The Rise of the Supertall

By Philip Oldfield

The completion in 1930 of the Chrysler Building in New York, at a height of 319 meters, marked an important watershed in tall building design. The building, which would be the world's tallest until the opening of the Empire State Building the following year, became the first to surpass the 300-meter / 984-foot mark, the point at which the Council on Tall Buildings and Urban Habitat (CTBUH) defines a building as being *supertall*. In the 79 years since its completion, only 37 additional buildings have achieved this same feat, and only 18 cities can today lay claim to be home to a supertall tower. However, despite the current economic crisis, projections show these figures are set to change dramatically in the upcoming years. By the end of 2010, the CTBUH estimates that the number of supertall buildings in the world will have more than doubled *Figures 1a and 1b*.

In addition, a small but growing number of these supertall projects have started to look at appropriate environmental responses as a main design generator – a direction which is now gathering pace rapidly with the ongoing realisation regarding the effects of climate change and the urgent need for more sustainable building types and patterns of life. What follows then is a look at some of these sustainable, supertall towers that are currently under construction…

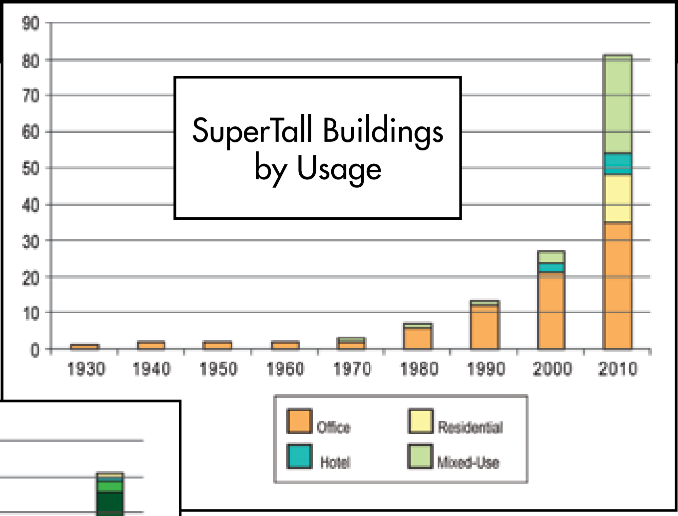

Figure 1b: Total number of Supertall Buildings in the World by Usage. ©CTBUH.

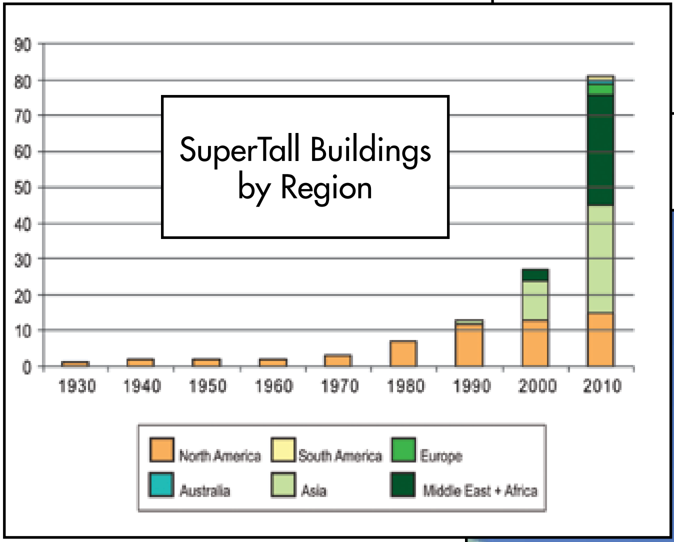

Figure 1a: Total number of Supertall Buildings in the World by Region. ©CTBUH.

Bank of America Tower, New York

Cook + Fox Architects (366 meters / 1200 feet)

This 54-story office tower will be the second tallest building in New York upon completion later this year (*Figure 2*). However, it is the building's green credentials and cutting-edge technologies, rather than its height, that catches the eye. For example, the building uses a natural gas-fired cogeneration plant to generate electricity, with the waste heat used to produce hot water for heating in the winter or cooling in the summer with an absorption chiller. It will collect and treat stormwater, water that condenses from steam and air-conditioning equipment and water from lavatory sinks, and use this to flush toilets and supply the cooling tower. The low-iron glass facade and floor to ceiling glass means the interior workspaces are flooded with natural light, while the tower filters 95% of particulates meaning air exhausted from the building is, in effect, cleaner than the air drawn in. All in all, according to the project architects, the tower will consume about half the energy from the grid and half the water of a typical building its size, and will achieve a LEED Platinum rating – the highest sustainable certification from the US Green Building Council.

