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“"If laid end-to-end, the combined height of all 200-meter-plus buildings completed in 2018 would exceed the length of Manhattan Island, which is about 21.6 kilometers long.”"

Year in Review, page 41
Americas

Ever the skyscraper epicenter, the most interesting trend to observe in New York City of late has been the extension of tall building construction to boroughs outside of Manhattan. Even before Amazon announced it would build an East Coast headquarters in Long Island City, Queens, dozens of projects were up and running in what now will assuredly be a frantic race. Among these was Handel Architects-designed Queens Plaza Park, a 230-meter, 67-story tower, which began construction in late 2018 with ascent above ground expected within the first half of 2019. The residential project will incorporate a historic adjacent clock tower into the scheme.

Montréal’s “Quartier des Spectacles” is known for its vivacious nightlife and light displays, but until now, not for skyscrapers. That may be about to change if a proposal for a two-tower mixed-use complex called Maestria goes forward. The 51- and 53-story towers would be linked by a brightly illuminated skybridge at the 25th floor.

In Chicago, the sting of losing out on Amazon HQ2 was softened somewhat by the news that Salesforce would be bringing 1,000 jobs to an office tower at Wolf Point South, designed by Pelli Clarke Pelli, joining one existing and one under-construction tower on the prominent junction of two Chicago River branches.

In San Francisco, the Millennium Tower has sunk 430 millimeters and tilted 360 millimeters to the west since it opened in April 2009. The latest plan to stabilize it would sink piles to bedrock from the sidewalk on the building’s southwest corner. The estimated cost is US$100 million, less than a third of the previous rescue scheme.

In Los Angeles, the Arquitectonica-designed Fifth and Hill project is moving forward. As the 240-meter residential/hotel tower rises, it is characterized by a collection of protrusions, including cantilevered swimming pools and other amenity spaces, as well as an automated parking facility.

In Buenos Aires, will host Argentina’s first Ritz-Carlton hotel and residences project at Puerto Madero. The development includes the construction of a 39-story tower and four levels of parking, with an investment of $300 million. The hotel and apartments are planned for the first nine floors, while residences will occupy the rest of the building. The tower’s inauguration is projected for 2023. In Argentina’s second-largest city, Córdoba, a development called Pocito Social Life, containing a mall with 180 commercial premises and 750 parking spaces, three 110-meter residential towers with 945 apartments, and a co-working space, has been proposed. Its third and final tower will round out the project by 2027.

In Tegucigalpa, Honduras, a planned 24-story residential project called Anthurium will commence pre-sales in February 2019, targeted at high-income Hondurans in a bid for them to stay in the country. Among the project’s amenities is an advanced, artificial-intelligence (AI)-driven security system.

In San José, Costa Rica, into a tech hub has begun to bear fruit, as firms such as Microsoft and Cisco Systems have announced office tenancies at Torre Universal, a 22-floor commercial office tower that broke ground in the La Sabana district in late 2018. The high-spec building, designed by Gensler, has received an initial investment of US$50 million.

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If that seems like a long timeline, perhaps the planners are taking a cue from the experience of Horst Paulmann, the entrepreneur who has been trying to fully open Santiago’s Torre Costanera since it was completed in 2014. The 300-meter tower, tallest in South America, is part of a larger complex, of which less than 20% has been leased so far. The hold-up is due to overlapping jurisdictions negotiating with the developers about traffic mitigation and other site improvements to accommodate the project once it is fully leased. The mitigation works were expected to cost anywhere from US$18 million to US$36 million.

Ambitious plans were launched for a residential tower in Quito, Ecuador, which would be festooned with a different type of tree atop each of its units, which would be cantilevered to optimize views of the volcanoes and mountains behind the city. The Bjarke Ingels Group-designed IQON also comes with a plan to place fully-grown trees in a local park, to be replaced on the building by saplings every five years. The 35,000 square-meter project is under construction.

Asia and Oceania

A competition to design a new “landmark tower” for Auckland has concluded, with Woods Bagot and Peddle Thorp submitting the winning bid. The high-rise at 65 Federal Street will rise 180 meters, and is to contain 226 apartments and a five-star hotel, along with a ground-floor market place. Construction is set to finish in 2022.

A competition of another sort was underway in Sydney, where the real-estate market in North Sydney, across the Harbour Bridge from the city center, is heating up. A proposal for a hotel/office building at 88 Walker Street was increased from 35 to 48 stories, such that by its completion in 2021 it would clear its nearest rival, 100 Mount Street, by seven floors. The latter, designed by Architectus and Skidmore, Owings & Merrill, and set to complete in 2019, was originally billed as the next-tallest building in North Sydney.

In Brisbane, the highly anticipated 25 King office building has completed. The Bates Smart-designed project, the tallest engineered-timber office building in Australia, stands at 46.8 meters. The building is a centerpiece of the larger Showgrounds redevelopment north of the city center.

“R&D and deadlines make uncomfortable bedfellows.”

