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Special Issue: Women in the Tall Building Industry

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“Basically, women in the tall building industry need to be twice as enterprising as men to achieve the same effect. Megaprojects are usually associated with huge budgets, so [in places like Russia], the men involved are usually trying to guess whether the women involved have a celebrity husband or father.”

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Americas

Mexico has witnessed a surge in tall building activity through the first half of 2017. The majority of development has taken place in **Mexico City,** where the skyline is crystallizing around the tall buildings rising along Paseo de la Reforma. Most recently, architects Richard Meier & Partners announced that **Torres Cuarzo** are over 80% complete and expected to be finished before the end of the year. The project features two towers rising from a unified base, with the taller tower functioning as an office building and the other as a hotel.

In **Cancún,** Zaha Hadid Architects revealed initial designs for a six-tower residential complex known as **Alai.** The development seeks to prioritize the surrounding ecology (including a woodland nature reserve, wetlands, and a lagoon) by setting aside just 7% of the property for the total built footprint of the towers. Additionally, all structures will share an elevated platform that will allow vegetation and wildlife to thrive below.

Just across the Gulf of Mexico from Cancún, a number of high-profile developments in **Miami** are recently completed or entering their final stages. **Biscayne Beach,** a luxury condominium building, has finished construction, with unit closings underway and

Alai, Cancun. © Pulso Inmobiliario

Torres Cuarzo, Mexico City. © Courtesy of Richard Meier & Partners Architects

occupant move-in imminent. The 391-unit building has sold 99% of units, save two penthouses.

Another luxury condominium, **Aria on the Bay,** designed by Arquitectonica, recently topped out and is expected to complete in 2018. Upon news of the milestone, the developer announced that 80% of the units in the 163-meter building were already sold. The high rate of sales is attributed to low deposit requirements. This incentive is available because all loans on the building have been paid off.

Most notably, **Panorama Tower** has also topped out. The 252-meter high-rise is poised to become the tallest building in the city upon final completion, surpassing the Four Seasons Hotel & Tower, completed in 2003, by 12 meters. Although leasing had not begun on the mixed-use building at the time of its topping-out, it is expected to open before the end of the year.

The appearance of a 250-plus-meter building on the Miami skyline is a notable accomplishment, but pales in comparison to **New York,** where two new supertall towers are making their way through the city's crowded development pipeline. A construction start is imminent for the 340-meter **45 Broad Street** in the Financial District, featuring 205 condominiums, following a groundbreaking ceremony held by the development team.

Meanwhile, demolition permits were filed at the site of a proposed supertall tower at **80 South Street.** Like 45 Broad Street, plans for a tower at this site have gone through a number of iterations. The site's current owner took possession in March 2016, having secured 76,000 square meters in air rights for the parcel.

Construction is also ongoing at **425 Park Avenue,** where Foster+Partners has designed a renovation of a 118-meter 1950s-era office tower. By renovating the outdated building rather than demolishing it, the new tower can reach greater heights, due to quirks in the city's building code. It is expected to be 258 meters tall upon completion.

Asia & Oceania

Topping headlines worldwide was the completion of **Lotte World Tower** by Kohn

Aria on the Bay, Miami. © Schwartz Media Strategies

Pedersen Fox Associates (KPF) in **Seoul,** South Korea, after nearly six years of construction. The sleek, tapered form of the tower (and its extreme height relative to its surroundings) allows it to stand out from Seoul's mountainous topography. At 555 meters, the supertall was certified by CTBUH as the fifth-tallest building worldwide.

Not to be outdone, **Ping An Finance Center,** also by KPF, was finished in **Shenzhen,** taking the fourth spot on CTBUH's list, with a height of 599 meters. The tower rises from a prominent location in the heart of the city's Futian District, with transit connections at its base connecting it to the city and larger Pearl River Delta region.

Elsewhere in China, construction is finishing on **Chaoyang Park Plaza,** a two-tower commercial and residential complex rising from the southern edge of the eponymous park in **Beijing.** The 12-hectare project takes the shape of mountain rock formations, inspired by scenes in traditional Chinese *shan shui* paintings. The 120- and 108-meter towers are connected by a 17-meter-high glass atrium and transition space.

In **Melbourne,** Australia, construction has completed on Elenberg Fraser's **EQ Tower,** delivering 633 apartments to the city's

Lotte World Tower, Seoul. © Cyberdoomslayer (cc-by-sa)

Panorama Tower, Miami recently topped out. © Phillip Pessar (cc-by-sa)

central business district. The 63-story tower includes a number of high-end amenities as well as energy-efficient features, such as photovoltaic solar panels and a rainwater harvesting system. Construction of the tower was accomplished using innovative façade installation techniques to improve site safety.

Just a block away, a developer is planning what it says will be the world's tallest student

Ping An Finance Center, Shenzhen. © Ping An Finance Center

45 Broad Street, New York. © CetraRuddy Architecture

accommodation building at **97 Franklin Street.** Although few details have been revealed about the project, it is expected to comprise 740 student beds and 146 city-living units across 60 stories, with a US$222 million price tag.

Perhaps even more outsized is the planned supertall tower in **Gold Coast** known as Imperial Square Stage 3. The 108-story

Chaoyang Park Plaza, Beijing. Source: Baidu

Ten Significant Tall Buildings, and the Significant Women Behind Them

Abstract

Recently, there has been a growing and overdue recognition in the architecture discipline that women are under-represented, not just in terms of leadership positions held, but also in terms of receiving credit for the work they have done. The tall building industry includes many disciplines, from contracting to construction and engineering, each of which has a similar but subtly different track record and perspective on the subject. This variation on the Case Study model highlights 10 tall buildings and the work of women in leadership roles – recognized at the time or not – who brought these great works to life.

Keywords: Gender Equity, Architecture, Engineering, Construction, Urban Planning

Introduction

The following round-up of projects and associated people is by no means definitive or the "last word" on the subject. It is meant to be the beginning of an ongoing dialogue within and beyond the industry. We hope that it proves to be both inspirational and informative.

Lever House, New York (1952)

The Lever House, built as the headquarters of the British soap company Lever Brothers, is considered one of the seminal tall buildings in the International/Modernist style. It was one of the first buildings to break the "wedding cake" mold of previous New York skyscrapers, which had been so shaped to conform to the city's 1916 zoning laws, intended to prevent tall buildings from depriving streets of light. The Lever House avoided this shape by occupying less than 25% of its lot, allowing it to be built as a vertical slab. The building's blue-green, heat-resistant glass curtain wall – only the second to be installed after the United Nations Secretariat Building – was considered revolutionary at the time, and its elegant plaza and ground-floor spaces are still celebrated. It was declared a New York City landmark in 1982.

Natalie de Blois, *Design Coordinator, Skidmore Owings and Merrill (SOM), New York*

Natalie de Blois played a significant role in the design of Lever House, as well as several other Modernist buildings by SOM, including the Union Carbide (now JP Morgan Chase Tower) in New York and the Equitable Building in Chicago. But her role at the time was rarely mentioned, with credit having gone to Gordon Bunshaft and other men. "Natalie and Gordon Bunshaft were a team," said Beverly Willis, founder of the Beverly Willis Architecture Foundation. "He took all the credit and she did all the work" (Dunlap 2013). Her work was later recognized by Nathaniel A. Owings, one of the three original partners, in his autobiography, *The Spaces in Between: An Architect's Journey* (1973). "Her mind and hands worked marvels in design – and only she and God would ever know just how many great solutions, with the imprimatur of one of the male heroes of SOM, owed much more to her than was attributed by either SOM or the client," Owings wrote.

Lever House, New York. © David Shankbone (cc-by-sa)

Seagram Building, New York. © Antony Wood

The Seagram Building, New York (1958)

Considered to be the high point of the International Style in tall buildings, the Seagram further refined the innovations of the Lever House, with its signature bronzed-steel mullions extending the length of the building, as a way of expressing the structure inside. It was the first tall building to use high-strength bolted connections, to combine a braced frame with a moment frame, and to use a composite steel and concrete lateral frame. Its uniformity was popular with office renters and developers, which allowed them to maximize usable floor space. It was the inspiration of countless similar, if lesser buildings the world over (Lambert 2013).