Figure 2: Bank of America Tower, New York. ©Marshal Gerometta/CTBUH.

Sinosteel International Plaza

Tianjin, MAD (358 meters / 1175 feet)

The most striking feature of this 358 meter office tower and adjacent hotel in Tianjin is the dynamic façade that wraps around them (*Figure 3*). Built up of five differing sizes of hexagonal windows – a traditional motif in Chinese architecture – the façade at first appears random. However, the positioning and size of the hexagons are actually determined by the surrounding air-flows and sun studies, therefore assisting in reducing unwanted solar gain and minimizing winter heat loss from the tower. With the modern fully glazed skyscraper often criticised for its environmental performance, the increased levels of envelope opacity, and direct response to site and climate present within this supertall design, is clearly a model for the future.

Figure 3: Sinosteel International Plaza, Tianjin, ©MAD.

London Bridge Tower, London

Renzo Piano Building Workshop (310 meters / 1017 feet)

Also known as the 'Shard of Glass', the London Bridge Tower will be the UK's first supertall building when completed (*Figure 4*). A truly mixed-use tower, the building will house offices, a hotel, residential apartments and public spaces, such as viewing galleries and restaurants, at multiple levels. While this mix will create a vibrant building, it will also allow energy to be shared between the different uses, with heat rejected from the office spaces in winter used as background heating in residential spaces. Excess heat can be dissipated naturally through the 60 meter-tall 'radiator' at the tower's apex; this functions by wind blowing over finned-tubes of coolant water, thus reducing their temperature. The building's facade is a triple-glazed, externally ventilated system, while many corners of the tower also house naturally ventilated winter gardens which can be used as meeting rooms or breakout spaces.

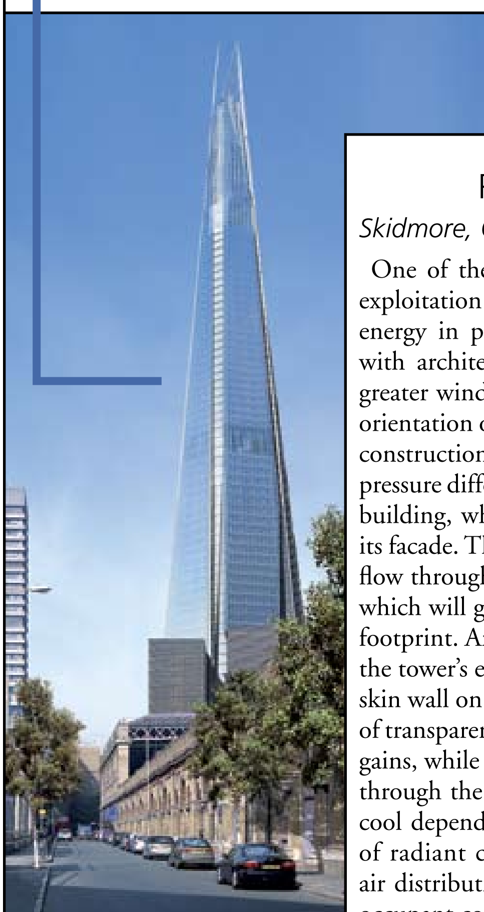

Figure 4: London Bridge Tower, London. Courtesy of Hays Davidson and John Mclean. ©RPBW.

Pearl River Tower, Guangzhou

Skidmore, Owings & Merrill LLP (310 meters / 1016 feet)

One of the recent trends in sustainable high-rise design is the exploitation of on-site energy from renewable sources. Wind energy in particular is being tested on many high-rise designs, with architects and engineers looking to take advantage of the greater wind speeds present at height. For example, the form and orientation of the 71-story Pearl River Delta tower currently under construction in Guangzhou (*Figure 5*) is such that it creates a pressure differential between the windward and leeward sides of the building, which facilitates air flow through four openings within its facade. The aerodynamic form of the tower accelerates the wind flow through these openings and onto vertical axis wind turbines, which will generate clean energy and reduce the building's carbon footprint. Another factor that makes a major contribution towards the tower's energy performance is the internally ventilated double-skin wall on the north and south facades. This provides high levels of transparency and occupant comfort by mitigating glare and solar gains, while the air within the cavity is also continuously extracted through the ceiling void, where it is utilized as a pre-heat or pre-cool depending upon external temperatures. In addition, the use of radiant cooling ceilings, in conjunction with an underfloor air distribution system, reduce energy requirements and enhance occupant comfort. All in all, these factors, amongst others, reduce the building's energy consumption by 58% compared to a code-compliant counterpart.