Green Communal Spaces at Height
In a High-Density City

Abstract

In contrast to the typically generic design of mixed-use developments in Hong Kong, SKYPARK is an exploration of the potential of “com-living” (communal living) in a densely-populated city. SKYPARK is an innovative mixed-use development in Mong Kok, one of the densest urban areas in Hong Kong. Featuring 439 residential units and a shopping mall. The development was targeted to build a community for young singles and couples attracted by the vibrant lifestyle of this iconic Hong Kong neighborhood. The project offers a new template for tall building design by strategically positioning a residential clubhouse and landscaped gardens on the top floor and the roof – an innovative response to high population density and lack of communal areas.

Keywords: Skygardens, Mixed Use, High Density, Residential, Communal Living

Project Background

SKYPARK is located along Sai Yee Street, Nelson Street and the world-famous Fa Yuen Street, nicknamed “Sneaker Street” due to its proliferation of sports-shoe shops (see Figure 1). It is a mixed-use urban redevelopment project created by New World Development Company Limited and the Urban Renewal Authority (URA).

The project occupies an urban site with an area of about 2,500 square meters, constrained by a 100-meters-above-principal-datum (mPD) restriction imposed by the government. The mixed-use redevelopment features a three-story shopping mall of about 5,000 square meters and a 20-story residential tower with 439 units, covering a total of about 17,000 square meters. With an average unit size of about 32 square meters, the flats are designed for young singles and couples who are attracted by the vibrant, energetic and fascinating lifestyle of the neighborhood. The tower is crowned by a green space, in which is set a clubhouse for residents (see Figure 2).

At the base of the tower, the FOREST shopping mall enhances the quality of urban space by breaking down a large podium into smaller blocks, echoing the intimately human scale of neighboring shopping streets, and enhancing and extending the existing street shopping experience to the mall’s upper levels.

The Challenges and New Visions

Mong Kok is a district of old and run-down buildings, over 50% of which are at least 50 years old (URA 2018). There have been many urban redevelopment projects within

Figure 1. The SKYPARK project is a combination shopping mall and high-rise residential tower along Hong Kong’s “Sneaker Street.”

Authors

Edwin (Chi Wai) Chan, Senior Project Director
New World Development Company Ltd.
35/F New World Tower 2
18 Queen’s Road Central
Hong Kong, China
t: +852 2832 3575
e: edwinchan@nwd.com.hk
www.nwd.com.hk

Janette (Wan Ming) Chan, Director
P&T Architects and Engineers Ltd.
33/F, 633 King’s Road, North Point
Hong Kong, China
t: +852 2832 3575
e: janette@p-t-group.com
www.p-t-group.com

Edwin (Chi Wai) Chan is the senior project director of New World Development Company. Chan has over 22 years’ experience in the building industry, including more than 16 years in the private property development sector. He specializes in enhancing and optimizing the investment potential of developments, while promoting the best bespoke artisanal built environment for various communities. As a developer with world vision, New World has been implementing one-step forward solutions with innovative professional consultants to improve the community through designing various outstanding projects.

Janette Chan joined P&T in 1988 and became director in 1998. She directs various stages of projects, from design to project management, and has an extensive portfolio of projects including offices, luxury and low-cost residential, commercial complexes, hotels and institutional projects. She believes this diverse wealth of experience provides her with the ability and confidence to provide the best solutions to new challenges. Chan has always devoted her energy and competency to designing the highest-quality built environment, and to enhancing quality of life. She is also committed to community service programs for people in need.
the district. The typical result has been that sites were surrounded by old buildings up to 90 meters in height, so that only a few of the topmost floors could enjoy the skyline of Hong Kong Island and sea views of Victoria Harbour. A common pattern of urban redevelopment, with expensive and prestigious penthouse units on top of residential towers sitting on enclosed and bulky commercial malls, was exploited to deliver maximum profits in the property market. The density of the area allows very little opportunity to provide open space and communal areas, calling into question

[Mong Kok is one of the most crowded urban districts in the world, with a population density reaching 44,000 people per square kilometer. This affords just 23 square meters of living space per person."

Figure 2. The roof of SKYPARK is exploited to its full potential, providing green recreation space to residents of small units in a crowded city. 

"Mong Kok is one of the most crowded urban districts in the world, with a population density reaching 44,000 people per square kilometer. This affords just 23 square meters of living space per person."
Urban Design

Low-Rise to High Density in 15 Years: Inversion and the Toronto Exurb

Abstract

Toronto’s most significant urbanization occurred in the automobile era, with a typical downtown business core and periphery of low-rise bedroom communities. But population growth, greenbelts, and changing attitudes point toward multiple high-rise growth clusters as the prevailing current and future model. This paper examines the lessons learned from a region that has seen massive growth, and the ways in which the future of development is being shaped as a different kind of city, a network of rapidly rising skylines and high-rise, high-density interconnected centers.

Keywords: Density, Growth, Exurb, Suburb, Vertical Urbanism

Introduction

Toronto is a city that came into its own with the advent of the automobile. A rail- and port-centric industrial center, its evolution into a metropolis has always been tied to individual transport into and out of the downtown. As a result, the suburbs of Toronto flourished as typical bedroom communities, with a sea of cookie-cutter houses, each suburb barely distinguishable from the other.