Phyllis Lambert, *Owner's Representative Seagram Corp., New York*

Phyllis Lambert, the daughter of the Seagram beverage company owner Samuel Bronfman, played an integral role in selecting Ludwig Mies van der Rohe and Phillip Johnson to design the Seagram Building. Bronfman had originally planned to hire Emery Roth & Sons as the architect, but Lambert intervened – at the age of 27 – having learned about van der Rohe at Illinois Institute of Technology, where she had been a student and van der Rohe was head of the architecture school. Her career of advocacy for better urban design continued when she mounted numerous protests against ill-advised construction projects in her hometown of Montréal, Canada. She later founded the Centre Canadien d'Architecture (Canadian Center for Architecture), which holds one of the world's most significant collections of architectural drawings.

Frontiers in High-Rise Outrigger Design

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Abstract

In 2012, CTBUH published the first ***Outrigger Design for High-Rise Buildings Technical Guide.*** *In 2016, the CTBUH Outrigger Working Group felt it would be beneficial to update the design guide with variations of outrigger systems and tall building projects that have been newly proposed or successfully implemented since that time. The Working Group reached out to colleagues to collect information on recently developed outrigger systems and real project examples that demonstrate their viability and value. The second edition of the guide, published recently in 2017, includes innovative approaches to address previously recognized design concerns and limitations. It also includes more project examples with new approaches to optimize building performance through dampers incorporated within outrigger systems. This paper summarizes the major updates of the second edition and highlights several projects of significance to the contemporary discussion of outrigger technology.*

Keywords: Outriggers, Structural Engineering, Wind, Seismic

Design Considerations for Outriggers Supporting Complex Forms

"Stiffness Effects from Overall Systems" is a newly added section of the Technical Guide, which discusses outrigger interactions with complex architectural forms such as twisted, tilted, and tapered shapes, now common trends in contemporary tall building design. For practicality, such designs utilize a vertical core located within the building envelope for most of the height, with outriggers used where the core alone provides insufficient lateral strength or stiffness. A key point here is that the stiffness contribution of the outrigger system will be affected by overall building geometry. Unlike a straight tower with a central core and symmetrical outriggers to perimeter columns at each side, in a tilted structure, outriggers can be asymmetrical and have varying lengths. A second point is that tilted structures have inherent lateral displacements due to the destabilization effect of gravity loads alone, which should be expected. Surprisingly, a study shows that lateral displacements of tilted structures under wind loads can be less than those of an equivalent straight tower, if a beneficial stiffening effect of triangulation occurs between outrigger levels (see Figures 1 and 2).

The effect of building taper is also discussed. For a building that tapers narrower with height, compared to a straight building of the same total floor area, there are smaller wind and seismic loads imposing on the building structure below thanks to reduced upper-floor footprints and wind tributary "sail" areas, a relatively wider base, and reduced outrigger arm lengths at the building top. The benefits are more pronounced for taller towers.

Hybrid Outrigger Systems

Another new chapter discusses innovative hybrid outrigger systems. While traditional outrigger systems sustain maximum forces when the building is experiencing maximum lateral displacements, hybrid outrigger systems can exhibit different relationships. Several examples of hybrid outrigger systems are presented.

Damped outriggers

The most significant of these, damped outrigger systems use the leverage of stiff

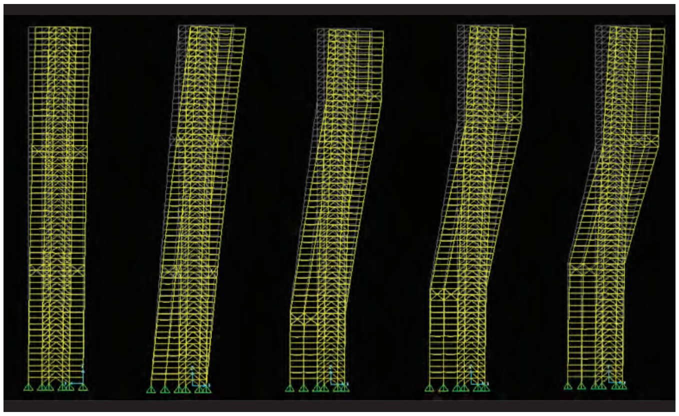

Figure 1. Tilted 60-story study structures with outriggers and tilt angles of 0, 4, 7, 9, and 13 degrees showing exaggerated gravity deformations. Source: Moon 2016

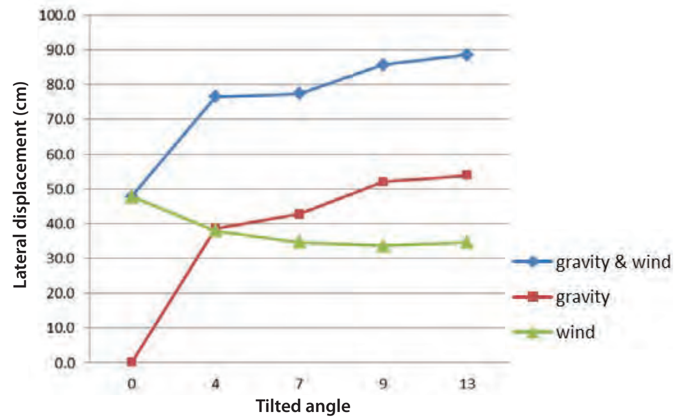

Figure 2. Lateral displacements of 60-story tilted outrigger structures with tilt angles of 0, 4, 7, 9, and 13 degrees . Source: Moon 2016

outrigger arms projecting from a building core to efficiently drive nonlinear damping devices. The resulting supplementary damping can significantly reduce tall building accelerations, deformations, and forces from vortex-induced oscillations (VIO) in wind, or reduce building deformations and structural demands in earthquakes. Supplementary damping can take the form of viscous dampers, viscoelastic dampers, tuned mass dampers (TMDs), tuned liquid column dampers (TLCDs), or sloshing dampers. But mechanically damped outriggers can provide supplementary damping contributions comparable to a TMD or TLCD without the attendant space, weight, or tuning requirements.

Viscous dampers work at all frequencies, generate greater resistance as the driving velocity increases, and convert motion to heat based on the resistance times travel distance. Viscous dampers are most efficient, compact, and cost-effective when driven through larger travel distances at higher velocities, making the large relative movements between outrigger tips and perimeter columns an efficient location for placing relatively compact dampers between them. To protect the structure from excessive forces, modern viscous dampers can be designed for a nonlinear response to driving velocities using either of two different strategies: nonlinear resistance and pressure relief.

Mechanisms for increased damping with outrigger systems

Relative vertical movements between ends of stiff, disconnected outriggers and perimeter columns in tall structures can be leveraged to yield supplemental damping by introducing vertically mounted dampers between the outrigger ends and the perimeter column (Smith and Willford 2007). These movements are proportional to the lateral drift of the structure and can typically be of relatively small magnitude, particularly in wind events. Mechanisms can be utilized to amplify these relatively small vertical movements to potentially increase supplementary damping. A concept for one such mechanism – where the damper movement and velocity are amplified, thus increasing the supplemental damping in the structure – was described by Mathias et al. (2016).

