In Focus

BOOK REVIEW OF SUPERTALL: HOW THE WORLD'S TALLEST BUILDINGS ARE RESHAPING OUR CITIES AND OUR LIVES, BY STEFAN AL (W. W. NORTON, 2022)

Since 2007, for the first time in our human history, more than half of the world's population is now living in cities. As the world is expected to urbanize even further over the next few decades, the question is how cities can absorb urban population growth. The boundaries are exacerbated by the effect of climate change. Can skyscrapers serve as an architectural solution? How can we build them to cope with an ever-growing population and climate changes?

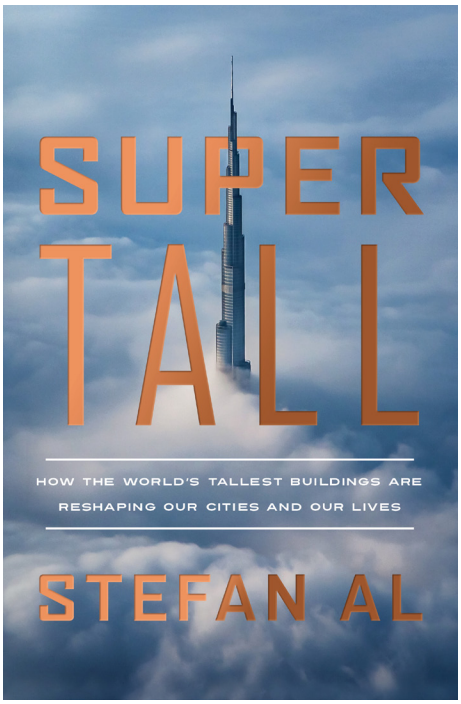
Supertall, a new book by Dutch architect and professor Stefan Al, offers an authoritative and insightful analysis on the future of the skyscraper, pointing to such directions as regenerative sustainability. It is a thoughtful account of the skyscraper's history and future trajectories, using some of the most famous buildings to tell the story. Al has done extensive research to help us understand how these supertall structures are made, including all the technical marvels and design innovations that allow us to make life in them possible, while relating to a complex system of external climatic factors.

The evolution of tall buildings has been remarkable. For instance, supertall buildings were first built for a single use, whether it be office or residential. But now they are increasingly becoming mixed-use, combining office, residential, hotel, commerce, and community activity areas. Concepts are becoming more mixed and flexible, extending the life cycle span of these types of structures.

His reflections of materials are very insightful. Typical construction materials used in tall buildings have changed over time, and a new environmental ethic may soon lead to further evolution. The first tall buildings were built mostly from steel frames. Today, as the compressive strength of reinforced concrete has increased, they are mostly constructed out of high-performance concrete. Al explains how the world is overly reliant on concrete, given the significant impact on global carbon emissions (about 5% of the world's total), which in turn increases climate change. Mass timber, as Al points out, offers the most promise as a more sustainable building block for skyscrapers reaching up to 30 stories.

Elevators have transformed as well. The fastest elevator is now moving passengers at a speed of 76 km/h, although the average elevator still transports people at around 22 km/h. There is research being done on the so-called "wonkavator," or the Multi, which is the world's first cableless elevator developed by ThyssenKrupp elevator company. It is a magnetically levitated elevator that could move both upwards and sideways and allow for new skyscraper design, which up until now has been constrained by vertical elevator cores.

For skyscraper architects and engineers, understanding aerodynamics is vital since wind is the most potent force affecting tall buildings. Computer simulations and more specifically computational fluid dynamics simulations help architects iterate various designs, optimizing wind reduction. In addition, since taller buildings swing more than other structures in strong gusts of wind, they can make people queasy. Such inventions as the tuned mass damper reduce the shake of a building, which acts as a giant counterweight moving in the opposite direction of the



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wind. Better aerodynamics also means a reduction in materials needed to construct buildings.

One serious challenge in the case of tall buildings is making them climatically comfortable since in most cases they are absorbing a large amount of solar radiation. Besides, occupancy and equipment add thermal loads. As a result, HVAC (heating, ventilation, and air conditioning) equipment is substantial. Tall buildings need mechanical floors every 20 to 30 stories, which are off-limits to the general public, just to host machinery and water pumps. More sustainable skyscrapers are able to reduce cooling loads through operable windows, smaller window areas, shading devices, as well as thermal chimneys and atriums. These all could add to the "thermal aesthetic" appeal of the building. The use of sensors to monitor and improve energy efficiency is important as well, although excessive data collection could have a potential downside and be considered an invasion on people's privacy.

The reaction of the general public must also be taken into account. Skylines are often protected in historic cities, such as traditionally low-rise skylines in Europe. Restrictions are, for example, related to preservation of the right to light of shorter buildings. However, height restrictions may also come from "view protection corridors". This is the case of London where they try to preserve historical views. Not more than a century ago in these cities, buildings were typically not allowed to be taller than a safety fire ladder or a steeple of a cathedral. The current rise of tall buildings in these cities is illustrative of today's urban renaissance.

In some cities, like New York, unique conditions exist that lead to taller buildings. The purchase of air rights above New York City allows developers who "buy" the right to erect taller structures. This can result in very tall buildings, even on sites that are relatively small. The city also has a regulation in which mechanical floors do not count as buildable areas. This allows developers to build even higher when they have entire floors dedicated to mechanical equipment. But arguably New York's most innovative contribution is how the city incentivizes the creation of open space by the private sector in exchange for granting more development rights.

Hong Kong's skyscrapers are famous for their location near public transit stations. The city even features elevated footbridges that interconnect various skyscrapers and subway stops, making the city the poster child of transit-oriented development. As a result, Hong Kong has the lowest per capita energy cost for urban transportation. Singapore manages to incorporate greenery and vegetation into its skyscrapers. A new regulation forces developers to build green walls and roof gardens, contributing to Singapore's image of a Garden City. Such a biophilic approach has an important role in preserving biodiversity as well as providing temperate microclimatic conditions.

In conclusion, it appears that cities around the world will continue to build tall buildings, albeit in different ways. The book highlights the many examples of how skyscrapers can be built more regeneratively, and how the axes of ecology, decarbonization and human health are (or are not) tackled. Skyscrapers are an important typology, and their performance can be considered controversial in light of climate change: Al's book thus offers a valuable contribution to unlock a more sustainable and holistic design of tall buildings.

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