But then, immigration, geography and provincial planning policy created a bottleneck. A lake to the south and an arcing greenbelt to the north, east and west meant land development opportunities were less available. As the Greater Toronto Area’s population grew (at a rate of 100,000+ per year), housing prices rose and development sites became scarce. Direction of new density to a number of growth centers has further contributed to a search for new solutions.

Those growth centers have densified, but the real answer has emerged in the encircling suburbs. Beginning with the removal of height limits for buildings in Mississauga’s city center and continuing across the region, the highest-density development outside of the downtown core is now in the formerly sleepy suburb of Vaughan, which is building a new 162-hectare metropolitan center at the end of a subway line connected to Toronto’s downtown core. The (outer suburbs) are now ripe with potential, and developers are recognizing that there is an appetite for high-density multifamily living, even on the periphery of the metropolis, a demand fueled both by end users and investors able and willing to fill a rental housing gap exacerbated by cost increases. An “exurb” is defined as “a region or settlement that lies outside a city and usually beyond its suburbs and that often is inhabited chiefly by well-to-do families” (Merriam-Webster 2018).

Background and History

In the context of large global cities and international rates of urban population growth, Toronto is not remarkable. Toronto is a fast-growing city, which now has the fourth-largest population in North America behind Mexico City, New York City, and Los Angeles (after overtaking Chicago in 2013) (Moloney 2013), but compared to rates of growth in Asian cities like Chongqing and New Delhi or the tremendous growth rates in

“Between international immigration and domestic migration to Toronto, a bare minimum of 40,000 housing units per year should be constructed... but the region has been hard-pressed to deliver 25,000 units per annum.”
the cities of Africa like Lagos (projected by some to be the world’s largest city by the end of the century), Toronto is a small dot on a very large map.

Toronto and the surrounding areas were, of course, inhabited by various First Nations – Huron-Wendat, Ojibwa, Anishinaabe, and Iroquois among others – for thousands of years prior to the arrival of Europeans. But the modern urban history of the area dates back to the establishment of the Town of York in 1793. The City of Toronto as we now know it was incorporated in 1834 with a population of only 9,252.1 With the exception of a decade-long postwar surge which saw the population rise by 50%, modest and primarily single-digit annual growth was the norm for the first 150 years.

The future looks different. The Greater Toronto Area (GTA) is projected to increase by 2.8 million, or 40.8%, to reach almost 9.7 million by 2041 (Ontario Ministry of Finance 2018, The Canadian Magazine of Immigration 2016).

What’s Driving Density?

The foundation of Toronto’s future growth and prosperity as the centerpiece of Canada’s economic engine was laid by a combination of the postwar population surge and the transfer from Montreal to Toronto of big business, including the financial sector, in the face of the Quebecois nationalist movement in the 1970s (Belanger 2000).

For the next 30 years, the population growth of the city proper remained relatively modest, adding only 10%, while the metropolitan overall area grew at 2–3% annually, almost doubling by 2001, primarily through sprawl across the suburbs. In 2003, then-Premier of Ontario Dalton McGuinty made a case for the establishment of a greenbelt in Ontario, which became law on June 24 of the following year.

“Ontario’s Greenbelt is the solution for fresh air, clean water, healthy local food, active outdoor recreation, and a thriving economy. At almost 809,370 hectares, it’s the world’s largest permanently protected greenbelt, keeping our farmlands, forests, wetlands safe and sustainable,” according to the Friends of the Greenbelt Foundation (2018) (see Figure 1).

The GTA’s population increased by about a million people during the 2001–11 census period in which the greenbelt was implemented, reaching a total of more than six million (Pelley 2017). In spite of the real data supplied by Neptis and others, the perception of land supply constraint caused prices to rise sharply for low-rise housing, particularly in central areas. It also caused the development industry to rethink its housing supply trajectory. Many developers that had been primarily low-rise housing builders began to think about high-rise development, while companies that already had both low- and high-rise business units boosted their high-rise groups. Many land owners began to think that perhaps their land originally destined for low-rise housing could accommodate much more.

Whereas for 20 years the City’s planning policies forbade the building of office space without the appropriate supply of housing, suddenly housing was being built in lieu of adequate space to support the growth of employment.

Though the OP covers many things, one of its most consequential directives is to prescribe where density will be permitted. Toronto is in large part filled with single-family residences (the “neighborhoods”), and at the heart of the OP is the preservation of those existing low-rise communities. High density is permitted in only five zones across the city, one of which is the downtown core. Medium density (4–11 stories) is permitted along the arteries of the city known as the “Avenues,” and almost everywhere else, density increases are not permitted (Novakovic 2015).

Figure 1. The protected greenbelt encircling the Greater Toronto Area has evolved from its beginnings in 1985.
Source: Friends of the Greenbelt Foundation
How Do Outdoor Pollutant Concentrations Vary Along the Height of a Tall Building?

