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Skyscrapers and Skylines: 1885–2007

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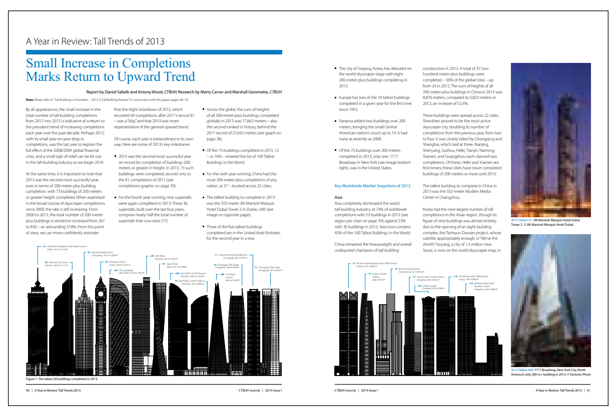
A Year in Review: Tall Trends of 2013
Small Increase in Completions Marks Return to Upward Trend

"We are not contextualists in the sense of feeling obliged to be similar, but we are contextualists in the sense that every one of our buildings is a comment on its context. Sometimes a comment is critical; sometimes it is supportive in enlisting that context into a greater whole."

Rem Koolhaas, page 48

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Asia and Oceania:

Casting a sober pall over the apparent shortcuts taken on Asia's frantic path to vertical growth, two major fires shocked the tall-building industry late in 2013. Both appeared to be the result of negligent practices. In **Guangzhou,** China, the unfinished high-rise **Jianye Mansion** was ablaze for 11 hours before 380 firefighters were able to bring it under control. The 25-story tower was abandoned in 1998 before being fully completed, and was reportedly being used as a storehouse for leather, shoes, and wooden boards. Fortunately, no injuries were reported.

In **Mumbai,** India, the outcome was far worse – seven people were killed and numerous firefighters injured in a massive fire on the 12th floor of the 26-story **Mont Blanc** residential tower. The fire was particularly concerning, as several elements of the fire code appeared to have been ignored in its construction, including a lack of required sprinklers inside apartment units, inadequate approach road width, an inadequate amount of required open space for egress, and insufficient exiting stairs. The fire should not be considered an isolated incident, authorities warned: in 2013, 285 in-city and 659 suburban high-rises in Mumbai were served notices for failing to comply with fire safety requirements, according to the Mumbai Fire Brigade.

THEY SAID

"We shouldn't be scared of tall buildings… We need to be building at higher densities to deliver the number of homes London needs."

Susan Emmett, a director of residential research at estate agency Savills commenting on record number of London skyscraper plans. From "Campaigners Warn Against Record Number of London Skyscrapers Plan," Financial Times, January 27, 2014

Jianye Mansion, Guangzhou. © 感光度

More macabre news came from China's south, where plans were revealed for a 20-story vertical cemetery in famously space-starved **Hong Kong.** In a city where even the dead are running out of places to stay, the proposal for the columbarium, dubbed **"Le Fabergé"** due to its egg-like shape, was being taken seriously. The tower would include 50,000 niches for crematorial urns on 12 floors, with the rest of the building housing a library and museum. The site is on a former factory grounds and is adjacent to an existing cemetery and crematorium.

On a higher note, **Shenzhen** saw the completion of one of OMA's best-known designs, the **Shenzhen Stock Exchange.** The 250-meter skyscraper, nicknamed "the Miniskirt," features a three-story podium that has been elevated 36 meters above the ground.

In **Shanghai,** Foster + Partners and Thomas Heatherwick have unveiled images of the **Bund Finance Centre,** which is now under construction in on the banks of the Huangpu River. The 420,000-square-meter complex will feature two 180-meter office towers at the end of Shanghai's waterside street, The Bund. Across the water, the state-owned developer of **Shanghai Tower** sought to hire a leasing agent to draw global tenants to the 220,000 square-meter, 632-meter-tall building, a highly unusual move in China, particularly for state-sponsored buildings.

In **Singapore**, one of the more exotically sculptured skyscrapers in recent years arrived in the form of the **Ardmore Residence,** a 36-story residential tower near the Orchard Road luxury shopping district. Inspired by the lush gardens of the city, the Residence is organized around specific views and repeats a landscape theme through the entire tower. The projected next-tallest building in the island city-state, the 290-meter **Tanjong Pagar Centre,** was to receive a touch of class with the arrival of prime tenant Clermont, a

Le Febergé, Hong Kong. © South China Morning Post

Shenzhen Stock Exchange. © OMA/Philippe Ruault

Bund Finance Centre, Shanghai. © Foster + Partners & Heatherwick Studio

Ardmore Residence, Singapore. © Pontiac Land Group

luxury hotel and private-residence brand, by 2016.

Just north in **Kuala Lumpur,** Malaysia, REX Architecture revealed its design for the 380-meter **Equator Tower,** which lives up to its name and location by exposing itself equally to solar radiation from all directions. To counteract this challenge, the tower will feature a retractable Teflon-coated, glass-fiber reinforced sunshade that will protect from glare while still offering views. During daytime hours, the sunshade is stretched across the building on a tensile cable net. Sections of the veil can be retracted at night or on overcast days.

Further south, in **Kotte,** Sri Lanka, the **Clearpoint Residencies** broke ground with the intent of becoming the world's tallest vertical garden. The 46-story, 164-unit tower would give each apartment its own garden terrace, such that residents can still get the advantage of ground-floor living in proximity to greenery.

To the east, another tropical island placed a major green (and tall) stake in the ground. In **Jakarta,** Indonesian energy company Pertamina has started construction of the 530-meter, 99-floor **Pertamina Energy Tower** project, which is to include wind turbines in its clamshell-shaped crown. The building, designed by SOM and to be constructed by Turner International, will seek Platinum accreditation from Indonesia's Green Building Certificate Institute. Not to be outdone, KPF announced a groundbreaking for the 210-meter **Sequis Centre Tower,** which is

Tanjong Pagar Centre, Singapore. © Samsung CT Corp.

Equator Tower, Kuala Lumpur. © REX

Clearpoint Residencies, Kotte. © Milroy Perera Associates

A Coat of Many Colors


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Tamara Roy
Tamara is an architect and urban designer working at the forefront of innovative housing. Tamara's recent academic projects include the Tree House Residence Hall at the Massachusetts College of Art and Design, described as the "most interesting high-rise in Boston," as well as new housing at UMass Lowell and Worcester Polytechnic Institute. Tamara received her Bachelor of Architecture from Carnegie Mellon University and her Master of Architecture and Urban Design from the Berlage Institute. Tamara was the recipient of the BSA Women in Design Award of Excellence in 2012.

The Tree House, a 20-story residential tower for 493 freshmen, is inspired by Gustav Klimt's painting, *The Tree of Life*. It is clad in more than 5,000 composite aluminum panels of various widths and depths, resulting in an organic, colorful expression along Boston's Huntington Avenue, also known as the Avenue of the Arts. Opened in 2012, the new residence hall includes a ground floor café and living room, a second-floor health center, third-floor "pajama programs" consisting of communal spaces, and 17 floors of suites with lounges and studio workrooms.

The Massachusetts College of Art and Design

Opening in 1873 as the United States' first independent public college of art and design – and the first art school to grant a degree – Massachusetts College of Art and Design (MassArt)'s mission is to educate tomorrow's fine artists, designers, and art educators in the creative process. In 2007, the school found itself woefully short of student residence halls, and hoped to achieve the housing of 50% of its student body through the construction of a new building.

The MassArt campus sits along the Avenue of the Arts (Huntington Avenue), near Symphony Hall, the Museum of Fine Arts, and the Isabella Stewart Gardner Museum. Housed in a series of brick buildings punctuated by a 1960s 11-story black glass tower, the school was ready for a new image. After doing an extensive economic feasibility study for two potential locations for the residence hall, it was determined that a 21-story tower of narrow footprint, snug to the rear of an existing faculty parking lot and visible from Huntington Avenue, was the best choice.

Good Timing for Funding

When the request for proposals went out to qualified architect/contractor teams in 2007, the US economy teetered on the brink of the largest recession of the last 50 years. The Massachusetts State College Building Authority (MSCBA) develops residence halls and other revenue-generating facilities for the nine state university campuses; these projects are funded through revenue bonds whose debt service is offset by the student rent and fees. The Commonwealth of Massachusetts neither funds these projects nor guarantees these bonds.