A damped outrigger system disengages the outrigger elements (reinforced concrete walls or steel trusses cantilevered from the core) from the floor framing at their top and bottom edges and from the perimeter columns. This makes it possible to generate relative vertical movements between the outrigger ends and the adjacent perimeter columns when a structure is subjected to seismic and wind loads; the drift displacements/velocities can be captured to generate supplementary damping. To increase the efficacy of a damped outrigger system and create large velocities that would generate increased damping, the use of a mechanism has been proposed (see Figure 3). The geometric

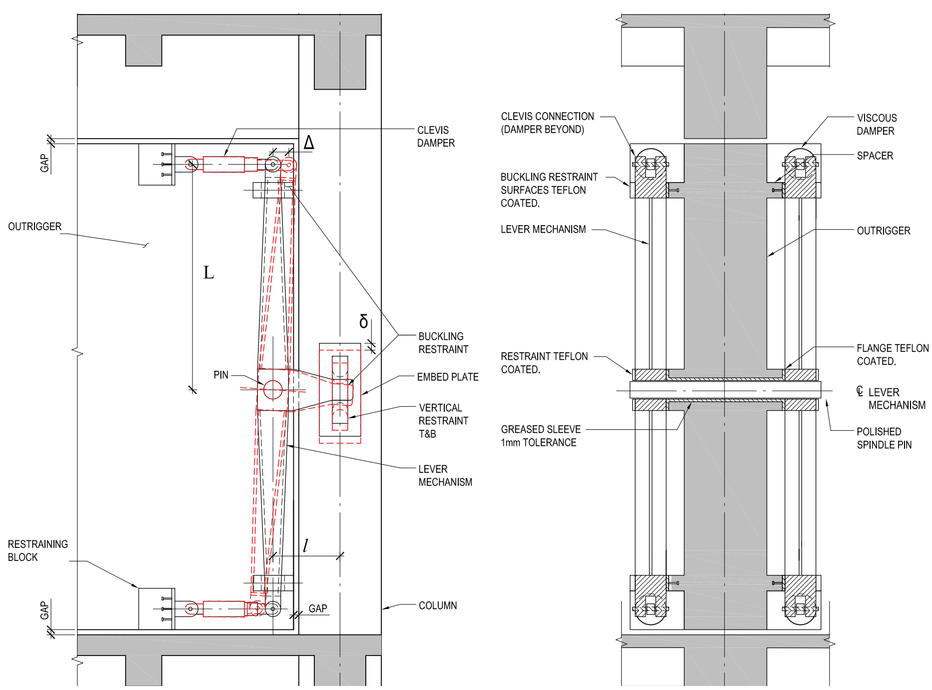

Figure 3. Schematic components of an amplification mechanism (displaced configuration of the system shown in red dotted lines). © SOM

A Tale of Two Singapore Sky Gardens

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Abstract

This paper examines the effectiveness of the design strategies used in two HDB developments for encouraging active usage and social interaction. The study was conducted through systematic user surveys and site observations, the findings of which were then corroborated with the literature review. The study was successful in making the following conclusions: diversity in scales and design characteristics creates more opportunities for residents to use sky gardens; provision of varied programs in the sky gardens can contribute to their utilization, offsetting the deterrence posed by inaccessibility; direct visual connection between the residential units and the sky gardens should be avoided, due to concerns about privacy; and the usability of the sky gardens can be maximized by complementing the programs with improved accessibility, scale, and environmental protection.

Keywords: Sky Garden, Social Interaction, Density

Introduction

With a population density of 7,797 people per square kilometer, Singapore is one of the world's densest countries (Singstat 2016). Due to Singapore's high population density and limited land area, expanding vertically was considered as the most viable option. This model has been developed by the Singapore Public Authority, which resulted in the Housing Development Board (HDB) blocks that currently house about 85% of the residential population. The height of HDB blocks averaged 10 to 12 stories in the 1960s and increased to 30 stories in the 1990s (Yuen 2009). Developments since 2000, such as Pinnacle@Duxton and Skyville@Dawson, have risen more than 40 stories, and future developments are likely to rise even higher (see Figures 1 and 2).

Despite the generally positive perceptions that Singaporeans have of high-rise public housing, it is important to note that high-rise living carries the disadvantages of inconvenience and negative effects on the health and well-being of residents (Williams 1991; Gifford 2007; Evans et al. 1989). Negative effects include fear, dissatisfaction, stress, behavior problems, suicide, poor social relations, reduced helpfulness and sociability, and hindered child development. However, studies have shown that there is marked improvement in performance and behavior of residents with increases in the apparent "natural-ness" of views in high-rise living (Taylor, Kuo & Sulivan 2002). It was also found that the negative effects of high-rise living could be alleviated by providing access to green spaces within these vertical environments, a strategy that has been widely adopted in highly urbanized Singapore.

> "A survey of a typical HDB New Town, Choa Chu Kang, revealed that only 10–20% of the surveyed respondents visited the rooftop gardens regularly. Issues with accessibility, programming, and the lack of thermal comfort were identified as the key reasons for poor usage."

Literature Review

Sky gardens and sky decks are contemporary interpretations of Le Corbusier's concept of "streets in the sky," communal spaces found above ground level. Bridging high-rise towers at intermittent levels creates neighborhoods in the sky that tie programs together, integrate green spaces within structures, and enhance secure egress and mobility, while creating new vantage points from which to view the city. Such spaces often serve as

Figure 1. Skyville@Dawson, Singapore. © WOHA

Figure 2. Pinnacle@Duxton, Singapore. © ARC Studios

platforms where residents are able to bridge the divide between the otherwise vertically segregated levels in a high-rise tower. The insertion of sky parks into residential towers brings recreational activities closer to the high-rise residential units, accommodating residents who would otherwise be deprived of convenient access to recreational spaces (Pomeroy 2012). Greenery becomes an integral part of these sky parks, providing restorative effects on users' health, attitude, and perceived stress levels (Clay 2001; Nielsen & Hansen 2007).

Sky gardens in Singapore originally evolved from the greening of car-park roofs in HDB New Towns. Whilst they contributed to visual delight, they were not successful public or social spaces, due to the dominance of open-ground floor area (void decks). A survey of roof gardens in a typical HDB New Town, Choa Chu Kang, revealed that only 10–20% of the surveyed respondents visited the rooftop gardens regularly (Yuen & Wong 2005). Issues with accessibility, programming, and lack of thermal comfort were identified as the key rreasons for poor usage (see Table 1). The underutilization of such spaces leads to the creation of further redundant spaces that add stress to the issues of land scarcity and housing quality in the context of increasing densities. This supports the need to improve sky garden designs, so that the issue of underutilization can be ameliorated.

In recent years, there has been a shift from repurposing HDB New Town carpark roofs into gardens to more purpose-built sky gardens that play an integral role in the development. Implementation of the Landscaping for Urban Spaces and High-Rises (LUSH) program and the Green Plot Ratio (GPR) standard have increased the appropriate proportion of green- to built-up areas, such that their aforementioned benefits are enjoyed by the inhabitants (URA 2014; Ong 2003). Some studies relate the success of such spaces to dedicated functions and unrestricted access to the public (Hadi, Heath & Oldfield 2014).

The literature review evidences that existing studies of high-rise sky gardens primarily focus on assessing their design, environmental, behavioral, and social components individually. This paper, however, investigates the effectiveness of sky gardens implemented in two specific HDB developments, the Pinnacle@Duxton and the Skyville@Dawson, through an analytical framework focusing on their accessibility, program, and design characteristics holistically.

Methodology

The methodology involves triangulation of data obtained from the literature review,

Program	Ability to cater to different age groups
	Contribution to enriching residents' daily routines
	Ability to enable social interaction
	Ability to spur spontaneous activities
Accessibility	Activation of the space
	Presence of visual connectivity
	Physical connectivity to main circulation routes
	Management of public or private access
	Availability of amenities that allow for greater convenience
	Orientation of building
Design Characteristics	Presence of shelter from sun and rain
	Presence of breeze and natural ventilation
	Appropriate scale/size of space
	Presence of greenery
	Placement of sky garden – exclusivity
	Presence of vantage point for views

Table 1. Assessment framework for identifying desired characteristics of communal sky gardens in residential high-rises.

Micro-MACRO Living in the Global High-Rise


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Abstract

What housing models should dense urban cities pursue to address population rise, housing shortages, and changes in demographics? As cities seek to address large discrepancies between their housing stock and their population, many developments opt for buildings with large footprints and massing bulk. While these multi-family housing developments offer large quantities of units, they diminish the street environment with their monumental bases – often occupied by a single use or a few large uses. This paper explores the viability of "micro-macro" living, in which one's private residential unit decreases in size, in favor of increased social interaction, sense of community, and density and diversity of neighborhood amenities. "Small" or "micro" need not connote a living experience that is diminished or isolated. By understanding the challenges and opportunities in the design and construction of micro-unit apartments, cities can address growth and density without undermining diversity and social interaction.

