Case Study: Lotte World Tower, Seoul

2017 Year in Review: Global Diversity of Tall Increases

New Insights on the Postwar “Glass Box”

Using Ancient Techniques to Drive a New Prefab Steel System

Talking Tall: Dr. Cheong Koon Hean, Singapore’s Urban Visionary

In Numbers: Impact of 2017 on the World’s 100 Tallest Buildings

Debating Tall: Skyscrapers as Severe-Weather Shelters?
“Until the economic and social benefits of more resilient tall buildings are more seriously considered, resiliency will remain near the bottom of a long list of design drivers.”

Leung, page 5
Americas

Although not part of the Hudson Yards project in New York, the adjacent 3 Hudson Boulevard is benefiting from the flow of interest in office space on Manhattan’s West Side. The project’s program had originally been contemplated to include condominiums, but it has been subsequently redesigned, increasing its floor plate and shrinking its height slightly. It’s expected to complete by 2021. A much more controversial redesign has been proposed for the iconic 550 Madison Avenue, designed by Philip Johnson and built for AT&T in 1983, and later held by Sony. The monumental brick façade of the building is set to receive a glassy makeover, which would enclose a public garden with birds and butterflies. The proposal has drawn much opposition, as the building is considered an exemplary work of Postmodernism, and the new design would fundamentally change its street presence.

Across the river in New Jersey, the seemingly boundless demand for real estate in the New York metro area continues to spill over. Also not without controversy, neighbors were loudly opposing plans for a four-tower development at 615 River Road in Edgewater, a suburban community not accustomed to projects of its proposed scale – up to 218 meters in height and containing almost 2,000 residences. Meanwhile, downriver in New Jersey City, the site was being cleared for the FXFOWLE-designed Harborside Tower, which would be the city’s first new commercial office building in decades.

The developers of 300 Biscayne, a 317-meter residential tower, claim that the proposed building would not only be Miami’s tallest, but also the tallest residential building south of New York. In another (apparent) first, to unknown effect, the project is also “the first completely overseen by health guru Deepak Chopra.” More conventional measures of building-industry health are looking positive in the Magic City, although the resulting designs and marketing campaigns belie the heavy international competition for real estate investment in the metropolis. Sports-car maker Aston Martin has broken ground on the Aston Martin Residences, taking the form of a 66-story sail, rather than a car. The launch of the project coincides with that of “Project Neptune,” neither a car nor a building, but a “luxury mini-submarine project.” Meanwhile, a group of Turkish developers have proposed The Sterling, a 73-story mixed-use development in the shape of a tulip, the national flower of Turkey.

When word emerged that online retailer Amazon was looking to build a second headquarters in North America that could employ 50,000 people, hundreds of cities fell all over themselves to assemble site candidates that would appeal to the behemoth. Chicago was no exception, throwing back the curtains on the Solomon Cordwell Buenz master-planned River District, containing more than 830,000 square meters of development rights. Also revealed was the Burnham Lakefront, the SOM master-planned redevelopment of the Michael Reese Hospital site on the city’s
South Side, offering some 98 hectares of land. A third, more centrally located site along the Chicago River, The 78, developed by Related and also master-planned by SOM, already has designated part of the site for an 1,800-student capacity multi-university complex called the Discovery Partners Institute, as well as a provision for up to 40% green and open public space. Separately, developers revealed plans for what would be among the tallest buildings in the city. The taller of the two towers in the One Chicago Square residential project, designed by Goettsch Partners, would rise to 314 meters and 76 stories.

Come Amazon or not, other American cities were also thinking about exceeding past limits. Dallas was examining a proposal for the Dallas Smart District, whose first phase would have up to 93,000 square meters of office space, grocery stores, hotels, and green space. Its centerpiece, a 341-meter, 78-story Pelli Clarke Pelli-designed skyscraper, would become the city’s new tallest building.

Denver, the Mile-High City, was also thinking of height in a different context. A proposal for the Six Fifty 17 residential/hotel tower, at 308 meters, would become that city’s tallest by almost 100 meters, dwarfing the current title-holder, Republic Plaza. And Portland, much more famous for its relaxed lifestyle and eco-friendliness than its skyline, also got into the game, with a proposal for a set of 296-meter twin towers, linked by a skybridge, as part of a bid to redevelop its US Post Office site. Somewhat truer to form, it was also announced that Framework, the winner of the US Tall Timber design competition (Journal 2016 Issue I) and now under construction, would include affordable housing.