At the time, the Strategic Plan for MassArt included the need for several hundred additional beds to meet its recruitment and retention goals. This was a significant opportunity to build required residence hall capacity at a time of low-interest bond financing, competitive bidding, and tighter pricing, which would provide better value for the students who would live in the future building. The available land for this project was limited, and the only way to construct an affordable residence hall on the very small buildable footprint was to design a tall building. "Given the financial constraints of the project and the physical constraints of the site, the Tree House Residence Hall provided the campus with a cost-effective and energy-efficient building that is a


Figure 1. Mirrored artwork at the café. © Lucy Chen

dynamic addition to the skyline, as well," according to Edward Adelman, Executive Director of the MSCBA.

A Hyper-Collaborative Design Process

The rapid schedule and highly competitive economic climate demanded an integrated approach to decision-making – a way of working together through pre-construction pricing, planning, design, and construction that involved weekly fluid sharing of computer models between architects, engineers, and sub-contractors, rarely seen outside the design/build industry in projects of this size. The project opened three months ahead of schedule and came in under budget. Much of this can be attributed to efficient information management.

The design of the new residence hall is the result of an interactive and flexible process. The architects sought a vision that could harmonize the aspirations of college professors, administrators, students, trustees, alumni, and the building's owner. The team conducted in-depth benchmarking and hosted focus groups with students, residence assistants (RAs), and facilities managers. The stakeholder involvement culminated in an 85-person design charrette that focused on four areas: open space, exterior design, common space, and typical floors/units.

Out of the exterior design group arose the idea of realizing the building as an artistic landmark.

In September 2012, the incoming student residents voted to nickname the building "The Tree House."

Many of the participant comments were woven into the final planning and design:

- The open space should be primarily a place for sitting, in variously sized groups, clearly identified as MassArt's public plaza.
- The green design approach should not be accomplished through "gadgetry," but

Figure 2. Windows configured in response to the passive daylighting techniques. © Chuck Choi

> "MassArt wanted the building to stand out in the Boston skyline and meaningfully identify them as an art college… It was the students' idea that the building look like a painting and that it be just as colorful and vibrant as they are."

Skyscrapers and Skylines: New York and Chicago, 1885–2007

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Jason Barr is an associate professor of economics at Rutgers University, Newark, and the Director of Graduate Studies for the economics department. He received his Bachelor's degree from Cornell University in 1992, and his PhD from Columbia University in 2002. His research interests include urban and real estate economics. In particular, Dr. Barr studies the economic determinants of skyscraper height since the late 19th century. His work has appeared in prominent economics journals, such as the *Journal of Regional Science,* the *Journal of Economic History,* and *Real Estate Economics.* He is currently writing a book on the history of the Manhattan skyline.

Figure 1. Home Insurance Building, Chicago, 1885.

This paper investigates skyscraper competition between New York City and Chicago from 1885 to 2007. Skyscraper rivalry between these cities is part of US historiography, yet little work has explored the veracity of this belief. Using a newly created data set on skyscrapers, a series of statistical tests were performed to see whether there is, in fact, competitive interaction across cities. First, the results show that each city has "positively" responded to decisions in the other city, suggesting that residents in each city have a desire to build more and taller than the other. Second, height regulations for each city have periodically reduced the size of each city's skyline, and have spurred increased building activity in the other city, providing evidence that skyscraper space is substitutable across cities.

Introduction

Since the late 1880s, New York and Chicago have been two of the world's premier skyscraper cities. By 1929, New York and Chicago contained 68% of the nation's buildings of 20 stories or greater in height (Weiss 1992). Of the ten current tallest buildings in the United States, four are in Chicago and four are in New York; six would be in New York, if the Twin Towers had not been destroyed (Skyscraper Center 2013).

Ever since the telegraph and railroad created a national market in the mid-19th century, businesses and residents have had much greater mobility and locational choices. Given the ability of labor and capital to go where the returns are greatest, we would expect this to generate some competition between leading cities. If residents of one city see its rivals growing rapidly, they may feel compelled to respond.

Historically, skyscrapers have embodied two types of competition. The first is regional competition for employment and industrial growth. Economic activity must be housed somewhere; if developers don't provide the space in one location, developers in another place will. As the economy evolves, buildings age and become functionally obsolete. The needs of businesses and residents change, and, again, if one city doesn't supply these needs, then another city will. Thus, competition is about luring businesses and residents, and promoting job growth and profits.

However, because of their symbolic and aesthetic nature, skyscrapers can also be used to express psychological or sociological needs. A tall building can be a monument to local pride or a work of civic art that enhances citizens' sense of place. The skyscraper can advertise the city, as a form of "urban boosterism," drawing tourists, and placing it within the national and international conversations on cities.

Additionally, tall buildings can be used to express developers' desire to engage in conspicuous consumption (or investment) to project economic strength, and achieve a higher social status. But the need for pride-, ego- or advertising-based construction is also a competitive process, since the height and size of these projects mainly serve their purposes only relative to the height and size of other projects.

The two forms of competition can lead to two different outcomes. On the one hand, if developers in City 1 go on a building spree, it will reduce the price of building space. If developers in City 2 see a falling price, the rational response is to hold off on construction because of declining revenues from new projects. This "negative" response by builders means that skyscrapers in the two cities are "strategic substitutes": if City 2 sees that City 1 is heavily engaged in construction, builders in City 2 find that reducing construction is the most profitable response. In general, markets in which a handful of firms all produce a similar commodity will exhibit this strategic-substitutes property.

Companies, for example, are frequently moving their corporate headquarters, based on which city provides the best "bundle" of office space, employees, and access to markets and suppliers (Strauss-Kahn & Vives 2009). If these companies see an opportunity to move to a city with newer office space, they will do so.

However, if building height has non-expressly-economic purposes, such as advertising, local pride, or ego satisfaction, then relative height is an important strategic variable. If developers in one city go particularly tall, builders in the other city will respond "positively" by adding height to their buildings. In this case, building heights can be called "strategic complements," in the sense that heights in the two cities move together. Since Chicago and New York were the first skyscraper cities in the United States and were linked economically, we can look to these two cities to test these competition theories.

Figure 2. Bayard-Condict Building, New York, 1899.
© Antony Wood

"Architects consider each city to have its own style, its own way of shaping its local environment, its own individualistic contributions to the history of architecture. Yet these contributions were not developed in isolation. There is a considerable amount of competitive interaction between architects, contractors, and developers in both cities."

With the completion of the Erie Canal in 1825, and the settling of Chicago in the 1830s, New York and Chicago became trading partners. Capital, imports, and settlers flowed west, while agricultural goods flowed east. But as the relationship developed, they also became rivals.

In 1871, Chicago's Great Fire destroyed much of the city's office space, and gave it the chance to build a modern, fireproof business district. The Home Insurance Building, completed in Chicago in 1885 (see Figure 1), was the first to incorporate an iron-skeleton structure to bear the load of the building; it paved the way for the city's early skyscraper boom. Architects, engineers, and builders who "cut their teeth" on Chicago's first generation of skyscrapers were later employed in New York as well. This interaction has lead John Zukowsky to write: "Chicago and New York – these are often thought to be the two great superpowers of American architecture. Architects consider each city to have its own style, its own way of shaping its local environment, its own individualistic contributions to the history of architecture. Yet these contributions were not developed in isolation. Throughout the 19th and 20th centuries there has been, and still is, a considerable amount of competitive interaction between architects, contractors, and developers in both cities" (Zukowski 1984:12).

Figure 3. Flatiron Building, New York, 1902.
© Marshall Gerometta

The list of past and present interactions is long, but here are a few important examples. In the early period, Louis Sullivan, arguably Chicago's most famous skyscraper architect, designed one of his signature buildings in New York – the Bayard-Condict Building, in 1899 (see Figure 2). Builder and skyscraper pioneer George Fuller and his firm built skyscrapers such the Monadnock (1893) and the Rookery (1888) in Chicago, and the New York Times (1904) and Flatiron (1902) building (see Figure 3) in New York, the latter of which was also designed by one of Chicago's most famous architects, Daniel Burnham.