Keywords: Micro-Units, Affordable Housing, Density

Introduction

The challenge of micro-units lies not only in their small dimensions, but also in the larger opportunities to address how the needs of urban dwellers have changed. From demographics to modes of living and working in cities, these changes bear witness to a confluence of contributing factors. In cities globally, people are living greener, healthier lifestyles, and are therefore living longer. They are also marrying later, partly due to the fact that women are studying and working more, as well as divorcing more. The result is evidenced by a global rise in solo living by 30% in the last decade. In Manhattan, nearly half of the population lives alone and the nuclear family (traditionally characterized by two parents and children) has decreased to below 20% (Perine & Watson 2011) (see Figure 1). The paradox in the United States lies in the fact that, despite the shrinking family unit, the size of the average house has nearly tripled between 1950 and 2016 (Perry 2016). This is partly born out of turn-of-the-century housing reforms, when the journalist Jacob Riis exposed the horrific living conditions of New York City's immigrant population. His photographs of overcrowded tenement housing without proper ventilation and daylight brought about the city's current housing regulations, which set the new standard for life safety and apartment sizes (37 square meters with a 2.4-meter ceiling height minimum). Yet, the large apartments for nuclear families that the regulations encouraged no longer fit with the city's demographics. There are 1.8 million small households, with only one million suitable apartments to house them in New York City. As demand outpaces supply, the rental cost per unit of area in studio apartments outstrips that of larger apartments, contributing to informal and illegal sublets and subdivisions. How should the city respond if people cannot find appropriate housing due to cost or lack of availability?

> "Even with the extra dimensions allowed for modular construction, the Carmel Place project relied on a construction tolerance of 38 millimeters in certain areas, in order to retain a financially viable unit count."

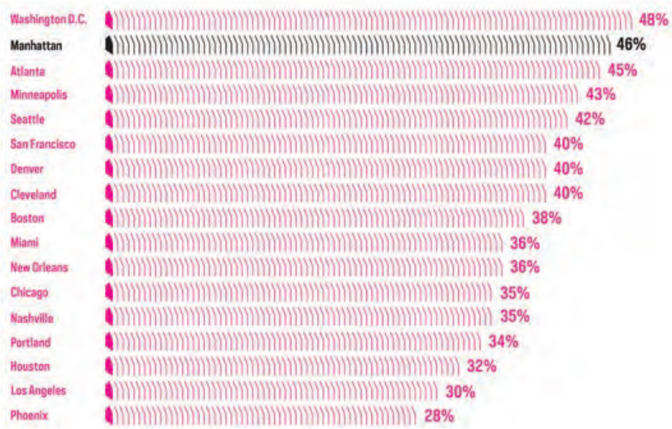

Figure 1. Percentage of single households in the United States.

Figure 2. Carmel Place, New York.

Running parallel to demographic change, one finds transformations in the relationship between work and workers. Thanks to technology, work has lost its temporal and physical boundaries. Work has stretched across longer hours, intermittently invading traditionally "off" hours and creeping into informal, casual settings outside of the workplace. On the other hand, the notion of "home" and its domestic armature have found physical expression in the work and public spheres. Amenities for living, recreation, and social interaction have been atomized and dispersed beyond the rigid delineation of "home." The very concept of micro-living is thus tied to macro-pressures of population change and its corresponding housing supply challenges, as well as changes in how and when we work. What are the numerous constraints that the planning, design, and construction of micro-units must synthesize, to make them a livable, humane, and essential typology within a city's diverse housing stock?

Figure 3. Street view of completed Carmel Place project. © Iwan Baan

Micro-Constraints: Planning and Design

In response to research highlighting the mismatch of New York City's housing stock relative to its current population, the mayor's office, the Department of Housing Preservation and Development, and the City Planning Commission launched a public competition in 2012. Entitled ***adAPT NYC,*** the competition posed the question – should the city reduce the current 37 square-meter minimum for new apartments? Carmel Place, the winning proposal, was conceived as a pilot project to test exactly how small a livable, humane apartment could be (see Figure 2). Although the project received a mayoral override for the minimum apartment size under the Quality Housing Program, it still complied with all other building department rules regulating residential unit interiors. These include the Americans With Disabilities Act (ADA) – accessible kitchens and bathrooms, minimum habitable room dimensions (14 square meters, with 2.4-meter ceilings), and requirements for light, air, and separation of the kitchen from the living area.

In terms of zoning, Carmel Place received an override for residential density (the number of apartments in a building as a ratio of overall area). It is the first and only building in the city consisting of 100% micro-units or studios (see Figure 3). Other overrides acknowledge the challenges of modular construction. Structurally integrated modules that do not rely on a primary structural core produce double floor/ceiling and wall assemblies when stacked. The redundancy results from structural self-stacking requirements, connection details on site, and shipping constraints of individual modules, which are required to protect the module structurally and from the elements during staging and setting (see Figure 4). To encourage modular construction in the city, the project was

Figure 4. Modular assembly underway at Carmel Place.

Improving Energy Performance In Gulf-Region Residential High-Rises

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Abstract

Energy consumption in Gulf Cooperation Council (GCC) countries has been rising over the last four decades. The residential building sector alone accounts for more than 50% of all delivered energy consumption, and half of this is attributed to the use of air conditioning for cooling. Better building design, triggered by stricter building regulations, could drive down this energy use considerably. In this work, the authors have reviewed, evaluated, and compared the current building-energy regulations in the Gulf Region, as applied to residential tall buildings. The goal was to understand and discuss the major challenges, opportunities, and novel approaches being developed and deployed.

Keywords: BuildingCode, Energy Efficiency, Façade

Introduction

While holding approximately 30% of the world's proven oil reserves and 22% of the world's proven gas reserves (BP 2016), the energy demand in the six countries of the Gulf Cooperation Council (GCC), consisting of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE), has been increasing sharply in the last decades. This is driven by a rapidly growing population and the huge diversification plans, massive industrialization, and construction projects that aim to pull the economy away from oil dependency. Perhaps ironically, this has resulted in more energy-intensive developments, which in turn require more fossil-fuel consumption. As a result, the GCC countries are among the top 25 countries for CO_2 emissions per capita, according to the United Nations Statistic Division (2007) and the Climate Analysis Indicators Tool (CAIT), which stresses the need for ecological modernization and environmental improvements (Lahn et al. 2013).

This rapid development in the Gulf Region is also strongly associated with tall building construction, which plays a crucial role in emphasizing the role of global placemaking and international tourism within the growing cities of the GCC countries, typified by the race to construct the world's tallest building – first the Burj Khalifa in the UAE, and now the Jeddah Tower in Saudi Arabia. While this high-density construction typology can be regarded as a necessity in the hot desert climate of the region in order to avoid sprawl and reduce energy and efficiency losses (Hammoud 2016), the availability of cheap energy has created a significant number of tall buildings characterized by fully glazed façades, which are implemented without consideration of cultural context nor in compliance with fundamental energy efficiency rules (Meir et al. 2012).