With its tall buildings long relegated to flat tops and boxy frames, Los Angeles is beginning to add some of its characteristic idiosyncrasy to its skyline. A curving apartment building is planned to add some variation to the horizon at 2900 Wilshire. The legendary Sunset Strip is targeted as the location for a sinuous Edition Hotel & Residences tower, with irregularly curved and rotating floor plates that project beyond the building envelope to create outdoor spaces as the floors rise and shift in position. Perhaps most eye-catching was a video rendering of the upcoming (W)rapper, a 17-story office building with a crazy-quilt of exterior bracing and an asymmetrical shape, offering column-free floor plates, expansive views, and access to the nearby Expo transit line.

Toronto continued to be one of the most exciting cities in the Americas for skyscraper development. The country’s first supertall, The

“Almost all those point blocks and slab blocks should never have been built, because high-rise social housing ostracizes the underprivileged into special places for the poor, and therefore they become colonies of underprivileged people.”

Lotte World Tower: Seoul’s First Supertall

Abstract
The Lotte World Tower became the world’s fifth-tallest building upon completion in 2017, and is currently the only supertall building (300 meters or higher) in Seoul. As it is located a fair distance from other tall buildings, the project’s designers bore substantial responsibility to not only create an enduring skyline icon, but also to provide a culturally relevant and well-integrated project within the urban grain. Beyond the spectacle of its sleek design and great height, the tower is part of a mixed-use complex that has provided additional public amenities. With its diverse program, it is hoped the project will become a beloved destination in Seoul.

Keywords: Supertall, Seoul, Mixed-Use

Introduction
The design of Lotte World Tower is both the product and an instigator of an urban paradigm shift—a restructuring of the commonly held beliefs that surround the nature of the urban environment. It is inevitable that globalization and urbanization will persist, raising issues regarding population growth and urban density. The supertall towers and “vertical cities” created in response to these conditions present a solution. Opportunities abound to enhance vertical construction so that it can offer the diversity and experiential qualities typically found in linear, horizontal urban centers.

Major achievements in building technologies, including vertical transportation and structural systems, have accelerated the development of supertall towers around the world, but their social acceptance remains critical to their continued success. The newly completed Lotte World Tower in Seoul is removing...
barriers – both physically and psychologically – as it breaks the boundaries of vertical construction.

As the fifth-tallest building in the world, Lotte World Tower has a responsibility to its occupants and neighbors. Rising to 555 meters, the tower’s design takes the horizontality of the city and transforms it vertically, offering a range of programming while remaining thoroughly attentive to individual experience. The tower focuses on a vertical programming strategy that supports efficient circulation, structural safety, and comfort. It offers a confluence of supportive systems that creates an experience reflective of its height and stature.

Lotte World Tower takes the horizontal life of a city and flips it on end (see Figures 1 and 2). But this is not just an act of replication. The inversion delivers a new experience to the urban dweller, one that is expressed and felt vertically. The tower boasts 123 floors of mixed-use programming, designed with specific attention to the lives of the people within its walls. Retail, entertainment, and cultural programming provide a base for state-of-the-art offices, residences, and a luxury hotel, all topped with one of the most impressive observatories in the world (see Figure 3).

Vertical Program

The programming strategy for Lotte World Tower is meant to be immersive and holistic. Public space is located throughout the tower, rather than being segregated on the ground floor, encouraging people to explore upper-floor destinations, including restaurants, lounges, viewing facilities, and other amenities. The design’s intent was to provide flexible and convenient places for the day-to-day necessities of residents and office workers. While this story begins in the lobby, the pull of the sculpted interior ceiling panels and the multi-story, curving glass curtain wall (see Figure 4) invite further exploration.

Vertical stacking increases the efficiency of the supertall’s programming, as well as its elevator
Reconstruction as Research: Digital Modeling of Key Postwar Skyscrapers

Abstract
The 2016 CTBUH Student Research Funding Program, kindly sponsored by Underwriters Laboratories, allowed researchers to use digital reconstructions from extant drawings and publications to research and illustrate the evolution of key cladding and environmental technologies used on tall buildings constructed in the Post-WWII era. They uncovered that the “glass box” model only emerged once MEP systems and glazing technology had both advanced.

