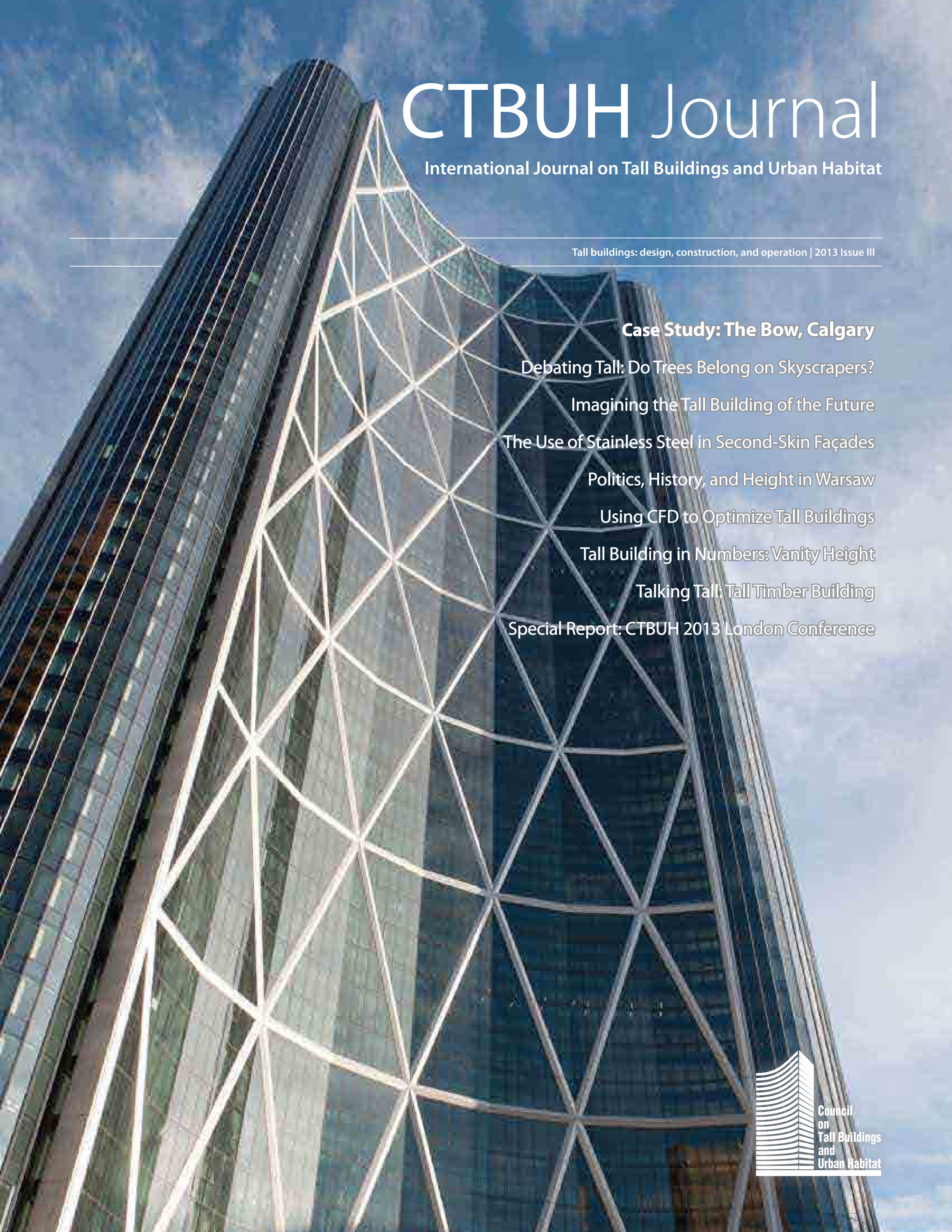

CTBUH Journal

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Tall buildings: design, construction, and operation | 2013 Issue III

Case Study: The Bow, Calgary

Debating Tall: Do Trees Belong on Skyscrapers?

Imagining the Tall Building of the Future

The Use of Stainless Steel in Second-Skin Façades

Politics, History, and Height in Warsaw

Using CFD to Optimize Tall Buildings

Tall Building in Numbers: Vanity Height

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Special Report: CTBUH 2013 London Conference

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"We have a 'wood first' policy in British Columbia, where public buildings have to consider the use of wood first and effectively prove why they can't use wood in the building design in order to proceed."

Michael Green, page 46

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

Ideal Executive Chairman Datuk Alex Ooi showing the scale model of the Tree Sparina, Penang. © The Star/Gary Chen

The Astaka, Johor Baru. © GDP Architects

Asia and Oceania

Asia and Oceania continues to be a hotbed of tall-building activity.

China BROAD Group, the company hoping to build the world's tallest skyscraper in record time, held a groundbreaking ceremony on July 20, in **Changsha,** China. The group is planning to build the 838-meter **Sky City** using its prefabricated modular construction method, which has won the 2013 CTBUH Innovation Award (see page 59).

The founder of BROAD Group, Chairman Zhang Yue, announced the tower will be completed by April 2014. However, at press time, reports circulated that Sky City did not have proper planning permission and no work had progressed since the groundbreaking.

The tower, designed to be taller than Dubai's Burj Khalifa by 10 meters, will contain a hotel for 1,000 guests and housing for up to 31,400 people, ranging from penthouses to high-density units for low-income tenants. It will also contain a hospital, schools, shops, restaurants, and offices, creating an entire city within the building.

According to BROAD Group, 90% of the building will be pre-fabricated in the company's factories, by up to 20,000 workers in four months. It will take three months for 30,000 workers to finish fabricating the units and construct the building on site.

"Land use is a top concern in China," Zhang told the audience at the CTBUH 2013 London Conference. "Occupation of the land has caused a lot of social and environmental issues. It has created huge demand for transportation and energy consumption. In the end, energy conservation is the focus of everything."

THEY SAID

"We have learnt how to make money out of tall buildings, and the value of tall buildings in the world has become really important commercially."

Emaar Properties' Chairman Mohamed Alabbar, who is considering building a skyscraper taller than Kingdom Tower. From "Burj Khalifa Developer Considers New World's Tallest Tower for Dubai to Beat Saudi." The National. May 1, 2013.

Marina Bay Financial Centre, Singapore. © Raffles Quay Asset Management Pte.

Crown Hotel Barangaroo, Sydney. © Wilkinson Eyre

The combination of land use and social issues are driving other projects in the region also. In Malaysia, **Penang**-based developer Ideal Property Group is set to launch its **Tree Sparina** high-rise condo development next month. The tower is the centerpiece of the first phase of the 10-hectare Ideal Vision Park mixed-use development project, which will ultimately be the largest affordable housing project on the island.

Malaysia's tallest residential building, a 301-meter luxury tower, may be built in the city of **Johor Baru. The Astaka** is the first tower in a US$1.2 billion development that will ultimately include three office towers, two residential towers, and a major shopping mall.

The **Marina Bay Financial Centre** celebrated its official opening May 15 in **Singapore**'s central business district. The four-tower mixed-use development has been under construction since 2006 and is almost 100% occupied.

Further south, Wilkinson Eyre Architects won the bid to design the new **Crown Hotel** in

Australia 108, Melbourne. © Febder Katsalidis/Dave Simmons

Sydney as part of a larger US$6 billion Barangaroo Redevelopment Master Plan. The firm's organic design is an abstraction of three stems growing out of the ground and twisting as they reach the top of the structure.

Sydney Central Station redevelopment plan. © Urban Growth NSW / Architectus

THEY SAID

"I don't worry about making a bad project anymore, because I can just clad it with plants."

Winy Maas, MVRDV, tongue-in-cheek, during an address to Otis College of Design, Los Angeles, February 20, 2013.

At the time of the competition, Barangaroo was Sydney's biggest regeneration project since the 2000 Olympics. However, a new project in the city center could potentially double that record. The New South Wales government is recruiting international companies to help redevelop the space over Sydney's **Central Station** inner-city rail lines and adjacent land. The project intends to create a new heart for the city and would become the largest urban renewal project in Australia.

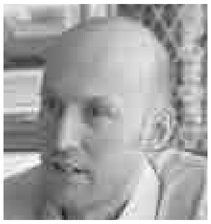
Not all tall building projects are progressing as well Down Under. Plans to build what may have been the Southern Hemisphere's tallest skyscraper in **Melbourne** have been abandoned. Designers abandoned plans for **Australia 108** after a series of code requirements rendered the proposal "impossible." New plans for the site are expected to be shorter than 100 stories.

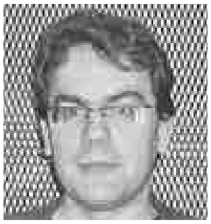
Middle East

A few years of economic decline slowed construction in the United Arab Emirates, but a series of new projects have rolled out, indicating that commercial property developers are finding renewed confidence in the market. The **Dubai Multi Commodities Centre (DMCC)** is planning to build what could ultimately be the world's tallest commercial tower. Ahmed Bin Sulayem, Executive Chairman of DMCC, has selected a plot of land located on the southern side of the Jumeirah Lake Towers master-planned community. The company is still in the

Case Study: The Bow, Calgary

Rising Above and Bending Aside To Make Space and Place


James Barnes


Jonathan Hendricks

Authors

James Barnes, Partner

Foster + Partners
Riverside
22 Hester Road
London SW11 4AN
United Kingdom
t: +44 20 7738 0455
f: +44 20 7738 1107
e: jbarnes@fosterandpartners.com
www.fosterandpartners.com

Jonathan Hendricks, Senior Principal

Yolles
Queen's Quay Terminal
Suite 550–207 Queen's Quay West
Toronto, ON M5J 1A7
Canada
t: +1 416 561 5245
e: jonathan.hendricks@ch2m.com
www.ch2mhill.com/yolles

James Barnes
James Barnes is a partner at Foster + Partners and was project architect for The Bow, a major new high-rise landmark for Calgary and an environmentally sustainable headquarters for one of Canada's leading energy corporations. He joined Foster + Partners in 2001 and became a partner in 2008. His current role extends to the procurement and management of work across North America and the Middle East, where he is involved in a range of projects, including the competition-winning design for a new skyscraper at 425 Park Avenue, New York, and a new development within the King Abdullah Financial District, Saudi Arabia.

