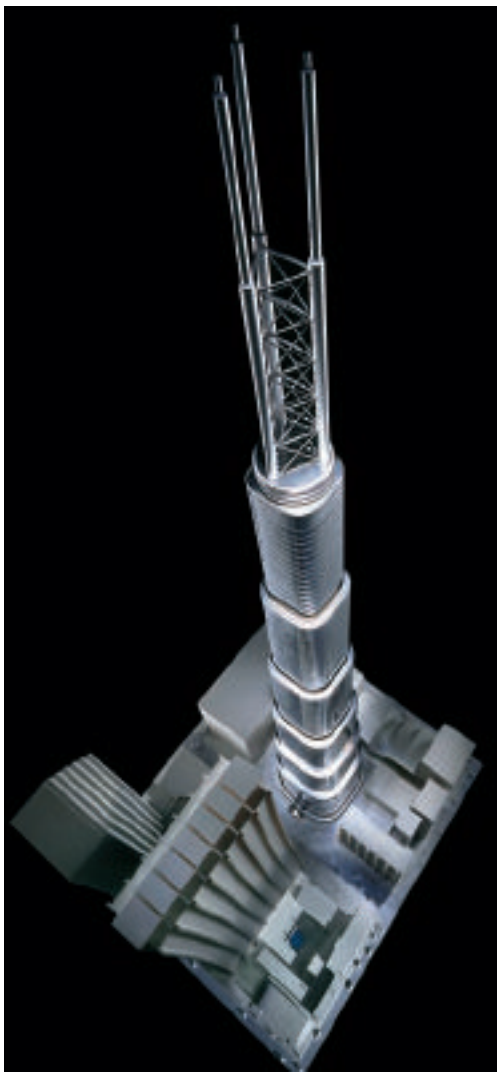
On the eve of the millennium there was a new race for the title of tallest building in the world. Several countries announced projects intended to win this prize. The unrealized Miglin-Beitler Tower, planned for Chicago in 1988 after a design by Cesar Pelli, would have reached the symbolic height of 2,000 feet (610 meters). One of the most famous projects was Norman Foster's 1989 project for a Millennium Tower for Tokyo. This study for a vertical town was planned to accommodate 60,000 inhabitants and was to have been built in the Bay of Tokyo. At 2,754 feet (840 meters), it would have far exceeded all its predecessors. The design, similar to that of the John Hancock Center, was planned as a rigid tube, albeit now conical in order to withstand both wind and earthquakes. Norman Foster's projected Millennium Tower for London—1,265 feet high (386 meters)—was also not realized. Nevertheless, in 2004 he was able to use the intended site for a different purpose, namely for the somewhat smaller Swiss Re Headquarters (p. 132). In 1989 Jean Nouvel made plans for a Tour Sans Fin in the district of Paris known as La Défense. At 1,377 feet (420 meters) this would have held the record in Europe. In 1995 in Australia, the investor Bruno Grollo announced the construction of a 1,625-foot (495-meter) tower for Melbourne, designed by Harry Seidler. At much the same time—in 1996—the architects' team Future Systems was planning a 1,450-foot (442 meter) tall building for London to be called Green Bird. Another record-breaking project was presented in 1996 by a group of Spanish architects led by Javier Pioz: the Bionic Tower for Shanghai embodied a visionary approach based on findings arrived at through bionics. At 4,029 feet (1,228 meters) and with room for 100,000 people it would have dwarfed all the

Norman Foster, Millennium Tower, Tokyo, project, 1989

Future Systems, Green Bird, London, project, 1996

Cervera & Pioz, Bionic Tower–Vertical City, project, 1999

Jean Nouvel, Tour Sans Fin, Paris, project, 1989–92



Skidmore, Owings & Merrill, 7 South Dearborn, Chicago, project, 1998

record holders of the past. Yet another unrealized record-breaking project was planned in 1998 by SOM 7 South Dearborn for Chicago; it, too, would have risen to the symbolic height of 2,000 feet (610 meters).

Most of these highly ambitious projects failed for financial reasons. In the end, just before the new millennium, the record went to Malaysia. In 1998 the Petronas Towers won the title of tallest skyscraper of the millennium for Asia. At 1,483 feet (452 meters) they are taller than the Sears Tower in Chicago—even if this height was only achieved by the addition of masts. A year later the Jin Mao Tower in Shanghai (p. 126) only reached 1,380 feet (421 meters), although that was still taller than the Empire State Building.

