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This Issue

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Front cover: Vista Tower—overall view. © Tom Harris, Courtesy Studio Gang
Back cover: Vista Tower under construction, near the topping out of the structure. © Nick Ulivieri Photography

This issue arrives at an auspicious moment for the Council, which this year celebrates its 50th anniversary, echoing the theme of our 2019 World Congress, "50 Forward | 50 Back," exploring the critical past and essential future of the tall building and the city. Inside, we've assembled papers and features that address these themes, relating them where applicable to programming at the Congress itself. A curated sample of the breadth and depth of our program is available in the 2019 Congress Special on page 20.

Vista Tower, the subject of our case study (see page 12), is situated prominently at the intersection of the historic axes of the Chicago River and Lake Shore Drive. It is one thing to choose a significant location for the city's future third-tallest building; it is quite another to turn that location into a gateway that unites parkland with riverfront recreation, crossing beneath a three-level roadway that had blocked access for decades. On the one hand, the building is very much in the Chicago tradition of structural bravado; on the other, it uses that bravado to hearken a future where skyscrapers are unitary forces and no longer urban barriers.

Looking back through history can sometimes unveil surprises and rattle received certainties. This just might be the case with the Home Insurance Building, long considered in popular convention to have been the "world's first skyscraper." But as our *Debating Tall* (see page 5) suggests, and an entire day of similar debates at the First Skyscrapers | Skyscraper Firsts Symposium on Day 4 of the Congress may confirm, it can be valuable and revelatory to interrogate long-held perceptions.

Likewise, on the "50 Back" theme, the story of skyscrapers and steel is less straightforward than one might imagine, and has in fact been, and promises to continue to be, a near-constant drumbeat of innovation, as evidenced in the paper *Steel and Skyscrapers: A Productive History and a Sustainable Future* (see page 28). Bringing us into the "now," as in right now – look around you – at least one or two of your office neighbors has probably installed a space heater below their desk or blocked a vent over their head with an improvised baffle. Addressing a problem that has plagued high-rise office buildings for decades, the authors of *Personal Office Air: Ending Thermostat Wars* (see page 36), provide a fresh perspective on maintaining a comfortable workplace. Looking "forward," directly into the jaws of a very immediate future already in evidence – the fact that one of the world's megacities is sinking so alarmingly fast that the government of Indonesia is to be relocated away from it – the authors of *A Responsible Urban Rejuvenation of Jakarta* (see page 44) take on the existential challenges to a city and its inhabitants.

Our *Tall Buildings in Numbers* data study (see page 52) traces the history of "50 Years of Tall Building Evolution," examining how the many conflicting and contemporaneous architectural styles of the past half-century manifested in some of the world's most famous tall buildings.

Among the best ways to truly take account of the megatrends of 50 years of large-scale architecture and urban design is to speak to someone who has lived through and contributed substantially to that dialogue. That was my distinct pleasure, when I sat down with Moshe Safdie for the *Talking Tall* interview (see page 54). From his graduate-student days in Montreal designing Habitat 67, to the city-sized Raffles City development nearing completion in Chongqing today, Safdie has a unique ability to synthesize the themes of three-dimensional city-making that the Council has been addressing through the years. I'm expecting his keynote at the end of this Congress to be as inspiring as his work I've had the privilege to visit. Consider this my invitation to both.

All the best,

Daniel Safarik, *CTBUH Editor in Chief*

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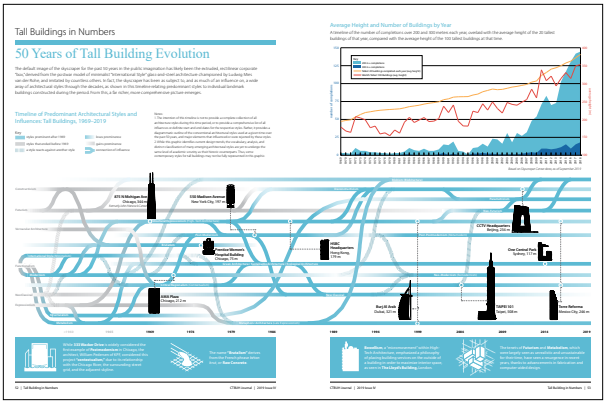
Tall Buildings in Numbers

50 Years of Tall Building Evolution

> "A survey of 34,000 people across 215 office buildings in the US found that 42% of people are dissatisfied with the temperature in their offices."

Pescheira, et al., p. 36

Global News

Visit the daily-updated online resource for all the latest news on tall buildings, urban development, and sustainable construction from around the world at: ***ctbuh.org/news***

Americas

Vancouver has been the site of multiple noteworthy projects of late. A futuristic-looking tower featuring a series of stacked and rotated glass cubes will host several tech giant tenants in its new office space. Dubbed **400 West Georgia,** the 91-meter-tall building is currently under construction, with an estimated date of completion in 2022.

Another Vancouver tower featuring geometric forms of glass, **The Stack** is the redevelopment of 1133 Melville Street in the city's downtown. When complete, the project could become among the tallest office towers in the city and will introduce 50,167 square meters of AAA-class office space. The building's architect explained that by "stacking" the cubes, and rotating them, more outdoor spaces were created for the building's occupants to enjoy.

The Stack, Vancouver. © Oxford Media

Passive House milestones are set to be met, with a third exciting Vancouver project. In the city's West End, a proposal for a 60-story passive house tower, potentially one of the world's largest, has been released. Named **1075 Nelson,** the building conforms to the City of Vancouver's 2016 zero-emission building plan, which aims to keep all new constructions from releasing operational greenhouse gas emissions entirely by 2030.

The Bay Area in the United States continues to undergo a flurry of activity. In **San Francisco**'s Transbay District, **The Avery,** a 56-story residential glass tower, has reached completion. The tower is outfitted with luxury touches throughout its 118 condominiums, including a pet spa and a private formal dining room—but the pinnacle is undoubtedly its penthouse, a 400-square-meter residence going for US$15.9 million. As part of a mega-campus in **San Jose,** a new office tower is expected at **200 Park Avenue** in the city's downtown area. Ultimately, the aims of the campus include increasing pedestrian activity along adjacent boulevards.

In Southern California, two new skyscrapers have been green-lit in **Los Angeles.** The first, called **Fifth & Hill,** features a series of cantilevered swimming pools woven into the pixelated upper floors. The hotel and residential tower features an at-height connection to a popular restaurant via its 13th level, and received near-unanimous approval from the Los Angeles city planning commission. Meanwhile, plans for the **8th and Fig** tower to deliver 438 market-rate condominiums to the city were also approved. The tower will be built across the street from the FIGat7th shopping center.

Guatemala continues to experience a wave of development, with a variety of high-rise projects in unconventional forms and color schemes. One that could become the tallest tower in the country is set to begin construction in 2019. Called **Torre Manatí,** the 37-story project in **Puertos Barrios** is estimated to receive an investment of US$15 million. The tower will function as a residential development, with 120 luxury apartments gaining access to numerous amenities, such as a private beach, and views of the Gulf of Honduras.

Vistana is another luxury tower that has been proposed in **Guatemala City's** Zona 14. Reaching 19 stories, it is to offer 64 apartments, a business center, and floor-to-ceiling windows. A colorful, dual-tower residential project is also being proposed for Zona 5. The project's proximity to a nature preserve has required rigorous testing, inclusive of soil and water studies. Another complex, **Parque 15,** will consist of three apartment towers in Guatemala City's Zona 15. The project will be well-integrated with automated systems for lighting, entry, music and other functions.

Amidst proposals, work is entering its final phases on the two-tower complex known as **QUO,** also located in Guatemala City. The 16- and 17-level buildings will offer both office and residential space, totaling approximately US$30 million in investments. The mixed-use project is set to be completed ahead of schedule in the first quarter of 2020.

In **Puerto Cancún,** Mexico, a new shark-fin shaped high-rise, **Shark Tower,** is to provide

THEY SAID

> "The irony of being harassed by security guards representing private lease holders while on a tour 'celebrating' the same spaces... is it really #publicspace just because there's no wall? #ctbuhwalks"

Jodi Allemeier, Senior Manager, PwC South Africa, reporting from the CTBUH Global Walk, Cape Town, South Africa, June 27, on Twitter and Instagram

Block 675, New York City. © FXCollaborative

housing while also harvesting valuable information on the local shark population's behavior in response to human activity in the oceans. The uniquely-shaped tower will feature 134 apartments across its 20 stories, as well as a research laboratory. In line with its mission, the building aims to reduce water and energy usage throughout daily operations.