Improving the Social Sustainability of High-Rises

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For most of the postwar period, people moved to the suburbs in search of a better life. But if cities can offer them substantial reasons to keep coming back, such as jobs, entertainment, and amenities, dense urban areas can be an equally viable and socially sustainable habitat. In many parts of the world, tall housing has been mostly restricted to social housing and to upscale market-rate residences. Middle-class families have historically been left out of the equation. This paper studies the social benefits of horizontal neighborhood communities that have for decades been the preferred environment for raising families, and explores the challenges and rewards of transferring those features to a vertical format.

Recent trends of urbanization have caused a dramatic increase in the worldwide urban population. The failures of the tower block schemes of the 1960s made living in high-rises unpopular in Europe and North America. For much of the last century, developers have historically found tall buildings appropriate only for office and commercial uses. However, limited buildable land resources have inevitably changed city growth patterns from outward horizontal spread to vertical growth. The re-emergence of the high-rise as a housing typology presents the opportunity to consider the mistakes of the past and address the demands of a wider population.

The current trends of residential living in the sky reveal that home buyers today hold a different perspective on high-rise living. They expect a vibrant urban setting. They are moving to developments that require little maintenance and provide communal space for recreation and socializing. As these shifts occur, designers and developers have a mission: to understand these needs and desires and translate them into sustainable, integrated residential places.

> “A deficit of social support, reduced exposure to divergent views, the lack of ability to consider opposing viewpoints and the gestation of mistrust or general disengagement from the community are all results of reduced physical interaction.”

Residential Tall Buildings' Re-emergence

Today the world is facing escalating rates of urbanization and exponential growth in the use of energy and resources. The world population presently stands at 6.9 billion – a figure expected to reach 10.1 billion by the year 2100 (United Nations 2011). Furthermore, statistics indicate that "… in developing countries, the urban population is expected to double from 2.6 billion in the year 2010 to 5.2 billion by 2050. Developed nations show an increase in urbanized populations from 0.9 billion in 2010 to 1.1 billion in 2050. However, during the same period the world's rural population decline is 0.6 billion"(ibid). This has been the principal cause of the ever-increasing demand for homes – a challenge for all cities across the world (see Figure 1).

History has witnessed various planning discourses intended to solve the problem of housing, such as "urban sprawl," which loosely follows the principles laid down by Ebenezer Howard and Le Corbusier. This single-use, automobile-driven suburban development had dominated the urban milieu in the latter half of the 20th century, which has been condemned due to its negative environmental and social impact. By the 1990s, the "Compact City" model, based on the principles of "New Urbanism," was envisioned as a solution to urbanization. It promotes "mixed-use, high-density living,

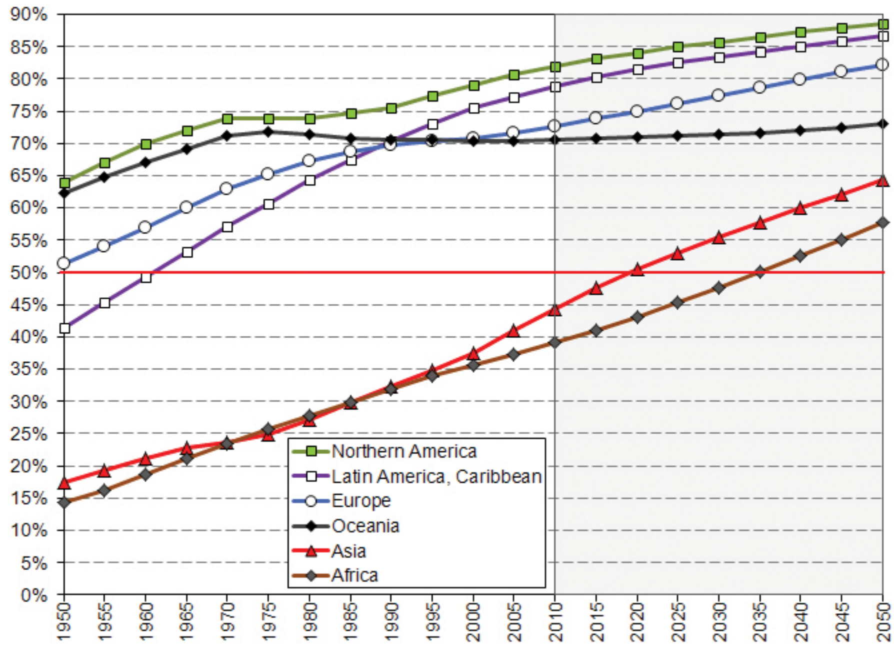

Figure 1. Urbanization trends. Source: UN, Department of Economic and Social Affairs. 2012. ***World Urbanization Prospects, the 2011 Revision.***

based on efficient public transport systems, walkable neighborhoods, increased opportunities for social interaction and an overall sustainable system with low energy consumption and reduced pollution" (Burton et al. 1996).

Dense urban living proves better for the people and the city in terms of retaining countryside, saving time and money on travel, reducing infrastructure, and allowing people to enjoy the vibrancy of city life. However, a challenge to architects and planners lies in translating this urban compaction into a sustainable future for our cities. In pursuit of this goal, the beginning of the 21st century saw planners and municipalities choose developments with smarter, more community-focused plans. These movements aim to achieve sustainable neighborhoods. "Smart growth" does so by focusing on regional characteristics to foster a unique sense of place and community, offering better employment, transportation, and housing solutions. Urban infill focuses on development of vacant, undeveloped, and underdeveloped land parcels within an existing community and organizing populations densely, and increasing work and play opportunities through adjacency.

Such trends, when combined with scarcity of land and increasing need for affordable housing, are pushing high-density residential buildings to the forefront. Though the idea of living in supertall buildings has gained momentum with the introduction of high-end luxury apartments, the experience of high-rise affordable housing has not been as satisfactory. Despite the middle class' increasing difficulty in purchasing homes, and the fact that the designs of residential high-rise solutions for this demographic are not backed up by much research into the actual experience of living in them. Many of these projects still continue to resonate with the fears and problems of the past; they are considered to be socially unsustainable.

The Significance of Social Sustainability

Today, social sustainability is regarded as an important pillar of sustainability in general. As per the 1992 UN Earth Summit and the 2000 Presidency Conclusions of the European Council, "social concerns will be taken up for due consideration in the sustainability agenda" (United Nations 1993). Social sustainability is defined as a "development that is compatible with the harmonious evolution of civil society, fostering an environment favorable to the compatible cohabitation of culturally and socially diverse groups, while at the same time encouraging social integration, with improvement in the quality of life for all segments of the population" (Polese & Stren 2000). Also, social communities are defined as "places where people want to live and work, now and in the future. They meet the diverse needs of existing residents without compromising on those of the future, by being sensitive to their environment and contributing to a high quality of life."

Social sustainability is now of paramount concern alongside mankind's withdrawal from traditional social structures. This has happened with the invasion of electronic social networking and the diminishment of outdoor spaces in which children can play and adults can interact. Technology enables leisure and work from home but is making people less social in the physical world (Beld 2012). A deficit of social support, reduced exposure to divergent views, the lack of ability to consider opposing viewpoints and the gestation of mistrust or general disengagement from the community are all results of reduced physical interaction. A generation conditioned to isolation could have devastating effects on society.

Evolution of Social Spaces in Residential High-rises

The practice of living in multistory structures dates back to ancient Rome, where such structures often appeared as mixed-use buildings with shops for the rich on the lower floors and housing for the lower-class residences above. Medieval city skylines also reveal such mixed-use towers. However, purely residential tall buildings did not begin to dominate the city skylines until after the Second World War. In the years that followed, social movements motivated architects to conceptualize housing for the masses, as well as the growing middle class in the cities. The Modernist, Humanist, and Rationalist movements laid out their visions of ideal residential living, which reached their zenith in

Midcentury (un)Modern

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Curtis Wayne is an architect, professor of structural engineering, and the author of *The Shape of Things that Work: The Fourth Architecture.* His approach to buildings is to raise the level of comfort, utility, and beauty in our built landscape, not merely their aesthetics. A native of Chicago, Curtis now resides and practices in New York City. He is a graduate of The Cooper Union for the Advancement of Science and Art, New York City and of the Harvard Design School.

The genesis of PlaNYC, New York City's ambitious sustainability agenda, was the need to accommodate an estimated one million more people by 2030 within the existing urban fabric. First released in 2007 with an update in 2011, PlaNYC sets its sights on what New York City needs to accomplish by 2030 to reduce greenhouse gas emissions, protect the quality of drinking water, and reduce wastewater outflows while improving the quality of life for 9.1 million inhabitants.