Abstract

It is generally assumed that vertical pollutant dispersion can reduce exposures to ambient pollutants in tall buildings, as concentrations of some ground-source pollutants are diluted at higher floors. However, no measurements of pollutant concentrations have ever been made specifically along the height of a building that would qualify as a supertall building by CTBUH Height Criteria. This paper summarizes the 2016 CTBUH Research Seed Funding study, conducted during a one-week period in the summer of 2017, which measured the vertical variation in the concentrations of several outdoor pollutants and environmental parameters along the height of an approximately 60-story, 300-meter building in downtown Chicago. Floor height was found to be more strongly correlated with PM$_{10}$, PM$_{1.5}$, PM$_{10}$, CO$_2$, and O$_3$ concentrations than with local wind speed and direction.

Keywords: Pollution, Height, Environment

Introduction

Elevated outdoor concentrations of airborne pollutants such as particulate matter (PM), ozone (O$_3$), and nitrogen oxides (NO$_x$) are associated with increased risks of a variety of health effects (EPA 2009 & 2016). However, because outdoor pollutants can infiltrate and persist indoors where people in industrialized countries spend the majority of their time (Klepeis et al. 2001), much of their exposure to pollutants of outdoor origin often occurs inside buildings (Chen, Xhao, and Weschler 2012a & 2012b; Meng et al. 2005; Weschler 2006). Associations between outdoor pollutant concentrations and adverse health effects are commonly made using large epidemiological studies that rely on stationary ambient measurements with air sampling heights of two to 15 meters above ground (EPA 2012). But what does this mean for occupants of tall buildings, where outdoor air intake heights can be hundreds of meters above ground level?

To the authors’ knowledge, no measurements of pollutant concentrations have ever been made specifically along the height of a building that would classify as a tall or supertall building by the CTBUH Height Criteria (CTBUH 2019). Several studies have investigated this vertical variation for a limited number of pollutants along the height of mid-rise buildings, including: a 35-meter building in Boston (Wu et al. 2014); a 40-meter building in China (Li et al. 2005); a 55-meter building in Chile (Villena et al. 2011); a 42- and a 127-meter building in Singapore (Kalaarasan et al. 2009). These field studies have generally confirmed findings from atmospheric measurements and models, demonstrating that particulate matter concentrations tend to decrease with building height, potentially offering a protective effect at higher floors, while ozone concentrations are likely higher at higher elevations, potentially offering a protective effect at lower floors. However, none have extended beyond 130 meters in height, and the types of pollutant measurements have been limited.

Despite the lack of measurements to date, a few small epidemiology studies have suggested that building height could play an important role in human health, and that the vertical variation in pollutant concentrations might contribute to this effect. For example,
a recent study in Switzerland suggested that differences in environmental exposures may have contributed to reductions in all-cause mortality that were associated with increasing residential floor height in buildings (Panczak et al. 2013). Similarly, a study of office buildings in the United States found significantly higher building-related symptoms reported by occupants working on the floors of buildings that had outdoor air intakes less than 60 meters above ground level, which may have been due to greater levels of pollutants from vehicles at air intakes nearer the ground (Mendell et al. 2008).

This work presents results from a pilot study, funded by the Council on Tall Buildings and Urban Habitat (CTBUH) through sponsor Taipei Financial Center Corporation, in which the vertical variation of several outdoor pollutants and environmental parameters were measured along the height of a single tall building in downtown Chicago, from June 22–29, 2017. The aim was to provide novel measurements to quantify the dispersion of ambient pollutant concentrations and environmental parameters along the height of the case study building, and to determine the importance of building height and local meteorological factors in influencing the observed variability in the resulting data. This work has already been published in the Journal Building and Environment (Azimi et al. 2018); here only a brief summary and several excerpts are presented.

Methods

Field measurements

The case study building, which will remain unnamed and whose ownership will not be identified, was approximately 60 stories (300 meters) tall. Several field measurement approaches were discussed with the building engineers and ownership representatives in order to balance equipment costs, accuracy, and practicality, including: (1) multiple instruments measuring simultaneously on multiple floors; or (2) one set of mobile instruments to scan the height of a building, via (a) a pulley system or similar technology to lower and raise an instrument platform or (b) using a drone or other aerial vehicle to lower and raise a (likely much smaller) instrument platform. Both options 2a and 2b were deemed impractical for the purposes of this work, as neither approach would allow for longer-term measurements (i.e., at least one week continuously) but would be limited to short-term measurements (i.e., a few hours). Additionally, neither approach would allow for actual simultaneous measurements, meaning that a true comparison of matched, simultaneous, time-stamped data could never really be made (i.e., only repeated scans of the building height would be achievable). Option 1 was chosen as the most realistic approach from the standpoints of both data quality and practicality.

However, Option 1 also has its own limitations. For example, air quality monitors that are formally designated as Federal Reference Methods (FRM) or Federal Equivalent Methods (FEM) to most accurately measure pollutant concentrations are often at least US$10,000 and thus prohibitively expensive for simultaneous measurements in five locations. Therefore, to be able to establish a finer vertical resolution in matched time-resolved pollutant measurements, a number of more cost-effective air quality monitors on the market were used and calibrated against each other and/or against research-grade FRM/FEM methods in a lab when possible.