A massive four-tower complex has been proposed for a redevelopment of the Metro **Toronto** Convention Center called **Union Park,** after an initial plan was overlooked by the Toronto City Council. The updated proposal would comprise office space, retail space and a total of 800 rental apartments distributed across the four towers. Further east in **Montreal,** a luxury 38-story project has been launched. **1111 Atwater** is a mixed-use development that will include luxury penthouses, rental residences, retail and commercial space. The penthouses are estimated to cost between CA$2 million to $15 million (US$1.5 to $11.5 million).

A 1910s-era skyscraper in **New York City**'s financial district is being renovated, though it will preserve its Beaux-Arts origins. The **Equitable Building** was one of the city's early high-rises, and provoked enough outrage at its cast shadows that the famous setback resolution of 1916 was decreed in New York shortly after its completion in 1915. Uptown, demolition has been completed for two residential skyscrapers, at a Hudson Yards site, which will be 58 stories; and the other at **60 West 30th Street,** which will rise 42 stories. The two buildings will be part of the **Block 675** Complex. Elsewhere in the city, excavation work has started at **Strata Tower,** a 34-story building with a delivery date sometime in 2022. Renderings of the project show greenery along the east elevation's staggered terraces.

Chicago's iconic **Willis Tower** has reopened its Wacker Drive lobby as part of a three-year-long, US$500 million renovation. The new lobby allows more light to enter the building, and features an original art installation. Demolition permits have been obtained to demolish an older Michigan Avenue building in Chicago's downtown area. The four-story masonry building will be replaced with a 46-story mixed-use tower. **300 NMA** joins recent skyscraper projects **Cirrus** and **Cascade** as part of a transformation of "Millennium Mile," a segment of Michigan Avenue south of the Chicago River.

In the southern United States, a landmark high-rise is getting a new lease on life in **Shreveport.** The neo-classical 10-story building was the first skyscraper in the city when it was completed in 1910. After being purchased in 2017, the building, now re-christened **The Standard 509,** has been retrofitted to include 72 apartments.

Over in **Charlotte,** it has been announced that the city's South End will host a major retailer's 2,000-employee global tech hub. The 23-story tower will be called **Design Center Tower,** and may help to boost Charlotte's tech job creation rate past that of rival Raleigh.

Miami has been seeing a fair amount of development as well, with three 50-story-plus towers making progress. **One Thousand Museum,** a 61-story residential tower, has officially opened on Biscayne Boulevard, offering 83 units for purchase. The tower, the last residential project in the United States by the late Zaha Hadid, has been nicknamed "Scorpion Tower," due to the resemblance of its exterior to an insect's exoskeleton. A 50-story office tower, **830 Brickell,** is also underway in Miami, and is proposed to reach 223 meters upon its competition in 2021.

One Thousand Museum, Miami.
© One Thousand Museum

A New View, and a New Gateway, for Chicago

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Jeanne Gang, architect and MacArthur Fellow, is the Founding Principal and Partner of Studio Gang, an architecture and urban design practice headquartered in Chicago with offices in New York, San Francisco, and Paris. Jeanne is internationally recognized for her powerful designs that arise from a process foregrounding 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, including the Aqua Tower in 2010 and now Vista Tower, currently under construction in the same neighborhood in Chicago. In addition to smaller-scale cultural and community projects, Gang is leading major projects throughout the Americas and Europe, including the Richard Gilder Center for Science, Education, and Innovation at the American Museum of Natural History in New York, the United States Embassy in Brazil, the O'Hare Global Terminal in Chicago, and towers in New York, San Francisco, Toronto, and Amsterdam.

Juliane Wolf, architect, is a Design Principal and Partner at Studio Gang, where she designs and advocates for built structures that simultaneously serve communities and their environments. Wolf has brought her expertise in sustainability and low-energy structures to bear on the Studio Gang portfolio. With experience in complex visitor-serving organizations as well as tall buildings and other large-scale typologies, she has led some of the studio's most celebrated projects, including Writers Theatre, Vista Tower, and the new Global Terminal at O'Hare International Airport, the studio's largest project to date.

Abstract

Upon completion, Vista Tower will become Chicago's third tallest building, topping out the Lakeshore East development, where the Chicago River meets Lake Michigan. Occupying a highly visible site on a north-south view corridor within the city's grid, and in close proximity to the Loop, the river, and the city's renowned lakefront park system, this mixed-use supertall building with a porous base is simultaneously a distinctive landmark at the scale of the city and a welcoming connector at the ground plane. Clad in a gradient of green-blue glass and supported by a reinforced concrete structure, the tower is composed of an interconnected series of stacked, frustum-shaped volumes that move rhythmically in and out of plane and extend to various heights. The tower is lifted off the ground plane at the center, creating a key gateway for pedestrians accessing the Riverwalk from Lakeshore East Park.

Keywords: Chicago, Skyscrapers, Mixed-Use, Urban Design

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Juliane Wolf will participate in the Session 7C panel discussion *High-Rise Design Drivers: Now to 2069,* on Wednesday, 30 October. Vista Tower is the subject of the off-site program on Thursday, 31 October.

Introduction

Due to the enormity of structure necessary for tall buildings to cantilever skyward from their bases, and their economic models that tend toward exclusivity, their impenetrability at ground level is practically assured. The design of Vista Tower asks the question: What if skyscrapers can be porous connectors, rather than barriers, for the public realm? Defining a new edge of the city, Vista Tower tightly knits the downtown Lakeshore East community to its surroundings with unprecedented urban

Figure 1. The building is composed of four volumes, which allows the massing to adjust to the site's geometry, while creating a generous entry plaza on the northeast and southwest sides of the building.

connections and enhanced public access to the Chicago River. Three volumes weave in and out to create the tower, while a fourth, lower volume anchors the ensemble to the riverfront. These interconnected volumes house 396 condominiums as well as a 191-key 5-star hotel, restaurants, and amenity spaces. An innovative structural system minimizes structure in the center at ground level, creating a key pedestrian connection between the Chicago Riverwalk and the nearby community park (see Figure 1).

The essential "building block" of the architecture is a 12-story truncated pyramid called a frustum. Stacked and nested, right-side up and upside-down, the frustums form the tower's flowing volumes, which, surprisingly, are made entirely of vertical elements. The frustum geometry creates a tall building with eight corners instead of four, providing inhabitants with daylight and fresh air from multiple orientations, while also allocating green space atop the building's various heights. Reinforcing the tower's flowing appearance is a gradient of high-performance glass that has been optimized for solar performance according to the variations in floorplate size. Now under construction, Vista Tower has achieved its final height and its cladding is nearly complete. It has already become a familiar landmark for Chicagoans, who can see how the city's skyscraper legacy is being translated into a contemporary expression that embraces the public realm.

Design Brief and Inspiration

Designing Chicago's third-tallest building presented a great opportunity to create a tower that would function as a distinctive anchor at the scale of the city while also making fine-grained connections for people at the ground. Achieving this goal proved particularly challenging because Vista Tower's "ground" plane is in fact a three-level roadway (Upper Wacker Drive, Lower Wacker Drive, and Lower Lower Wacker Drive) that has limited access to Chicago's riverfront for decades (see Figure 2). From the beginning, the tower was thought of as a piece of urban

Figure 2. Vista Tower, Chicago, as seen from the north bank of the Chicago River. © Tom Harris, courtesy of Studio Gang

50 Forward | 50 Back

Abstract

On the 50th anniversary of the Council on Tall Buildings and Urban Habitat's founding, the CTBUH 10th World Congress returns to the Council's home: Chicago. Focusing on the theme 50 Forward | 50 Back, the Congress explores the most significant advancements in tall buildings and cities from the last 50 years, whilst inquiring into the future of our cities 50 years from now. This event thus represents a critical reflection on both the skyscraper typology and urban development, by marking their trajectory to date, and considering the evolutions that must take place to accommodate a dynamic and uncertain global future. The tension between human-centric and technologically-advanced design progress that was brought into sharp focus in the late 1960s, arguably, has never truly been resolved. We again stand at a critical juncture in time, amidst major change in the typological status of tall buildings, the cities they call home, and the people that inhabit them. The Congress directly addresses critical issues in the future progression of our cities, drawing the most important lessons from the past. The following pages contain highlights from the program.

Keywords: Sustainability, Tall Buildings, Vertical Urbanism, Mass Timber, Smart Buildings

Perfect City: What are the Drivers of the Modern Metropolis?

Opening Plenary—50 Back: Urban Evolutions
Tuesday, 29 October

Joe Berridge, Partner, *Urban Strategies*

The world is rapidly urbanizing and at the same time an elite of global cities seems to be gaining more and more economic and cultural power. That growth seems fueled by similar forces: the financial services industry, high-achieving universities, a vibrant tech sector, a vigorous cultural life and well-connected airports. Yet we all share the same problems of inadequate transport infrastructure, rising social inequality, a lack of affordable housing, and a sense of urban sameness. In this presentation, dive deep into the drivers of global urban success and examine the cities that are most successful in tackling these common problems.

