

# Skyscrapers

## Race for the Clouds

The archetypal modern building type reaches stratospheric heights as expanding economies in Asia and the Middle East make their marks with super-tall towers.

by JASON EDWARD KAUFMAN

At sunrise in the summer of 1974, young Frenchman Philippe Petit ventured out onto a 3/4-inch cable vibrating between the towers of the World Trade Center, a quarter-mile above the New York City sidewalks. With no harness and no safety net, he traversed the 200-foot chasm eight times, punctuating his 45-minute performance by lying on his back and resting sidesaddle on the wire, peering 100 stories down at his stupefied audience before rising to continue his mind-boggling promenade. The feat made him an instant celebrity.

Alain Robert, another Frenchman, coincidentally, similarly defies tall buildings. “The French Spiderman” (he likes to sport the superhero’s costume) has scaled the facades of many of the world’s tallest buildings, relying only on his agility, powerful grip and a bag of climbing chalk for his unauthorized ascents. The stakes could not be higher: One wrong move, and he would plummet to his death. ▸



Photo: Tandem Stills + Motion/Andy Lerner.

Currently the world's tallest skyscraper, Burj Khalifa in Dubai.





Petronas Towers in Kuala Lumpur, Malaysia, were the world's tallest skyscrapers from 1998 to 2005; currently they are sixth and seventh tallest.

The mere thought of a skyscraper's dizzying roof edge is unimaginably terrifying. The death-defying resolve and physical skill required to ropewalk or climb at such windswept heights is plainly incomprehensible. Why would anyone attempt it? Petit, 65, says he is an artist compelled to perform inspiring acts of beauty, and he often is called on to do so in celebration of a venue's inauguration or anniversary. Robert, 53, uses his climbs to advocate awareness of global warming and other worthy causes, and has made publicity climbs using just suction cups and a harness.

Mastering tall buildings, these extraordinary individuals symbolically tame the faceless commercial and technological forces that increasingly overwhelm us. Like the corporate leaders, developers, designers, engineers and laborers who make skyscrapers, they share the eternal human desire to reach for the sky. That quest has spurred epic ascents of the great mountains, the invention of flying machines, exploration of outer space and the race to build ever-taller structures. More than any other architectural form, the skyscraper exemplifies the achievements of modern civilization. Much as medieval Europe competed to erect grand cathedrals, modern cities court worldwide attention by constructing spectacularly tall buildings. Many are veritable wonders of the modern world, latter-day counterparts to the Pyramids, the Hanging Gardens of Babylon and the Colossus of Rhodes. ▶



Photos: (left) Getty Images/Tavelpx Ltd.; courtesy Taiwan Tourism Bureau; (facing, inset) Getty Images/Richard Anson.



Taipei 101 in Taipei, Taiwan, was the world's tallest skyscraper from 2005 to 2010; now it's the fifth tallest.



The iconic Chrysler Building rises above the clouds in New York City.



One World Trade Center (Freedom Tower) in New York City is at present the fourth tallest skyscraper in the world.

## Icons of The American Century

In the 20th century, skyscrapers transformed the look of cities. The modern metropolis is no longer merely a densely built hub of population and commerce, but a stage set teeming with cloud-piercing structures whose crenelated crowns form skylines as identifiable as fingerprints. Seen from the opposite shores of its flanking rivers, Manhattan appears as a manmade mountain range. The identifying sunburst peak of the Chrysler Building, the setback pinnacle of the Empire State Building and the sloping tor of Citigroup Center huddle in Midtown, while the crystalline, faceted Freedom Tower rises from the island's southern tip. As picturesque as an alpine vista, the Manhattan Mountains are a manufactured landscape, an expression of the financial might, technological know-how and ambition that powered The American Century.

For the first 98 years of the last century, New York and Chicago claimed the world's tallest buildings, reflecting America's status as the dominant economy and superpower. The Empire State Building, completed in 1931, reigned for four decades until the Windy City's John Hancock Center and Willis Tower (formerly Sears) usurped the title. Since then, the balance of skyscraper power has shifted to Asia and the Middle East, where real estate values and civic pride increasingly propel expansion skyward.