Ultimately, several commercially available monitors were selected to measure concentrations of size-resolved particulate matter (PM; 0.3–10 µm), ozone (O₃), nitrogen dioxide (NO₂), carbon dioxide (CO₂), and carbon monoxide (CO), along with temperature and relative humidity in outdoor air along the height of the building. Size-resolved PM number concentrations were also used to estimate PM₁₀, PM₂.₅, and PM₁ mass concentrations. Simultaneous measurements were made using multiple sets of instruments placed in the outdoor air intakes on the mechanical systems located on four different floors (i.e., the second, 16th, 29th, and 44th), as well as in an open-air area on the 61st floor located underneath a two-meter-high cooling tower stand. The location of measurements within the outdoor air intakes was upstream of any filtration or mixing processes. Measurements were made within approximately 200 millimeters downstream of a coarse metallic grate located on the exterior facade of the building, through which outdoor air flowed, and approximately three meters upstream from adjustable louvers that were located downstream of the exterior grate. The louvers controlled mixing between outdoor air and return air, and were located two to three meters upstream of a downstream filter bank.

All five sets of instruments were placed in the top drawer in five identical rolling tool carts with uninterruptible power supplies installed in the bottom drawer (see Table 1). The top drawer of each rolling tool cart was modified to include a small exhaust fan on one side and small holes for air intake drilled on the opposite side to continuously draw in sample airflow. A team of researchers distributed the monitoring instruments to be installed on each floor with the help of the "No previous measurements of pollutant concentrations had ever been made specifically along the height of a building that would classify as a ‘supertall’ building, according to the CTBUH Height Criteria."
Creating Industry-Accepted Criteria for Measuring Tall Building Floor Area

Abstract
The entire tall building industry relies on floor-area measurements to serve as a precise, unambiguous calculation to guide decisions. This can range from architects using the measurement to influence design interventions and engineers formulating the loads on their systems, to developers determining the value of their assets and property managers analyzing the efficiency of building components.

Unfortunately, the measurement systems for determining this floor area are not consistent across all markets, which creates a massive gap in the ability to compare projects across time and location, preventing evaluation of the success of one project against another, and making it difficult to build upon industry decisions made in the past. Work to create floor-area measurement standards that are accepted internationally is underway, but there is hesitancy from investors, governing bodies, and professionals that have used different methods for many years. This paper, one of the outputs of a one-year research project funded by ArcelorMittal, examines some of the problems with existing, local regulations, and presents the progress that has been made towards a globally-accepted standard.

Keywords: Floor Area, Real Estate Valuation, Standards, Materials

Introduction
If the ultimate objective of a building is to host, within its enclosure, a human activity, then the measurement of its internal floor area should reflect that objective. As the arbiter of height criteria and standards of measurement for tall buildings, the Council on Tall Buildings and Urban Habitat (CTBUH) is in a key position to assist the industry in coming to a consensus on how floor area is measured. In recognition of this, CTBUH received funding from ArcelorMittal to begin examining the existing strategies and complications around floor-area measurement. Measuring a building is a deceptively straightforward task, but exploration of the methods produces a wealth of discrepancies and unfamiliar acronyms.

Precise floor measurements are crucial for all disciplines within the tall building industry and serve as a valuable tool when conducting cost surveying/comparison analysis, or when determining planning permissions, maximum allowable floor occupancies, energy consumption, elevator capacity, etc. In all of these crucial activities, an accurate floor measurement is needed to serve as a basis of comparison to determine a building or space’s “per-square-meter” efficiency and value – figures expressed in dollars per square meter, energy usage per square meter, occupancy per square meter, construction speed at number of square meters per day, etc. With an accurate measurement, it is possible to compare buildings across markets and across time, but the cardinal stipulation is that the measurement system must be consistent, clear, and internationally accepted.

“Due to inconsistencies and variations in measuring standards between different markets, declared areas of the same building can deviate up to 24%.”
In a study by global property firm JLL, it was found that, due to inconsistencies and variations in measuring standards between different markets, declared areas of the same building can deviate up to 24% (Hall 2016). This can have huge implications. For example, in an office building, it may be determined that each employee needs at least a total of 10 square meters to work comfortably. By dividing the total floor area by 10, this can determine the amount of employees that can work in a specific area (i.e., the population of the space). With measurement deviations of 24%, a potential office tenant may be looking for space for 100 employees, but the leased or purchased space may only be suitable for 76 members of staff. This global variation in standards has been an impediment to international investment, particularly for office buildings (see Figure 1).

Acknowledging the need for a consistent method across international markets, and to promote international investments, the International Property Measurement Standards Coalition (IPMSC) was established in 2013 by the World Bank, with the sole mission of developing and implementing international standards for measuring the floor area of property. CTBUH joined this group of more than 80 professional and not-for-profit organizations from around the world, to contribute considerations on the unique aspects of tall buildings and their impact on the development of an internationally-accepted standard.