Jonathan Hendricks
Jonathan Hendricks is a Senior Principal at Yolles, having worked with the firm for 20 years from bases in Toronto and London. He has been privileged to have had the opportunity to collaborate with some of the world's most renowned architects such as Foster + Partners, Rogers Stirk Harbour + Partners (formerly Richard Rogers Partnership), Raphael Viñoly Architects, Pelli Clarke Pelli (formerly Cesar Pelli Architects), and others, on a full range of project types in Europe, North America, and Asia. Jonathan acted as the Structural Design Principal on The Bow, and contributed to the structural design concepts that define the building.

The Bow, which opened officially in June, is the latest and most ambitious high-rise development in the Canadian city of Calgary, designed for the energy companies Encana and Cenovus. The client's aim was to create a world-class building that would be a defining landmark on the city's skyline. Today, with its distinctive curved diagrid steel structure visible from far away, its "sky gardens" and dramatic full-height atrium, the scheme has delivered on those goals. Not only has this 237-meter giant set records as Canada's largest steel-framed building, Calgary's tallest tower, and the highest Canadian tower outside Toronto; Calgarians have already adopted it as a symbol of their city.

In these pages we explore the origins of the Bow, and how the design met the challenges of the brief. We look at its complex engineering and construction, and consider its contribution to the city that surrounds it.

A Tall Order

In 2005, Foster + Partners were selected to design new headquarters for Encana Corporation, a North American energy giant based in Calgary. With its employees formerly housed in a number of buildings around the city, Encana needed a landmark building that would bring its staff together and, in providing a superb working environment, help the company to attract and retain the most talented people. Their vision translated into a brief for almost 186,000 square meters of office accommodation, along with abundant retail and public space.

The client and local planning authorities envisaged the building as a major presence: The first spectacular marker in a masterplan to develop a new zone of the city, it was also expected to meet city policy goals for sustainable development.

Above all, the building would be a commercial headquarters for several thousand staff. As well as requiring space for a great many people, Encana had a particular way of dividing up their teams which would need to be reflected very precisely in the design of the building. The budget was strict, the schedule was demanding and there were real obstacles to overcome, including planning restrictions affecting the height of the building. But for

Figure 1. The Bow, Calgary.

Figure 2. View to the city.

the design team, this was an opportunity to design a new star in the world's high-rise firmament.

The City

The province of Alberta, where Calgary is located, is epic in the scale of its landscape, agriculture, and mineral reserves. From its first settlement in 1875 and its history of pre-eminence in the cattle trade, Calgary has grown into one of Canada's largest cities and is a magnet for big business, particularly the global energy industry. It is "an optimistic city, a city on the rise," as Mayor Naheed Nenshi described it during the Bow's opening ceremony – an exciting place into which to introduce an iconic tower.

The city is surrounded by wide-open spaces, so that The Bow announces itself dramatically, from far away, and from many vantage points (see Figure 1). It sits at the confluence of the rivers Bow and Elbow. The great prairies roll eastwards and, stretching out toward the snowy caps of the Rockies to the west, is Banff National Park. The views from within the building are magnificent on every side (see Figure 2).

The climate is dry, with the highest number of sunny days in Canada. The summers are pleasant, while winter temperatures plummet far below freezing, occasionally rocketing upwards when the warm Chinook wind arrives. Alberta is a place of strong winds, and Calgary boasts a wind-powered rapid transit system. A leader among Canadian cities for energy efficiency, it has set out a sustainable development plan for a whole century, and was the first Canadian city to impose a Leadership in Energy and Environmental Design (LEED) certification policy on all public buildings.

The Site

The Bow is an important catalyst for renewal, and forms the first phase of a masterplan covering two city blocks on the east side of Centre Street, a major axis through downtown Calgary, south of the Bow River. A new quarter, the East Village, will be developed nearby, extending from the downtown district into a neglected area that was once, before its decline, the center of Calgary.

Design Process

Early in the design process, the client visited London for a two-week workshop. During this time, the design team created a shared "working studio" dedicated to the project, with daily design reviews from Lord Foster, the architects' design board, and the client team. By the end of the period, the team had worked through hundreds of potential layouts and had agreed a concept to take forward. The collaborative approach continued throughout, with regular meetings held in Toronto, Calgary, and London.

The curved shape of the building was chosen because it made best use of the site area, provided the most perimeter accommodation and created a well protected outside public space within the arc's south-facing embrace (see Figure 3). It also shed wind load far better than an equivalent-sized rectangular building, reducing stress on the structure.

The team explored six alternative themes for the main structural configuration for the tower. Along with internal diagrams, they looked at a perimeter tube system and at a number of different diagrid patterns. The most efficient diagram was provided by a hybrid solution, which is described in the section on structure.

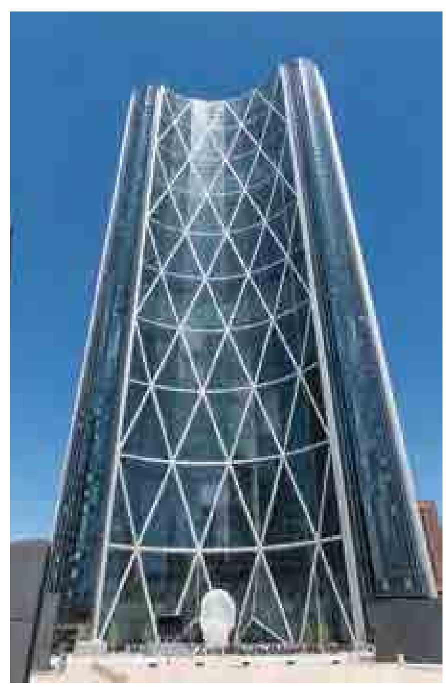


Figure 3. Diagrid structure.

Imagining the Tall Building of the Future

Josef Hargrave

Ralph Wilson

Authors

Josef Hargrave, Senior Consultant, Foresight + Innovation
Ralph Wilson, Mechanical Engineer

Arup
13 Fitzroy Street
London W1T 4BQ
United Kingdom

t: +44 20 7755 4357
e: josef.hargrave@arup.com / ralph.wilson@arup.com
www.driversofchange.com / www.arup.com

Josef Hargrave
Josef Hargrave is a senior Foresight and Innovation consultant at Arup. He is responsible for the firm's foresight activities and consulting services across the Europe Region. Josef works for clients spanning a wide variety of sectors and markets. His projects combine corporate foresight with Arup's global engineering and consulting expertise, providing clients with unique insights on the future of the built environment. Josef's passion is the future of cities: the structures, spaces, technologies, and experiences that will make life in the city sustainable in the long-term.

Ralph Wilson
Ralph Wilson is a mechanical engineer and sustainability specialist based in Arup's Building Engineering London group. He is an innovation enthusiast with a curiosity for the novel, and a particular interest in design that supports environmental awareness and behavioral change.

Predicting the future is an impossible task. One will never get it absolutely right. However, that does not make it a pointless exercise. Instead, such a discussion is a tool to enable conversations about the possible, and to inspire people to think beyond today and look at some of the trends that will shape our future.

The below text and corresponding illustration (see Figure 1) do not aim to depict what all buildings, or even all tall buildings, will look like in the future. Instead, we want to create a vehicle for conversation. We present a tool to highlight some of the functions and characteristics we may expect from cities and buildings in the future, and to explore what that may entail for the sector as a whole.

Can you imagine?

By 2050, the human population will have reached nine billion; of this, 75% will be living in cities. Until then, climate change, resource scarcities, rising energy costs, and a preoccupation with preventing and minimizing the effects of the next natural or man-made disaster will undoubtedly shape our vision of the built environment. As major cities reach their boundary limits, extending transit networks and patterns of urban sprawl will no longer provide an effective solution. Instead, demographic and lifestyle changes will serve as major catalysts in the shift toward increasingly dense and vertical urban environments.

As the future of cities takes center stage, what will we come to expect from the design and functions of the buildings within them?

The year 2050 will mark a generation of internet-native adults who will have lived all their lives engaging with smart devices and materials. They will have experienced technological breakthroughs that will redefine how human beings interact – not only with each other, but with their surrounding environment. We will live in cities where everything can be manipulated in real-time and where all components of the urban fabric are part of a single smart system and an "internet of things." These expectations set the tone for an environment that invites adaptation with ease; a place where hard infrastructure, communication, and social systems are seamlessly intertwined with a conscious necessity to integrate and engage in sustainable design practices.