The 2011 PlaNYC update underscores both the urgency of the City's sustainability issues and the opportunities these efforts represent:

- Climate change poses acute risks to the city. By 2030, average temperatures could rise by as much as 3 °F in New York (City of New York 2011: 10).
- The once-innovative energy infrastructure needs to be modernized; buildings are full of outdated equipment (City of New York 2011: 104).

A core question posed by PlaNYC is whether or not the city can support more people without placing additional burdens on the already stressed water and energy infrastructure. The purpose of the following paper is to investigate the role of 1950–1970s era office buildings in meeting this challenge.

Background

New York City's building stock is exceptionally diverse. It has many of the world's first modern skyscrapers and a rich lineage of architectural and historic landmarks; indeed, the fight to save many of these buildings in the 1960s helped launch the modern preservation movement. Today, members of New York's architectural community are vocal, parallel participants in historic preservation and environmental sustainability – movements that are growing around the country, thanks to a lively coalition of planners, advocates, architects, researchers, and building owners.

There is considerable potential to re-purpose existing structures to meet the demands of the 21st century. In particular, buildings with high ceilings and the potential for effective daylighting and natural ventilation make excellent candidates for retrofitting efforts. Recent work on the Empire State Building is a good example (NIBS 2012). Much can be learned from mass-wall buildings like this – their small, high windows present good opportunities for natural ventilation, and their energy performance may be better than that of postwar buildings.

However, the focus of this study is a subset of Manhattan office buildings, representing the first generation of single-glazed curtain-wall buildings in New York City such as 675 Third Avenue (see Figure 1). Prior to the 1950s, curtain-wall construction was very rare, and it was not until after the 1973 energy crisis that double-glazed windows became prevalent.

Some early curtain-wall buildings are spectacular architectural and historic assets, such as the 1952 Lever House and the 1958 Seagram Building. Along with many other variables relevant to the character of urban spaces and the operation of buildings, historic preservation is important to consider closely when evaluating the future of a structure. This study considers only the energy and water implications of potential changes to this building stock, and does not aim to determine the architectural significance of any particular building. While some of the office buildings from this era should arguably be preserved purely for their architectural merit, there are many that are commonplace and have been rendered obsolete by changes in the marketplace. Modern Class "A" office space – the target market of most new office development – requires an adaptability of space, safety, and longevity that many of these buildings cannot provide.

Figure 1. 675 Third Avenue, New York. © Tectonic Photo

While single-glazed curtain walls were considered innovative at the time, these enclosures generally do not meet current wind code requirements and are at high risk of failure in a serious hurricane. Mid-century code required meeting wind loads of 20 lb/ft^2 (and only for floors above 100 feet), whereas today façades in the region can experience loads above 70 lb/ft^2. Curtain walls from this era were intended to be as thin as possible; they utilized non-load-bearing systems hung on the exterior of a building's structural frame. Consequently, most of these buildings make poor candidates for straightforward façade retrofits, as their structures cannot bear the weight of a modern, double- or triple-glazed curtain wall or a double-wall system.

Floor structures in these buildings tend to be a composite of concrete-encased steel girders, beams, and filler beams, between which are thin, low-strength reinforced concrete "goulash" slabs. Incapable of supporting any concentrated point loading, they are generally limited to the barest of code-minimum distributed loadings. These buildings also feature tight column spacing, typically 20-by-20-foot bays, versus the 40-by-45-foot bays used today. This column spacing is problematic for Class "A"-type tenants' space planning. They have low floor-to-ceiling heights of eight feet or less, a strategy to squeeze as many floors as possible into then-regulated height and setback limitations. Many do not offer adequate handicapped accessibility, and in some cases do not meet current life-safety codes.

Most of these buildings have heating, cooling, and ventilation systems optimized for an era in which natural resources were cheap and plentiful. The preferred cooling system was the Constant Volume Reheat (CVR) system, where a constant volume of air is cooled and distributed throughout the building. In areas where thermostats sense a need for less cooling, the air-conditioned supply air is reheated with electrical-resistance or steam/hot water coils. While such systems generally have a low first cost, they are doubly inefficient, analogous to driving a car with the accelerator pushed to the floor and controlling one's speed with the brakes. These buildings also consume significant quantities of potable water that evaporates through their overactive cooling towers.

As these buildings have aged and architectural standards have changed, many cannot attract Class "A" tenancy. In particular, low ceiling heights seriously limit daylight and views in interior spaces. Also, a desirable density of workspaces is difficult to achieve with 20-foot column bay spacing. While control strategies can help increase vertical transportation, adding elevators is almost impossible. There are at least 107 office buildings from the 1958 to 1973 era in Midtown Manhattan alone, many of which have become Class "B" or "C" properties (Permasteelisa 2012).

Why have these outdated buildings not been replaced? The reason in many cases is that they are "overbuilt," containing more floor area than current zoning code permits. Many were built with FARs of 15 or greater; current zoning allows only 15 FAR in C5-3 and 12 FAR in most commercial zones (generally located along major avenues in Midtown). Demolishing these buildings and replacing them with less rentable square footage would be difficult or impossible to finance.

Figure 2. The charrette teams review the 675 3rd Avenue's retrofit potentials.

Given the pressure to improve the energy performance of New York's building stock, this report asks two main questions:

1. For the target group of early curtain-wall buildings, how much energy can theoretically be saved through retrofitting the envelope and mechanical systems?
2. How does a deep retrofit program compare to replacement with a new, high-performance green building?

Design Case Study

The authors identified a specific building as representative of the 1950s–1970s single-glazed Manhattan archetype. The target building was chosen based on several factors, including design elements typical of the period and access to reliable energy and water data. Drawings and operational data were gathered and analyzed, and a façade expert undertook site investigation to explore possibilities for retrofitting the envelope. The authors hosted a design charrette to evaluate a retrofit for advanced energy efficiency against designing a replacement building on the site.

The charrette team included architects, engineers, contractors, building experts, equipment manufacturers, and building owners, all with deep experience in high-performance buildings in the Manhattan market (see Figure 2). Teams made recommendations on qualitative aspects of state-of-the-art office buildings, including specifics related to the details of the façade, mechanical systems, and quality of the indoor environmental quality. Integral Group was hired to develop computer simulations of the baseline building and each retrofit option.

Tall Buildings in Numbers

All Buildings 200 meters or Taller Completed in 2013 (73 no.)