The two record-breaking structures—the Petronas Towers and the Jin Mao Tower—rely on a new construction method that uses megasupports—a cylindrical tube frame system constructed of high-strength concrete—plus a rigid concrete core. A number of additional steel outriggers connect the core and the megasupports at several points on two stories. This extremely resilient combined construction takes advantage of the particular qualities of concrete, above all its high degree of rigidity, in order to reduce vibrations at the higher levels. As a result, despite their height the Petronas Tower and the Jin Mao Tower have no need of sway reduction. Since the resilience of the concrete used here is continually being improved, even greater records may soon be set using this method.

In 2004, Taipei 101 (p. 134) claimed the next record for Asia. At 1,667 feet (508 meters) it is currently recognized by the International Commission as the tallest building in the world. Economic rivalries amongst the nations of Asia continue to be reflected in projects for ever taller skyscrapers. Even the catastrophe of 9/11 in New York has not halted this development. And at the main exhibition of the 2002 Architectural Biennale in Venice, skyscrapers—as part of our future—were a focal point of the presentation. Yet, frequently it is still the com-

mercially oriented American architectural practices like Skidmore, Owings & Merrill, Kohn Pedersen Fox, Murphy / Jahn and Cesar Pelli who operate worldwide, bringing to bear their long years of experience building sensational skyscrapers. The World Financial Center (p. 142) planned by Kohn Pedersen Fox for Shanghai typifies this, as does the Burj Dubai designed by SOM (p. 148).

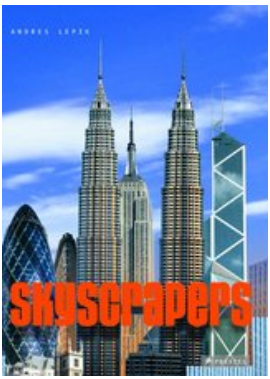
The World Trade Center

The latest generation of skyscrapers, striving to become the tallest skyscraper in the world, does incorporate extreme feats of construction, yet their design and conception are not really setting any decisive markers for architecture in the future. Both the Petronas Towers and the Jin Mao Tower consciously draw on motifs from the architectural traditions of the region in order to adapt the prevalent standard American skyscraper more than before to the culture of their own locations. Yet even in the case of Taipei 101, which was designed by a Chinese team, these record-breaking projects are little more than increasingly extreme products from the American skyscraper production line.

The competition, announced in 2002, for a new design for the site of the World Trade Center raised hopes that after the catastrophe of 9/11 New York might reconnect with its own tradition of building important skyscrapers. For it had been a long time since Manhattan had caused a stir on the stage of world architecture and the skyscrapers built in recent years certainly had not set any new standards. Soon after the attack, the idea of a new tall building plus a memorial had already been accepted, although there was no question of setting a new record for tallest building on this site. The competition entries by United Architects, THINK, Richard Meier with Peter Eisenman, Charles Gwathmey, Steven Holl and Norman Foster—all published in 2002—incorporated new important architectural concepts. Yet the tactical winner in this process was initially Daniel Libeskind, whose vocabulary of patriotic symbolism met the popular expectations of many levels of society. Taking the date of the American Declaration of Independence—1776—as the height of his Freedom Tower, Libeskind would en passant have reclaimed the world record for the tallest building for New York. However, in the end the leaseholder of the site, Larry Silverstein, had Libeskind's design reworked by David Childs, the designer at SOM, as a commercially viable product. From the point of view of the investor it was a logical move, above all because Libeskind had no experience as a designer of tall buildings. However, the final decision by the leaseholder reduced the preceding competition to pure sham. The story of the Chicago Tribune Tower seems to have returned in just a slightly different guise in early twenty-first century New York.

New Typologies

Right from the outset, commercial interests have driven the planning and design of skyscrapers—more so than any other type of building. Added to which, clients who build sensational skyscrapers can rarely count on a rapid return from potential tenants. Of much greater importance is the raised status of a firm, a city or even a country. Since this particular architectural race for the skies first began, record heights have generally been the most effective way to arouse public interest in one's role as the client. Yet at the same time, a high quality design is also crucial to one's public standing. It seems that at present the important architectural impulses are coming from projects that are not necessarily out to break records. Rem Koolhaas's CCTV Headquarters in Beijing (p. 144), for instance, with a complex design that presents a completely new challenge in terms of its stability, also reveals an interesting approach to spatial structure. And the sculptural form of Santiago Calatrava's Turning Torso



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