The Petronas Towers in Kuala Lumpur, Malaysia, surpassed Willis Tower in 1998. Six years later, they were overtaken by Taipei 101, which bowed in 2010 to Burj Khalifa in Dubai, the tiny oil-rich emirate whose adrenalized growth in the last five years produced five of the world's 25 tallest buildings. The exquisite, record-setting \$1.5-billion Burj soars more than half a mile above the desert, an architectural exclamation point that announces in no uncertain terms that the United Arab Emirates intends to make a mark in the 21st century. (The Royal Clock Tower Hotel in Mecca, completed in 2012 to service Muslims on the Hajj, looms over Islam's holiest shrine at 1,972 feet, currently No. 3 on the global list.)

The glory will prove ephemeral. Changsha, a city in southern China, has broken ground on Sky City, whose 2,749-foot design will surpass the Burj by 32 feet, and Kingdom Tower, under construction in Jeddah, Saudi Arabia, will outstrip them all, topping out at 3,281 feet, nearly two-thirds of a mile high. That height, too, may be eclipsed, as engineers assert that the latest technology is capable of exceeding the mile mark as soon as capital resources demand it. ▷

Architectural rendering of Kingdom Tower in Jeddah, Saudi Arabia, currently under construction. When complete, it will surpass the Burj and be the new tallest building in the world.



Photos: (top) Jason Kaufman; (below) Getty Images/Brian Lawrence; (facing) © Jeddah Economic Company/Adrian Smith + Gordon Gill Architecture.





## Tall Building Boom

By any measure, we are in the midst of a tall-building boom. Of the world's 50 tallest buildings, only 14 were completed before the millennium and just four earlier than 1990. The Council on Tall Buildings and Urban Habitat (CTBUH), a Chicago-based nonprofit recognized as the authority on skyscraper statistics, measures a building's height from "the level of the lowest significant open-air pedestrian entrance" to the architectural top, "including spires but no antennae, signage, flag poles or other functional-technical equipment." Many builders add "vanity height," raising a decorative apex above the highest floor in order to attain an edge in the race for the sky. The upper 623 feet of the Burj Khalifa is a case in point.

According to CTBU statistics, around 3,000 buildings are at least 150 meters tall (492 feet),

nearly 1,000 reach 200 meters (656 feet), 77 top 300 meters (984 feet) and two exceed 600 meters (1,968 feet). In terms of sheer numbers, Hong Kong has the greatest profusion of nearly 300 skyscrapers, besting New York and Dubai, home to 230 and 203, respectively, with Shanghai, Tokyo and Chicago next in line.

Within a decade, China's economic juggernaut will dominate the world's skyline. Of the 20 tallest buildings on earth, 12 are in China, including five of the top 10 and nine of the 12 tallest under construction. Five giants ranging from 1,440 to 1,614 feet have risen in the country since the turn of the century, including one each in Shanghai, Hong Kong, Nanjing, Shenzhen and Guangzhou. In the next several years, the Chinese will christen Shanghai Tower (2,073 feet), Ping An Finance Center

in Shenzhen (2,165 feet), Wuhan Greenland Center (2,087 feet), CTF Guanhzhou (1,739 feet) and three super-talls in Tianjin. And the proposed 2,297-foot Zhonghan Center in Suzhou may rival Changsha's 202-story Sky City as Asia's tallest building. Towers of impressive heights are on the drawing board for Jakarta, Hyderabad, Kuala Lumpur and Seoul, but the volume of skyscraper construction is rapidly urbanizing China outpaces even the explosive growth in the Middle East.

Europe's economy and urban fabric developed centuries before the advent of the skyscraper. Building costs are higher than in the emerging economies of Asia and the Middle East, and residents resist projects that threaten their cities' historic character. Public condemnation of the 1973 Tour Montparnasse in Paris resulted in a seven-

story height limit in the center, with taller buildings pushed to the outskirts at La Defense. London's first skyscraper went up in 1991 at Canary Wharf, similarly removed from the city center, but since then a crop of modest towers has risen in the financial district. Across the Thames, the 72-story pyramidal glass tower dubbed The Shard, finished in 2012, is the tallest building in the European Union, clocking in at 1,004 feet. (Londoners have nicknamed other suggestively shaped edifices The Pickle and The Walkie Talkie.) Moscow has several towers around that height.