Future technology will be far more focused on producing unique solutions for individual

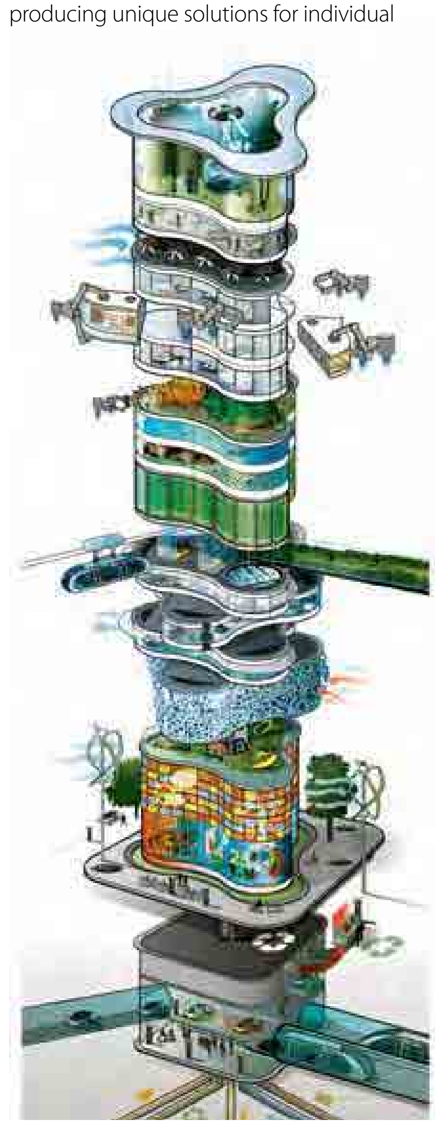


Figure 1. Arup Foresight: future urban building. © Rob House / Arup

Figure 2. Flight Assembled Tower. © Francois Lauginie

people. The necessity for our surrounding environment to inherently understand an individual's preferences and personal needs means all facets of the building network could respond to the specifics of each unique user, down to an individual's genetic composition.

In 2050, the urban dweller and the city are in a state of constant flux – changing and evolving in reaction to emerging contexts and conditions. The urban tall building of the future fosters this innate quality, essentially functioning as a living organism in its own right – reacting to the local environment and engaging the users within. A dynamic network of feedback loops, characterized by smart materials, sensors, data exchange, and automated systems merge together, virtually functioning as a synthetic and highly sensitive nervous system. In this sense, the building's structure is highly adaptive and characterized by indeterminate functions – a scheme in which space and form are manipulated depending on the time of day or the user group currently activating the structure. The system presents a spatial and formal condition that changes constantly. The structure's components are designed to be dynamic, intelligent, and reactive – it is a living structure activated by interaction with the users and its surrounding environment. Structural systems merge with energy, lighting, and façade systems to extend beyond the confines of physical limits, and to shape a new type of urban experience.

Can you imagine a building that has flexible components designed for continuous adaptability?

In this emerging age, significant developments in construction will advance current practices – prefabricated and modular structural systems will be moved and assembled by robots that work seamlessly together to install, detect, repair, and upgrade components of the building system. Technology, spaces, and façades will be rapidly modifiable, dictated by factors such as the addition or subtraction of program, density of dwellers, or other context-based and environmental cues.

There are already clues to this emergent future, albeit at a smaller scale. The installation *"Flight Assembled Architecture"* (see Figure 2) for example – a collaboration between architects Gramazio & Kohler and roboticists at ETH Zurich's Institute for Dynamic Systems and Control – features flying "quadcopters" that construct a six-meter-high twisting tower out of foam bricks. The tower itself is a 1,500-brick, 1:100 model of a "vertical village" conceived by the architectural team. Four flying robots work collaboratively to build it at a rate of 100 bricks per hour, with their movements dictated by digital design data that is translated into mathematical algorithms.

In the high-rise of 2050, materials will feature intelligent design and will be formulated as high-performance composites made from recycled and renewable elements, providing functions such as self-repair or purification of the surrounding air. Already in Mexico City, this idea is becoming a reality. At the Hospital Manuel Gea Gonzalez, the design firm Elegant Embellishments has installed a tiled façade over-cladding on the hospital's Torre de Especialidades (see Figure 3) that utilizes a

Figure 3. Torre de Especialidades, Mexico City. © Alejandro Cartegena

The Use of Stainless Steel in Second-Skin Façades

Catherine Houska

Author

Catherine Houska, Senior Development Manager

TMR Consulting
3209 McKnight E Dr.
Pittsburgh, PA 15237, United States
t: +1 412 369 0377
e: chouska@tmr-inc.com
www.tmrstainless.com

Catherine Houska
Catherine Houska is an internationally recognized expert on the architectural applications and atmospheric corrosion of stainless steel. She consults on new projects, provides forensic evaluations, and consultants for numerous international industry associations.

Houska is the author of over 150 articles and papers, and speaks regularly at conferences and workshops around the world. She is active in standards development (ASTM A01 steel and E60 sustainability, CRSI and ACI) and represents the Nickel Institute at the USGBC.

She holds a BS, Metallurgical Engineering & Materials Science, Carnegie Mellon University and an MBA, Weatherhead School of Management, Case Western Reserve University.

Exterior walls are being transformed from relatively simple climate-defensive mechanisms to more active membranes that screen weather to reduce energy requirements. Innovative designs are being used on award-winning projects around the world, and these concepts could be applied to a much broader range of buildings. Bioclimatic architecture refers to designing buildings to improve thermal and visual comfort. These designs incorporate systems that provide protection from summer sun, reduce winter heat loss, and make use of the environment for heating, cooling, and lighting buildings.

Long before central heat or air-conditioning, mankind modified building designs to suit the climate and achieve natural cooling or improved heat retention. The practice of screening exterior façades from sun or winter storms is an old concept that has regained popularity with growing international interest in bioclimatic design concepts that better harmonize buildings with their environments. These concepts can be important tools in achieving energy-consumption reduction goals, while transforming exterior walls from relatively simple "climate-defensive" mechanisms into more active membranes. These screens are increasingly being used on larger structures.

Bioclimatic façade systems can consist of traditional overhangs and setbacks, but increasingly a layer of screens is being placed outside of the primary environmental barrier. These screens serve as a double envelope or second skin to achieve the building's energy reduction goals. European and US research has improved the ability to model the screens' potential benefits. This article will discuss new modeling developments and illustrate how several types of exterior stainless-steel weather screens are being used on award-winning and innovative hybrid bioclimatic façade projects around the world and explores the potential for application of bioclimatic façades in high-rise buildings.

The emergence of whole-building life cycle assessments (LCAs) as a sustainable design tool is increasing awareness of the high environmental impact of repeated material replacement and encourages specification of durable products that will remain in place over the project's service life. Stainless steel is a logical material for corrosive environments with industrial pollution or salt exposure, particularly when there would be minimal to

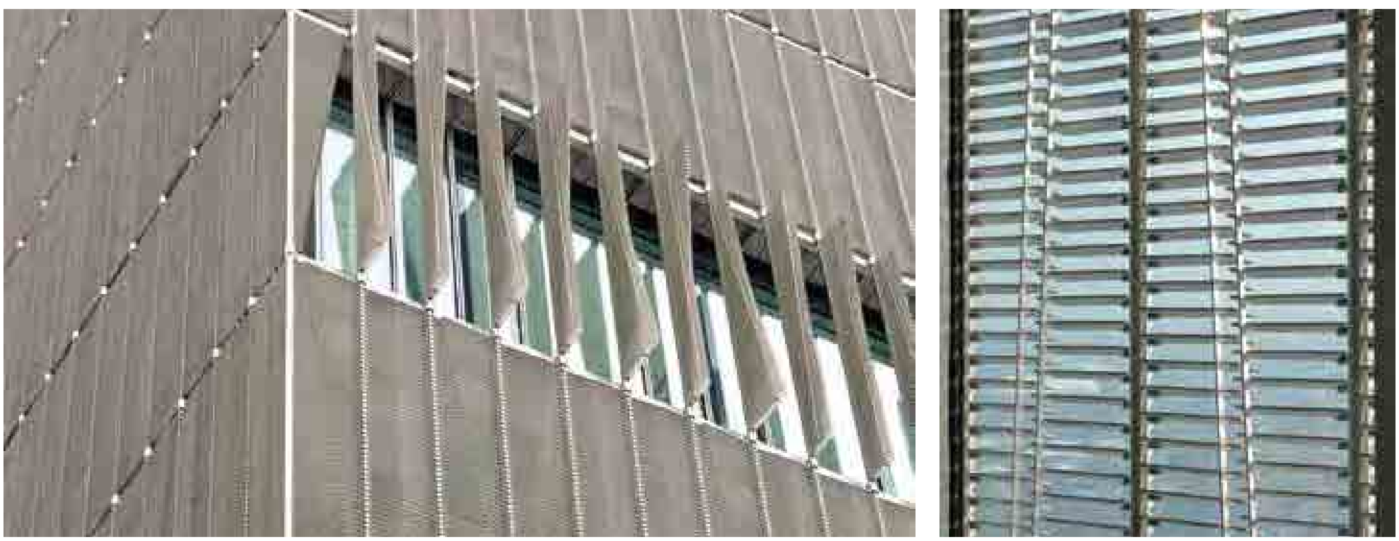


Figure 1. Type 316 stainless steel exterior sunscreens in varying styles were used on the ThyssenKrupp corporate campus to actively adjust to seasonal and weather conditions to reduce energy requirements. © ThyssenKrupp AG

no maintenance and there is an expectation of at least 50 years of service.

Bioclimatic Second-Skin Façades

Bioclimatic second-skin façades are typically between 0.2 and 4.5 meters away from the environmental barrier. The intermediate space can be used to moderate heat, light, wind, noise, pollution, and other environmental stresses. This space can provide shading, light and air redirection, thermal load balancing, and resistance to heat loss and gain.

The building inhabitants' connections with their surroundings are improved by these designs. The inner environmental barrier wall frequently has operable windows or provides other provisions for ventilation. The second skin at least partially shades the inner wall, reducing summer cooling requirements while still allowing daylight to enter the building. During the winter, these outer second skins can shelter the inner wall from winter storms, while allowing the sunlight to enter and warm up the building, lowering heating loads.

Bioclimatic second-skin weather screens can either be active, computer-controlled systems that constantly adjust to the environment or low-tech, fixed passive systems. Here, we focus on four screen types and provide both active and passive screen examples:

- fixed and operable louvers;
- woven mesh;
- perforated panels; and
- green (i.e., vegetated) façade screens.