Asia | Middle East | North America | Central America | Europe

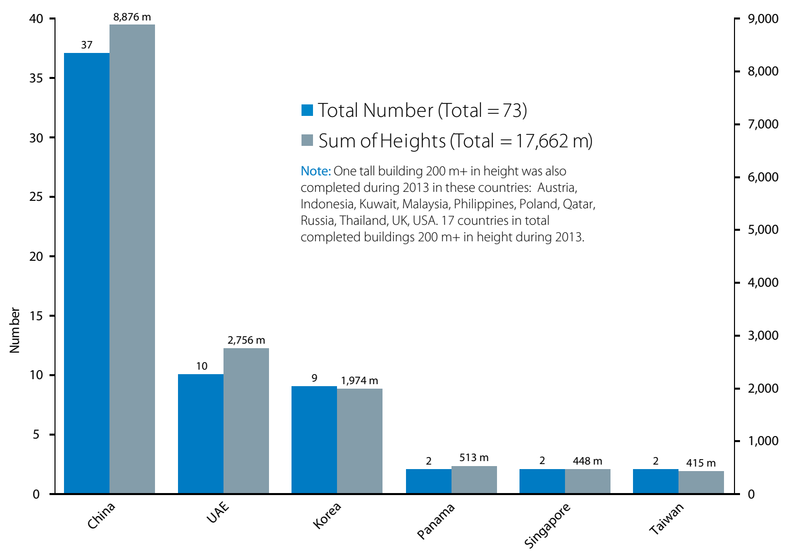
Rank	Building Name	City	Stories	m	ft
1	JW Marriott Marquis Hotel Dubai Tower 2	Dubai, UAE	82	355	1166
2	Mercury City Tower	Moscow, Russia	75	339	1112
3	Modern Media Center	Changzhou, China	57	332	1089
4	Al Yaqoub Tower	Dubai, UAE	69	328	1076
= 5	The Landmark	Abu Dhabi, UAE	72	324	1063
= 5	Deji Plaza	Nanjing, China	62	324	1063
7	Cayan Tower	Dubai, UAE	73	307	1008
= 8	East Pacific Center Tower A	Shenzhen, China	85	306	1004
= 8	The Shard	London, UK	73	306	1004
10	Dongguan TBA Tower	Dongguan, China	68	289	948
11	United International Mansion	Chongqing, China	67	287	942
12	Chongqing Poly Tower	Chongqing, China	58	287	941
13	Shimao International Center Office Tower	Fuzhou, China	56	273	896
14	Suzhou Center	Suzhou, China	52	268	879
15	Bicsa Financial Center	Panama City, Panama	66	267	876
16	East Pacific Center Tower B	Shenzhen, China	72	261	856
17	Jing An Kerry Centre Tower 2	Shanghai, China	58	260	853
= 18	Garden Square	Shanghai, China	63	258	846
= 18	The Metropolitan Office Tower	Tianjin, China	53	258	846
= 18	Radisson Plaza Hotel Xiaoshan Tower 1	Hangzhou, China	50	258	846
21	Conrad Hotel	Dubai, UAE	51	255	837
22	Gramercy Residences	Makati, Philippines	73	250	820
23	Yoo and Arts Tower	Panama City, Panama	78	246	808
24	Shenzhen Stock Exchange Plaza	Shenzhen, China	46	246	806
25	Federation of Korean Industries Head Office Building	Seoul, South Korea	50	245	805
26	The Westin Chongqing Liberation Square	Chongqing, China	54	245	805
= 27	Longemont Asia Pacific Center Tower A	Shenyang, China	56	245	804
= 27	Longemont Asia Pacific Center Tower B	Shenyang, China	56	245	804
29	World Trade Center Doha	Doha, Qatar	51	241	791
= 30	ASPIN Commercial Tower	Dubai, UAE	60	240	787
= 30	Central Bank of Kuwait	Kuwait City, Kuwait	42	240	787
32	Anhui International Trade Center Tower 1	Hefei, China	57	239	783
= 33	The Gate Residential Tower 1	Abu Dhabi, UAE	66	238	781
= 33	The Gate Residential Tower 2	Abu Dhabi, UAE	66	238	781
= 33	The Gate Residential Tower 3	Abu Dhabi, UAE	66	238	781
36	Reflection Jomtien Beach Oceanfront Tower	Pattaya, Thailand	57	234	768
37	St. Regis Luxury Hotel	Abu Dhabi, UAE	51	233	765
38	Jinao Tower	Nanjing, China	56	232	761
39	Tanhyun Doosan We've the Zenith 105	Goyang, South Korea	59	230	755
40	1717 Broadway	New York City, USA	65	230	754
41	Marina Bay Suites	Singapore, Singapore	66	227	744
42	Anhui Province Radio & TV Center	Hefei, China	46	227	743
43	China Merchants Tower & Woods Park	Shenzhen, China	38	225	738
44	Tanhyun Doosan We've the Zenith 104	Goyang, South Korea	57	224	735
45	Asia Square Tower 2	Singapore, Singapore	46	221	727
46	DC Tower I	Vienna, Austria	60	220	722
47	C&D International Tower	Xiamen, China	49	219	720
48	Nanhu Mingdu Plaza	Nanning, China	47	218	715
49	Liyuan Skyline City	Nanning, China	57	218	715
= 50	Tanhyun Doosan We've the Zenith 106	Goyang, South Korea	54	215	705
= 50	Tanhyun Doosan We've the Zenith 103	Goyang, South Korea	54	215	705
= 50	Tanhyun Doosan We've the Zenith 102	Goyang, South Korea	54	215	705
53	Xiamen Financial Centre	Xiamen, China	49	213	698
= 54	Tanhyun Doosan We've the Zenith 101	Goyang, South Korea	53	212	696
= 54	Tanhyun Doosan We've the Zenith 107	Goyang, South Korea	53	212	696
= 54	Sky Tower B2	Wroclaw, Poland	50	212	696
57	Lifestyle Center Main Tower	Shijiazhuang, China	55	212	694
58	Peace Hotel Tower B	Nanchang, China	64	210	689
59	Farglory Financial Center	Taipei, Taiwan	32	208	683
= 60	The City Center @ Batavia City	Jakarta, Indonesia	47	208	682
= 60	China Merchants Bank Mansion	Shanghai, China	37	208	682
62	Far Eastern Banciao Tower	Banqiao, Taiwan	50	207	680
63	Tanhyun Doosan We've the Zenith 108	Goyang, South Korea	51	206	676
64	Jahe Plaza	Dalian, China	54	205	673
65	Golden Mansion Center	Tianjin, China	36	203	666
66	Century Plaza Tower 1	Liuzhou, China	57	203	664
= 67	Innovation & Entrepenuership Tower	Harbin, China	40	201	659
= 67	Yuxi Mining Building	Yuxi, China	39	201	659
= 69	Aiqun Huijing Wan Tower A	Guangzhou, China	49	200	656
= 69	Aiqun Huijing Wan Tower B	Guangzhou, China	49	200	656
= 69	Lot G Office Towers	Kuala Lumpur, Malaysia	45	200	656
= 69	Phoenix International Book City East Tower	Suzhou, China	42	200	656
= 69	Palm Springs International Center Tower 1	Chengdu, China	41	200	656

Note: Ranking is determined by feet. All heights are rounded to the nearest whole number.

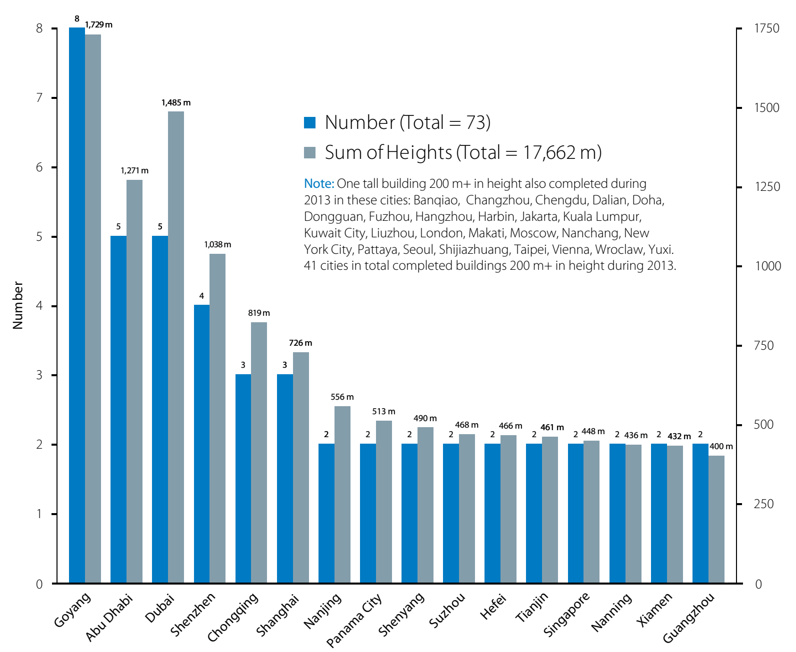
2013: A Tall Building Review

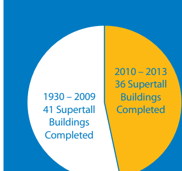
Note: For a detailed overview of tall building construction in 2013, see pages 40–47

Tall Buildings 200 meters or Taller Completed in 2013: by Country



Tall Buildings 200 meters or Taller Completed in 2013: by City

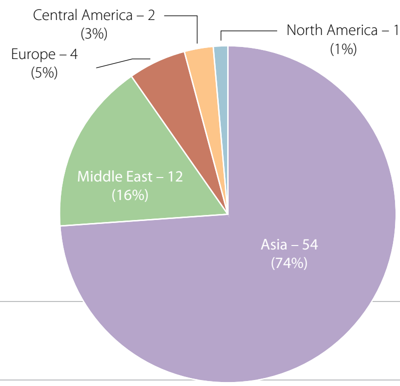




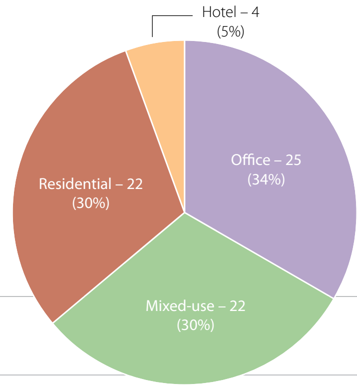
For the fourth year running, nine supertall buildings were completed in 2013. These 36 supertalls are almost half the total number of supertalls that currently exist (77 total)