The Economic and Energy Context

Since the discovery of oil in the region in the 1930s, GCC countries have relied on oil for national and energy security. The exploitation of vast oil reservoirs in the area in the second half of the 20th century has led to unprecedented modernization and industrialization at both urban and rural levels. This rapid development caused a sudden growth in population and produced a significant rise in national income, which in turn created a great demand for housing. As a result, the decisions regarding the urban and built environment were made under increasing pressure, with no time for an evolutionary process for planning or design concepts. At the same time, this new architecture was enabled by plentiful air conditioning and economical mass production, replacing the more climatically and

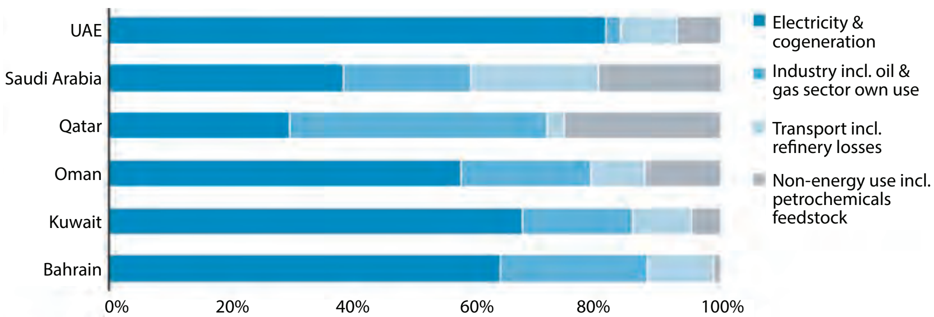

Figure 1. Simplified sectorial breakdown of the energy resources consumption in the GCC countries in 2010. Source: Lahn et al. (2013)

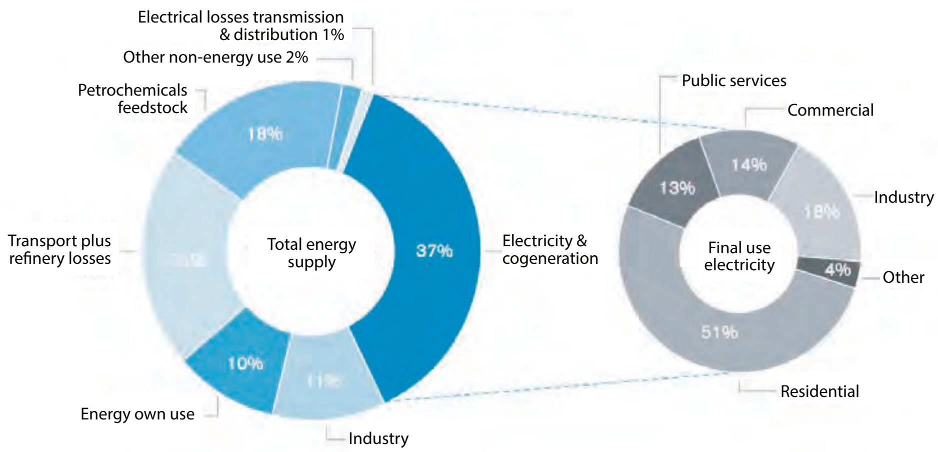

Figure 2. The total energy supply breakdown for Saudi Arabia, illustrating how 51% of the final electricity use is consumed in the residential sector. Source: Lahn et al. (2013).

culturally appropriate vernacular architecture. This was followed by the economic growth of the late 1990s and early 2000s that led to megascale projects and tower architecture, in line with the diversification plans that aimed to reduce reliance on oil-based income (Bahaj et al. 2008). This active construction, most evident in Dubai and Abu Dhabi in the UAE and Doha in Qatar, has occurred at a frantic pace, with no time to study or realize the implications on the environment. Accordingly, the issue of sustainability has been neglected. Consequently, in 2011, the GCC countries consumed almost as much oil and gas as Indonesia and Japan combined, and more than the entire continent of Africa, yet they have just 5% of Africa's population, and this high energy consumption has been rising inevitably and is expected to nearly triple by 2030, with Saudi Arabia being the largest contributor due to the country's much greater population and land size, which requires serious energy-efficiency policy interventions (Lahn et al. 2013).

To inform the appropriate design interventions, it is important to examine the energy uses in each country. Figure 1, shows a simplified sectorial breakdown of energy consumption in each GCC country, representing the four main segments: electricity and cogeneration, industry, transport, and non-energy use. The breakdown illustrates how electricity generation losses, mainly used for air-conditioning and water production, represent a high portion of energy consumption (Alnaser & Alnaser 2011, Lahn et al. 2013).

Focusing on energy consumption patterns, Figure 2 illustrates that 37% of the total energy consumption in Saudi Arabia is due to electricity and cogeneration, and 51% of this primary energy is consumed in the residential sector. This clarifies that housing and residential buildings are responsible for more than half of all delivered energy consumption across the country, with air conditioning comprising a disproportionate share. Cooling accounts for more than 70% of electricity consumption in the residential sector in Saudi Arabia and about 40% of the total annual electricity consumption (RCREEE 2015). This identifies buildings, especially residential, as a key area for improvement in energy efficiency, affecting the local economies in the region, as reducing the domestic use of fossil fuels would mean more exported oil and natural gas, besides the obvious local environmental benefits.

Following those lines, the global rise in sustainability awareness began to take hold amongst decision makers and developers in the GCC countries since 2009. Remarkable progress is evident in relation to clean energy targets and efficiency strategies that emphasize the sustainable energy transition, reflecting the governments' growing concern about domestic energy consumption (Lahn et al. 2013). Improving building efficiency is the one area where GCC countries have agreed to introduce a cooperative plan and are making progress on establishing a common buildings standard, taking into account the common climate and sociocultural factors. Pilot studies and practices show that adapting the built environment and building codes to work with, rather than against, the Gulf Region's harsh climate represents some of the largest proven savings in the GCC to date, with up to 60% reductions in energy demand due to changes to existing buildings, and 70% in new buildings, against the existing average (RCREEE 2015). However, these scattered conservation efforts have been largely ineffective, due to factors such as bureaucracy and governance challenges, lack of awareness, information, enforcement, and market incentives, as well as unpredictable political support. As such, it is essential to have collaboration between ministries, municipal governments, and electricity authorities to strengthen the enforcement of these common building standards.

Housing and Tall Buildings In the Gulf Region

Although the vast fossil fuel reserves in the GCC Countries resulted in a rapid economic growth, it is the desire to diversify from oil that

ASPECT: RATIOS – Voices of Women In the Tall Building World

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Ilkay Can-Standard
Ilkay Can-Standard is an architect/technologist and the founder of GenX Design & Technology. Her firm is focusing on helping architects, engineers and construction companies to transition to Building Information Modeling (BIM) technology, using the most effective and tested strategies. Can-Standard's goal is to help transform how we build and construct our cities. As Co-Chair of the CTBUH Young Professionals Committee (YPC) of New York, Can-Standard fostered an open dialogue between architects, engineers, developers and academics about developimg responsible buildings and cities. Since she co-founded YPC, the group grew from 30 people to over 1,000 today. Can-Standard previously worked as an Associate Principal at Kohn Pedersen Fox Associates on award-winning projects, both locally and internationally.

Martina Dolejsova
Martina Dolejsova is currently the Communications Coordinator at Studio Libeskind. She earned her M.S. in Critical, Curatorial and Conceptual Practices of Architecture at Columbia GSAPP, in which her thesis focused on discussions of gender and the built environment from the 1990s, as well as the beginning impact of Internet technology on visual communications and identity.

Abstract

ASPECT: RATIOS is the outgrowth of a program developed by the CTBUH Young Professionals Committee in New York, beginning in 2016. The purpose of the lecture series, and of this special edition, is to showcase some of the exemplary work done by women in the tall building field. The impediments and setbacks faced by women in a male-dominated field are an infrequently discussed reality. CTBUH invited female colleagues to reflect on their experiences as women in a variety of roles and disciplines. We provided preliminary questions, but did not presume what subjects would be of most interest, and thus our invitation was very open-ended. The responses we received in some cases addressed gender inequality head-on; in others, colleagues held forth on a subject of personal importance to them. In all cases, the goal is the same: we want these voices to be heard. With a greater number of women entering the science and technology field, the conversation about their contribution to the tall building industry is more relevant than ever before.

Keywords: Gender Equality, Personal Essays, Architecture, Engineering

Introduction

Any metrics for the number of women who work on tall buildings are difficult to find, but this report recognizes the range of women involved in tall buildings and their respective range of experiences. Elena Shuvalova speaks about the invisible boundaries in that "any high post occupied by a woman in the tall building industry (is) to be a challenge." MaryAnne Glimartin further attests that women in such leadership roles must have the skills of being fierce and incredibly adaptive.