Tension-supported systems, such green screens and louvers, parallel the inner wall, while lightweight framing can be used to vary the distance between the inner insulated skin and second skin, making seamless curving, geometric, and other shapes possible by using woven mesh or perforated panels.

These second weather-screening skins can cost-effectively reduce energy consumption while improving the building's appearance, at a much lower cost than is possible through modifying load-bearing walls (Murray 2009 & 2011). These façades can also enhance building security and safety by providing visual barriers.

In fixed, woven meshes, perforated panels, or louvers, several factors influence the solar shading benefit and natural interior lighting levels, the opening size, solar reflectance and transmittance influence the solar shading benefit and natural interior lighting levels. Therefore, seasonal daylight modeling is necessary for design optimization. In climates where the sun angle significantly changes with each season, fixed louvers may allow sunlight to enter in the winter, while reducing heat gain in the summer.

Active Second-Skin Façades

There are many variations on active second-skin façades, but they are typically operable metal louvers, wooden slats, or perforated panels supported by stainless-steel tension systems or frames. All have integrated computer-controlled mechanical systems that work with the building's heating and cooling systems to respond dynamically to varying conditions (Gonchar 2007, RMI 2008).

Sections of the shading system open or close with changes in the sun's trajectory or the weather. This allows active second-skin façade systems to maximize the benefits of solar radiation or lighting, minimize heat gain, or shield the inner wall during winter storms, reducing heat loss. Natural ventilation is maximized to improve occupant health and control building temperature levels.

Energy is necessary to operate these systems, and maintenance of the mechanical and sensing systems is required. Active second-skin façades have been particularly popular in Europe, Asia, and Australia, although some of the earliest examples are in North America (e.g., Occidental Chemical Center, Niagara Falls, New York, completed in 1980).

ThyssenKrupp Campus

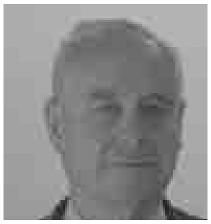
The TKQ architect consortium, consisting of JSWD Architekten and Chaix & Morel, designed a seven-building corporate campus in Essen, Germany for ThyssenKrupp, which

> “Bioclimatic second-skin façades are typically between 0.2 and 4.5 meters away from the environmental barrier. The intermediate space can be used to moderate heat, light, wind, noise, pollution, and other environmental stresses.”

was awarded a Gold-level German Certificate for Sustainable Buildings. Energy requirements are expected to be 20 to 30% below statutory requirements. The integrated computer-controlled environmental systems adjust the natural ventilation and sun-shading levels to respond to changing weather conditions. When used with geothermal heating and cooling, the need for air-conditioning was eliminated, and winter heating requirements were greatly reduced (see Figure 1).

All the buildings are simple, glazed shapes made more interesting by their Type 316 sunshade systems. Building Q2, the corporate conference and training center, has custom, perforated, passive sunscreens. Active motorized horizontal slat sunshades were used on Building Q1. Motorized triangular, square, and trapezoidal fins were employed on Buildings Q5 and Q7. A dull abrasive blasted finish was applied to the outside, while a highly polished finish was applied to the inside of the slats and fins. Adjustment of the slats' angles determines interior light and temperature levels.

Politics, History, and Height in Warsaw



Ryszard Kowalczyk

Jerzy Skrzypczak

Wojciech Olenski

Authors

Ryszard Kowalczyk, Structural Engineer
University of Ecology and Management in Warsaw
ul.Wawelska 14, Warszawa 02-061, Poland
t: +48 604 212 829
e: r.kowal@ubi.pt

Jerzy Skrzypczak, Architect
Biuro Projektów Architektury J&J Spółka z o.o.
ul. Zygmunta Glogera 3 lok.17
Warszawa 02-051, Poland
t: +48 22 823 10 38
e: bpajj@bpajj.com.pl

Wojciech Olenski, Urban Planner
Municipal Office of Town Planning and Development Strategy of the City of Warsaw
Pl.Defilad 1, pok.1319, p.13, Warszawa 00-901, Poland
t: +48 22 656 65 19
e: w.olenski@poczta.onet.pl

Ryszard Kowalczyk is a professor at the University for Ecology and Management in Warsaw. He has compiled more than 60 years of research, consulting, and teaching in various universities and research institutes in Poland and overseas. He has also been a UNESCO expert for vocational and technical education in the Middle East (1983–1989). His main fields of research are: structures, dynamics of structures, and structural systems of tall buildings.

Jerzy Skrzypczak was an academic teacher and supervisor of theses at the Technical University of Warsaw from 1955 to 2002. Skrzypczak has won numerous awards and distinctions in urban planning and architectural competitions, including the Distinguished Honor Award of the Association of Polish Architects in 2005. Since 1998 he has been the general designer and partner of Biuro Projektów Architektury J&J Spółka z o.o.

Wojciech Olenski is an urban planner for the City of Warsaw. Since 2007, he has specialized in city landscape modeling, with special reference to simulation of high-rise buildings in the spatial structure and panorama of the city, and the preservation of the UNESCO registered historical complex. He has elaborated a methodology for evaluating the location and form of tall buildings.

This paper describes the present high-rise boom in Warsaw, which is related to unprecedented development of the capital of Poland in the last 15 years and the spatial expansion of a high-rise zone created 40 years ago on the western side of the city center. Today, Warsaw is ranked fifth in Europe in terms of the number of high-rises and is considered the second-most preferred city in Europe (after London) for high-rise investment (see Table 1). The contemporary skyline of Warsaw combines the historic panorama of the Old Town complex (a UNESCO World Heritage Site since 1980) with a large cluster of modern skyscrapers around the centrally located Palace of Culture and Science. For the past five years, by using 3-D computer simulations, it has been possible for urban planners to design a future city skyline with new skyscrapers while maintaining visual protection of the Old Town silhouette.

Introduction

The contemporary skyline of Warsaw, as seen from the waterfront of the Vistula River, is composed of two independent landmark clusters (see Figure 1): one is visible on the escarpment in the form of a historical silhouette of the Old Town, defined by church and palace towers; the other, located in the distant background is the New City with skyscrapers. The coexistence of two different concentrations of building types, extending parallel to the river, is the defining characteristic feature of the Warsaw cityscape.

Presently, the city skyline is changing its scale and shape. This is most visible in the Western Center District (so called "Warsaw Manhattan") – a special area with skyscrapers designed over 40 years ago as a counterpoint to the domination of the controversial Palace of Culture and Science. In the last 10 years, the number of high-rises erected in this area has doubled, and the height of towers has increased by 50%. But the biggest changes will occur in the near future (see Table 2), as the next ten high-rises are planned here, half of which will exceed 200 meters in height. In total, in the last seven years, developers submitted plans for nearly 70 tall buildings.

Digital Model of Warsaw Cityscape Transformation

For the evaluation of the city skyline, a comprehensive urban elaboration was developed in the Municipal Office of Town Planning and Development Strategy of the City of Warsaw based on precise methodology, the consideration of different scales of perception of tall buildings and the use of a digital 3-D model of the city as a tool. The virtual 3-D model of Warsaw was made in 2007–2008 by two specialized geodetics and geoinformatics companies, using data from aerial photos and field measurements. The digital model is compatible with the GIS software used by urban planners.

Figure 1. Structure of the left-side panorama of Warsaw seen from the Vistula River. © Wojciech Olenski

City	Existing 100 m+ tall buildings	Under construction	Planned	Tallest building height in 2013 (rank in Europe)	Tallest building planned
Moscow	93	23	8	339 m (1) Mercury City	360 m Federation Towers – Vostok Tower
Istanbul****	42	21	23	261 m (5) Sapphire Tower	–
London	38	6	44	306 m (2) The Shard	–
Frankfurt am Main	30	2	23	259 m (6) Commerzbank	369 m Millennium Tower
Paris***	27	1	6	231 m (16) Tour First	320 m Hermitage Plaza
Warsaw	17	4	20*+30**	237 m (18) Palace of Culture & Science	282 m Kulczyk Investment Tower

* Projects approved by City Hall (with land use conditions or in local development plans)
** Projects waiting for the decision of City Hall
*** Includes Courbevoie, the location of La Défense
**** Considered to be part of Europe

Table 1. European cities with the greatest number of buildings taller than 100 meters. Source: City of Warsaw documentation and CTBUH Skyscraper Center.

Name	Architects	Height	Status	Function	Comments
Kulczyk Silverstein Properties Tower	A. Wyszynski	282 m	proposed	mixed-use	–
Trade Tower Center	J. Skrzypczak J. Jańczak	235 m	proposed	offices	on the site of Intraco II Tower
Palace of Culture and Science	L. Rudniew	231 m	1955	office	protected monument
Warsaw Spire	Jaspers-Eyers Architects	220 m	2015	offices	conflict with UNESCO skyline
Złota 44 Tower	D. Libeskind	192 m	2013	apartments	–
Warsaw Trade Tower	Majewski, Wyszynski, Hermanowicz Architekci/RTKL	208 m	1999	offices	conflict with UNESCO skyline
InterContinental Hotel	T. Spychala	164 m	2003	hotel	–
Rondo 1	Skidmore, Owings & Merrill	159 m	2006	offices	–
Cosmopolitan	H. Jahn	159 m	2013	apartments	–
Warsaw Financial Center	J.Skrzypczak J.Jańczak / KPF/ Epstein & Sons	144 m	1999	offices	2008: winner of Trane Showcase Building Award
Prudential	M. Weinfeld	69 m	1936	offices	protected monument
Cedergren / PASTA	B. Brochowicz-Rogoyski	55 m	1908	offices	protected monument

Table 2. The highest buildings in central Warsaw (including the oldest).

The two main objectives of the analysis are protection of the historical cityscape and creation of a modern city center. Tall buildings are studied, both as architectural objects and urban structures. The analysis allows visualization and review of all newly proposed tall buildings, enabling a decision process with regard to the buildings' siting and height.