Eight cities are examined, with guidance for how they might best mobilize themselves for success. No city is perfect in every category, but each offers unique insight: Shanghai, in its dramatic expansion of its subways and management of unprecedented growth; Singapore, in its a unique way of making large projects happen; London is restructuring of its growth to revitalize the east of the city; Sydney, in its response to the challenge of tech giants;, Manchester, in its inspired re-invention of its economy; Belfast, in its forging of civic peace after two decades of urban civil war, and Toronto, the city that successfully settles more immigrants than any other.

Lessons from each of these cities covers not just the strategies each city employs, but also analyzes the leadership involved and the quality of the urban places they achieve, suggesting at a formula for the "perfect city."

A New Chicago Legacy: High-Rise Buildings as an Equitable Development Tool

Opening Plenary—50 Back: Urban Evolutions
Tuesday, 29 October

Eleanor Gorski, Acting Planning Commissioner, *City of Chicago*

Chicago is an active test bed for policy innovations that are leveraging unprecedented downtown construction activity on behalf of under-invested neighborhoods, local infrastructure, and city landmarks. The improvements include new density bonus provisions that are generating tens of millions of dollars' worth of grants for small businesses, an expanded downtown zoning district that is bringing office and residential uses to outmoded industrial corridors, and new approaches to density and design that are making Chicago more urban, sustainable and affordable. These new policy innovations are coincident with ongoing efforts to preserve and protect Chicago's most noteworthy high-rises.

As the principal planning agency for the City of Chicago, the Department of Planning and Development (DPD) promotes the comprehensive growth and sustainability of the city and its neighborhoods. The department also oversees the city's zoning and land use policies, and employs a variety of resources to encourage business and real estate development, historic preservation, accessible waterfronts, walkable neighborhoods, and related community improvements. This presentation provides an invaluable insight, through the eyes of a high-level official, into the workings of the third-largest city in the United States. It can serve as a template for other cities seeking to drive innovation and high-rise development, in the context of a city seeking more equitable and better health and economic outcomes for all citizens.

Formgiving—Giving Form to the Future

Closing Plenary—50 Forward: Urbanism for the Future
Wednesday, 30 October

Bjarke Ingels, Founding Partner, *Bjarke Ingels Group*

Architects and city-makers today find themselves designing for a future that is on track to be drastically different in the next half-century. There is clearly an appetite for "sustainability" in all its dimensions, and we still want buildings that soar, that speak to us, that inspire. The great human migration to cities, particularly in the developed world, is on a collision course with climate change. The forms we are creating now must embrace this paradox, harnessing technology that will make structures and cities timeless, and buildings that are robust and yet adaptable, with the permanence of landscapes and the dynamism of intelligent machines.

What we design today gives form to the future, and what we understand today as our limitations are in fact the driving forces of design. We will design buildings that look "different" because they will perform differently, and because we have no choice. By necessity, our thinking will be more multidimensional, more conscious, and our cities will reflect that thinking.

Mass Timber and the City

Closing Plenary—50 Forward: Urbanism for the Future
Wednesday, 30 October

Karim Khalifa, Director Buildings Innovation, *Sidewalk Labs*

Cities around the world are wrestling with urban problems associated with rapid growth—from rising costs of living, access to housing and longer commutes. How can cities be built that benefit everyone? Focusing on building innovation practices, Sidewalk Labs is leading the development of the first-ever neighborhood built entirely of mass timber—a burgeoning material that is just as strong and fire-resistant as steel or concrete, but dramatically more sustainable—to address some of the toughest challenges.

Sidewalk Labs' proposal for Toronto's Eastern Waterfront also includes a mass timber factory, which would not only accelerate project timelines by up to 35% without compromising safety or design excellence, but also help to catalyze an industry focused on sustainable construction and building technologies in Ontario that could be applied in cities across the globe. An innovative approach to building design that uses mass timber is discussed; one that can help urban environments move one step closer to sustainable, accessible and affordable housing for all.

110 North Wacker, Chicago

Jim McCaffrey, Senior Vice President, *Howard Hughes Corp.*

Anthony Scacco, Executive Vice President, *Riverside Investment & Development*

Considerations for the development of the office space at 110 North Wacker are referred to as a case study in order to explore the relationship between commercial real estate and fundamentally driving the user's access to talent. Key design considerations and decision-making for commercial office towers in a dense urban setting are reviewed through subject matter that focuses on goals common to modern office users. The implications of these goals on the design process of high-rise buildings are discussed thoroughly, including matters of enhancing branding and identity; enhancing recruitment and retention capabilities; optimizing space efficiency and lease economics; encouraging collaboration; adopting new technology standards and addressing the growth and flexibility needs with respect to uncertain economic conditions.

Each of these goals necessitates careful thought by the users, (relative to the premises design) and by owners, insofar as planning and infrastructure decisions can serve to limit—or enhance—the opportunities on which users can capitalize. The rate of technological advancement facilitates innovation, yet requires constant monitoring and updating of best practices. The user's premises designs are largely dependent on the core-and-shell planning decisions made by owners. Ultimately, the "optimal" building designs originate based on a deep, "inside-out" focused dialogue between owners and users.

110 North Wacker, Chicago. © Goettsch Partners

Completion Date: 2020 (expected)
Height: 249 m, Stories: 56
Function: Office

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Jim McCaffrey & **Anthony Scacco** will present in Session 2G, *Developments in Chicago,* on Tuesday, 29 October. **110 North Wacker** will be featured in the Off-Site program on Thursday, 31 October.

The Garden City in Three Dimensions

Closing Plenary—50 Forward: Urbanism for the Future
Wednesday, 30 October

Moshe Safdie, Principal, *Safdie Architects*

The avant-garde in architecture today often treats towers as heroic sculptural objects within the skyline of the city. There is little exploration of the livability and quality of life within the tower, let alone a critical assessment of how it might respond to the density, scale, mobility and transportation issues of our era. Subsequently, there has been less attention to the impact on the quality of life of high-rise buildings, be they residential, workspaces, or public institutions.

Steel and Skyscrapers: A Productive History and a Sustainable Future

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Shelley Finnigan advises tall-building project owners and their design and construction teams how ArcelorMittal's products and materials enable sustainable structures. A licensed structural engineer (Illinois), Finnigan holds master's and bachelor's degrees from Purdue University and is presently Chapter Chair of CTBUH Chicago.

Jean-Claude (JC) Gerardy, an experienced structural engineer, received his degree from University of Liège (Belgium) before embarking on his career at ArcelorMittal. Gerardy has worked throughout the world promoting ArcelorMittal's innovative structural steel solutions. His successes are exemplified in the efficiencies HISTAR steel brought to Shanghai World Financial Center (China), J57 Mini Sky City (China), and Emirates Tower (UAE).

Nicoleta Popa has managed, coordinated and advised on research projects featuring partners and subcontractors from across Europe, the United States, and China. Each project aims to increase steel's sustainability contribution to the construction of tall buildings, with deliverables including new products and solutions; modifications to standards, codes, and regulations; and development of new technical agreements, design aids, promotional materials, and campaigns. Popa's expertise includes sustainability, cost optimization, composite construction, fire design, and building physics.

Dario Trabucco is Associate Professor at the IUAV University of Venice, Trabucco has been the principal investigator of several research projects focusing on the sustainability of tall buildings, the development of innovative structural systems and the development of international standards on the measurements of a tall building floor area, as well as several other research topics.

Abstract

This research aims to demonstrate recent developments in the partnership between steel and skyscrapers. It highlights steel's sustainability characteristics and explores the impact that the material and its supply chain have on the complete life cycle analysis of a building. The study summarizes climate-action initiatives in the steel production industry, recognizing how responsible producers are striving to reduce the carbon impact of this reliable structural material. It explores the material's influence on design and construction efficiencies, alerting designers to a selection of the latest innovations in specifications, design methods, and evaluation ideologies. The overarching goal of this research is to unlock creativity in the design community by presenting experts with a summary of new ideas on how to create sustainable, cost-effective, optimized buildings for the future.