Keywords: Curtain Wall, Façade, Construction, Digital Modeling

Introduction
The postwar “glass box” is perhaps the most ubiquitous skyscraper type – even today, this fundamental formulation of the 1960s defines much high-rise construction. Yet cladding a structural frame with a thin, mostly transparent curtain wall was a counterintuitive strategy for much of the 1950s. Architects instead relied on the pre-war formula of punched windows within a predominantly solid, often vertically-striated curtain wall. The authors argue that glass skins only emerged as enabling technologies evolved, and that systems such as fluorescent lighting and air-conditioning had to be supplemented by developments in glazing before the International Style dream of high-rise glass architecture made any sense (Leslie 2018).

Approach
Much of this research involved archival work on the materials and systems themselves, examining patent documents, corporate archives, and accounts of new innovations in the architectural press. To show how this influence worked, the authors wanted to examine key buildings in detail, in particular, to look at how systems and materials were integrated into floor plate layout and in curtain wall design. The 2016 Student Research Grant from the CTBUH, sponsored by Underwriters Laboratories, funded Research Assistantships for Iowa State’s Construction History Research Group (CHiRG). These assistantships were dedicated to building fully detailed digital reconstructions of building floor plates and skins, which allowed visualization of the three-dimensional ramifications of these technologies.

The Evolution of the Glass Box: Six Key Buildings
The selection of examples for this project was determined by a review of press coverage in the early- to mid-1950s, regarding the application of then-new technologies in commercial construction, such as ducted air-conditioning, insulated glazing, heat-absorbing glass, and fluorescent lighting. Six buildings demonstrate the then-contemporary state of the art in construction, and the application of a new product or system: Equitable Building, now called the Commonwealth Building (Portland, 1949), United Nations Secretariat (New York, 1952); Alcoa Building, now called the Regional Enterprise Tower (Pittsburgh, 1953), Lever House (New York, 1953); Prudential Building, One Prudential Plaza (Chicago, 1954); and Inland Steel Building (Chicago, 1957) (see Figure 1). These buildings present a convoluted but discernible timeline in the evolution of the so-called “glass box.” Lever House and Inland Steel are paradigmatic instances of the type – though, as the research confirmed, Lever House was not as extensive an application of glass cladding as is often claimed. Similarly,
the United Nations Secretariat is often claimed as the “first glass curtain wall,” though its installation shows the complicated influences of burgeoning technology and conservative expectations for elements such as operable windows. Alcoa and Prudential are rarely mentioned in standard architectural histories, as their predominantly solid-paneled skins appear to be both stylistically and technically retrograde, given their dates. This is particularly the case with the extent of glazing and the sophisticated detailing of Equitable, which was precocious in almost every aspect of its cladding and environmental control.

From a chronological standpoint, these buildings trace an unclear evolutionary path; the advances made in the Equitable Building and the glazed nature of the United Nations were ignored by designers of solid-skinned buildings of the early 1950s. In the case of Alcoa, the same firm that had designed the United Nations’ façade just a few years earlier, Harrison & Abramovitz, reverted to a more solid façade appearance.

Simple chronology, however, does not account for the technical and environmental influences that shaped these structures, which have not been adequately accounted for in standard architectural histories. In particular, as environmental technologies came online through the 1930s and 1940s, cladding materials and systems lagged behind lighting and air-conditioning in their effectiveness. Glass proved troubling in terms of both its insulating value and its transmission of sunlight, until key innovations that addressed these issues became technically feasible two decades after air-conditioning established itself as a reliable, affordable amenity. As late as 1958, authoritative writing on curtain walls described an ongoing “reconsideration of the window,” noting that with atmospheric and lighting control now being handled mechanically, “the functions of the window have often been narrowed to providing outlook or view alone” (Hunt 1958).

Windowless office and factory buildings present a persistent counter-narrative to the mythical march toward glass architecture promoted by Modernists such as Mies van der Rohe. Smaller windows – and thus solid skins – were promoted throughout the key decade of the 1950s for their ability to “considerably reduce air-conditioning equipment requirements and operation costs” (Hunt 1958). Predominantly solid skins, such as those of Prudential and Alcoa, were logical responses to the availability and efficacy of the mechanical and cladding technologies of the moment. Equitable’s prescient glass and aluminum skin was the result not only of a forward-thinking architect and client collaboration; it was also a response to Portland’s mild, cloudy climate and to the ready availability of affordable aluminum in the Pacific Northwest.