Practical objectives of the analysis concern the limitation of existing and new skyscraper zones, subjecting some areas to mandatory height limits (in the background of the UNESCO complex) and defining the maximum number and size of tall buildings in the city center. This is related to the so-called "visual absorption capacity" (VAC) in relation to the cityscape. In a climate where the scale of tall buildings is increasing every year, this analysis helps drive discussion about the future shape of city panoramas, and the possible limits of Warsaw landscape transformation.

Tall Buildings as a Main Feature Of the Expanding City Center

Throughout the history of the spatial development of Warsaw, the city center was always marked by the highest buildings and towers visible in the panorama. In medieval times, the most important landmark of Warsaw skyline was a Gothic cathedral with an enormous 80-meter tower, which was captured on many historical drawings of the city skyline. The tower was a great engineering achievement, not only because of the height but also due to very difficult foundation conditions. Unfortunately, after 100 years it was destroyed by a hurricane in 1602.

The first real high-rise that served as an office building was the headquarters of the Swedish telephone company Cedergren, also known as PASTa, completed in 1910 in the "Chicago School" style. With its height doubling the width of the street frontage, the 55-meter tower had an interesting quasi-historical façade and an observation terrace on the top.

The first modern skyscraper in Warsaw was built between 1931 and 1933 for the Prudential Insurance Company and quickly became the highest building in the city, and a symbol of modern Warsaw. At the time it was the second-highest building in Europe. Its elegant 66-meter tower was accented by stone façades. It was built on a welded steel frame, one of the first such solutions in the world and was designed by Stefan Bryła, one of the pioneers of welded structures. Current reconstruction plans calls for restoring the 1936 television station mast built on the roof of the skyscraper and destroyed in World War II. Both high-rises, PASTa and Prudential, have been preserved in

Using Computational Fluid Dynamics To Optimize Tall Building Design

Authors

Ahsan Kareem
Seymour M. J. Spence
Enrica Bernardini
Sarah Bobby
Daniel Wei

NatHaz Modeling Laboratory
University of Notre Dame
156 Fitzpatrick Hall
Notre Dame, IN 46556
United States
t: + 1 574 631 5380
f: +1 574 631 9236
e: kareem@nd.edu / sspence@nd.edu / ebernard@nd.edu / sbobby@nd.edu / lakeat@gmail.com

Ahsan Kareem is the Robert M. Moran Professor of Civil Engineering and Geological Sciences and the director of the NatHaz Modeling Laboratory at the University of Notre Dame. His research uses computer models and laboratory and full-scale experiments to study the dynamic effects of environmental loads under winds, waves, and earthquakes in order to understand and predict the impact of natural hazards on the constructed environment and to develop mitigation strategies that enhance the performance and safety of structures.

Seymour M. J. Spence is a Research Assistant Professor at the University of Notre Dame, USA. His main interests are centered on the areas of aleatory dynamics and optimization theory applied to large-scale and uncertain structural systems. His research is currently focusing on the performance-based topology/design optimization of structural systems subject to combined time-variant/-invariant uncertainties, as well as methodologies and procedures for the efficient CFD-based aerodynamic shape optimization of tall buildings.

Enrica Bernardini earned her PhD from the University of Perugia, Italy, in 2012. She then joined the NatHaz Modeling Laboratory at the University of Notre Dame, USA, and is currently a Visiting Research Assistant Professor. Her main research interest is the definition of reliability and performance-based methodologies for the design of wind-excited tall buildings. More recently, she has been focusing on the possibility of developing strategies for the shape and topology optimization of tall buildings.

Sarah Bobby is a graduate student at the University of Notre Dame and is currently researching the use of performance-based analysis methods and their integration with topology optimization procedures to obtain efficient conceptual designs for aerodynamically sensitive tall buildings.

Daniel Wei's expertise is in Computational Fluid Dynamics (CFD). He has been developing various modules with OpenFOAM (an open-source finite volume code) since 2005. He has strong skills and experience in various CFD-related fields, including mesh enhancement and moving, turbulence modeling (RANS, LES and hybrid), and high performance computing.

In recent years, designers of tall and supertall buildings have been challenged to reconcile modern architectural features with new sustainability and efficiency requirements. In response to these needs, this paper examines innovative tools that can give the designers of tall buildings the possibility of thoroughly exploring the design space, both in the definition of the external shape of the building and in the identification of its structural system. These tools are envisaged as fundamental contributions to the development of a global integrated framework for the shaping and topological optimization of tall buildings.

Definition of the Geometric Form

While designers clearly understand that geometric modifications, such as the introduction of chamfered corners, can significantly reduce the aerodynamic response of tall buildings (Miyashita 1993, Kareem 1999, Gensler 2010, Xia 2010), a systematic approach for taking full advantage of aerodynamic building sculpting is still missing. Indeed, in the preliminary phases of the design process, several configurations are often considered and studied in order to identify the one that yields the best aerodynamic performance. Such assessments have to be conducted via wind-tunnel tests, as the relation between the external shape of a structure and the resulting intensity of the aerodynamic excitation is not straightforward, and the beneficial influence that specific geometric modifications can have on the wind loads is difficult to predict. As an alternative to wind-tunnel tests, computational fluid dynamics (CFD) has recently gained interest in civil-engineering applications. Due to the resources and time necessary for performing each test, geometric form definition can only be carried out as a trial-and-error procedure, in which a limited number of possible configurations, chosen based on experience, can be examined.

CFD simulations can be used to investigate feasible shape changes and discover the optimal configuration in a large search space, and have thus become the subject of increasing interest (Bobby 2013).

Identification of the Structural System

When dealing with the difficulties associated with the design of structural systems for buildings of extreme height and complicated geometric profiles, the classic approach is essentially based on adapting traditional systems that have been defined based on experience with relatively simple vertical forms. This hinders the exploration of innovative structural solutions, which until now have been available to a select few (e.g., Khan 2004, Katz & Robertson 2008). For this reason, topology optimization techniques – which aspire to automatically determine the optimum material layout of a structure and are widely used in the aerospace and mechanical engineering fields – are now gaining attention in structural system design (Sarkisian 2011, Stromberg 2012).

In particular, recognizing that the numerous uncertainties affecting the problem may have a strong influence on the results, researchers have become interested in performing performance-based topology optimization (PBTO), in which the inherently uncertain structural environment is explicitly considered. Additionally, in the traditional design process, the structural system definition and the detailed-design stage are seen as distinct and subsequent. However, the global mechanisms characterizing the behavior of the structural system and the properties of the structural elements are highly interactive and, if an optimal structural efficiency is desired, topological and detailed design optimization should be carried out in an integrated fashion. This objective is extremely demanding, and is here envisaged as a challenge to be addressed at a later stage. Having said this, the aforementioned objective must be kept in mind during the development of topology optimization procedures, therefore allowing a later integration.

The Proposed Framework

The development of a framework that guides the tall building design process through the various stages and allows the thorough exploration of the design space would be of primary interest to designers. This paper introduces a framework for the CFD-aided shape optimization and PBTO of tall buildings, through the presentation of innovative design strategies, which are presented as part of a future global design process for tall buildings.

The Shape Optimization Strategy

The shape optimization strategy, which represents the first stage of the proposed framework, consists of finding the external geometry of the building that gives the best aerodynamic performance and fulfills at the same time a set of constraints. The initial geometry is described in terms of a limited number (N) of parameters, collected in the vector $\mathbf{q}$, representing the design variables of the optimization algorithm. The objective function to be minimized can be chosen as a generalized aerodynamic measure, $G(\mathbf{q})$, related for example to the fundamental generalized forces acting on the building or to the base moments. Constraints can include limitations on the floor area or a maximum allowable shape change. The optimization problem can therefore be posed mathematically as:

Find: $$\mathbf{q} = \{q_1, \ldots, q_N\}^T \quad (1)$$

to minimize $G(\mathbf{q})$ (2)

subject to:

$$C_r(\mathbf{q}) = 0, \; r = 1, \ldots, R \quad (3)$$

$$D_s(\mathbf{q}) \leq 0, \; s = 1, \ldots, S \quad (4)$$

where equations (3) and (4) represent R equality constraints and S inequality constraints, respectively, imposed on the design variables. The presence of the constraints is particularly important, as it allows for control of desired features of the shape, and to avoid selecting a final shape purely as the result of an automated procedure. For every optimization cycle, the use of CFD analysis allows the estimation of the objective function for the current configuration, which is subsequently modified until convergence is reached.

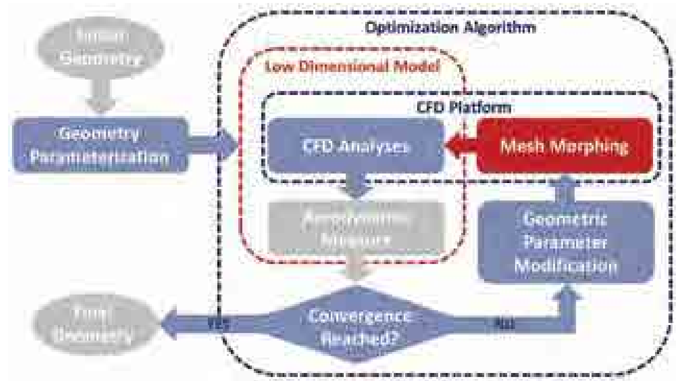


Figure 1. Overview of the proposed shape optimization strategy.

This strategy, which couples CFD simulations and optimization, poses many challenges. First of all, a suitable optimization algorithm should be robust and able to provide a steady and fairly rapid convergence. In addition, the practical implementation of this framework is highly constrained by the necessity of a trade-off between trustworthiness and time-efficiency of the CFD analysis embedded in the optimization loop, which requires multiple evaluations. For the success of the optimization strategy, choosing the most appropriate and efficient methodology for solving the Navier-Stokes equations within the CFD analysis is of paramount importance.