Keywords: Steel, Sustainability, Skyscrapers, History

Introduction

Steel and the skyscraper have a partnership that spans more than a century (see Figure 1). In combination with various advances in building technologies, steel enabled the 1930s surge in high-rise construction and high-strength steel led to its 1970s renaissance. As the tall building revolutionized the urban landscape—facilitating the reorganization of societies and their priorities—steel, due to its affordability and durability, has always been the material of choice for the design and construction of building's primary structural systems. Today, however, society's burgeoning concern for sustainable development and conflicting messages on the affordability, safety and environmental impact of steel have resulted in confusion about its place in high-rise construction. Steel has, in fact, benefited from recent technological advancements that improve its sustainability profile. Its role in complete life cycle assessment of a building provides insights on climate-action initiatives that steel producers are implementing to address global warming concerns. Summarized herein is a selection of the latest innovations in specifications, with a focus on very high-strength steels, which can help reduce the amount of steel used in buildings. Also covered are design methods, emphasizing ways to simplify fabrication and erection, which can help to reduce the amount of energy used in construction of a building; and evaluation ideologies, aimed at standardizing floor area measurements, which can help increase the operational efficiencies of buildings, and therefore positively influence their environmental impact.

Sustainability of Steel

According to the United Nations and International Energy Agency (UN, IEA 2017) the built environment is responsible for 39% of global energy-related CO_2 emissions and more than 35% of global final energy use. Therefore, to meet the global ambition of limiting the worldwide temperature change to 2°C above pre-industrial levels, it is imperative that all members of the development, design and construction

communities take responsibility to achieve this goal. In particular, members must be educated on the wholesale environmental impact of buildings; they must understand the mechanisms that positively and negatively affect sustainable outcomes; and they must base their design choices on the true characteristics of a material—ranging from product details to the sustainability initiatives implemented by producers.

Life Cycle Assessment of Tall Building Structural Systems

Striving to inform the community on the true environmental impact of the building industry, CTBUH endeavored on a two-year-long research project to analyze the whole life cycle of a tall building's structural system. Supported by ArcelorMittal, the project studied the extraction and production of the structural system's building materials, transportation of said materials to site, construction operations, final demolition of the building, and the end-of-life of the materials" (Trabucco, et al. 2014, 2015, 2016). As the first complete life cycle assessment (LCA) to be performed on tall building structural systems, the project faced a myriad of decisions to isolate variables and determine the best course forward in evaluating impacts. Ultimately, it was determined that the project would focus on global warming potential (GWP) to evaluate the amount of carbon that is released throughout the life cycle of a structure; and on embodied energy (EE) to serve as an indicator of the consumption rate of electricity, fossil fuels and natural gas during a building's lifetime.

Among many conclusions, the results of the LCA study reconfirmed one issue that is already understood: obtaining an accurate LCA is not yet an exact science. Its challenges lie in the selection of appropriate boundary conditions, establishment of assumptions, and in the sensitivity of its outcomes to even the smallest decisions of a project. Therefore, it is important that project stakeholders (designers, consultants, and materials suppliers) work together early in the design process to ensure that structural systems are highly optimized and use innovative

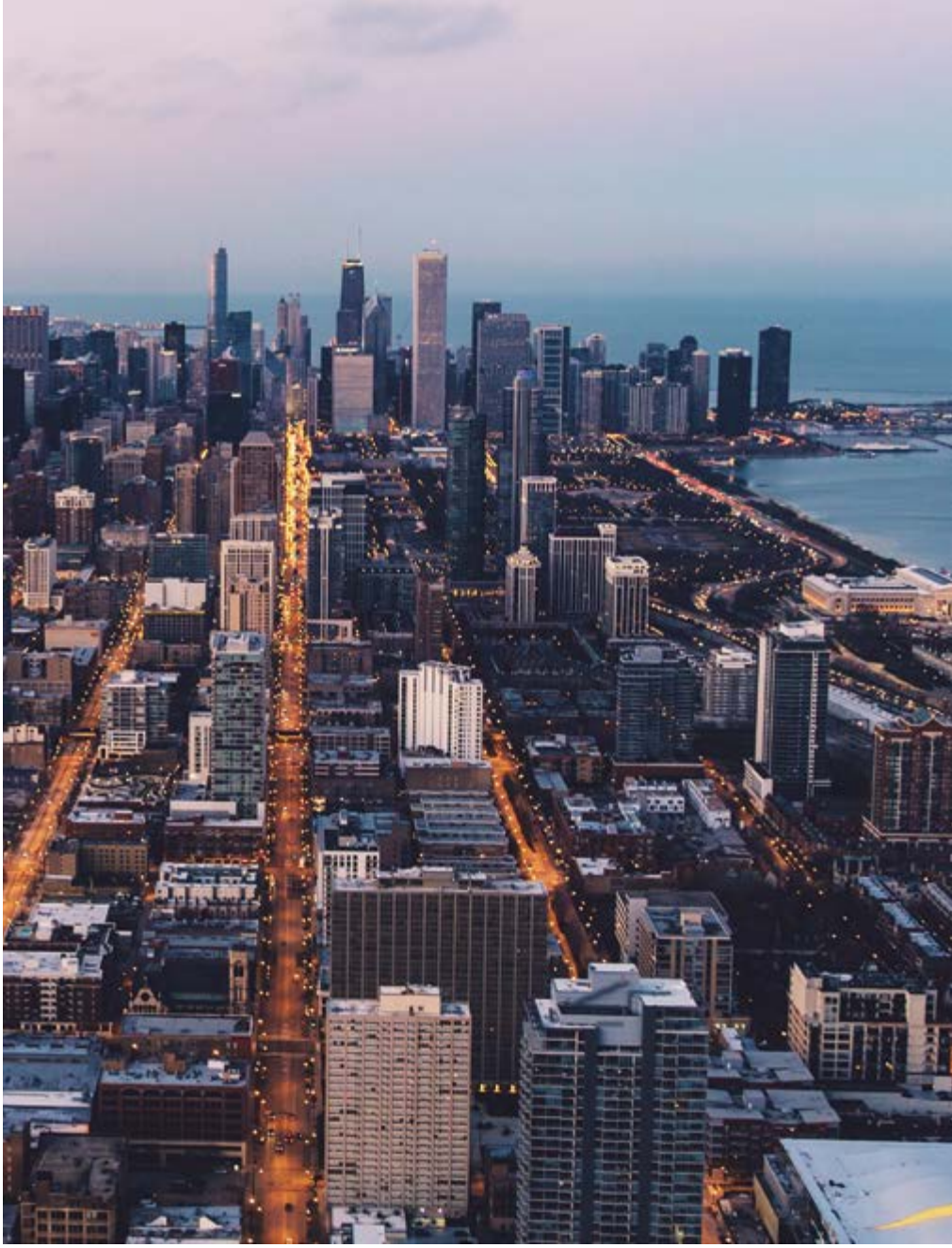

Figure 1. Steel enabled the 1930s surge in high-rise construction, and high-strength steel led to its 1970s renaissance. © Austin Neill (cc by-sa)

products that positively affect the sustainability bottom line (e.g., through energy-saving production methods, by reducing the weight of material in the final structural system, etc.). Narrowing the discussion to conclusions of interest for this study, the LCA study revealed that:

1. On average, design solutions based on steel typically demonstrate better environmental performance when compared to concrete systems. More specifically, in terms of GWP, steel systems always outperform concrete with lower GWP values. For EE values, steel systems outperform concrete when considering the life cycle through "Module D", which accounts for the benefits of end-of-life recycling of steel; however, as an optional module for assessment, it is at the evaluator's discretion whether or not this is taken into account, and results can differ if Module D is ignored.

2. The recyclability of steel benefits all tall building scenarios at the end of their life cycle, as even concrete buildings feature recyclable steel reinforcing bars. Though disparate opinions exist on whether this benefit should be realized, the LCA study concluded that the high recycling potential is an intrinsic value of steel and this 'credit' should be

Personal Office Air: Ending Thermostat Wars


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Gabriel Peschiera heads up the Smart Buildings initiative at Jaros, Baum & Bolles, a leading MEP consulting engineering firm, working across traditional building trades, including IT, BMS, mechanical and electrical to deliver innovative technology solutions for both new construction and existing buildings. Peschiera has a strong background in technology development, having worked on multiple startups, including a venture-backed startup that developed HVAC control software and hardware to maximize thermal comfort and air quality in commercial buildings. He also has firsthand experience as a building energy consultant.

Gregory James is an Associate at Jaros, Baum & Bolles, joining the firm in 2004. James uses complex engineering software tools to execute computational fluid dynamics analyses of airflow distribution in built structures as well as in different aspects of engineering analysis for the firm. James is also involved in building energy modeling and has performed numerous studies related to energy-conservation measures in buildings. He earned his master's degree in Engineering from the University of Illinois at Urbana/Champaign, and his PhD in Mechanical Engineering from the New Jersey Institute of Technology.