The tallest in Latin America is the 64-story Gran Torre Santiago in Chile, and in Africa, the 50-story Carlton Centre in Johannesburg. ►



Engineering Feats and Financial Challenges

The Book of Genesis recounts the Babylonian attempt to “build us a city and a tower, whose top may reach unto heaven.” God humbled them by making each person speak a different language, which forced them to abandon their Tower of Babel. Since then, construction of transcendent buildings has markedly improved, made possible by advances in building materials and methods. The great leap skyward occurred in the late 19th century when steel frames replaced masonry and the elevator made high floors practical. Today, steel is often combined with reinforced concrete to form a rigid central core from which a load-bearing outer wall is linked by cantilevers. This tube-within-a-tube scheme, in use for half a century, reduces the amount of material required to reach great heights, with the added benefits of allowing column-free floor plans and less massive exterior supports, affording better views.

Technical innovations, such as heavy pendular tuned-mass dampers, counter sway and insure structural integrity, even in the face of typhoons and earthquakes. There are remarkably few architectural failures in the United States, but in China and India, shoddy construction and inadequate oversight have resulted in several epic failures, though thankfully none involving super-tall skyscrapers, which tend to be overengineered. Three-dimensional modeling has lowered construction costs and opened up unprecedented formal possibilities. Rather than stacks of boxes, skyscrapers have become tapered or rounded sculptural forms, whose aesthetic impact is as important as their function.

One of the more radical high-tech variations on the horizon is the 1,476-foot-tall building that Pasadena, California-based GDS Architects has designed for Incheon, South Korea. Tower Infinity seeks to showcase South Korean innovation by becoming the world’s first invisible skyscraper. HD cameras will take live feeds of the surroundings that

will be reproduced on LEDs mounted on the glass facades, ostensibly blending the building into the landscape.

The preeminent architectural firm for super-tall buildings is Skidmore Owings & Merrill (SOM), the Chicago-based enterprise responsible for half of the tallest 20 buildings in the world. Adrian D. Smith, who worked there from 1967 to 2006 before co-founding Adrian Smith + Gordon Gill Architecture, designed the Burj Khalifa, Jin Mao Tower in Shanghai, Trump International Hotel and Tower in Chicago, as well as the Kingdom Tower in Jeddah, Saudi Arabia. William Baker, a structural engineer at SOM who worked with Smith on the Burj, says that the tube system employed in these buildings could pass the mile mark. (In the 1950s, Frank Lloyd Wright proposed such a tower for Chicago as a way of reducing urban sprawl.) “The issue is not structural, it’s expense,” says Philip Bernstein, a Yale University architecture professor and executive with architectural software corporation Autodesk. “It’s fantastically expensive to create these structures and a tremendous challenge to make them financially viable. The Burj is not about money,” he adds. “It’s about making something tall.”

On the one hand, developers create skyscrapers to maximize rentals on expensive land, but on the other, there are limits to the amount of new space a market will bear, and the high cost of construction makes rentals affordable mainly to high-end businesses and hotels, which is why very few skyscrapers offer private residences. Smith told architectural historian Judith Dupré that Chinese cities grant developers of super-tall buildings the rights to develop nearby sites. “The developer will make money not on the super-tall, but on the land around it,” he says. But even in the absence of such incentives, builders are lured by the aura and brand recognition that a distinctive skyscraper can produce. ▷

Photo: Courtesy GDS Architects.



Architectural rendering of Tower Infinity in Incheon, South Korea. Screens on the facade will show live feeds from HD cameras trained on the sky and surroundings to make the building appear invisible.





Glass observation deck,  
Willis Tower, Chicago

### View from the Top

Instant landmarks, many towers are tourist destinations fitted out with soaring observation decks. The opportunity to go to the top is irresistible, and there is no better way to get the lay of the land. With dining and retail added to ticket revenues, observatories can be big earners, and operating them is big business. The Empire State Building raked in \$92 million in a recent year, 40 percent of the property’s revenues, while Chicago’s Willis Tower took in around \$25 million and the John Hancock Center around \$10 million. A few years ago, the Paris-based tourist-site operator Montparnasse Group 56 bought the Hancock’s 94th floor observatory for \$44.2 million. Legends Hospitality, a company that operates concessions at the Yankees and Cowboys stadiums, has an \$875-million, 15-year lease on One World Trade Center’s three-floor observatory, projected to attract 3.8 million when it opens in 2015.