Deeper floor plates also resonated with developing planning standards, to allow larger expanses of open, flexibly-planned offices. This was evidenced not only by the size of the floor plates themselves – in some cases twice as wide as recommended depths for pre-war, naturally-ventilated floor plates – but also by the provision of mechanical services (see Figure 2). Supply registers and fluorescent light fixtures were typically arrayed on three-meter modules, a recommended dimension for offices and open-plan workspaces that appeared in standard references of the era, in particular Kenneth Ripnenn’s encyclopedic Office Building and Office Layout Planning (Ripnenn 1960).

Despite their apparently retrograde skins, Alcoa and Prudential do deserve greater recognition for their technical achievements alongside their deeper plans. Harrison and Abramovitz’s charge at Alcoa was not only to provide office space for the newly-renamed Aluminum Corporation of America; it was also designed to be a demonstration of aluminum’s versatility for a company keen to find new markets for its product. Aluminum...
Helping Cities Plan High-Rise Growth

Abstract
Two studies, both completed for the City of Toronto, are focused on helping cities navigate the issues associated with high-rise growth. The first, the Downtown Tall Buildings study, developed a new vision for how tall buildings should fit in downtown Toronto; where they belong, how tall they should be, and how they should be designed in order to relate appropriately to people and their surroundings. It focuses on harnessing the vitality and energy of well-designed and well-located tall buildings to positively invigorate downtown streets and contribute to making great cities. The second, Growing Up: Planning for Children in New Vertical Communities, focuses on how cities can better accommodate families in high-rise-dominated, dense urban cores by exploring the needs of families at three scales: the unit, the building, and the neighborhood. The findings of these studies provide strategies and guidelines to help connect high-rise developments to their people, communities and cities.

Keywords: Urban Design, Urban Planning, Vertical Urbanism, Density

Toronto on the Rise
Canada's largest conurbation, inclusive of the Greater Toronto Area (GTA) and surrounding municipalities, has experienced unprecedented population, employment, economic, and development growth in the last decade. Various demographic and population data sources estimate that this area will see a net increase of over 3.5 million residents – more than Toronto's current population – over the next two decades (StatCan 2016), amounting to an average annual change of 108,766 new residents per year for the Toronto Census Metropolitan Area. Roughly 46% of this growth is expected to be absorbed by the City of Toronto proper (Toronto Foundation 2016) and is focused in Toronto's downtown core, as defined in the Official Plan of the City of Toronto. Each year, this area absorbs more than 10,000 new residents into an already intensely developed urban fabric that is expected to roughly double in population (from 250,000 to 475,000) over the next 23 years – a growth rate that is four times that of the rest of the city (City of Toronto 2016). Additionally, an average weekday sees the Downtown swell by over 800,000 employees, students, shoppers, and visitors. While these figures could be considered overwhelming, they are also illustrative of the pull of opportunities and high quality of life that Toronto offers, as evidenced by the vibrancy of its neighborhoods, streets, and increasingly its rising skyline (see Figure 1).

As Toronto has taken its first steps onto the stage of global cities, a wide range of growth issues have quickly compelled it to become an incubator for solutions to the challenges global cities increasingly face. Like other subjects of cumulative study, the planning and design fields rely on didactic approaches that add to the body of knowledge and the built landscape. Today's Toronto City Planning Division reflects this recursive layering methodology, as its planning tools and framework rely upon the continual study of emergent issues. This paper shares the results of the two aforementioned studies. Also at issue is a proposals report and...
initiative entitled TOcore that seeks to consolidate existing studies and other complementary data into a comprehensive set of policy directions to shape the future of Toronto’s downtown core. These reports, studies, and legislation enter into the public realm as “living documents” that are continuously edited.

In 2010, a team consisting of Hariri Pontarini Architects and urban design and planning consultancy Urban Strategies Inc. was retained as a consultant by the Toronto Planning Division to report on its tall building study, a framework for regulations intended to shape Toronto’s downtown, in anticipation of a development boom that was then just gathering steam. In Toronto, the typology of dense high-rise multi-family buildings has had to adapt over time, through the lenses of urban planning and architectural praxis, to the changing contextual and demographic demands on residential development. The following three cases show how Toronto’s body of planning mechanisms and research have become a heavily layered, nimble, and responsive toolkit.