Abstract

Delivering personal thermal preference in an open-plan office has eluded building design professionals for years. Surveys have shown that being too hot or cold is the number one complaint for people in offices. The challenge is to deliver different thermal conditions for occupants who sit near each other in such a way that meets aesthetic, cost, and energy constraints. Power over Ethernet, the Internet of Things, mobile and wearable devices, and small-scale energy harvesting represent a paradigm shift in how we think about building occupant experience. At the same time, there is increasing attention on the importance of indoor air quality, challenging designers to improve ventilation effectiveness. The results of a personal air control pilot study, in which 10 occupants were able to regulate overhead cooling via web browser, included collaboration with a mechanical contractor to price personal office air designs relative to a base scheme for ground-up construction and fit-outs. Other recent efforts in personal thermal control, as well as the various cost, aesthetic, and energy implications of providing microthermal zones at scale are analyzed.

Keywords: Human Comfort, Office, Technology, Occupancy, MEP, Sustainability

Background

A survey of 34,000 people across 215 office buildings in the US found that 42% of people are dissatisfied with the temperature in their office (Huizenga et al. 2006). Dissatisfaction is so common that it is almost an accepted fact of office life. The central issue is not that offices are generally too hot or too cold, but that at any given moment they are too hot for some and too cold for others. Fighting over the thermostat setting is a familiar issue: in one survey 20% of respondents reported getting into an argument with their coworkers about the temperature (Career Builder 2015). A review of field studies has shown that office occupants' preferences for effective temperature can span as much as 6°C (10.8°F) (Zimmermann 2008). In other words, each person would need to have the ability to create an effective temperature that's as much as 6°C (10.8°F) different from his or her neighbor in order for all to be satisfied. This idea is impossible with current design practices that are one-temperature-fits-all. Building certifications such as LEED and WELL have recognized this, and now offer credit for individual air temperature and air speed control, and the smart buildings movement, which is built on the adoption of distributed devices networked together to provide an enhanced, more personalized experience to building occupants, facilitates the accommodation of individualized comfort zones.

At the same time, indoor air quality has become increasingly mainstream and important to large companies seeking to maximize employee productivity. Recent media examples include articles from The New York Times (Greenwood 2019) and The New Yorker (Twilley 2019). The traditional approach to air quality has been to deliver more outside air, after filtration and/or newer treatment technologies such as air

ionization. However, conditioning more outside air means higher energy consumption at a time when the focus is on reducing carbon footprints. Recent research shows that improving ventilation effectiveness, or the degree to which outside air serves occupants, can provide a path toward improved air quality without increasing energy consumption. A 2018 study shows that air movement near the face breaks the "personal CO_2 bubble", reducing CO_2 concentration by 177 ppm with very light air movement near the face (Ghahramani et al. 2018). As another study mentions, without air movement near our face, "we mainly breathe the air that came from around our feet" (Mazanec et al. 2017).

Various models for personal temperature control in offices, including devices for each worker, have been explored over the years. However, schemes such as underfloor air distribution and custom desks with built-in cooling devices have not been adopted widely. These systems also do not deliver improved ventilation effectiveness, as they either don't use outside air or, in the case of underfloor air, don't deliver outside air directly to the occupant. Underfloor air has suffered challenges with having diffusers in the floor: aesthetics, chairs rolling over diffusers, furniture blocking diffusers, and debris falling into diffusers. Desks with built-in cooling are expensive and are impractical to rearrange when floor changes are needed.

A pilot study was conducted in 2019 of personal overhead air diffusers in an office environment with approximately 300 employees in New York City. Personal overhead air distribution provides a potential practical solution for both delivering personal temperature experience and improving air quality for occupants.

Delivering increased comfort has traditionally been seen as a trade-off with energy efficiency; however, the opposite is true. Allowing personal cooling control via overhead air enables average space temperature to be warmer while improving thermal comfort and reducing cooling energy consumption.

Diffuser Design Leveraging a CFD Model

The goal in the design of the personal air diffusers was to enable occupants at adjacent desks to have distinct thermal experiences. The concept was to use a mild discharge air temperature, so as to limit drafty sensations from overly high temperature differences between head and feet, and enable occupants to adjust the velocity of air leaving the diffuser.

The computational fluid dynamics (CFD) model was developed to inform the design of the diffuser, replicating the real-world space that was to be used for the pilot.

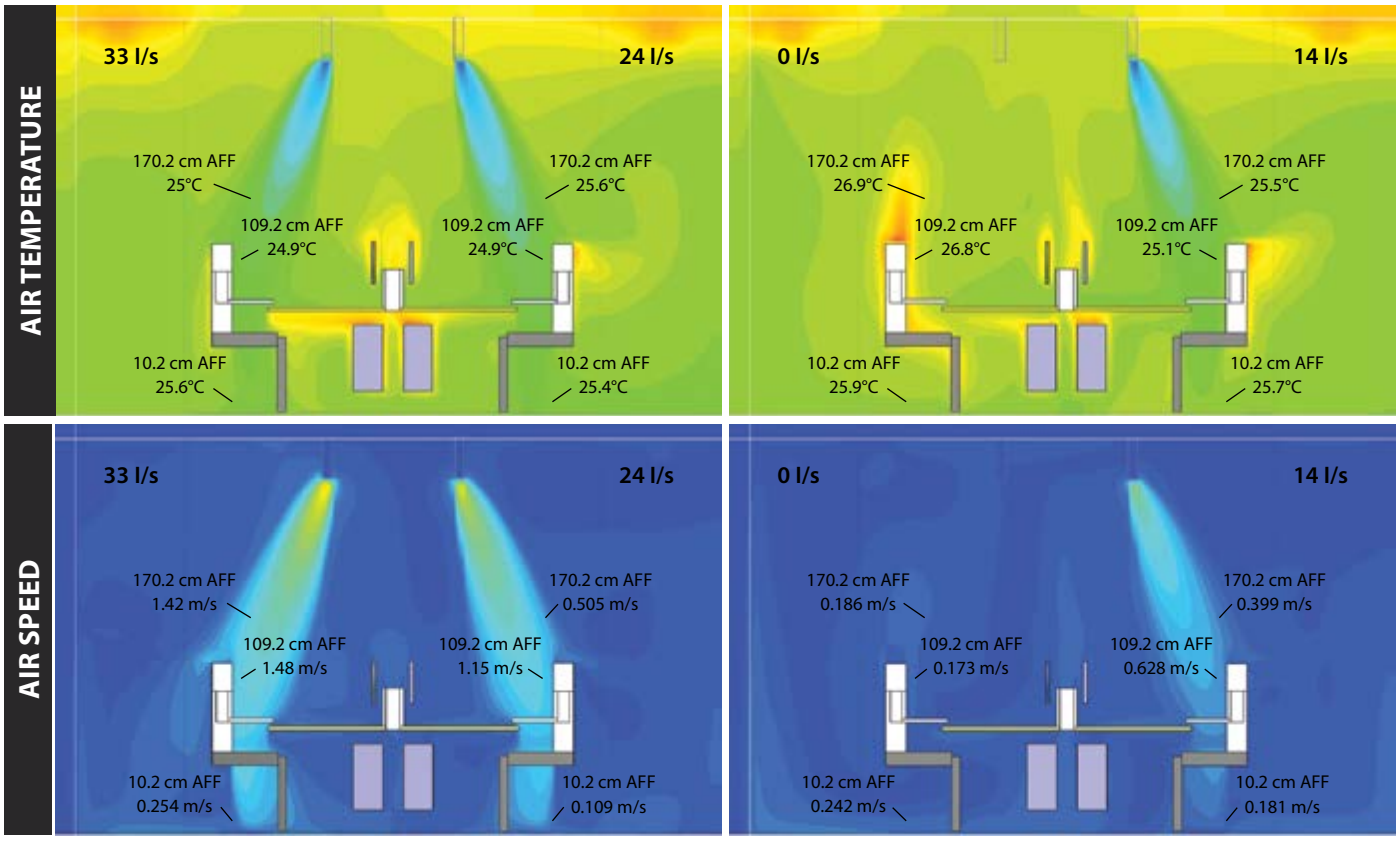

Figure 1. CFD model results for air velocity and temperature at different personal air diffuser flow rate settings.

A Responsible Urban Rejuvenation of Jakarta

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Patrick Daly has led the design of some of the past two decades' most enduring and recognizable architecture, with a special focus on tall and supertall buildings. Throughout his career, he strives to discover superior solutions to create timeless, innovative architecture. Daly is focused on designing lasting work that manifests a project's higher purpose and potential, while seamlessly considering its programmatic parameters. Utilizing a process that optimizes efficiency and responds to each project's unique demands, Daly has built a versatile and distinguished portfolio.