In pursuit of entertainment dollars, observatories

are engaged in a thrill race. Willis Tower installed glass boxes that project from the side of the building, enabling visitors to step out into midair. One World Trade Center will have video screens in the floor that simulate a knee-wobbling view straight down. And Shanghai Financial Center has glass floors and outward-tilting walls designed to increase vertigo.

Prior to the Burj, communications towers in Tokyo, Canton and Toronto were the tallest manmade structures. Several of their observatories have recently taken the exhilaration factor to dizzying extremes, allowing visitors to walk outdoors onto narrow ledges and even to lean over the edge while attached to overhead safety lines. Towers in Macau and Auckland go a step further, offering bungee jumps. As skyscraper owners seek to compete with such attractions, it may not be long before we have the opportunity to follow in the legendary footsteps of Philippe Petit.

Photos: Getty Images/Bloomberg; (facing) Jason Kaufman.

### Skyscraper Specifics

#### Empire State Building, New York, N.Y.

**Completed:** 1931.

**Architect:** Shreve, Lamb & Harmon Associates.

**Height:** 1,250 ft. (1,453 ft. to tip of broadcast tower).

**Floors:** 102.

**Observatories:** 1,250 ft. (floor 102); 1,050 ft. (floor 86).

**Visit:** Daily until 2 a.m. \$25 (floor 86); \$48 express entry; additional \$17 (floor 102); \$10 audio tour.

**About:** The Art Deco icon on Fifth Avenue at 34th Street is arguably the world’s most famous office building. Recent upgrades have refurbished the landmark lobby. A top tourist destination, the building draws several million visitors to observatories on floors 86 and 102.

#### Taipei 101, Taipei, Taiwan

**Completed:** 2004.

**Architect:** C.Y. Lee & Partners.

**Height:** 1,667 ft.

**Floors:** 101.

**Observatories:** 1,258 ft. (floors 88–89);

1,285 ft. (floor 91, outdoors).

**Visit:** Open daily. Adults NT\$500 (\$17);

fast pass NT\$1,000 (\$33).

**About:** Rising majestically from the eastern district of the Taiwanese capital, this postmodern pagoda is traditional Asian architecture amplified by technology and the design is layered with symbolism. The building has 2.3 million square feet of office space and nearly 800,000 square feet of retail. The \$1.8 billion project was originally for three towers, but it was decided to combine them to create the world’s tallest building, a title held until Burj Khalifa opened in 2010. The island’s seismic activity and typhoon season required innovative engineering, including 380 foundation piles drilled 262 feet down, some 98 feet into bedrock. Recent modification of the electrical, water and lighting systems make Taipei 101 the world’s tallest green building.

#### One World Trade Center, New York, N.Y.

**Completed:** Opens Spring 2015.

**Architect:** Skidmore Owings & Merrill.

**Height:** 1,776 ft.

**Floors:** 104.

**Observatory:** 1,268 ft. (floors 100–102).

**Visit:** Daily; hours and ticket prices not announced.

**About:** Ground Zero’s master planner Daniel Libeskind set the height at 1,776 feet in reference to the Declaration of Independence. SOM retained that symbolic height when brought on to design the “Freedom Tower.” The crystalline building’s chamfered facades form triangular facets that meet in a square at the top where the spire beacon will emit light visible from 50 miles. Millions have been flocking to the World Trade Center Memorial and National September 11 Memorial Museum that lie at the base of the tower. The memorial consists of two reflecting pools set within the square footprints of the original Twin Towers. The names of the 2,983 victims of the 2001 and 1993 attacks are carved into metal plates atop stone parapets that frame the pools. Water cascades 30 feet down on all four sides, then passes into a deeper well at the center of each sunken pool. Rising



from the tree-lined plaza is the Memorial Museum that narrates the history of the World Trade Center and considers the global context and implications of the attacks. Hundreds of artifacts include a section of the three-pronged steel uprights that formed the base of the Twin Towers, and the last steel column (above) removed from the site, adorned with photographs, prayers and other tributes left by first responders and recovery workers. And biographies, portraits, spoken remembrances and personal mementos pay homage to each individual who perished.