The proposed shape optimization strategy is shown in Figure 1. With the aim of overcoming – partially, at least – the aforementioned difficulties, we propose adopting a low-dimensional model of the load distribution, whose features will be described in the following pages. We also examine mesh-morphing algorithms within the CFD platform.

The low-dimensional model

The proposed low-dimensional model, which assesses the effect of wind loads acting on the entire structure, is introduced as an essential component of the aerodynamic optimization strategy. The aim of the model is to allow rapid assessment of the objective function, during each iteration of the optimization process, from a limited number of two-dimensional CFD simulations, therefore avoiding the need to carry out time-consuming three-dimensional simulations involving the entire structure. The use of this model is fundamental for the practical implementation of the proposed shape optimization strategy, because it allows a substantial reduction of the computational burden associated with the CFD simulations and consequently expedites the optimization, while at the same time providing a reliable estimation of the objective function.

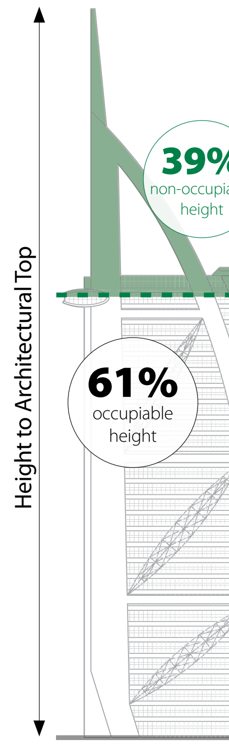
The low-dimensional model allows the reconstruction of the entire floor-load spectral structure from information pertaining to a limited number of two-dimensional simulations carried out on n representative slices, as schematically represented in Figure 2. The model is based on defining a vector of parameters $\mathbf{q}$ that give a three-dimensional parametric representation of the building's envelope. The choice of the number and position of the slices over the building height will depend on the complexity of the geometry (typically, in presence of marked changes of section over the height, one slice can be chosen for each cross-section). The adoption of this model will allow the evaluation of the objective function from the reconstructed floor-load spectral structure, considerably reducing the computational burden associated with the simulations and therefore significantly contributing to the applicability of the optimization procedure.

In a similar fashion to the models developed for the assessment of the cross-power spectral

Vanity Height: the Empty Space in Today's Tallest

We noticed in Journal 2013 Issue I's case study on Kingdom Tower, Jeddah, that a fair amount of the top of the building seemed to be an unoccupied spire. This prompted us to explore the notion of "vanity height" in supertall[1] buildings, i.e., the distance between a skyscraper's highest occupiable floor and its architectural top, as determined by CTBUH Height Criteria.[2]

Note:
[1]Historically there have been 74 completed supertalls (300+ m) in the world, including the now-demolished One and Two World Trade Center in New York.
[2]For more information on the CTBUH Height Criteria, visit http://criteria.ctbuh.org

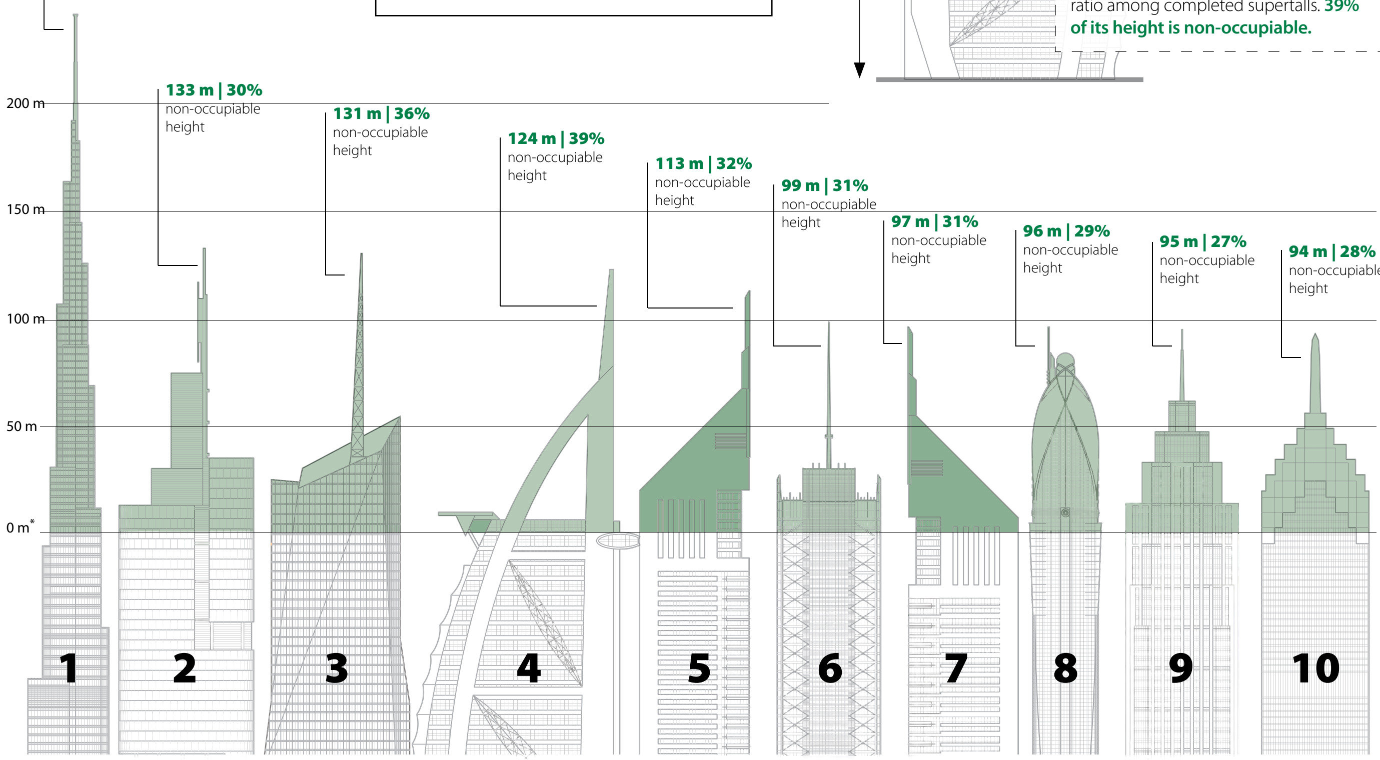


Burj Al Arab
With a vanity height of nearly 124 meters within its architectural height of 321 meters, the Burj Al Arab has the highest non-occupiable-to-occupiable height ratio among completed supertalls. **39% of its height is non-occupiable.**

World's Ten Tallest Vanity Heights (as of July 2013 data)

Below are the ten tallest "Vanity Heights" in today's completed supertalls.

* The highest occupied floor height as datum line.
** The highest occupied floor height.



Burj Khalifa 828 m | 585 m** *Dubai, 2010*	**Zifeng Tower** 450 m | 317 m** *Nanjing, 2010*	**Bank of America Tower** 366 m | 235m** *New York, 2009*	**Burj Al Arab** 321 m | 198 m** *Dubai, 1999*	**Emirates Tower One** 355 m | 241 m** *Dubai, 2000*
New York Times Tower 319 m | 220 m** *New York, 2007*	**Emirates Tower Two** 309 m | 213 m** *Dubai, 2000*	**Rose Rayhaan by Rotana** 333 m | 237m** *Dubai, 2007*	**The Pinnacle** 360 m | 265 m** *Guangzhou, 2012*	**Minsheng Bank Building** 331 m | 237 m** *Wuhan, 2008*

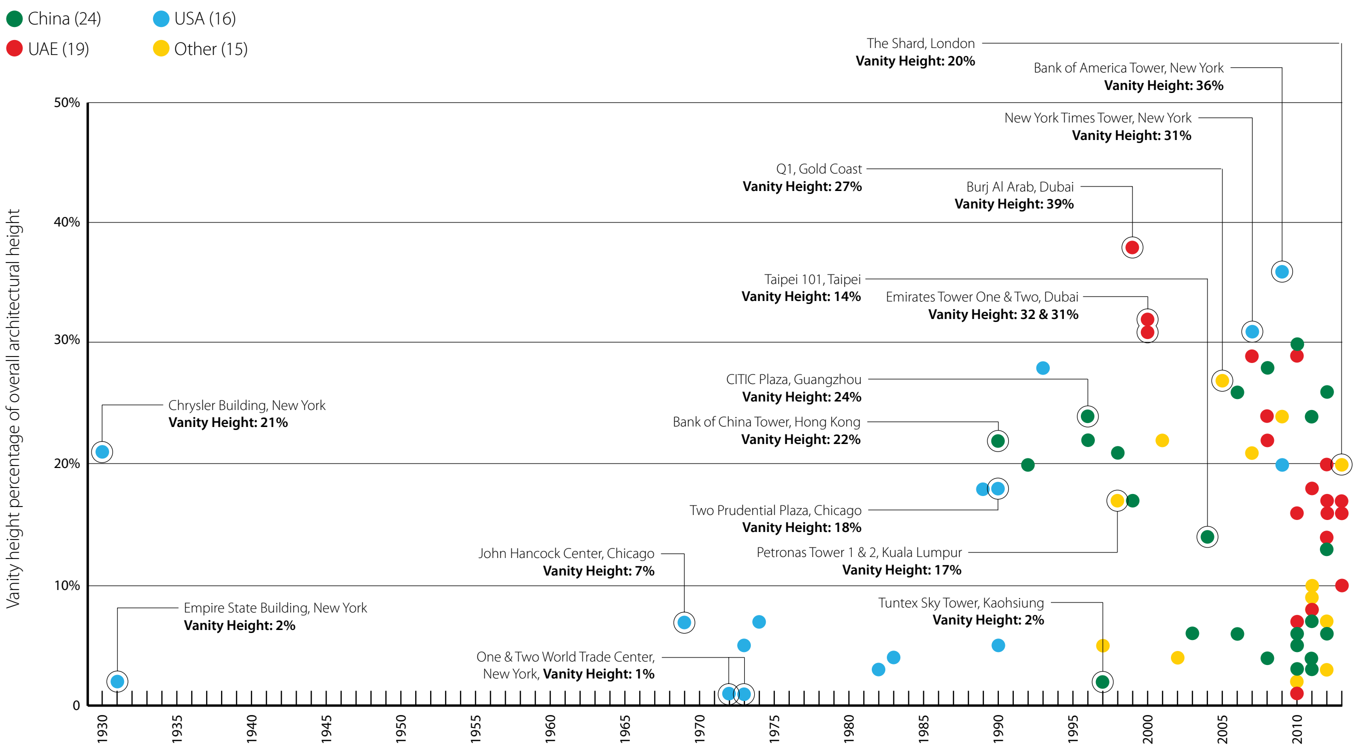
Without Vanity Height, 44 (61%) of the world's 72 supertalls[1] would measure less than 300 meters, losing their supertall status. The tallest of these is Guangzhou's 390-meter CITIC Plaza.