Paolo Testolini is Woods Bagot's Global Leader for Cities and Places, with 20 years of experience in Urban Planning and Environmental Design. He has worked internationally across a range of sectors, with specific expertise in mixed-use, retail and residential projects. His work regarding the approach to and realization of Smart Cities has been published widely. Testolini participated in the CTBUH 2018 Middle East Conference and has taken part in other international events as a panelist and speaker, sharing his passion for creating sustainable spaces and places for people to work, live and play.

Abstract

Sinking faster than any other big city on the planet, over 40% of Jakarta is now below sea level. Solutions to prevent the decay of one the world's great cities must address permeability, reducing sprawl and building dense high-rise communities. Aquifers are being depleted by both legal and illegal wells pumping out water and, consequently, the city is sinking. Future-thinking urban planning—intrinsically connected to nature and biomimicry, and building tall can reverse the damage and save the city. The centerpiece of the plan is the preservation of Jakarta as one of the region's leading cities with a macro urban concept, using advanced sustainable strategies currently deployed successfully in other regions of the world, whilst underscoring Jakarta's identity through quality places and a sustainable economy.

Keywords: Architecture, Master Planning, Mixed-Use, Sustainability, Parametric Design, Urban Planning

Introduction

Jakarta is sinking faster than any other big city on the planet. The aquifers on which the city sits are being depleted by legal and illegal wells pumping out groundwater and, as a result, the ground level is falling. More than 40% of the land area is now below sea level. Jakarta's equatorial location also makes it the region's most vulnerable city to climate disasters such as flooding (see Figure 1). Land subsidence exacerbates these risks. Sharing common causes, those threats have to be addressed together.

This ecological crisis raises the question of how Jakarta can continue to grow as Indonesia's economic engine. Indonesian President Joko Widodo (see Figure 2) has proposed relocating the capital outside of

Figure 1. Urban flooding is a persistent problem in Jakarta. © Afriadi Hikmal

Figure 2. Indonesia president Joko Widodo.
© Oscar Siagian

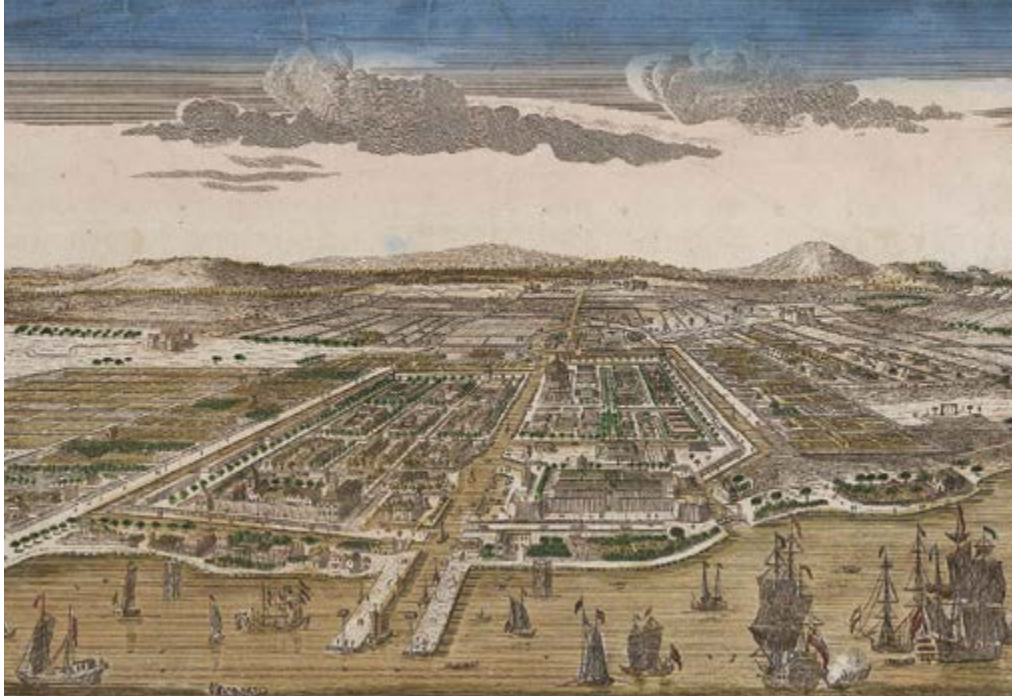


Figure 3. Historical Jakarta (then called Batavia) circa 1780. Source: Tropenmuseum

Jakarta. But with 10 million current residents, Jakarta is too important to abandon, especially if solutions are available.

A Vision for Modernization

Two issues—ecological and economic—need to be reframed to generate a vision of modernization that heals instead of damages a delicate ecology. The key to fixing the urgent problem of subsidence is to rehabilitate the underground water. As these water systems actually begin above ground, their rehabilitation goes hand-in-hand with re-establishing the city with restorative strategies.

The authors' team has developed a new plan that provides data-driven analysis to interconnect the natural context with urban parameters, producing an overall urban regeneration strategy that intervenes strategically within the fabric of the city by mitigating the sinking challenges while activating growth. The team will also develop a public, interactive platform, including mapping the underground aquifers, so that citizens, officials, and developers can learn more about their city's challenges and participate in its rejuvenation.

Existing Context

Jakarta is bounded on the south by Mount Gede and on the north by the Java Bay and Java Sea just beyond the inlet. Thirteen rivers flow through the plains north towards the sea, with the main Ciliwung arterial cutting the length of the Basin and dividing it east to west. The porous alluvial floor once captured the ample rains and allowed that water to seep underground into the aquifers that buoyed the land.

Figure 4. National monument Monas in Merdeka Square. © Healza Kurnia Hendiastutjik / EyeEm

When the Dutch arrived in the 1600s, they built a district, Kota, in the far north of the city, where to this day one of the region's most active ports operates (see Figure 3). Importing the Amsterdam model, they built a series of canals that still course through the area. While the original buildings still stand, the location is also sinking at a high rate of three-to-four inches per year, and the effects—abandoned buildings and markets, high floods—are glaringly apparent.

The current capital resides in the center of the city, around Merdeka Square (see Figure 4), critical to the Indonesian peoples' sense of freedom, as it commemorates their independence on August 17th, 1945. Aside from housing the administrative services for

50 Years of Tall Building Evolution

The default image of the skyscraper for the past 50 years in the public imagination has likely been the extruded, rectilinear corporate "box," derived from the postwar model of minimalist "International Style" glass-and-steel architecture championed by Ludwig Mies van der Rohe, and imitated by countless others. In fact, the skyscraper has been as subject to, and as much of an influence on, a wide array of architectural styles through the decades, as shown in this timeline relating predominant styles to individual landmark buildings constructed during the period. From this, a far richer, more comprehensive picture emerges.

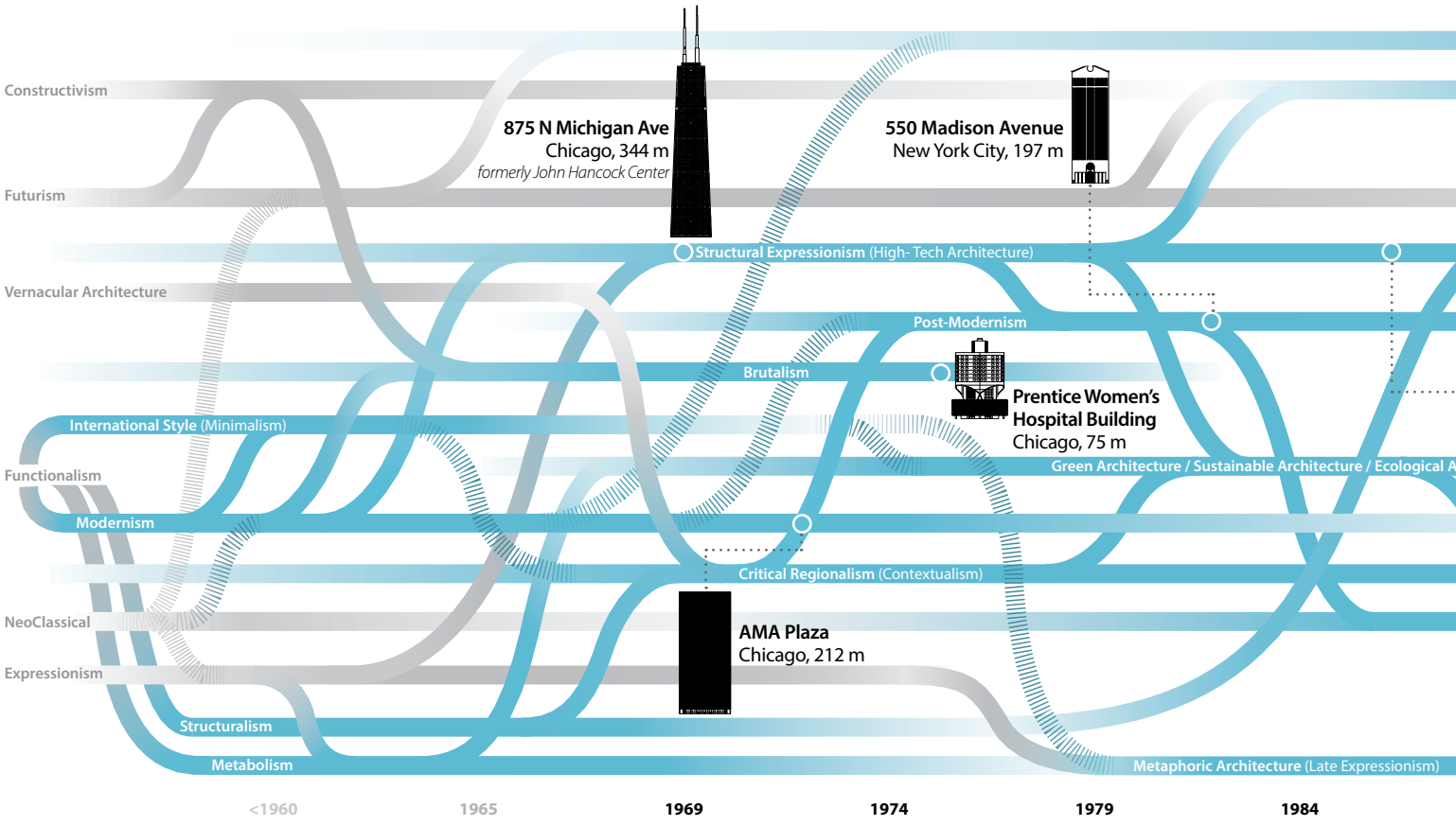
Timeline of Predominant Architectural Styles and Influences: Tall Buildings, 1969–2019

