

Only way is up for towers that reach for the sky

Skyscrapers have captured our imagination for decades with their beauty and apparently gravity-defying structures. [Douglas Murphy](#) introduces some of the most breathtaking

The technical challenges of the skyscraper, the architectural typology that most embodies the 20th century, were largely worked out by the end of the 19th. The Eiffel Tower of 1889 took developments in iron and sent them straight up into the sky. The relatively lightweight and modular iron (later steel) frame allowed for almost

continuous vertical extension in a manner no other material was capable of. It was the tallest building in the world for another 40 years. The major functional innovation that the Manhattan builders were able to take advantage of was the express elevator: from then on, real estate could be multiplied into the sky as far

as it was possible to lift people. New York is also blessed with schist, an incredibly tough stone bedrock that provided ample foundations for the blossoming towers of Midtown. Architecturally, the skyscraper also presented a problem of civic expression: how should a building that size look? The solution, perfected by

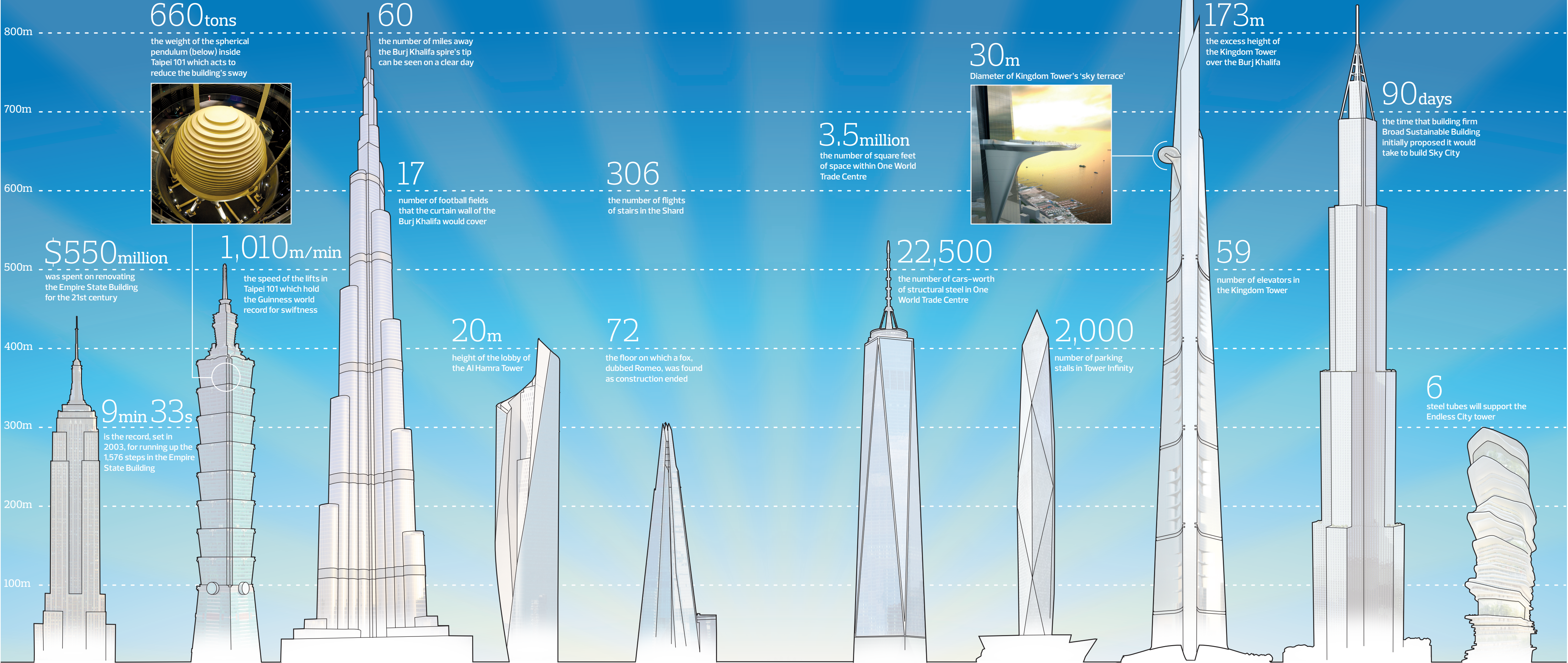
American architect Louis Sullivan, was to adapt the model of the classical column, with a base, a top and a shaft of variable length in between. Variations on this strategy have moulded the design of skyscrapers ever since. The steel frame and deep concrete foundations mean that there is really no limit to the height of a skyscraper,

provided you can afford it. But when the towers get really big, strange things start to happen: the flexibility of a Hong Kong skyscraper in a typhoon makes for a disturbingly seasickening experience. Super-tall buildings such as the Burj Khalifa in Dubai or the forthcoming Kingdom Tower in Jeddah have to be as aerodynamic as

possible to reduce wind loads, while if flexibility is still a serious issue, a tuned mass damper — a giant weight that gets hydraulically pushed against the direction of the tower's flex, as found at the very top of Taipei 101 in Taiwan, might be your best option. Two trends in architecture look set to change the skyscraper over coming

years. As they get larger and larger, the demand to bring more varied parts of the city up inside them will become greater as a round trip to the ground takes longer. Also, developments in ecological technology mean the sheer size of skyscrapers might make them ideal locations for generating energy or even producing food.