Existing Standards

In every major tall building market, there is an accepted method for measuring floor area, but often the organization or standard that is referenced and relied upon differs. The Royal Institute of Chartered Surveyors (RICS) is a global professional body dedicated to promoting and enforcing standards in land, real estate, construction, and infrastructure. While the standards and regulations that they have produced on how to measure property are primarily used in the United Kingdom, they also have an impact on the standards being implemented in other countries. Like RICS, the Building Owners and Managers Association (BOMA) is internationally known for setting the standard for measuring buildings, beginning with the publication of the Standard Method of Floor Measurement for Office Buildings in 1915. The BOMA standards are the approved methodology for measuring floor area by the American National Standards Institute (ANSI), making it the most widely-used standard for measurement in the United States. While jurisdictions outside of the UK and US utilize the standards created by RICS and BOMA, they also generally employ the specific standards produced by their respective governments. For example, in Hong Kong, the Building (Planning) Regulations produced by the Hong Kong Buildings Department are used; in Australia, the Property Council of Australia (PCA) Methods of Measurement is used; and in Singapore, the Handbook on Gross Floor Area produced by the Urban Redevelopment Authority (URA) is used.

Within these standards, a building’s floor area is commonly defined by Gross Floor Area (GFA) or Gross External Area (GEA); however, there are countless other terms used, including the Gross Internal Area (GIA), Net Internal Area (NIA), Gross Leasable Area (GLA), Net Rentable Area (NRA), and Carpet Area, among others. All of these methods for measurement differ in the specific building elements that they include or exclude. Also, the same definition may vary from standard to standard, so the NRA may not be the same from one market to the next. When a potential tenant is looking at a new building unit, the total cost is often dictated by a monetary value per square meter, multiplied by the total area. Without a single, internationally-accepted practice for measuring the area, the total value of that area is not uniquely identifiable.

Existing measurement practices

Generally, GFA and GEA are considered to be the total floor area contained within a building’s envelope, measured to the external face of the external walls. This is the “all-inclusive” measurement, and generally the biggest number used when defining a building’s floor area. Along with being the most common method for measuring building floor areas, it is also considered the simplest and least-controversial method. Using GFA and GEA measurements is the typical method used for city planning.
Abstract
The 2018 CTBUH Tall Building Year in Review and Tall Buildings in Numbers data analysis report found that 143 buildings of 200 meters’ or greater height were completed in 2018, down by four from the all-time record of 147 in 2017.* The year also saw 18 completed “supertalls” (buildings of at least 300 meters’ height), the largest number ever. The report covers other statistical highlights of 2018 and predicts completions for 2019.

Note: Please refer to Tall Buildings in Numbers – The Global Tall Building Picture: Impact of 2018 in conjunction with this paper, pages 48–49
*The study sets a minimum threshold of 200 meters’ height because of the completeness of data available on buildings of that height.

Keywords: Statistics, Construction, Completions, 2018, Height, Urbanization

Figure 1. Number of 200-meter-plus buildings completed each year from 1960 to 2018, with projections through 2019.

Notes:
1. We can predict 2019 building completions with some accuracy due to projects now in advanced construction. A range is given to acknowledge the challenging factors in predicting building completion dates.
2. Totals after 2001 take into account the destruction of the World Trade Center Towers 1 and 2.

Total Number of 200-Meter-Plus Buildings in Existence at Key Points from 1920 to 2019
The astronomical growth in tall building construction observed over the past decade continued in 2018, though the total number of completed buildings of 200 meters’ or greater height leveled off at 143 (see Figure 1), after hitting an all-time record of 147 in 2017. The total number of 200-meter-and-higher buildings in the world is now 1,478, a 141 percent increase from 614, in 2010. The total sum of heights of all completions in 2018 was 35,246 meters. This is down slightly from the all-time high of 35,849 in 2017, but it’s still an impressive figure – if laid end-to-end, these buildings would exceed the length of Manhattan Island, which is about 21.6 kilometers long. The tallest building to complete in 2018 was the 528-meter China Zun in Beijing (see Figure 2). It is the fourth year in a row in which the tallest building to complete in that year is in China.

**Key Worldwide Market Snapshots of 2018**

**Asia (Not including Middle East)**

With 109 buildings, representing 76 percent of the total, Asia remained at the top of the rankings in 2018, recording slightly fewer than its 2017 total of 113 buildings of at least 200 meters in height (see Figure 3). For the 23rd year in a row, China has maintained its reign as the most prolific country when it comes to the construction of 200-meter-plus-tall buildings, with 88 completions in 2018, for 61.5 percent of the total. This is a record for China, exceeds last year’s figure by eight, and represents an even greater proportion of the global total than the 2017 figure of 54.4 percent. China’s previous record was set in 2016, with 86 buildings of 200 meters or higher. Second place was again held by the United States, with 13 completions, up from 10 in 2017 (see Figure 4). And once again, outdoing its own record from last year, Shenzhen, China, recorded 14 completions, making this the third year in a row in which the city completed the world’s largest number of 200-meter-plus completions, and comprising nearly 10 percent of the global total. In addition to first-place Shenzhen, Beijing and Shenyang, tied for third with eight completions, and Nanning, with seven completions in sixth place, are in China. Jakarta, Indonesia, and Kuala Lumpur, Malaysia, were tied for seventh place, with five completions each (see Figure 6).