Key

- styles prominent after 1969
- styles that ended before 1969
- a style reacts against another style
- loses prominence
- gains prominence
- connection of influence

Notes:

1. The intention of this timeline is not to provide a complete collection of all architecture styles during this time period, or to provide a comprehensive list of all influences or definite start and end dates for the respective styles. Rather, it provides a diagrammatic outline of the conventional architectural styles used at a given time over the past 50 years, and major elements that influenced or were rejected by these styles.
2. While this graphic identifies current design trends, the vocabulary, analysis, and distinct classification of many emerging architectural styles are yet to undergo the same level of academic scrutiny as their historic counterparts. Thus, some contemporary styles for tall buildings may not be fully represented in this graphic.

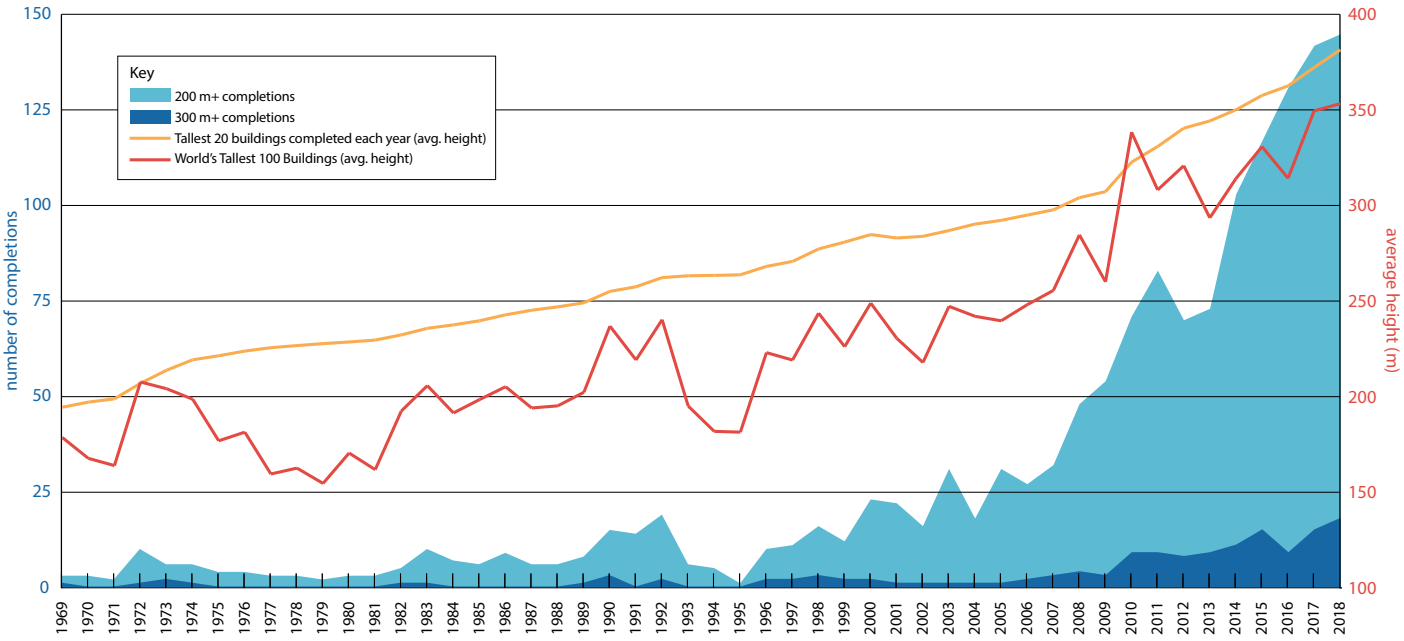


While **333 Wacker Drive** is widely considered the first example of **Postmodernism** in Chicago, the architect, William Pedersen of KPF, considered this project **"contextualism,"** due to its relationship with the Chicago River, the surrounding street grid, and the adjacent skyline.

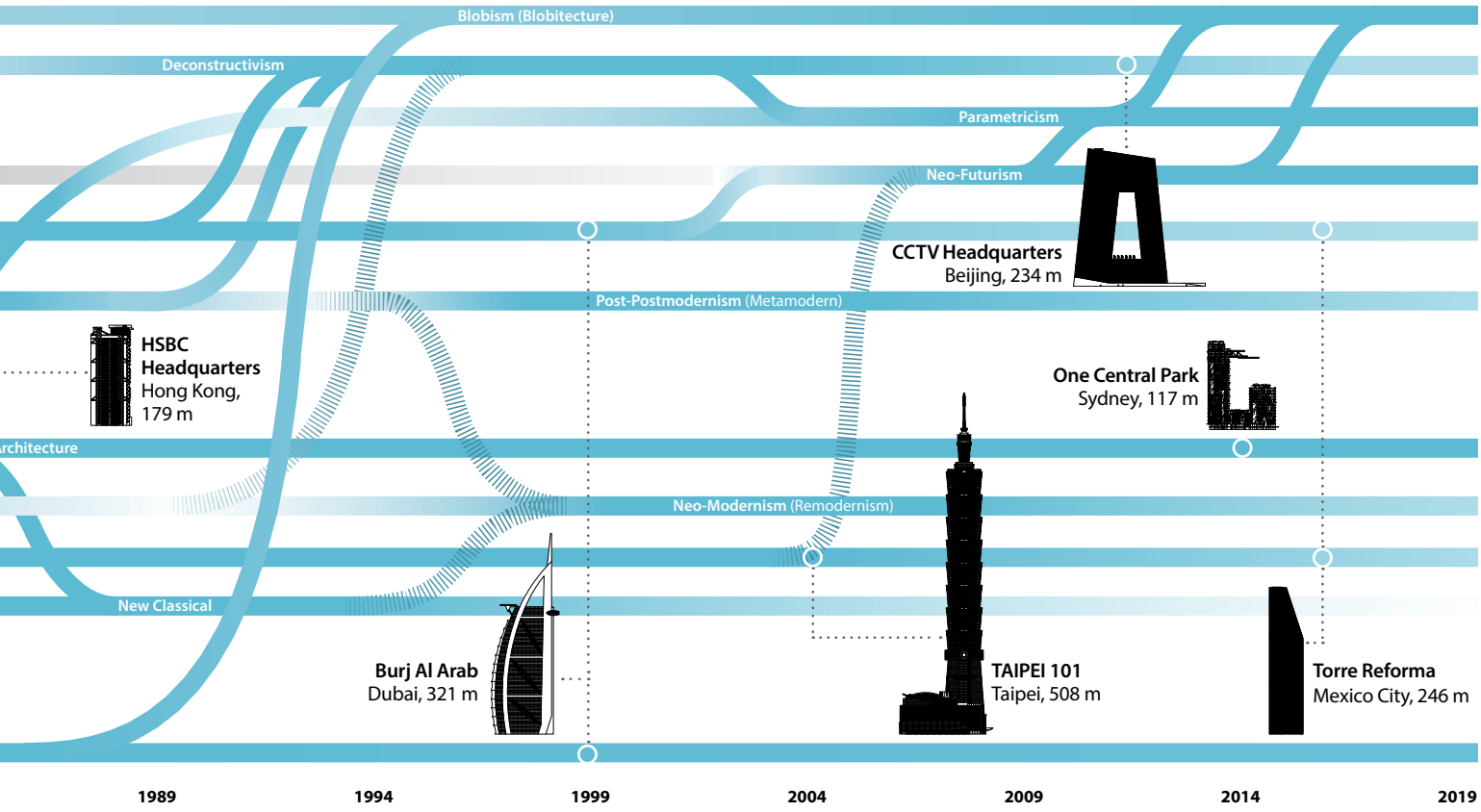
The name **"Brutalism"** derives from the French phrase *béton brut*, or **Raw Concrete**.