Architect Pascale Sablan follows the empowered lineage of architect Norma Sklarek (the first licensed female African-American architect, in 1954) and has a tenacity equaled by her humanity, in testifying how a building's language can contribute to social objectives and improve lives. Architect Caroline Stalker's advocacy on urbanism and tall buildings takes another approach, one that is particular to the subtropical climate of northeastern Australia. Prof. Elena Mele explores how representation is as much a production of structural engineering as it is a creative flow of ideas.

Architect Nicole Dosso, the lead technical coordinator at SOM, addresses the hard realities of engineering tall buildings in a description of "touchdown zones," the places where they meet the ground (or an engineered deck). Yet, even as their design becomes increasingly digitized, tall buildings are still an art, as structural engineer Wing-Pin Kwan points out in her essay on the importance of freehand drawing diagrams to foster flexibility, quick thinking and working out problems while on your feet. Architect Sara Beardsley shows that tall building design is as much a science as it is an art, and this fact feeds upon society's historical encouragment of men to study the sciences and women to do otherwise. Where are tall buildings going next? Prof. Helen Lochhead's personal response, a refreshing aside to the standardized, professional language typically used in the industry, communicates the importance of possessing agility in making personal connections and collaborations in order to effect change within underlying gender structures.

It's inarguable that a tall building is built through a collaboration of many people. As these towering achievements are increasingly dynamically and intricately linked to women, it is important to tell their stories and to keep this door open for future generations.

Sara Beardsley, *Adrian Smith + Gordon Gill Architecture, Chicago*

What do you think is the biggest challenge women face in the tall building industry?

As an architect at AS+GG, a firm well known for supertall and highly sustainable projects, I have been fortunate enough to take on leadership roles in both design and technical aspects of a variety of building typologies – including tall buildings – to interface with clients, to travel, and to present our work.

A challenge women face is that, historically, the tall building industry has attracted and retained a lower proportion of women architects than most other specializations in architecture. This issue may be related to similar challenges currently faced in other STEM (science, technology, engineering, and math) fields, as tall building design is as much a science as it is an art. However, great strides have been made in the past few decades, as more female design and technical leaders in the tall building industry continue to emerge and be recognized for their contributions.

Attrition among mid-level women architects occurs across all specialties for a variety of reasons, but studies have shown that "career perception" – including real or perceived challenges in career advancement and access to opportunities – is a leading factor. Another contributing factor is work-life balance, as the tall building industry can be especially demanding in this area, especially considering the needs for long or nontraditional hours, work on international projects, and travel. One way to improve perceptions, and increase opportunities for women to specialize, endure, and become leaders in the tall buildings field, is by better supporting them in the critical early and middle parts of their careers through improved mentorship. It is also very important to provide the guidance and encouragement necessary to a diverse group of university students to foster their interest in tall buildings, so that they can master the skills they need to succeed in a very competitive market.

Based on what you have learned as a professional, what would you go back and improve about the education in your discipline?

Many of the new or soon-to-be graduates I have met have never thought about what type of firm they wish to work for, or what type of projects they wish to work on in their careers. While university-level programs should always strive to train well-rounded architects, the last years of an architectural program should also give students more opportunities to specialize in the various sub-disciplines of architecture, with access to industry experts, to better prepare them for the workplace and make intelligent choices about the right fit for their careers. Students should begin to have conversations about their career path with professors and career coaches early, even if they do not know yet where that path will take them. It would be wonderful for our industry if more universities offered a tall building specialty and more high-rise studios within their architecture programs.

Sara Beardsley has been a Senior Architect with AS+GG since 2007 and has spent more than 10 years as a team leader contributing to large international projects, including Jeddah Tower, FKI Headquarters in Seoul, Astana Expo 2017, the Willis Tower proposed renovation, and Trump Tower Chicago. In 2011 Beardsley was the recipient of the national AIA Young Architect Award and in 2010 was one of Crain's Chicago Business' ***40 under 40.***

Nicole Dosso, *Skidmore Owings & Merrill, New York*

Touchdown

New York City is a unique place to build. Designing and constructing buildings over existing infrastructure significantly increases the challenges associated with tall buildings. Here, it can't be taken for granted that there will be *terra firma* on which to place a building's foundations. Several of the towers constructed above the formerly open-air rail yards at Hudson Yards (see Figure 1) and Manhattan West literally do not touch the earth.

At a critical structural point, primary building columns at grade and their associated foundations need to find their "touchdown zones" between existing tracks and the overhead catenary lines and signals servicing the railroads. Touchdown zones rarely align with the idealized column spacing planned for towers. Therefore, complex structural transfers that navigate between two grids are required, greatly increasing the complexity of coordination, construction, and cost.

Beyond structural and traditional technical considerations, such as wind acceleration and stack effect, tall buildings constructed over rail yards have a heightened concern for vibrations, acoustics, security, and track exhaust.

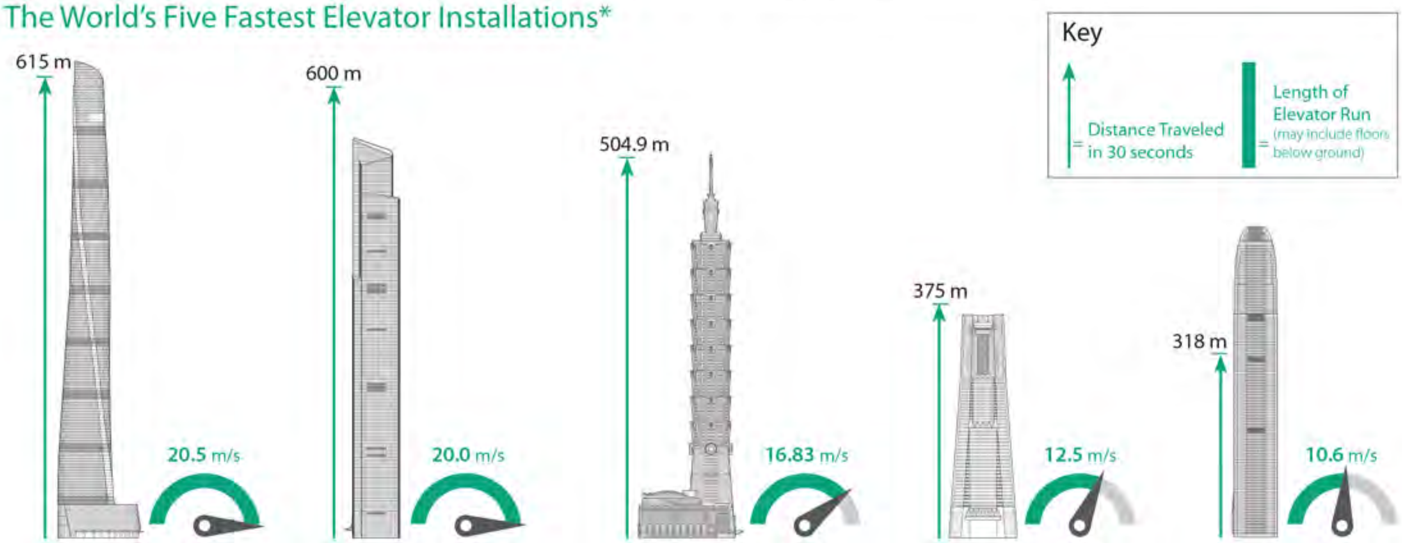
At track level, clear heights established by legal easements and train dynamic envelopes must be maintained. Limited clearances can impose challenges to vertical transportation regarding elevator pit depths, which correlate to a reduction in speed and cable travel lengths.

Construction precision and timing are critical when working at, above, or adjacent to active rail tracks. Work needs to be scheduled in advance and performed during coordinated outages to minimize disruption to rail service. Site logistics and physical constraints, such as the type and size of equipment that can be used at track level, can influence design

Vertical Transportation: Ascent & Acceleration

As part of a recent collaboration with the Guinness Book of World Records, CTBUH certified that Shanghai Tower has the fastest elevator and the longest elevator run of all commercial buildings in the world. Expanding upon this study, CTBUH sought to determine the records for speed and length of run among the world's tall buildings. The findings and related data are displayed here.