Toronto’s Tall Building Guidelines: An Archetype for Living Documents

Before 2010, the City of Toronto, like other large North American municipalities, had three sets of guidelines to evaluate tall building development proposals: a city plan (2006), existing zoning by-laws, and a set of design guidelines to determine floor plate sizes, setbacks and distances between adjacent buildings. Increasingly – as demographic and economic conditions began to shift towards innovation, information, research, and technology-based drivers for Canada’s largest and most productive city – it became apparent that the growth of Toronto’s downtown had to be treated as a special case, with guidelines designed specifically for these conditions. To give some context, based on the most recent information available, Toronto’s Downtown contributes 51% of the city’s overall GDP, 33% of its jobs, 25% of its tax base, 37% of its residential development pipeline (approvals), and 45% of its non-residential pipeline, all falling in only 3% of the city’s land area (City of Toronto 2016).

With the downtown already replete with tall buildings, and with pressure mounting for more, the city planning department began to enact amendments to the official plan to engage in neighborhood-specific issues through a series of secondary and site-specific plans. While these secondary plans, (10 of which currently fall within the downtown core) address all levels of planning issues within their bounds, the Tall Buildings: Inviting Change in Downtown Toronto study looked at the high-rise typology specifically as the future dominant architectural typology of the downtown area. In broad strokes, this study sought to develop a vision for how tall buildings should fit into downtown Toronto; where they belong, how tall they should be, and how they should be designed to relate appropriately to people and their surroundings. It focused on harnessing the vitality and energy of well-designed and well-located tall buildings to positively invigorate downtown streets and contribute to the health of the GTA as a whole.

The initial vision of the Tall Buildings study began with two streams of research. The first was a review of existing policy and regulations, as well as an analysis of the existing stock of 68 tall buildings within the study area, conducted with the intent of identifying trends in the decision-making process leading up to final zoning approvals. Additionally, a review of how six other “precedent cities” (Boston, Calgary, Chicago, New York, San Francisco, and Vancouver) apply regulatory systems to their downtown cores.
Applying Ancient Structural Principles To a New Prefabricated Steel System

Abstract

Numerous ancient timber structures located in high seismic zones of China are still standing today, long after experiencing strong earthquakes over hundreds of years. One of the important factors in their longevity is the adoption of the mortise-and-tenon joint as the main connection system. The seismic deformation and sliding friction between the tenons and mortises of timber structures can transfer and absorb seismic energy, such that timber structures exhibit excellent seismic performance. Based on the same concept, the authors propose applying a similar joint within a steel frame structure: a new prefabricated steel structure system that adopts connections similar to those of the mortise-and-tenon joints in timber structures.

Keywords: Mortise-and-Tenon Joint, Seismic Performance, Steel Structure, Prefabrication, Modularization, Bolt/Weld-Less Installation, Structural Steel Adhesive

Introduction

Since the annual steel production of China exceeded 100 million metric tons in 1996, China has been the largest steel producer in the world for the past 20 years. In 2016, the annual steel production was more than one billion metric tons, which accounted for about 50% of overall world steel production. However, the ratio of structural steel used in the building industry represents only about 5% to 6% of the total steel production in China, compared with a ratio of 20% to 30% in other developed countries. There exists a great potential for further development (Yue 2016; Zhang & Zhang 2016).

In order to fully capitalize on the advantages of steel buildings, and to upgrade the ratio of structural steel used in the building industry in China, innovation in the methodology, fabrication, and installation technologies of structural systems is required.

To achieve these targets, this paper proposes that mid-rise and high-rise buildings be supported with a new prefabricated steel structure system, with connections similar to mortise-and-tenon joints used in timber structures. The main structural components of this system could be easily and accurately installed on-site, without any bolted or welded connections.

Seismic Performance of Ancient Timber Structures with Mortise-and-Tenon Joints

Origins of the mortise-and-tenon structure

The Hemudu site, in Yuyao, China dates from the Neolithic Age, more than 7,000 years ago. Since archaeological excavation began in 1973, a high number of tenons and mortises have been found at the site (see Figure 1). This indicates that the technology had already been skillfully mastered and widely adopted to build dwellings at that time (Gao, Zhao & Xue 2008).

Seismic performance of existing ancient timber structures in China

The Yingxian Wooden Tower, constructed in 1056, is located in Shanxi province (see Figure 2). The tower, octagonal in plan is 67.3 meters high and has a bottom diameter of 30.3 meters. All the connections of the tower are mortise-and-tenon joints, and there are no iron connectors or nails. It is still intact after having suffered many strong earthquakes, including more than 10 earthquakes with a seismic intensity exceeding 5.0 on the Richter Scale (Gao, Zhao & Xue 2008).
The Nanchan Temple, also located in Shanxi, is the world's oldest wooden structure. The Great Buddha Hall, which is 11.75 meters long and 9.9 meters wide in plan, was constructed in 782 (see Figure 3). During the past 1,200 years, it has endured eight 5.0-plus-intensity earthquakes without sustaining damage (Zhuang & Tang 2009).