GRAPHIC: PETE GUEST



1 EMPIRE STATE BUILDING Completed: 1931 LOCATION: New York, US COST: \$41m HEIGHT: 443 metres FLOORS: 103 The tallest building in New York City until 1972, when it lost the title to the North Tower of the World Trade Centre. Following the horrific destruction of the tower in the 9/11 attacks, however, the Empire State Building once again became the tallest skyscraper in the city, until surpassed by One World Trade Centre earlier this year.	2 TAIPEI 101 Completed: 2004 LOCATION: Taipei, Taiwan COST: \$1.7bn HEIGHT: 508 metres FLOORS: 101 With a design similar to that of a growing bamboo stalk, Taipei 101 is a skyscraper that incorporates many traditional themes in its structure. Among them, dragon-like symbols are incorporated on the corners of the building to ward off negative energy, while the eight sections to the tower echo the Chinese lucky number. It is built to withstand typhoons and earthquakes.	3 BURJ KHALIFA Completed: 2010 LOCATION: Dubai, UAE COST: \$1.5bn HEIGHT: 830 metres FLOORS: 162 Currently holding the title of the world's tallest building, the Burj Khalifa boasts some very clever features. Among them, the stepped sections of the structure are set back in a spiral so as to disrupt the flow of wind around the building, preventing the formation of vortices that can cause pressure problems and result in unwelcome vibrations. It has 900 residential apartments.	4 AL HAMRA TOWER Completed: 2011 LOCATION: Kuwait City, Kuwait COST: \$730m HEIGHT: 412 metres FLOORS: 74 Bearing a passing resemblance to a curl of orange peel, the curious shape of the Al Hamra Tower is no whimsical flourish. Its twisted form capitalises on the views over the Arabian Gulf while mitigating against the sun. The office windows are cut at an angle while the thick south-facing outer wall that wraps around the inner core acts as a sort of buffer, absorbing heat from the sun.	5 THE SHARD Completed: 2012 LOCATION: London, UK COST: \$695m HEIGHT: 306 metres FLOORS: 72 (habitable) Part of the London Bridge station development, the Shard is the capital's tallest building and, in fact, the tallest in the EU. So far. Allegedly architect Renzo Piano came up with the design on the back of a napkin, however its snappy moniker was the result of a barbed insult from English Heritage which was less than thrilled at the idea of the glass tower piercing the city's historic skyline.	6 ONE WORLD TRADE CENTRE Completed: 2013 LOCATION: New York, US COST: \$3.9bn HEIGHT: 541 metres FLOORS: 104 Built adjacent to the city's memorial to the devastating attacks of 9/11, One World Trade Centre, formerly known as the Freedom Tower, is now the tallest building in New York, standing at 1,776ft. This is a significant number, corresponding as it does to the year in which the declaration of independence was signed in the United States.	7 TOWER INFINITY Projected completion: 2014 LOCATION: Seoul, South Korea COST: Unknown HEIGHT: 453 metres FLOORS: 27 Boasting a much ballyhooed optical system, Tower Infinity claims to be the first 'invisible' skyscraper, with a set of cameras and LED lights to project views from behind the building on to the front. Happily, however, planes landing at the nearby airport won't get mixed up in this game of peekaboo: the red light of so-called 'anti tower' will remain visible at all times.	8 KINGDOM TOWER Projected completion: 2019 LOCATION: Jeddah, Saudi Arabia COST: \$1.2bn HEIGHT: 1,000 metres-plus FLOORS: Estimated 200 With foundations finished this year, work is continuing apace on this kilometre-high building that is said to resemble a 'bundle of leaves shooting up from the ground'. The platform jutting out was originally designed as a helipad, but with pilots shying away from the idea of landing on it, it was repurposed as a 'sky terrace' - that's a viewing platform, if you were wondering, within its walls.	9 SKY CITY Projected completion: 2014? LOCATION: Changsha, China COST: \$1.47bn HEIGHT: 838 metres FLOORS: 202 Sky City scooped the headlines when building firm Broad Sustainable Building announced it could be knocked up in a mere 90 days. That was in 2012. Since then, ground has been broken, but work has halted amid a tussle over permits. If it ever is built, however, it will be a sight to behold with plans revealing that it will house schools, hospitals and even farms within its walls.	10 ENDLESS CITY Projected completion: unknown LOCATION: London, UK COST: Unknown HEIGHT: 300 metres FLOORS: Unknown The Endless City might look like a wobbly multi-tiered sandwich, but in reality it is a vision for the future, comprising indoor parks, retail areas and private apartments within a 'vertical street' to create a true community. The designed, proposed by Chinese firm SURE Architecture, scooped first prize at this year's SuperSkyScrapers Awards.
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