According to current CTBUH Height Criteria regarding telecommunications towers, a 50% vanity height would deem any structure a non-building!

At 244 meters, the Burj Khalifa's Vanity Height would be an impressive stand-alone skyscraper. If built in Europe, it would become the continent's 11th-tallest building.

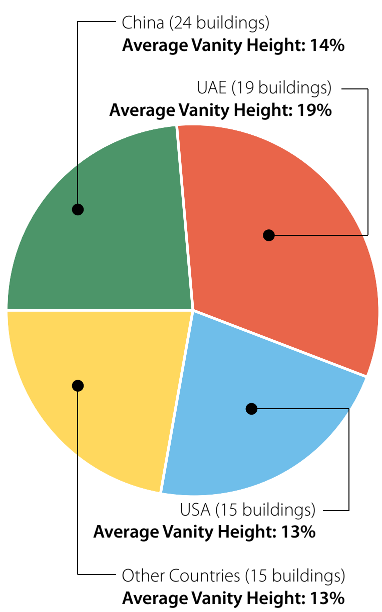
History of Vanity Height

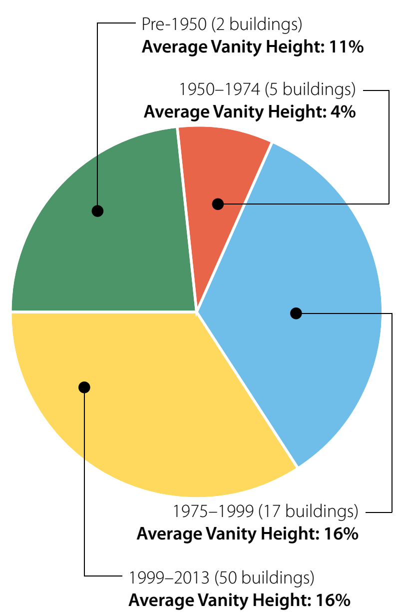
The graph below charts Vanity Height as a percentage of overall architectural height for some of the world's 74 completed supertalls.[1]

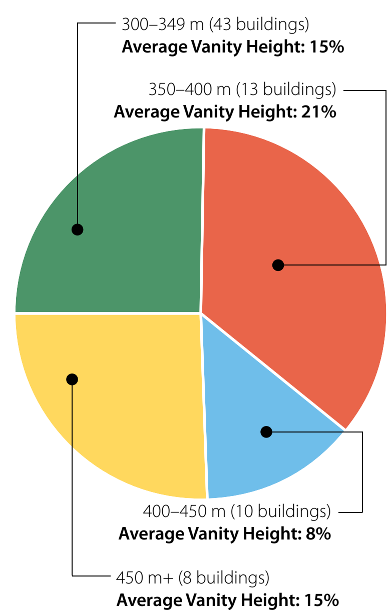


Vanity Height in Detail

The graphs below examine the average Vanity Height of completed supertalls by country, date of completion, and architectural height







With no spire, The Index, in Dubai, has a vanity height of only 4 meters – just 1% of the building's overall height.

New York City contains two of the tallest 10 Vanity Heights – and is set to gain a third with the completion of One World Trade Center in 2014.

The Ukraina Hotel in Moscow, Russia (206 m, b. 1955) has 42% Vanity Height – the "vainest" building overall in the CTBUH database.

Finding the Forest Through the Trees: Building Tall with Timber

Michael Green

The pursuit of new technologies for building tall has fostered a new perspective on one of mankind's oldest building materials: wood. Through research such as the recently-published ***The Case For Tall Wood Buildings,*** Vancouver architect Michael Green has been singing the praises of using mass timber to build tall structures for years, and has just broken ground on what will be the tallest wood building in North America. Green spoke with CTBUH Editor Daniel Safarik about the critical role wood will play as a practical and sustainable building material in a dense urban future.

Interviewee

Michael Green, Principal

Michael Green Architecture
57 E Cordova Street
Vancouver V6A 1K3, Canada
t: +1 604 336 4770
e: hello@mg-architecture.ca
www.mg-architecture.ca

Michael Green
Michael Green is dedicated to bringing attention to several of the overwhelming challenges in architecture today. The first is climate change and how the built environment is an enormous contributor to the factors damaging the very environment designers and architects are seeking to improve. The second is the profound reality that over the next 20 years, 3 billion people, or 40% of the world, will need a new affordable home. Michael believes in championing a shift to new ways of building that will complement the intersection of man's greatest building challenges.

How did you develop an interest in pushing the limits of building tall in wood?

It comes from building with my grandfather in his shop as a kid. He loved to woodwork. I've been around wood all my life.

Later, I was working for Cesar Pelli, and we were doing things like the Petronas Towers. I thought steel and concrete were interesting, but the innovations were just building on previous engineering breakthroughs.

It was informative to see how inspired communities became by building tall. I watched the excitement in Malaysia about the Petronas Towers, and how that kind of transformed the image of the country.

Figure 1. North Vancouver City Hall, Canada. © Michael Green Architecture

The role of tall buildings as icons for their communities is an interesting one. It creates a competitive spirit between communities, allowing us to push the limits.

What made you think about building tall with wood?

I started building more and more with wood, realizing that it was an absolute land of opportunity from an innovation point of view.

About 10 years ago in Central Europe, the introduction of cross-laminated timber (CLT) panels started to change the way buildings could be done at a larger scale. CLT is a great product, but is really just one of many mass timber panels that would allow us to really dramatically change the scale of what we can build with.

CLT is made by taking boards that can be 1x4s, or 2x4s, or 2x6s. These are laid down side by side, pasted with glue, and then another set is laid on top at 90 degrees, creating what is like a jumbo piece of plywood.

It creates a panel that has great inherent strength and allows you to use a wood grade that you would never use for structural material on its own, because it's of poor quality. When you start gluing it together in this way it gets the inherent benefit of this cross-laminated strength. So it allows us to use trees that are of a lower quality.

Why would we want to use lower-quality trees?

In North America we are losing huge tracts of our boreal forests to the mountain pine beetle. If you fly over British Columbia, Washington, Colorado, and Idaho, there are huge tracts of dead trees. They typically go from being a deep green to red. The mountain pine beetle used to die off every winter because of cold. Now, because of climate change, it's not dying off. So the beetle has just devastated the forest.

CLT gives us a chance to use this otherwise dead forest as a building material that sequesters carbon. Otherwise, the trees just fall back to the forest floor and rot, releasing all the carbon that they've ever sequestered during their life back to the atmosphere.

How do wood buildings "sequester" carbon?

These are vast tracts of dead forest. And so when you use them for forestry, that carbon stays in that product, until we put it in a building and it burns, or the wood rots. As long as it's in a protected building, it becomes a great sequestration vehicle. When you clear the trees then you're giving opportunity for new trees to grow back and increase the return of an otherwise dead forest. Today, it often ends up being shipped to China, and used to make formwork for concrete buildings. So, the idea that somehow we're saving trees by going with concrete is completely not true.

What was your breakthrough project with mass timber?

The North Vancouver City Hall project is not a tall building, but uses laminated strand lumber (LSL) in a really new way (see Figure 1). Ironically, it came with the downturn in the world economy. The wood industry, which hadn't been very focused on innovation, realized they could sell the full panels.

They lightened up their attitude, and then we showed them what could be done. I was down at Weyerhauser talking to their CEO and they're just kind of waking up and going, "Wow, this is exciting."

Why did we not identify this opportunity earlier?

To me, architects have been focused on the future of sustainable building at a very suburban scale. You see a lot of straw-bale, rammed earth and stacked containers. But to say "that's the future" is nonsense. Those are great, interesting, fun stories, but that's not where the energy is. The energy has to be an urban environment. Big buildings are the future. There's no question. So we needed to kind of step back and say, "How can we build in the future, using a rapid renewable, carbon sequestering material, at a big scale?" And mass timber panels are what allow us to do it. We still are going to use glue-lam beams and columns, but now we have the panels, and that means our floors can be built out of something completely different.

Were there any precedents to your concept?

CLT platform construction has been done before, but that approach requires a whole lot of load-bearing internal walls and doesn't do well with lateral loads at height. It doesn't work in an environment where you want lots of planning flexibility. A developer doing a tower wants the freedom to say, "I want the walls here, or I want to grow this suite and shrink this suite." They don't want to be hemmed in by load-bearing structural walls. So that became an important goal for me.

How was your approach different?