The Hall of Supreme Harmony inside the Forbidden City (Palace Museum) of Beijing was first completed in 1420, and then reconstructed after suffering several fires (see Figure 4). The current structure was constructed in 1695. It is 26.9 meters high, 64 meters long, and 37 meters wide. After reconstruction, it survived seven strong earthquakes with a seismic intensity of 6.0 or higher, and whose epicenter was less than 90 kilometers away. During an 8.0-magnitude quake in 1679, no damage occurred, even though the epicenter was only 45 kilometers away (Zhou et al. 2013).

The Yingxian Wooden Tower has been certified as resistant to a 7.0-magnitude quake, and the Nanchan Temple and The Hall of Supreme Harmony are rated to withstand an 8.0-magnitude event. All these timber structures are still standing after suffering several strong earthquakes in the past hundreds of years, and have clearly proven the excellent seismic performance of timber structures, largely on account of the mortise-and-tenon connections used in all three structures. The deformation and frictional sliding between tenons and mortises, combined with the light weight, good ductility, and strong energy dissipation capacity of the system, allowed the buildings to balance, absorb and ultimately dissipate the seismic energy they experienced, and preserved their integrity (Gao, Zhao & Xue 2008; Zhuang & Tang 2009; Zhou et al. 2013).

Recent Applications and Existing Drawbacks of Prefabricated Construction

Prefabication in construction is a priority of the Chinese government. Li Keqiang, Prime Minister of China, recently called for an increase in prefabricated construction during the State Council Executive Meeting in September 2016. However, most of the completed prefabricated buildings to date are reinforced concrete (RC) structures. There are still very few steel structures, and these are mainly limited to single-story industrial plants and low-rise residential buildings. But there exists a great potential for developing prefabricated steel structures for use in more ambitious buildings.

Prefabricated steel members are generally connected by high-tension bolts or welds, while prefabricated RC members are connected on-site by concrete pouring or cement grouting. On-site assembly of either system is very time-consuming and labor-intensive. These challenges not only affect construction quality, but also increase construction costs, and increase the amount of crane time and the potential for accidents.
2017: Skyscraper History’s Tallest, Highest-Volume, and Most Geographically Diverse Year

Abstract

This 2017 Tall Building Year in Review / Tall Buildings in Numbers data analysis report shows that more buildings of 200 meters’ height or greater were completed in 2017 than in any other year, with a total of 144 completions. Notably, 2017 was also the most geographically diverse year in terms of the number of cities and countries that completed 200-meter-plus buildings, with 69 cities across 23 countries represented in the data, up from 54 cities across 18 countries in 2016. The report covers other statistical highlights of 2017 and predicts completions for 2018.

Note: Please refer to Tall Buildings in Numbers – The Global Tall Building Picture: Impact of 2017 in conjunction with this paper, pages 52–53

Keywords: 2017, Completions, Height, Statistics, Skyscrapers, Urbanization

More buildings of 200 meters’ height or greater were completed in 2017 than in any other year, with a total of 144 completions, marking the fourth consecutive record-breaking year (see Figure 2). This is an increase of 95% from 2013, when only 74 buildings of 200 meters or more were completed. The total number of 200-meter buildings in the world is now 1,319, an increase of 12.3% from 2016, and a 402% increase from 2000, when only 263 existed. The total sum of heights – that is, if the heights of all completions in 2017 were added together – was 35,145 meters, making 2017 the “tallest year ever.”

Notably, 2017 was also the most geographically diverse year in terms of the number of cities and countries that completed 200-meter-plus buildings, with 69 cities across 23 countries represented in the data, up from 54 cities across 18 countries in 2016. High-rise construction is no longer confined to a select few financial and business centers, but rather is becoming the accepted global model for densification, as more than one million people on our planet urbanize each week. Thirteen cities saw their first 200-meter-plus high-rise completion in 2017, in addition to the 28 cities and eight countries that saw their tallest building completed this year.