The World's Five Fastest Elevator Installations*



Shanghai Tower
Shanghai, 632m

CTF Finance Center
Guangzhou, 530 m

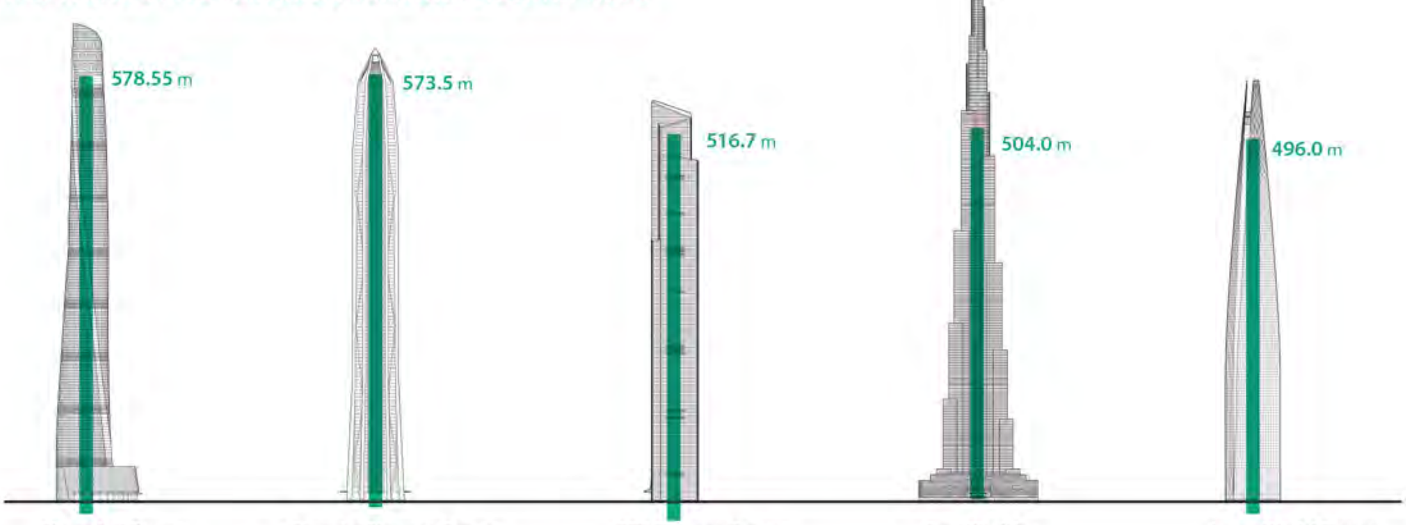
Taipei 101
Taipei, 508 m

Landmark Tower
Yokohama, 296 m

Two International Finance Center
Hong Kong, 412 m

**The speeds shown are maximum vertical speed achieved during the run. Elevators do not maintain a constant speed during the ascent, as they accelerate and brake at the beginning and end of each trip, respectively.*

The World's Five Tallest Continuous Elevator Runs



Shanghai Tower
Shanghai, 632m

Ping An Finance Centre
Shenzhen, 599m

CTF Finance Center
Guangzhou, 530m

Burj Khalifa
Dubai, 830m

Lotte World Tower
Seoul, 555m

The glass-sided **Bailong Elevator** in China is the world's tallest outdoor elevator at 326 meters. It takes visitors to the top of a quartzite cliff in Zhangjiajie National Park.

The 601-meter **Makkah Royal Clock Tower** in Mecca, Saudi Arabia, the world's current third-tallest building, is the world's tallest building that uses single-deck elevators exclusively.

Aufzugstestturm in Rottweill, Germany tests elevators for thyssenkrupp and features the nation's highest observation platform in a test tower at 232 meters above grade.

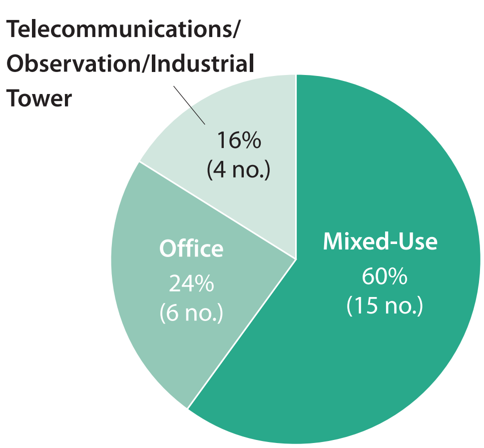
Fastest Elevators in the World

The table below includes all buildings that are completed (COM) or under construction (UC) (or currently on hold (OH) during construction), with elevators that run 10 m/s or higher. The current buildings with the top 5 fastest elevators are highlighted in green, while buildings containing the top 5 longest elevator runs are are in bold.

Elevator speeds for buildings under construction are anticipated and subject to verification upon completion.

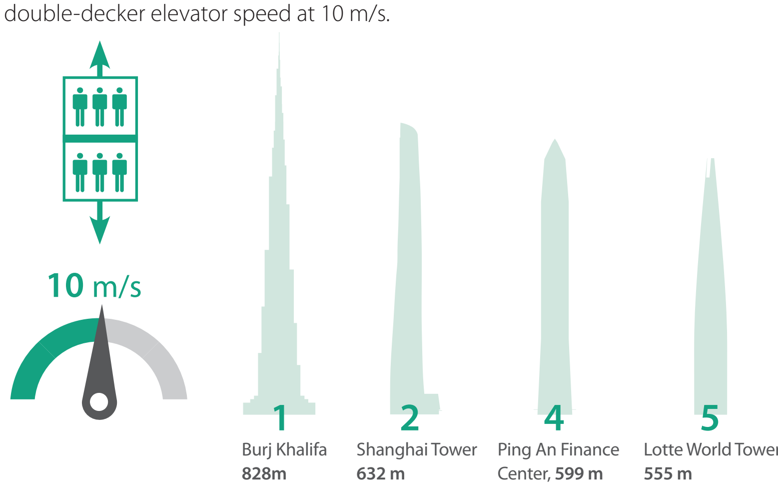
Rank	Building	City	Country	Height	Status	Completion Date	Elevator Speed
1	**Shanghai Tower**	**Shanghai**	**China**	**632**	**COM**	**2015**	**20.5**
2	**Guangzhou CTF Finance Centre**	**Guangzhou**	**China**	**530**	**COM**	**2016**	**20**
3	Suzhou Zhongnan Center	Suzhou	China	729	OH	0	18
4	TAIPEI 101	Taipei	Taiwan, China	508	COM	2004	16.83
=5	Wuhan Greenland Center	Wuhan	China	636	UC	2018	12.5
=5	Landmark Tower	Yokohama	Japan	296.33	COM	1993	12.5
6	Two International Finance Centre	Hong Kong	China	412	COM	2003	10.6
7	One World Trade Center	New York City	United States	541.3	COM	2014	10.16
=8	Jeddah Tower	Jeddah	Saudi Arabia	1000+	UC	2020	10
=8	**Burj Khalifa**	**Dubai**	**United Arab Emirates**	**828**	**COM**	**2010**	**10**
=8	Tokyo Sky Tree	Tokyo	Japan	634	COM	2012	10
=8	Merdeka PNB118	Kuala Lumpur	Malaysia	630	UC	2021	10
=8	Canton Tower	Guangzhou	China	604	COM	2010	10
=8	**Ping An Finance Center**	**Shenzhen**	**China**	**599.05**	**COM**	**2017**	**10**
=8	**Lotte World Tower**	**Seoul**	**South Korea**	**554.53**	**COM**	**2017**	**10**
=8	Busan Lotte Town Tower	Busan	South Korea	510.1	OH	2020	10
=8	Shanghai World Financial Center	Shanghai	China	492	COM	2008	10
=8	Al Hamra Tower	Kuwait City	Kuwait	412.6	COM	2011	10
=8	LCT Landmark Tower	Busan	South Korea	411.6	UC	2020	10
=8	T & C Tower	Kaohsiung	Taiwan, China	347.5	COM	1997	10
=8	China World Tower	Beijing	China	330	COM	2010	10
=8	Longxi International Hotel	Jiangyin	China	328	COM	2011	10
=8	Sunshine 60 Tower	Tokyo	Japan	240	COM	1978	10

Primary Function in Structures with 10+ m/s Elevators



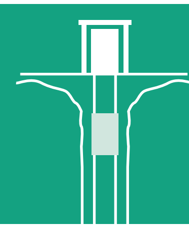
Tied for Fastest Double-Decker Elevators

Four of the five tallest buildings in the world are tied for the fastest double-decker elevator speed at 10 m/s.