Another standout achievement was for Bangkok, which recorded three completions, including the city’s and Thailand’s new tallest building, Magnolias Waterfront Residences Tower 1, at 315 meters, just edging past the incumbent 314-meter King Power MahaNakhon.

Breaking the 400-meter mark for the first time, Vietnam recorded the completion of Vincom Landmark 81 in Ho Chi Minh City, a 461-meter building, which ranks as the second-tallest building to complete worldwide in 2018.

A total of 19 cities worldwide got a new tallest building, all but five of which were in Asia. The new heights being reached in Southeast Asia are likely indicative of improving economic conditions in countries such as Thailand, Cambodia and Vietnam, which are experiencing growth in industrial production, foreign direct investment, and tourism, among other inputs.

Any discussion of business or industry in 2018 would have to consider the role of China, the world’s second-largest economy, which is undergoing changes under the leadership of President Xi Jinping. Bearing in mind that skyscrapers are lagging economic indicators that take years to plan, design and construct, the effects of...
The Global Tall Building Picture: Impact of 2018

In 2018, 143 buildings of 200 meters' height or greater were completed. This is a slight decrease from 2017's record-breaking total of 147, and it brings the total number of 200-meter-plus buildings in the world to 1,478, marking an increase of 141 percent from 2010, and 464 percent from 2000, when only 262 existed. Asia continued to be the most dominant region in terms of skyscraper construction, and China within it, as in several years previously. For more analysis of 2018 completions, see “CTBUH Year in Review: Tall Trends of 2018,” pages 40-47.

World’s Tallest Building Completed Each Year

Starting with the year 2003, these are the tallest buildings that have been completed globally each year.

The Average Height of the Tallest Buildings

China recorded 88 completions, the most by a single country, beating its own record by two. Eight is a lucky number in China. China Zun, at 528 meters, was the tallest building to complete in 2018. It is now the world’s eighth-tallest building.

A record number (18) of supertall (300 m+) buildings completed in 2018.
World’s Tallest 100: Analysis

A plurality of the world’s tallest 100 buildings are located in Asia, have a mix of uses, and employ composite structural systems.

Number of Buildings Entering the World’s 100 Tallest by Year

A total of 16 buildings entered the global 100 Tallest list in 2018, just below the 2011 record of 18.

The BD Bacata Torre 1, Bogota, Colombia’s new tallest building, began life as a “crowdfunding” project with small individual investments. The two tallest buildings to finish in San Francisco in 2018 have tech companies Facebook and Salesforce as main tenants.

353

The average height in meters of the 20 Tallest Buildings completed in 2018.
Talking Tall: Wuren Wang

China Zun: Beijing’s New Icon, 2018’s Tallest

At 528 meters, China Zun was the tallest building completed in 2018, and became the new tallest building in Beijing. It is the anchor of a 30-hectare new central business district (CBD) established on the east side of the city, where more than 20 buildings of 150 to 350 meters’ height will ultimately rise. CTBUH Editor Daniel Safark interviewed Wuren Wang of CITIC HEYE Investment Co. Ltd., on the eve of this significant occasion.

Why was it important to reach the 528-meter height of China Zun?
In the past 40 years, the CITIC Group has created landmarks for Beijing in every decade. For example, in the 1970s, we built the city’s first international-grade office building – the CITIC International Building on Chang’an Street. In 1989, we constructed the Capital Mansion, which, at 183 meters, was Beijing’s tallest building at that time. In the 2000s, we built the National Stadium (Bird’s Nest) for the 2008 Olympics. Now, China Zun, as a high-quality high-rise landmark building, reflects the maturation of our development process in our fourth decade, and that of the city as well.

We think China Zun’s appearance demonstrates the culmination of the world’s most advanced design concepts and equipment manufacturing capabilities, and that it affirms the construction speed of China’s high-rise building industry. In the future, it will continue to stand as a comprehensive model of whole-lifecycle management by the owner’s development team. It will also show the economic strength and outstanding social responsibility of CITIC Group.

Why was the “zun” form chosen? What are the symbolic, structural, and commercial motivations?
As the elegant shape of the building is derived from the ancient Chinese ritual vessel, the zun, people like to call it “China Zun” (see Figure 1). The association is one of affection, just like the National Stadium is called the “Bird’s Nest”. The zun is a vessel used as a ritual container in ancient Chinese feasts or ceremonies. It is a symbol that represents China as a “nation of etiquette”. China Zun’s shape is intended to signify that Chinese culture is striding into a new era, one in which it will move proudly forward and lead the world’s cultural and technological progress.

Additionally, the zun in Chinese culture resembles the idea: “Heaven is a circle and the Earth is a square.” Learning from that in a literal and practical sense, the structure of China Zun uses circles and squares in order to provide a solid and stable base as well as an elegant shape. At the same time, it reflects both the history and the profound connotations of Chinese culture.

