SEIZING THE TITLE of “world’s tallest building”—be it Joseph Pulitzer’s 20-story New York World newspaper building in lower Manhattan in 1890, the Empire State Building in 1931, or Kuala Lumpur, Malaysia’s gargantuan Petronas Towers in 1998—has always been about pushing the limits of architecture and engineering. But three years after the attacks of September 11 demonstrated how vulnerable such buildings are to terrorists, a surprising new competition is under way. The latest skyline king is a vaguely pagoda-like tower in Taipei, Taiwan, called Taipei 101 (see “Inside Taipei 101,” p. 52). Slated for occupancy this fall, the 101-story structure stands 508 meters tall, more than half a football field higher.
Taiwan’s record-breaking 508-meter, 101-story skyscraper is built to withstand frequent typhoons and occasional earthquakes. It sports the world’s fastest elevators and largest antisway system, seismic sensors, and Internet-linked security systems. ILLUSTRATIONS BY JOHN MACNEILL

EMERGENCY REFUGE AREAS every eight floors provide places to escape smoke and fire. The refuge areas are accessible via pressurized stairways. Firefighters can reach them by means of dedicated, specially reinforced elevators that avoid conflict with escapees.

A 680,000-KILOGRAM STEEL BALL, suspended from cables at the 92nd floor and visible from observation decks and a restaurant, stabilizes the building. When the building is pushed one way by wind, the massive ball swings in the other direction, absorbing energy and limiting building motion. It’s the largest antisway system of its kind in the world.

CORNER CUTOUTS on the building’s facade were shown by software to diffuse the impact of wind. During typhoon season, Taiwan is often buffeted by winds topping 160 kilometers per hour.
EIGHT CONCRETE-AND-STEEL SUPERCOLUMNS, measuring 2.4 by three meters at the bottom, carry the full load of the building and are designed to handle earthquake and typhoon forces. Smaller steel beams surround central stairways and elevators.

SENSOR AND SECURITY INFRASTRUCTURE
Seismic: Thirty seismic activity sensors monitor vertical and horizontal motions on six levels of the building.

Security: A total of 520 surveillance cameras, 330 radio frequency identification card readers, 170 security intercoms, and 2,600 door monitors protect occupants and can be controlled or monitored via the Internet.

Communications: Some 22.5 kilometers of fiber-optic cable carry data at one gigabyte per second and are backed up by microwave and satellite communication systems.

THE TOWER CONTAINS
■ 198,347 square meters of office space
■ 77,033 square meters of retail space
■ 83,000 square meters of parking, enough for at least 1,800 vehicles

OUTWARD-SLOPING windows have a seven-degree pitch above the first 25 floors, avoiding direct sunlight, allowing for energy conservation, and providing for better city views.

THE FASTEST ELEVATORS
in the world carry passengers from the first to the 89th floor at speeds as great as 1,010 meters per minute (38 miles per hour). An elevator cab (right, shown below floor level) is bullet shaped to make less sound, pressurized to be soft on passenger eardrums, and almost vibration free thanks to a damping system that senses shaking and counteracts it with small weights.
than Petronas. On the horizon are even taller skyscrapers, including the Freedom Tower proposed for New York City’s ground zero, and a business and residential colossus in Dubai, United Arab Emirates.

It’s getting crowded at the top: several other massive skyscrapers, while not quite record-setters, have risen in Asian cities in the past decade, with another under construction in Shanghai, China. Indeed, eight of the world’s ten tallest buildings are now in Asia. “Some Asian economies have grown more wealthy than before, and they now want to express their identities,” says C. P. Wang, the architect of Taipei 101. “To me, a skyscraper is an easy way to do that.” Indeed, proclaims Gail Fenske, an architecture professor at Roger Williams University in Bristol, RI, the world is in the midst of “a new skyscraper frenzy.”

The height records themselves can’t be credited to any breakthrough in technology. Apart from the introduction of higher-grade steel, composite materials, and new welding techniques, basic construction methods haven’t changed much in the past couple of decades.

Still, technology is a key enabler of this “frenzy.” For starters, the latest software helps architects and engineers work together, and with numerous models at the same time, says Dennis Poon, managing principal for Taipei 101 at Thornton-Tomasetti Engineers in New York City. “With these new tools, we can do quick 3-D analyses of several different types of designs,” says Poon. “We just don’t have to guess.” It is these analyses that make it possible to quickly determine the best designs for building the world’s tallest building in a typhoon-and-earthquake-prone area like Taipei.

And basic structural improvements fortify these buildings. Unlike the World Trade Center, the new skyscrapers have hardened-concrete cores that house elevators and stairways, better protecting potential escapees from fire and blast damage. Sensing and communications technologies—among them structural sensors that monitor swaying and radio frequency identification systems to enhance security—improve the buildings’ operation. The latest elevators include smart controls that do things like dampen vibrations and regulate air pressure. In all these areas, says Fenske, “the engineers are pushing the limits as far as they can.”

The result will be a new set of skyscraper records—ones that other engineers will surely seek to surpass in the years and decades to come.

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