Average Height and Number of Buildings by Year

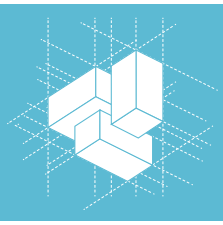
A timeline of the number of completions over 200 and 300 meters each year, overlaid with the average height of the 20 tallest buildings of that year, compared with the average height of the 100 tallest buildings at that time.



Based on Skyscraper Center data, as of September 2019



Bowellism, a "micromovement" within High-Tech Architecture, emphasized a philosophy of placing building services on the outside of a building in order to maximize interior space, as seen in **The Lloyd's Building,** London.



The tenets of **Futurism** and **Metabolism**, which were largely seen as unrealistic and unsustainable for their time, have seen a resurgence in recent years, thanks to advancements in fabrication and computer-aided design.

The Garden City in Three Dimensions

Moshe Safdie

Interviewee

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Moshe Safdie is an architect, urban planner, educator, theorist, and author. Over a celebrated 50-year career, Safdie has explored the essential principles of socially responsible design with a distinct visual language. A citizen of Israel, Canada and the United States, Moshe Safdie graduated from McGill University. After apprenticing with Louis I. Kahn in Philadelphia, Safdie returned to Montréal to oversee the master plan for the 1967 World Exhibition. In 1964 he established his own firm to realize Habitat '67, an adaptation of his undergraduate thesis and a turning point in modern architecture.

Author of four books and a frequent essayist and lecturer, Safdie's global practice includes projects in North and South America, the Middle East, the developing world and throughout Asia and Australia. Projects span a wide range of typologies, including airports, museums, performing arts, libraries, housing, mixed use and entire cities.

> "In 1967, the marketplace did not feel Habitat was reproducible. Now we have come full circle, and people are appreciating the principles behind it, and applying it within their own work."

With a career spanning back to the Habitat '67 residential complex in Montréal, Moshe Safdie's work has always evoked images of utopian science fiction, yet is grounded in sound, time-tested principles. He has a unique perspective to offer on the World Congress theme of "50 Forward | 50 Back." At 81, Safdie is showing no signs of stopping. The spectacular three-towered, "sky-pool"-bridged Marina Bay Sands project in Singapore will see a fourth tower added, with its own rooftop landscape. The massive eight-towered Raffles City Chongqing is nearly complete, and may soon claim the title of both highest and longest skybridge in the world. The recently opened Singapore Changi Airport "Jewel" features the world's highest indoor waterfall. CTBUH Editor Daniel Safarik capitalized on a rare pause in Safdie's schedule for an illuminating conversation.

CTBUH 2019
10th World Congress

Moshe Safdie will deliver a closing plenary address in the session "50 Forward: Urbanism for the Future," Wednesday, 30 October.

I'm interested is the progression of the idea of the three-dimensional city, that has gone through your entire body of work, and seems to be where you're headed as well. There has always been a strong sense of the human scale in your projects, even as they have become larger. What are some of the devices that you have used that relate the scale of human occupancy to the large gestures that the projects are also making?

In terms of scale, let's move from the domestic residential environment to the mixed-use city. In the case of purely residential projects, beginning with Habitat (see Figure 1), the key is the hierarchy of elements that make up a community. There are individuals and families, which translates into residences or houses. Then there are community groups, which have various scales of being. You have a bunch of people who live around a courtyard, you can call that "neighborliness." Then, there is a larger group of people who share schools, shopping and so on; it sort of builds up to form the entire city.

Architecture has to echo and reflect that, and it has to strive to maintain the legibility of this hierarchy. We are reasonably comfortable with a small village: it's all there; it's legible. The individual houses can be read in the fabric; they have their own identity, courtyards and various other devices define the next cluster, but when we stack it all vertically and multiply it to 50 times the density, it just takes more consciousnesses and more complexity to achieve the same ends.

So, beginning with Habitat one can see the cluster; you read the overall building in the fabric. But the original Habitat that never got built, which was proposed to the government, went further as a three-dimensional city, inasmuch as it contained the community facilities, the schools, the shops and all that. It was conceived as a mixed-use building that could contain residences, hotels or office space; and it had actually gone much further in showing how you achieve, not just a pure domestic environment, but a more mixed-use one.

For the larger Asian projects, in the same sense you fractalize surfaces where you want to make a lot of outdoor green spaces, and you break it down into legible parts as it gets larger and larger. You articulate the circulation in a way that you can read and understand its presence, both from outside and within the structures. I think seeing and understanding the circulation physically in the urban scale is yet another device to tell you where the entrances are, where movement is, unlike

when it is sitting in the depths of the building and you have no clue what is going on. Most high-rise development is problematic because it doesn't reveal all of these things. The dominant developer strategy goes for compactness as a form of economy.

The articulation of comprehensible, house-sized units is very clear in projects such as Habitat and Sky Habitat in Singapore. How does the response differ when you have a program like the commercial mini-cities of Marina Bay Sands or Raffles City?

Marina Bay Sands focuses on the top and ground. Hotels present a very different problem, but even there, I was charged with designing a single tower for 3,000 rooms. That was the original program. It would never have been a supertall (300 meters or higher) because there was a height limit. It would have been a large slab in the style of Las Vegas hotels. It would have formed a wall between downtown and the waterfront, and because I couldn't go 100 stories high, I would have to have spread into a long slab. I thought, the visibility of the harbor and downtown can't be lost. I broke it up into three, and made the big urban windows in between them open to the city. I broke it down even further, by pulling out the sidewall planes of the towers, so you read it as six buildings, via the layering that makes up the hotel rooms in each tower.

Then of course, there was a question of, in all that concentration, can you create some real leisure/recreation space? That gave birth to the SkyPark. All the roofs of the podium are part of the public realm. Even the mall in Marina Bay, which had initially been conceived as internalized, we pulled out and made it part of the promenade, so it's partially indoor and partially outdoor, and it's completely in the public realm. There, the focus is on how to make such a dense environment a true public realm, that's accessible to everybody and connects to the network of the city.

In Raffles City, we didn't go far enough in terms of the concept. There isn't enough distinction between the residential and the office and the hotel. Something we hoped to take further were the mixed uses; we might have been able to put some of the workspaces and some of the office spaces in lower levels, and then separate them via horizontal promenades and streets. The next layer might be residential, with some vertical stacking that might be legible outside the project.

Do you feel that this model, derived from the original Habitat, is replicable across all kinds of markets and all kinds of governments, and societies?

I think it is important, on one hand, to recognize regional differences. Doing this in a cold city like Montréal, as opposed to a tropical or sub-tropical climate, and depending on culture and economy, would tend to create variations. You couldn't build Habitat as I designed it in Saudi Arabia, simply because of the cultural requirement for privacy. Terraces to be enjoyed by the family can't be viewed by others, so there would be variations in the details. But in principle, the indoor and the outdoor space, the legibility, the identity, all apply. There are just variations in texture and in detail.

These principles were misunderstood after Habitat '67. People always wanted to decide if it was broad social housing or luxury housing, which was beside the point. Maybe because of the economic depression at the time, the marketplace did not feel that it was reproducible. Now we have come full circle, and people are appreciating the principles behind it, and applying it within their own work. Expectedly, you get strong visual connections, because the same principles yield the same textual urban fabric, so a whole bunch of people are acknowledging it now as the source of inspiration. That's sort of a nice thing to be experiencing.

What do you think about utopian high-rise projects in general? It seems their fates have been mixed.

Some utopian projects of the 1950s and 1960s never got built, so they remain a mystery.

Figure 1. Habitat 67, Montréal.

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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