Led by JW Marriott Marquis Hotel Dubai Tower 2, for the second year in a row, three of the five tallest buildings completed this year are located in the United Arab Emirates

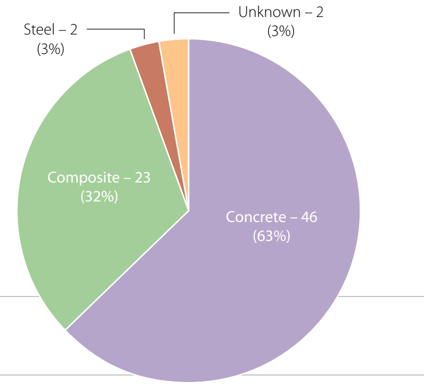
Tall Buildings 200 meters or Taller Completed in 2013: by Region

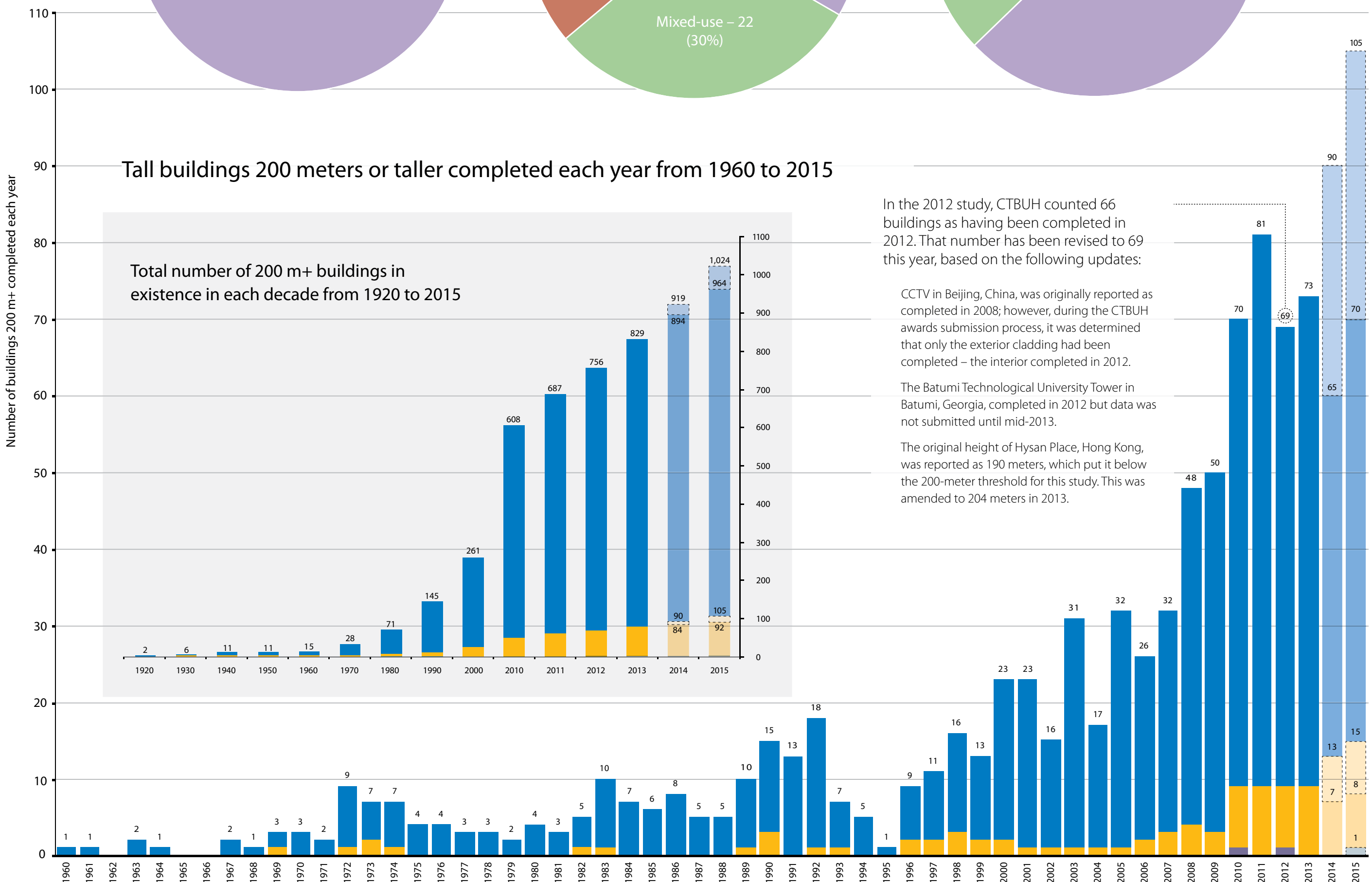


Tall Buildings 200 meters or Taller Completed in 2013: by Function



Tall Buildings 200 meters or Taller Completed in 2013: by Structural Material





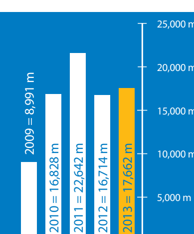
- Number of 200 m+ buildings
- Number of supertalls (300 m+)
- Number of megatalls (600 m+)
- Projected number of 200 m+ buildings
- Projected number of supertalls (300 m+)
- Projected number of megatalls (600 m+)

Notes:

1. We can predict 2014–2015 building completions with some accuracy due to projects now in advanced construction.
2. Totals after 2001 take into account the destruction of the World Trade Center Towers 1 and 2.

For the sixth year in a row, China completed the most 200m+ buildings of any country in the world; the 37 buildings in China were spread across 22 cities

Europe has two of the tallest 10 tallest buildings completed in 2013, the first time since 1953



The sum of all the 200+ meter buildings completed in 2013 was 17,662 meters, the second-tallest year in history, after 2011

Small Increase in Completions Marks Return to Upward Trend

Report by Daniel Safarik and Antony Wood, *CTBUH;* Research by Marty Carver and Marshall Gerometta, *CTBUH*

Note: Please refer to "Tall Buildings in Numbers – 2013: A Tall Building Review" in conjunction with this paper, pages 38–39

By all appearances, the small increase in the total number of tall-building completions from 2012 into 2013 is indicative of a return to the prevalent trend of increasing completions each year over the past decade. Perhaps 2012, with its small year-on-year drop in completions, was the last year to register the full effect of the 2008/2009 global financial crisis, and a small sigh of relief can be let out in the tall-building industry as we begin 2014.

At the same time, it is important to note that 2013 was the second-most successful year ever, in terms of 200-meter-plus building completion, with 73 buildings of 200 meters or greater height completed. When examined in the broad course of skyscraper completions since 2000, the rate is still increasing. From 2000 to 2013, the total number of 200-meter-plus buildings in existence increased from 261 to 830 – an astounding 318%. From this point of view, we can more confidently estimate that the slight slowdown of 2012, which recorded 69 completions after 2011's record 81 – was a "blip," and that 2013 was more representative of the general upward trend.

Of course, each year is extraordinary in its own way. Here are some of 2013's key milestones:

- 2013 was the second-most successful year on record for completion of buildings 200 meters or greater in height. In 2013, 73 such buildings were completed, second only to the 81 completions of 2011 (see completions graphic on page 39).
- For the fourth year running, nine supertalls were again completed in 2013. These 36 supertalls, built over the last four years, comprise nearly half the total number of supertalls that now exist (77).
- Across the globe, the sum of heights of all 200-meter-plus buildings completed globally in 2013 was 17,662 meters – also the second-ranked in history, behind the 2011 record of 21,642 meters (see graph on page 38).
- Of the 73 buildings completed in 2013, 12 – or 16% – entered the list of 100 Tallest Buildings in the World.
- For the sixth year running, China had the most 200-meter-plus completions of any nation, at 37 – located across 22 cities.
- The tallest building to complete in 2013 was the 355-meter JW Marriott Marquis Hotel Dubai Tower 2 in Dubai, UAE (see image on opposite page).
- Three of the five tallest buildings completed are in the United Arab Emirates, for the second year in a row.