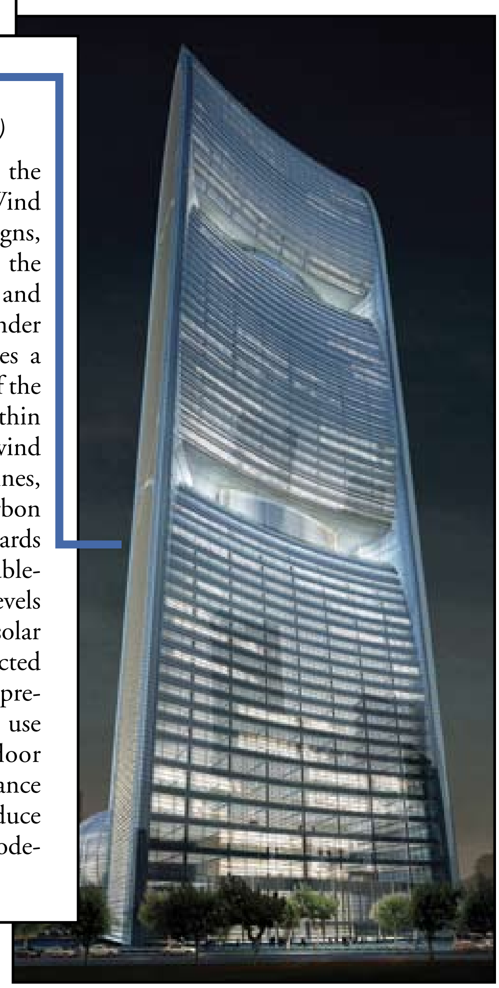

Figure 5: Pearl River Tower, Guangzhou. ©Skidmore, Owings & Merrill LLP 2007. All rights reserved.

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More to Come…

There is a tendency, given this increase in sustainable high-rise design, to consider that supertall buildings have progressed to their most advanced state. This is not, however, the case. While sustainable design approaches and technologies are beginning to be incorporated into supertall buildings, there is a long way to go before they can be considered truly sustainable. The embodied energies (and CO2 emissions) through constructing materials at height, combined with the high operating energy consumption through air-conditioning, lighting and vertical transportation, means that supertall buildings have to take every opportunity to both reduce energy consumption and harvest clean energy. The potential of energy harvesting at height – through wind, solar and other methods – cannot be denied.

A second challenge for the supertall building is to develop in design terms, and especially in the relationship with its urban location. Many supertall buildings historically seem to have been designed as either vertical extrusions of an efficient floor plan, or stand-alone pieces of high-rise urban 'sculpture'. In both cases the only relationship with the urban setting is a visual one, with the building usually dominating.

The third challenge for supertall buildings lies in their functional programs. To create a truly vibrant, mixed-use facility within both the building and the city, tall buildings need to innovate beyond the standard functions – office, residential and hotel – that account for perhaps 95 percent of space in tall buildings worldwide. Could the supertall of the future house vertical farms, schools and places of education and even sporting functions to create true vertical cities?

In conclusion, while it seems that architects, developers and engineers have risen to the challenge of building supertall, the challenge of creating buildings that are both supertall *and* supergreen still has a long way to go.▪

The Council on Tall Buildings and Urban Habitat, based at the Illinois Institute of Technology in Chicago, is an international not-for-profit organization supported by architecture, engineering, planning, development and construction professionals, designed to facilitate exchanges among those involved in all aspects of the planning, design, construction and operation of tall buildings. The Council is the arbiter of the criteria upon which tall building height is measured, and thus the title of 'The World's Tallest Building' determined. For more information, please go to **www.ctbuh.org**.

Pearl River Tower

Structural Engineer of Record: Guangzhou Design Institute (GZDI)

Bank of America Tower

Structural Engineer of Record: Severud Associates

Sinosteel International Plaza

Structural Engineer of Record: China Construction (Shenzhen) Design International (CCDI)

London Bridge Tower

Structural Engineer of Record: WSP Cantor Seinuk

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