Once again, for the 10th time in a row, China completed the greatest number of 200-meter-plus buildings in 2017 (see Figure 3), with 76 completions for 53% of the total. Although this is a slight decrease from 2016, when China completed 83 such buildings,
or 65% of the global total, China is still by far the world leader in skyscraper construction. In fact, the city with the most 200-meter-plus building completions, Shenzhen, China, finished 12 buildings, or 8.3% of the year’s global total, and more than any other country on the list, except China (see Figures 3 and 4). This is the second year that Shenzhen was the city with the most 200-meter-plus completions in the world. It’s the third year in a row in which the tallest building to complete in that year is in China. That building, Ping An Finance Center, also happens to be in Shenzhen (see Figure 1). The United States completed the second-greatest number of 200-meter-plus buildings of any country, with 10 buildings finished in 2017.

Key Worldwide Market Snapshots of 2017

Asia (Not including Middle East)

While 2017 may have been the most geographically diverse year for 200-meter-plus building completions, Asia retained its status as the world’s skyscraper epicenter, completing 109 buildings of at least 200 meters in height, representing 76% of the total. This marks a small decline from the 83% share it held in 2016, and is in line with China’s slight decline in total completion share (see Figure 6 and 11). The top two cities, Shenzhen and Nanning, are in China, with Jakarta, Indonesia and Chengdu, China, tied for third place with five completions each (see Figure 4). Surprisingly, Pyongyang, North Korea, tied for sixth place with four buildings of 200 meters or greater completed in 2017, after having completed no buildings over 200 meters in 2016.

Seoul, South Korea completed three 200-meter-plus buildings, including Lotte World Tower, a 555-meter mixed-use building – the city’s first “supertall”, or...
The Global Tall Building Picture: Impact of 2017

In 2017, 144 buildings of 200 meters’ height or greater were completed. This is the fourth record-breaking year in a row, and it brings the total number of 200-meter-plus buildings in the world to 1,319, marking an increase of 12.3% from 2016, and a 402% increase from 2000, when only 263 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 2017 completions, see CTBUH Year in Review: Tall Trends of 2017, pages 44–51.

World’s Tallest Building Completed Each Year
Starting with the year 2002, these are the tallest buildings that have been completed globally each year.
World’s Tallest 100: Analysis

As the graphs below show, Asia and the Middle East continue to ascend, while the mixed-use plurality deepens, along with the rise of composite structures.

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

A total of 14 buildings made it into the global 100 Tallest list in 2017, an upward swing from last year, when only nine buildings entered the list.

69 cities completed a building of 200 meters’ height or greater. The average height (in meters) of the World’s 100 Tallest Buildings is 372 meters.

2017 saw Huachuang International Plaza Tower 1, Changsha, as the only “supertall” (300 m+) building never to enter the World’s 100 Tallest Buildings list.
Talking Tall: Dr. Cheong Koon Hean

Nation-Building, Singapore-Style: Better Living Through Density

Dr. Cheong Koon Hean was the first woman to receive the Lynn S. Beedle Lifetime Achievement Award from CTBUH, in 2016. As the CTBUH Awards program expands into the Tall + Urban Innovation Conference in 2018 and a new CTBUH Technical Guide on urban spaces is released, featuring Marina Bay and many other successful urban developments, editor Daniel Safarik caught up with Dr. Cheong to look back upon the trails she blazed and the future she envisions.

What does it mean to you to have won the Lynn S. Beedle Lifetime Achievement Award from CTBUH?
I am thankful that CTBUH recognizes the work of government planners and their contributions in shaping urban habitats and creating quality lives for the people they serve. But urban planning is never a “one-man show.” The award is also a wonderful recognition of the good work of my colleagues in the Urban Redevelopment Authority (URA) and the Housing & Development Board (HDB) who have worked tirelessly, so that together, we can shape the Singapore cityscape and create endearing homes. The award also affirms the value of our contributions and spurs us on to bring about a positive change in our urban environment and to improve the lives of all Singaporeans. It’s a great honor to be among luminaries such as Cesar Pelli, Lord Norman Foster, and the late Minoru Mori, who have made such a positive impact on their own cities through their work.

Of what project or achievement are you most proud?
The development of Marina Bay, a collective effort involving many colleagues, remains one of the most fulfilling projects I have worked on (see Figure 1). Even today, I feel very proud and happy when I am there, and I continue to think of how we can improve it further, since it’s a continuous “work in progress.”

I have also found the formulation of our long-term concept plan extremely satisfying. We undertake reviews of our concept plan every five to 10 years, and while such long-term planning is less visible to the public, it is a crucial part of our work. Having worked on three rounds of concept plan reviews, I believe such far-sighted planning has enabled us to achieve a highly livable environment, in spite of our land constraints in Singapore.