What kind of design choices were made to ensure the safety of the tower in case of an earthquake?
China Zun was fortified to withstand an 8.0-intensity seismic event. To do this, we adopted a combination of anti-lateral-force structural systems, in a configuration we refer to as a “giant outer-frame tube plus core tube.” This ensures that it will safely survive the strongest earthquakes, that it will be repairable following moderate earthquakes, and will not register any damage in a minor earthquake.

Beijing is currently planning to move significant government and residential developments further to the south, as well as open a new airport in that direction. How do you think this will affect the business operations and appeal of China Zun and the Chaoyang CBD, whose value is partly based on distance from the center city and the Beijing Capital International Airport?
In September 2017, the Beijing municipal government released its General Urban Plan for the period 2016–2035. In part, it states that the strategic orientation of Beijing should be along several lines: as a national political center, a cultural center, an international...
The ‘zun’ in Chinese culture resembles the idea: ‘Heaven is a circle and the Earth is a square.’ Learning from that in a literal and practical sense, the structure of China Zun uses circles and squares in order to provide a solid and stable base as well as an elegant shape.

The China Zun, as a world-class, supertall headquarters building, conveys and strengthens the four-pronged objective of the Urban Plan. The China Zun decorates the skyline of Beijing, while at the same time, enriches Beijing’s reputation for modern architecture and civic landscapes. We believe that, regardless of future developments, the location-specific advantages of the China Zun, close to both the Beijing Capital Airport and the historic city center, as well as in the new CBD, will continue to make a large contribution to Beijing’s profile, and will benefit from that as well.

How does the building contend with the high levels of pollution for which Beijing is known?
The glass of the building is comprised of four layers, effectively forming a hollow curtain wall system. This is simple, smooth, and conducive to efficient cleaning. In addition, nine window cleaners are installed at the “waist” on the 73rd floor and at the roof, to ensure that comprehensive cleaning is practical on a frequent basis (see Figure 2). Additionally, the combination of the four-glass double-hollow curtain wall system and the high-performance air purification system of the building plays a role in preventing the ingress of outdoor air pollution and improving the internal circulating air quality of the building.

During the design phase, extensive use of Building Information Modeling (BIM) was made to coordinate more than 30 companies working on the project. To what degree has BIM been translated into the live, operational building, through incorporation into the Building Management System (BMS), for example? The China Zun project combined BIM, Integrated Business Management System (IBMS), Project Management (PM), and Facilities Management (FM) software together to establish the a “smart operation cloud platform.” Beginning with the lightweight BIM construction model, it has been separated into units and can offer a dynamic, three-dimensional virtual environment model of operational management. Based on this, using the Internet of Things (IoT) information integration, the following scenarios will be realized:

First, this model connects the dynamic data of the building automation (BA) system with the interface of the BIM model, so that the real-time BA monitoring data can be shared, and in the BIM virtual model, operational status can be observed directly. This turns the two-dimensional IBMS charts into dynamic three-dimensional BIM simulations. It makes the whole practice of operational management more vivid.

Second, the BIM model is associated with the security monitoring, fire alarm, water leak alarm and other systems. When an alarm is triggered, the camera associated with that location will connect to the BIM model, so that the problem can be quickly located and handled.

Third, by scanning QR codes affixed to the physical plant, the building’s “big data” network is established. Equipment classification, operational status and contract information are incorporated into the BIM model, giving a real time picture of the actual equipment. Employees can click the equipment model on the smart cloud platform, or scan the QR code on the equipment to read the information stored in BIM database. That way, whether an employee is in the building management office or in the field with a machine, they have the same product information, consumables data, awareness of the availability of spare parts, maintenance procedures, and so on. This makes operations management much more efficient, convenient and accurate.

Finally, the dynamic virtual environment model generated by BIM operating system can be co-operated and combined with digital platforms, such as municipal fire and emergency planning software. Then, we can use it to rehearse any kind of emergency plan and optimize it for our building.

“The ‘zun’ in Chinese culture resembles the idea: ‘Heaven is a circle and the Earth is a square.’ Learning from that in a literal and practical sense, the structure of China Zun uses circles and squares in order to provide a solid and stable base as well as an elegant shape.”
About the Council

The Council on Tall Buildings and Urban Habitat (CTBUH) is the world’s leading resource for professionals focused on the inception, design, construction, and operation of tall buildings and future cities. Founded in 1969 and headquartered at Chicago’s historic Monroe Building, the CTBUH is a not-for-profit organization with an Asia Headquarters office at Tongji University, Shanghai, a Research Office at Iuav University, Venice, Italy, and an Academic Office at the Illinois Institute of Technology, Chicago. CTBUH facilitates the exchange of the latest knowledge available on tall buildings around the world through publications, research, events, working groups, web resources, and its extensive network of international representatives. The Council’s research department is spearheading the investigation of the next generation of tall buildings by aiding original research on sustainability and key development issues. The Council’s free database on tall buildings, The Skyscraper Center, is updated daily with detailed information, images, data, and news. The CTBUH also developed the international standards for measuring tall building height and is recognized as the arbiter for bestowing such designations as “The World’s Tallest Building.”