#### Burj Khalifa, Dubai, United Arab Emirates

**Completed:** 2010.

**Architect:** Adrian Smith / Skidmore, Owings & Merrill.

**Height:** 2,717 ft.

**Floors:** 200 (163 inhabitable to 1,918 ft.).

**Observatory:** 1,483 ft. (floor 124).

**Visit:** Daily until 1 a.m.; AED125 (\$34);

AED400 (\$109) express entry.

**About:** The shimmering, staggeringly high Burj shatters the record for the world’s tallest building. Height is the point: The tower is the tallest manmade structure and has the most floors, highest occupied floor, highest restaurant, longest-traveling elevator, highest outdoor observation deck and even the highest fireworks display. Originally planned as the Burj Dubai (“burj” means “tower” in Arabic), the \$1.5-billion project was renamed after Sheik Khalifa bin Zayed al-Nahyan, leader of Abu Dhabi and president of the UAE, who bailed out Dubai in the financial crisis. Unlike most skyscrapers, the Burj is mainly residential. Upper floors are corporate rentals, with owner Emaar Properties’ CEO ensconced on the top 163rd floor. Floors 19 to 108 offer 900 luxury apartments, and the Armani-designed Hotel Dubai is on floors 38 and 39. Residents have their own library, a cigar club and several sky lobbies with fitness centers replete with swimming pools that extend to outdoor balconies. The public can shop in Dubai Mall, take double-deck elevators to Atmosphere restaurant on floor 122 and At the Top observatory on 124. Window walls and an open-air terrace afford 360-degree views of the desert, the rising city and the Arabian Gulf, with the palm-shaped archipelago of man-made islands visible in the distance. ▶





### Shanghai Tower, Shanghai, China

**Completed:** Scheduled completion in 2015.

**Architect:** Gensler.

**Height:** 2,073 ft.

**Floors:** 128.

**Observatory:** 1,841 ft.

**Visit:** Hours and ticket prices not announced.

### Shanghai World Financial Center

**Completed:** 2008.

**Architect:** Kohn Pedersen Fox.

**Height:** 1,614 ft.

**Floors:** 101.

**Observatories:** 1,388 ft. (floor 94); 1,440 ft. (floor 97 with retractable skylight); 1,555 ft. (floor 100, glass floor).

**Visit:** Daily until 11 p.m.; CNY120 (\$20) floor 94; CNY150 (\$25) all three floors.

### Jin Mao Tower, Shanghai, China

**Completed:** 1999.

**Architect:** Skidmore Owings & Merrill.

**Height:** 1,380 ft.

**Floors:** 88.

**Observatory:** 1,116 ft. (floor 88).

**Visit:** Daily until 10 p.m.; CNY100 (\$17).

**About:** This towering trio rises in Pudong, a former farming district on the East bank of the Huang Po River that in 1993 the Chinese government designated as the country's future financial hub. The tallest is Shanghai Tower, a \$2.4-billion office tower topping out at 2,073 feet, second-highest in the world. Shaped like a loosely furled scroll, the structure has two glass curtain walls, with space between them containing restaurants, retail and views of the city. Set to open next year, the building contains 2.4 million square feet of office space.

Across the street is Shanghai World Financial Center, whose trapezoid-pierced pinnacle suggests a Buddhist bell tower. The building has the world's highest observation deck, at 1,555 feet, part of a three-tier observation deck that affords views of Old Shanghai across the river and close-ups of the surrounding towers. The glass-floored Sky Walk 100 bridges the upper edge of the aperture at the building's apex, allowing visitors to feel as if they are floating in midair above the city.

Jin Mao Tower, an aesthetic triumph that follows Taipei 101 in translating the traditional Asian pagoda form into a high-tech super-tall building. The telescoping cylinder, sheathed in a glare-reducing metal lattice, has vertical fins and horizontal bands that mark off setbacks that diminish in elevation approaching the summit, giving a feeling of lift. ♦

Photo: Shutterstock/Artistic Photo.

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