The **Gateway Arch** in St. Louis, USA, features two "trains" of 8 capsules each, which ascend the curving 192-meter structure, turning through 155 degrees while remaining upright for the 4-minute journey.

One World Trade Center, New York, has an elevator run of 408.7 meters, extending deep into its basement. This is longer than its highest occupied floor – 386.5 meters.



Not all elevator test facilities rise into above-ground structures. The **KONE test shaft** in Tytyri, Finland, is the world's deepest elevator descent, at 350 meters.

Birds, Planes and Bio-Blitzes

Jeanne Gang

Interviewee

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Jeanne Gang
Architect and MacArthur Fellow Jeanne Gang is the founding principal of Studio Gang, an architecture and urban design practice with offices in Chicago and New York. Jeanne is recognized internationally for a design process that foregrounds the relationships between individuals, communities, and environments. Drawing insight from ecological systems, her analytical and creative approach has produced some of today's most innovative architecture such as the Vista Tower, currently under construction, and Aqua Tower in downtown Chicago. Jeanne is engaged in major projects throughout the Americas and Europe, including high-rise towers in New York, San Francisco, Toronto, and Amsterdam.

Figure 1. Aqua Tower, Chicago.
© Steve Hall / Hedrich Blessing

Having designed the 262-meter Aqua in Chicago, which completed in 2009, Jeanne Gang, principal and founder of Studio Gang Architects, received considerable attention for what was then the tallest building ever designed by a woman-led firm. The significance of her work extends far beyond this, as the head of one of the most innovative and research-focused practices working in the tall building industry today. Daniel Safarik, CTBUH Editor, spoke with Gang for her long-overdue **Talking Tall** *interview.*

What does it mean to you to be credited with what was at the time "the tallest building designed by a woman-led architecture firm"? Is that a meaningful distinction?

It's exciting to be designing tall buildings. It is a very complex process, and something that I think that would benefit from more women architects. Frankly, there is a lot to be invented and discovered in this building type. I think I brought some distinctive observations to the type – maybe not because I am a "woman architect," but because I am the architect I am.

Unfortunately, I would say the building type suffers because there is not enough diversity of all kinds of people who could be working on it, like young architects, small firms, racially diverse ownership of firms, and so on. It would be so much better if we had more diverse perspectives brought to it. So, the loss is really on the side of the industry.

There are small, local firms, gigantic multinational firms, and a range in between, each of which approaches the tall building differently. It's not so much about the characteristics of every person involved. Once you start looking at the typology, it is really shocking how much similarity there is in the make-up of the companies doing it, and it's reflected in the work.

The Aqua got a lot of attention when it was completed. How do you feel about it now?

I really like being in the same town as that building, because it was our first. Also, I tend to go back to it to see how it is being used and how the communities in the building have formed. I've always thought of that building as almost like a vertical piece of infrastructure that people can make their own on the inside. It's not the sort of building where every interior detail is dictated by the architect. It is a flexible structure that can be a hotel, condominiums, and apartments.

What I discovered is that it really is a very social building. The developer, Magellan Development Group, which also manages the building, tells me that there are very strong social connections in that building. There are activity groups, they've started their own gardens on the rooftop, and people talk to each other a lot more than they do in some of the other buildings (see Figure 1). It really plays out some of the ideas that we had in the beginning. To be able see that in reality is really important.

How would you say the ideas of communal space, balconies, shading, and modulated views in residential high-rise projects that you executed with Aqua have been modified for more recent projects?

One of the things I really liked about the balconies of Aqua was the social component, the fact that you could see the neighbors in an oblique way. That makes the balconies more like front stoops on a traditional house. I thought there was a lot of potential in that, but the downside was that, in order to get the cantilevers, we had to have a non-thermally-broken slab from inside to outside. We tried to have a thermally-broken slab, but could not achieve the cantilevers within budget.

We wanted to answer the question, "do thermal breaks in balconies improve energy performance?" There has been work done on it in Canada, but it was in a different climate (Hardock & Roppel 2013). The main reason to break the slab is to prevent condensation on windows, which is something that we have never seen on Aqua.

At City Hyde Park, we designed for two "personalities": people who like to have a view of the city, who live on the north side, and are perhaps a little more introverted; and people who live on the south side, who we thought of as extroverts. We put the balconies on the south side for these tenants, but also to help with solar shading. With our structural engineer, we devised something innovative – we placed the balconies on "stems," so the gravity loads are brought directly down to the ground (see Figure 2). That made it possible to have a thermal break between the balcony and the building. We're monitoring and testing those balconies so that we can make more data available for others who are considering doing balconies. It's kind of like we embedded the experiment into the building.

Also, from an architectural standpoint, it is great to be on those balconies because they are so interesting and spatially complex, and each is different. Some are very tall and cathedral-like, as you look up to see the next balcony from below. It almost looks like an Escher drawing from some angles.

What did your renovation and residential conversion of the Shoreland, a 1920s hotel, also on Chicago's South Side, teach you about communal space, room sizes, views, and some of the other characteristics that you pursue in your contemporary high-rise work?

It is so meaningful to have some historic buildings around; it really gives flavor and a sense of continuity to the city. And, of course it saves a lot of energy – the most sustainable thing you can do is reuse a building that is already there.

We learned a lot about how [1920s multi-unit residential] buildings are made. There is no above-ground parking. We used some interesting technology and applied a lot of skill to figure out how to get the parking below the building, given the column spacing and the site constraints. Inside, we have these incredible large spaces. We tested different types of programs we could bring to those spaces, working directly with a historic preservation consultant. We figured out ways to make it more sustainable, through insulation, through landscaping, and through strategies such as allowing the water to soak into the ground through pervious paving.

Basically, the more problems we work on and solve, the more we create solutions that can be applied in different scenarios. I've never wanted to specialize in one building type, and it really pays off when you do something new, because you encounter totally different kinds of spatial, construction, and technology issues. The knowledge you gain then becomes like arrows in your quiver that you can pull out on later projects.

At Shoreland, which is a big building, the corridors don't feel long, because they bend. You don't get the sense you are in an endless corridor. I applied that to the wings of the University of Chicago North Campus Residence Hall and Dining Commons, which are like long fingers. Each one has a slight curvature, which makes it feel more compact.

Figure 2. City Hyde Park, Chicago.

Your first supertall project will be the Vista here in Chicago. It's going to be one of the tallest in the city. How have you resolved the issues of placing such a large structure in the city, and preserving a human scale, in an area that is mainly multi-level roadways and did not have much human scale to begin with?

The innovation on that building is really about how it creates a connection between two public spaces, the Riverwalk and the park at Lakeshore East. The building is like these three stems. The core is in the outer two stems, and the inner stem lifts up – it has a lot less structure in it (see Figure 3). This makes it possible for the public to cross directly below the building. How many tall buildings do you know where you can walk from one side to the other without going inside the building? It is connected both on the ground level and along Upper Wacker Drive, a built-up roadway system, where there is a public connection between the hotel and residential portions of the tower, which leads from an overlook on the river to the Lakeshore East neighborhood.

Figure 3. Vista Tower, Chicago.

"Once you start looking at the tall building typology, it is really shocking how much similarity there is in the make-up of the companies doing it, and it's reflected in the work."

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 Headquaters 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."

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