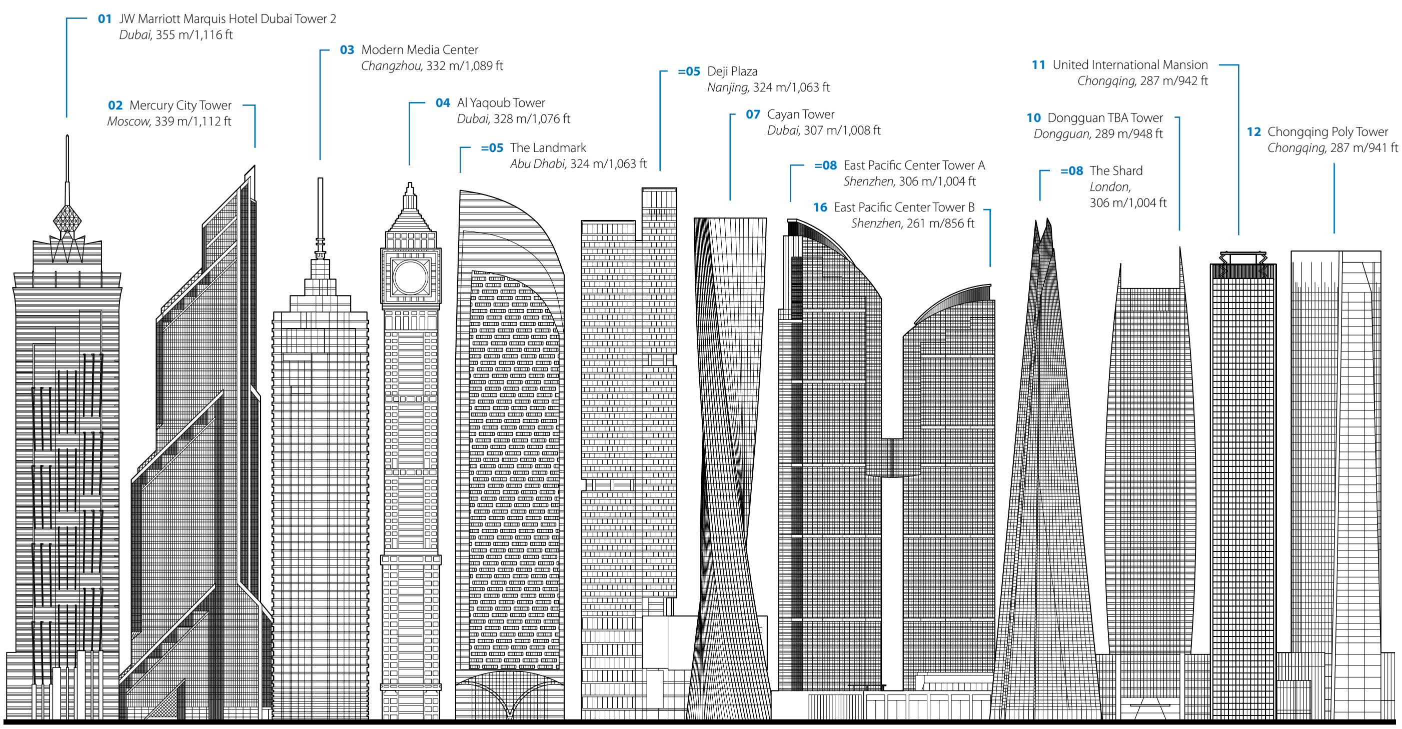


Figure 1. The tallest 20 buildings completed in 2013.

- The city of Goyang, Korea, has debuted on the world skyscraper stage with eight 200-meter-plus buildings completing in 2013.
- Europe has two of the 10 tallest buildings completed in a given year for the first time since 1953.
- Panama added two buildings over 200 meters, bringing the small Central American nation's count up to 19. It had none as recently as 2008.
- Of the 73 buildings over 200 meters completed in 2013, only one, 1717 Broadway in New York (see image bottom right), was in the United States.

Key Worldwide Market Snapshots of 2013

Asia

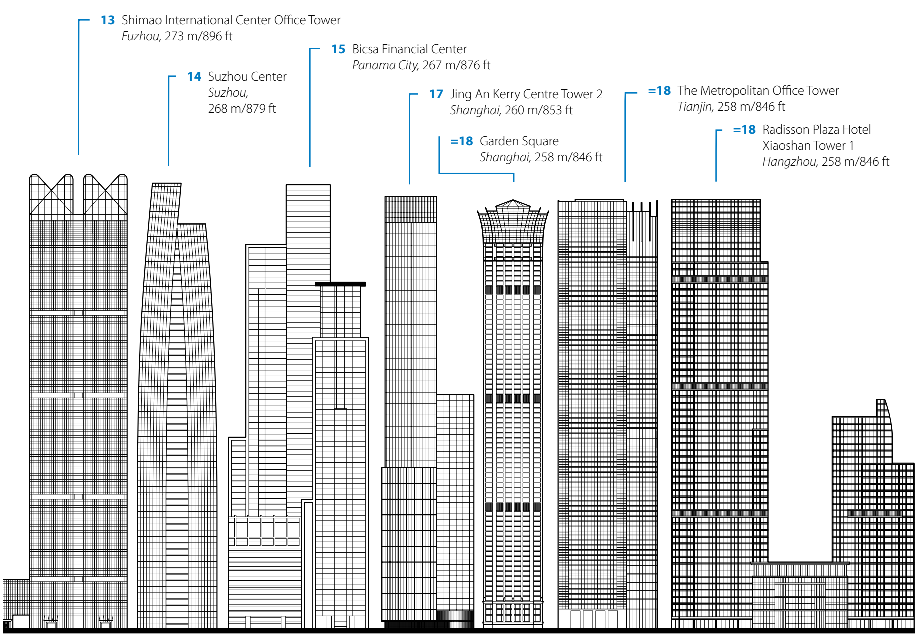
Asia completely dominated the world tall-building industry, at 74% of worldwide completions with 53 buildings in 2013 (see region pie chart on page 39), against 53% with 35 buildings in 2012. Asia now contains 45% of the 100 Tallest Buildings in the World.

China remained the heavyweight and overall undisputed champion of tall-building construction in 2013. A total of 37 two-hundred-meter-plus buildings were completed – 50% of the global total – up from 24 in 2012. The sum of heights of all 200-meter-plus buildings in China in 2013 was 8,876 meters, compared to 5,823 meters in 2012, an increase of 52.4%.

These buildings were spread across 22 cities. Shenzhen proved to be the most active skyscraper city, doubling its number of completions from the previous year, from two to four. It was closely tailed by Chongqing and Shanghai, which tied at three. Nanjing, Shenyang, Suzhou, Hefei, Tianjin, Nanning, Xiamen, and Guangzhou each claimed two completions. Of these, Hefei and Xiamen are first-timers; these cities have never completed buildings of 200 meters or more until 2013.

The tallest building to complete in China in 2013 was the 332-meter Modern Media Center in Changzhou.

Korea had the next-largest number of tall completions in the Asian region, though its figure of nine buildings was almost entirely due to the opening of an eight-building complex, the Tanhyun Doosan project, whose subtitle, appropriately enough, is "We've the Zenith." Goyang, a city of 1.5 million near Seoul, is now on the world skyscraper map, in

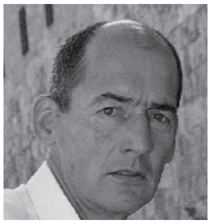


2013 Tallest #1: JW Marriott Marquis Hotel Dubai Tower 2. © JW Marriott Marquis Hotel Dubai

2013 Tallest #40: 1717 Broadway, New York City, North America's only 200 m+ building in 2013. © Tectonic Photo

The New Context of Tall

On the occasion of receiving the overall Best Tall Building Worldwide award at the 12th Annual CTBUH Awards ceremony for Beijing's CCTV Headquarters, Rem Koolhaas, founding partner, Office for Metropolitan Architecture (OMA), sat for an interview with Daniel Safarik, CTBUH Editor. Koolhaas was joined by David Gianotten, partner, OMA, who is intimately involved in the firm's Asian projects.