I have also enjoyed working on some of the recent new HDB Master Plans for public housing – particularly those in our new towns and estates, where we are introducing fresh design ideas that capitalize on each town’s surrounding environs and unique heritage. We’re even incorporating smart planning and smart technology to create a more sustainable, livable, and safe environment for residents (see Figure 2). I am excited that we are progressively implementing them, and look forward to creating the unique environments envisioned in these plans.

How is it that Singapore has a model of tall social housing that is unlike any in the world?
Singapore is unique because it is a city-state – it is both a country and a city. An island of only 720 square kilometers, it is about half the size of metropolitan London. Unlike other cities, Singapore not only has to provide the usual housing, commercial, industrial, social, and recreation facilities for its population; it

“[Singapore’s high quality of life] is possible only with good governance and clean government, the building up of capable institutions, and the harnessing of public-private partnerships and technology to ensure that our plans do get implemented.”
also has to cater to the needs of a country— including ports, airports, spaces for military uses, and water sufficiency.

Nonetheless, by carrying out long-term and comprehensive planning, we have managed to cater to all our needs, including safeguarding a primary forest rich in biodiversity right in the heart of the island, which doubles up as our water catchment area.

Given our land constraints, Singapore has no choice but to adopt a high-density development model in order to optimize our land to fit in all our needs. Yet, despite our land and resource constraints, Singapore has been ranked as one of the most livable cities in Asia. We try to create “livable density.”

How do you define “livable density”? It is about achieving a good-quality living environment despite the high density. Livable density can bring about opportunities, variety and convenience. With high density, we can offer closer proximity and easier access to a wider range of amenities (shops, schools, entertainment, leisure facilities, health facilities, etc.); more convenient and affordable public transport rail networks, which reduce traffic congestion; and more optimal and reliable infrastructure and utilities. Livable density also means that, even as we build new typologies of high-density housing, we are able to set aside sufficient parks and recreation facilities to make it a pleasant and green environment.

We take a lot of care to design and develop our buildings well. For example, within HDB, we study different types of housing typologies, so as to create good living and community spaces that are well ventilated, with a sense of space that suits our residents’ lifestyles, and which would encourage community bonding. In Singapore, we are the leader in precast concrete technology, which enables us to build productively and cost-effectively, while ensuring good quality finishes for our housing. We deploy various sustainability initiatives such as greenery, rainwater harvesting and the use of solar photovoltaics to generate energy.

Some say the special conditions of Singapore would be hard to reproduce elsewhere. But you have taken your work overseas to China, where you helped formulate the Sino-Singapore Tianjin Eco-city Master Plan, for instance. Do you think the Singapore model is exportable?

Every city has its unique challenges and must find solutions which suit their own context. However, there are useful good practices that may be applicable for most cities, and we all learn from each other.

For Singapore, we found that several success factors have helped us to transform into one of the most livable cities in the world today. Firstly, cities need to adopt long-term and visionary planning. This helps cities to plan ahead and resolve internal trade-offs; and to prioritize investments into much needed infrastructure to support urban growth.

There really has to be a focus on livability and sustainability. We are clear that we want to build a sustainable and livable environment and have put in concrete plans over many years to realize our vision. I think there is also a strong commitment on providing affordable housing through good policy design. For example, in Singapore buyers can use their Central Provident Fund (CPF), a compulsory retirement savings scheme, to help them to buy housing.

It’s important to develop innovative planning solutions and harness technology to support growth. For example, despite our small size, we have used technology to ensure that we will be “water sufficient” in times to come. We create the “illusion of space” in the way we juxtapose our buildings with green and blue elements. And all of this is possible only with good governance and clean government, the building up of capable institutions, and the harnessing of public-private partnerships and technology to ensure that our plans do get implemented.

And it is exportable, with determination and adaptation. Even with Tianjin Eco-city, one key challenge we faced was how to adapt our policies and practices such that they could be applied in China. This was where we worked very closely with our Tianjin counterparts to adapt our recommendations to suit the local social, cultural, environmental and economic conditions, legislation, and governmental structure.

What role do you expect the Internet of Things, smart buildings, and other technologies to play in the near future of tall residential developments?

In the next two decades, the pace of change will likely accelerate, given the rapid advances in technology. To ride the wave of technological change, Singapore too has...
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.”