Rem Koolhaas


David Gianotten

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Rem Koolhaas
Rem Koolhaas founded OMA in 1975 together with Elia and Zoe Zenghelis and Madelon Vriesendorp. He graduated from the Architectural Association in London and in 1978 published *Delirious New York: A Retroactive Manifesto for Manhattan.* In 1995, his book *S,M,L,XL* summarized the work of OMA in "a novel about architecture." He heads the work of both OMA and AMO, the research branch of OMA, operating in areas beyond the realm of architecture such as media, politics, renewable energy, and fashion. Koolhaas has won several international awards including the Pritzker Architecture Prize in 2000 and the Golden Lion for Lifetime Achievement at the 2010 Venice Biennale. Koolhaas is a professor at Harvard University where he conducts the Project on the City.

David Gianotten
David Gianotten joined OMA in 2008, launched OMA's Hong Kong office in 2009, and became partner in charge of OMA Asia in 2010. Gianotten oversees OMA Hong Kong and OMA Beijing and leads OMA's development in China and Asia. Projects currently under his supervision include the Shenzhen Stock Exchange, the Taipei Performing Arts Centre, the Chu Hai College of Higher Education in Hong Kong, and the end stages of the construction of the CCTV headquarters in Beijing. In 2010 he delivered the OMA conceptual masterplan for the West Kowloon Cultural District, the biggest cultural project in Hong Kong to date, and the Edouard Malingue Gallery, a contemporary art gallery in Hong Kong. Born in 1974 in the Netherlands, he studied Architecture and Construction Technology at the Eindhoven University of Technology. Before joining OMA, he was the Managing Director – Architect of SeARCH.

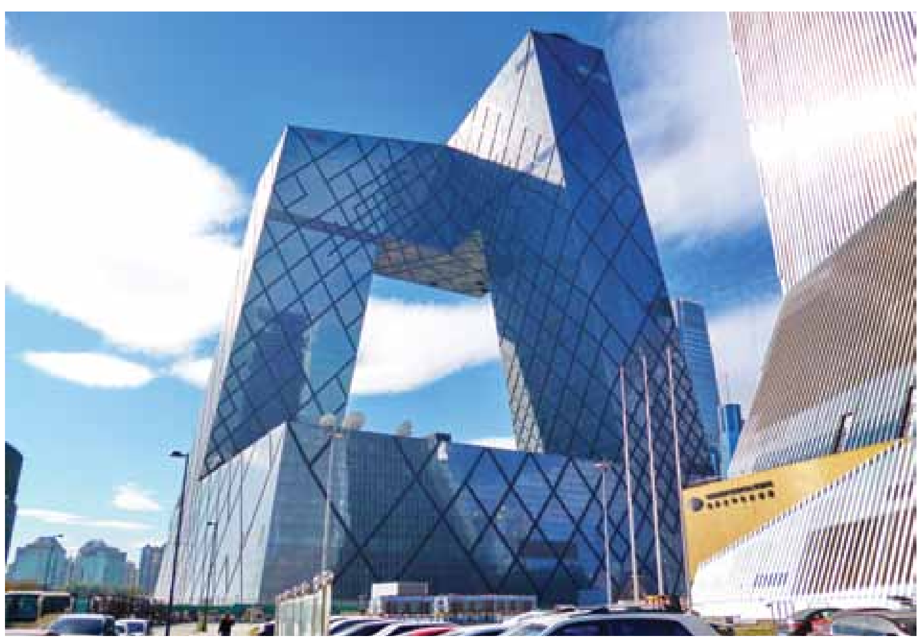
You recently completed the Shenzhen Stock Exchange – it's obviously a very different building from CCTV, in a different city. In the course of the decade or so since CCTV was proposed the Shenzhen Stock Exchange was completed. What has changed about working in China?

Koolhaas: I think a lot has changed, but there is another issue, which is maybe even more important, i.e., where a building or project is located. In other words, the culture in Beijing is very different from Shenzhen, which is a lot more comparable to Hong Kong or general Asian conditions. Also, the expectations of a building and discourse about a building is less unique in Shenzhen than it is in Beijing, and that has a number of advantages. The technical expertise is more distributed and common in Shenzhen. You cannot say absolutely that the quality is better in Shenzhen than in Beijing, but good quality is more common in Shenzhen, and more present.

One of the main things you also encounter is the difference in how the procedures work and the support the planning bureaus get. The planning bureaus can just be testing and approval bodies, but they can also really try to help a client and make it more professional. The support of the planning bureau is very different for each city. It is much more formal in Beijing, and much more design-oriented and hands-on in Shenzhen.

Gianotten: So, during the process, the client goes through a learning curve. In Shenzhen, that was really a two-sided effort. OMA and the planning bureau really worked together and supported the client in its ambitions.

In Beijing, the planning bureau supported the effort, but more from a technical perspective. From the client's perspective, it was at a greater distance. That made a very big difference in the process with the client, and also with the contractors. In the case of Shenzhen, the client was looking for different


CCTV, Beijing. © Butyrskii Igor

things, and was much more educated. They were really going for quality and had the financial means, and time built into the schedule. In the CCTV building it was a little bit more traditional, in that the client was mostly invested in the schedule and the financial aspects, leaving the architect to advocate for design quality. That is a very interesting difference, which also meant the speed of the two buildings was different.

Koolhaas: In Shenzhen, they have created a city of about 20 million now, in about 20 years. In Beijing, it is an ancient city that is modernizing now. So the perspective is also different. But what is interesting is that both had the same contractor. It wasn't the same people working on the two buildings, but what was very clear was that they had done many more international projects in between doing CCTV and the Shenzhen Stock Exchange. Doing SSE was more routine for them than when they were doing CCTV. In the past seven years, the level of architectural design, the skill of contractors, and the sophistication of clients has leapt considerably.

So, the quality is beginning to catch up with the speed?

Koolhaas: Yes, I would say so. You really see that when there is this good collaboration between government, client, architect, and contractor, that the quality can be achieved, and it is similar to many places we know in Europe.

I have some questions around the word "context," with which you have dealt harshly in the past. Looking at three of your tall buildings in three places – Beijing, Shenzhen, and the Rothschild Bank Headquarters in London, these are all quite different. Do you think there is a threshold of "bigness" beyond which buildings make their own context, and is that universal? Can or should they draw from their surroundings?

Koolhaas: It is really kind of childish to say so, but I think the quote "f––– context" has really been taken out of context. In every situation

"In the case of CCTV, you could say it is a very contextual building, but the context is not yet visible. It is a building that will be surrounded by 300 taller buildings, so therefore, we realized from the beginning it was a losing proposition to try to be taller. Therefore, we decided to be different, which is a very contextual approach…"

you have to judge the context. Sometimes there is a context that actually deserves recognition and acknowledgement. Sometimes you have no choice. In the case of Rothschild, we had no choice, because it is an incredibly medieval, delicate part of the city. Therefore you would not want to offend it or create a contrast, necessarily. So you develop ways that generate sort of analogies, and you expose elements of the context that have never been visible before.

I think in the case of CCTV, you could say it is a very contextual building, but the context is not yet visible. It is a building that will be surrounded by 300 taller buildings, so therefore, we realized from the beginning it was a losing proposition to try to be taller. Therefore, we decided to be different, which is a very contextual approach, I would say.

In Shenzhen it is also quite contextual, in the sense that the lifted podium actually works quite well in capturing the environment and making it play within an urban composition, and within, a kind of public space. So, I think it is always possible to work with the context, and I think we are getting quite refined and

Shenzhen Stock Exchange. © OMA/Philippe Ruault

Rothschild Bank Headquarters, London. © OMA

About the Council

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. Founded in 1969, the Council's mission is to disseminate multi-disciplinary information on tall buildings and sustainable urban environments, to maximize the international interaction of professionals involved in creating the built environment, and to make the latest knowledge available to professionals in a useful form.

The CTBUH disseminates its findings, and facilitates business exchange, through: the publication of books, monographs, proceedings, and reports; the organization of world congresses, international, regional, and specialty conferences and workshops; the maintaining of an extensive website and tall building databases of built, under construction, and proposed buildings; the distribution of a monthly international tall building e-newsletter; the maintaining of an international resource center; the bestowing of annual awards for design and construction excellence and individual lifetime achievement; the management of special task forces/working groups; the hosting of technical forums; and the publication of the CTBUH Journal, a professional journal containing refereed papers written by researchers, scholars, and practicing professionals.

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. CTBUH is the world's leading body dedicated to the field of tall buildings and urban habitat and the recognized international source for information in these fields.

Council on Tall Buildings and Urban Habitat

Council on Tall Buildings and Urban Habitat

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