I wanted to show that tall office buildings could be made of wood. To do that, we had to develop a whole new structural approach, which developed into Finding the Forest Through the Trees (FFTT).

I got together with Equilibrium Consulting, who are world-class wood engineers, and I said, "Guys, has anybody done something like this before?" It's a very simple structure, but it is really much more akin to balloon framing, where the walls go all the way through and the floors are hung between the walls, rather than stacked on top of the floors.

That does two things. It dramatically reduces the shrinkage. And it allows us to have these long vertical walls in the cores, which creates this great lateral bracing, and allows us to have an open column plan for each floor plate, allowing it be an office building or a flexible residential building.

When we tested this theory, what we found is that we got to 30 stories, and we actually just stopped even trying to go higher, because we knew people were talking about "tall" wood buildings being 10 stories.

What is your major proof point?

Wood is significantly lighter than concrete. That means you're not fighting the types of forces that you have in a seismic event, as you would be with a heavier concrete structure.

The really rigorous work we put into the tall wood study was focused around important questions. How is this going to work structurally? What's the market for it? What kind of flexibility do you need in a plan like I just described to make this work in a real marketplace? What's the cost of one of these buildings, and how does that compare to concrete? What's the carbon footprint, what's the energy footprint? What are the implications for envelope design, what are the implications for acoustic design?

So we did ***The Case for Tall Wood Buildings*** to say, "Here's why this makes sense and here are the parameters for measuring it as a successful solution."

Has that led to projects?

I have a brand new 12-story residential wood

> "Cross-laminated timber gives us a chance to use this otherwise dead forest as a building material that sequesters carbon. Otherwise, the trees just fall back to the forest floor and rot, releasing all the carbon that they've ever sequestered…"

CTBUH London Conference Gathers The Best of Tall Building Industry

Reporting by Rachel Coleman, *Alinea Consulting*; Sian Disson, *World Architecture News;* Robert Lau, *CTBUH* & Daniel Safarik, *CTBUH*

The 2013 CTBUH International Conference, *"Height and Heritage,"* was held in London from June 11–13, gathering more than 750 of the world's leading tall building owners, developers, contractors, architects, engineers, planners, policy-makers, and others. They ought to ultimately answer the pressing question: is Europe correct in taking its cities skywards and, if so, what do building designers, builders, and operators need to do to create their own brand of skyscrapers, appropriate to both the context and the age? While consensus may not have been reached on this singular question, the exchange of information and insight was of an unprecedentedly high level of quality.

Here are some of the highlights:

Opening Plenary: The Challenges of Building Tall in a Historic Urban Fabric

Antony Wood, *CTBUH (chair);* Peter Wynne Rees, *City of London;* Richard Pilkington, *Oxford Properties* & Carmine Bilardello, *Willis Group*

The opening plenary made it clear why the steering committee chose London as the venue this year.

As an introduction, Executive Director Antony Wood quoted one of Britain's most famous citizens and architectural observers. His Royal Highness Prince Charles had addressed the last CTBUH conference in London, in 2001, before the current burst of tower design and construction.

Wood regaled the audience with Charles' cutting words for the progenitors of "commercial macho turned into adolescent fantasy," but acknowledged that the Prince had a point when he pleaded with developers and city planners to place "buildings with their heads in the clouds" firmly with "their feet on the ground."

"Are tall buildings the answer?" Wood asked. "Is Prince Charles' message then as relevant as it is now?"

Peter Wynne Rees, City Planning Officer for the City of London, gave a presentation that could hardly have been engineered to be a more direct answer to that question. Celebrating the diversity and vitality of the 2,000 year-old City, Rees said that, counter-intuitively, a medieval city, densely settled and well-connected, might be the ideal ground for skyscrapers – so long as they do not impede the very characteristics that make a city appealing in the first place.

Noting that over 90% of 380,000 City workers commute by public transport, Rees said, "How can we make buildings more sustainable? By building them in a sustainable place. If you build a "sustainable" building in a place people reach mostly by car, you are wasting your time."

Criticizing edge-of-city developments (towers notwithstanding) such as Croydon, Canary Wharf and La Défense, Rees maintained that older districts in city centers are the ideal

Delegates listen in during the opening plenary session.

Session Snapshots

The Urban and Public Realm

Sir Stuart Lipton, *Lipton Rogers LLP (Chair);* Sir Terry Farrell, *Farrells;* Lee Polisano, *PLP Architecture* & Graham Stirk, *Rogers Stirk Harbour + Partners*

There was no shortage of provocative statements at the conference; this panel may have held the record. Sir Terry Farrell said he viewed the insistence on maintaining view paths to and from St. Paul's Cathedral as effectively creating "Hausmannized boulevards in the air," comparing London's planning constraints and heritage preservation laws to Baron Georges-Eugene Haussmann's design for Parisian boulevards under Napoleon III.

Turning a similarly critical eye to the interior environment, Sir Stuart Lipton said, "People will protest an animal kept in a cage all day, but not an office worker confined in a limited-exposure cubicle… We are moving from factory farming of people in high density-office layouts to free-range digerati," which could provoke a new line of more sociable skyscrapers, he added.

Sir Stuart Lipton discusses skyscrapers and society.

ground where young and enterprising people can intersect accidentally while having fun and working hard – which is how partnerships and ideas form, and money is ultimately made.

"If we are going to build beehives that poke through the clouds to accommodate people who need space, we have to do it carefully without messing up the gossip networks, because that is the compost where the flowers grow," Rees said. Despite his career as a city planner, Rees seemed to be saying that the best places are those where unplanned interactions happen with frequency. Towers are fine, as long as they contribute to, rather than drain, the energy. Putting a tower in a green field is like a morbid variation on "Field of Dreams": build it and they will come, but they will be the walking dead unless there is a real city that interchanges with its buildings meaningfully.

"Don't build tall to change your fortunes," Rees said. "Build tall because you are already successful and have run out of space. And when you do, do it well."

Next, Richard Pilkington, senior vice president of Oxford Properties described how London in 2008 was solidifying its role as one of the world's top financial centers, then found itself shaken as the rest of the world by the crash. "Now, having emerged from global crisis and, we hope, headed to full recovery, it is important for us to discuss what has changed," he said. "Banks are no longer a reliable source of funding; only well-capitalized investors can help. Investing and developing tall buildings in today's economic climate leaves no room for error." As such, the eccentric shapes of buildings in the British capital has less to do with the "look-at-me" iconic ambitions for which they are often pilloried in the press, than it does with the need to, first and foremost, be marketable, but also, to meet extremely constrained regulatory and financial conditions.

This was not to say that marketing and commercial verve are unimportant, or that they cannot be a part of context or built heritage. This point of view was provided by Carmine Bilardello, senior vice president of Willis Group, the construction insurer responsible for the Willis Building at 51 Lime Street, London and occupier of the Willis Tower, renamed from the Sears Tower, in Chicago.

Bilardello posited that today's corporate towers really are cathedrals, and that they serve as important a role in bringing people together and inspiring them as their ecclesiastical precedents.

"Publicity is about baptizing the building and making it a part of the culture," he said, noting that Prince Andrew had dedicated the Willis Building in the company of a priest. To be successful, tall buildings must engage the public while reinforcing the corporate brand at the same time.

Bilardello said he believes strongly in the integrity and importance of central cities, even in an era marked by much discussion of technology-enabled distance working.

"We did 700 interviews with people under age of 35" when planning its consolidation into 51 Lime Street, Bilardello said. " They all said, 'I don't want to work from home. I want to be in this

Peter Wynne Rees speaks during the opening plenary.

Richard Pilkington presents on the London market.

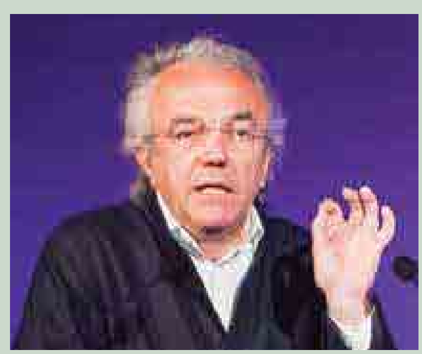
Carmine Bilardello of Willis Group presents during the opening plenary session

Session Snapshots

Building Tall's Environmental Challenges

Albert Williamson-Taylor, *AKT II (chair);* Kamran Moazami, *WSP;* John Kilpatrick, *RWDI;* Helmut Jahn, *Jahn Architects &* Werner Sobek, *Werner Sobek Group*

Werner Sobek presented a series of hard-hitting facts in this session, providing delegates with a number of points to mull over at the evening's dinner. He explained that our burgeoning population has used 50% of the available petroleum in the world and, should we continue to consume it at the same rate, we could run out by 2030. "We have an exploding population and an emissions problem," he explained, concluding, "We do not have an energy problem. We have a consumption problem."



Werner Sobek discusses the need for improved sustainability.

About the Council

The Council on Tall Buildings and Urban Habitat, based at the Illinois Institute of Technology in Chicago, is an international not-for-profit organization supported by architecture, engineering, planning, development, and construction professionals. Founded in 1969, the Council's mission is to disseminate multi-disciplinary information on tall buildings and sustainable urban environments, to maximize the international interaction of professionals involved in creating the built environment, and to make the latest knowledge available to professionals in a useful form.

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

The Council is the arbiter of the criteria upon which tall building height is measured, and thus the title of "The World's Tallest Building" determined. CTBUH is the world's leading body dedicated to the field of tall buildings and urban habitat and the recognized international source for information in these fields.

Council on Tall Buildings and Urban Habitat

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S.R. Crown Hall
Illinois Institute of Technology
3360 South State Street
Chicago, IL 60616

Phone: +1 (312) 567 3487
Fax: +1 (312) 567 3820
Email: info@ctbuh.org
http://www.ctbuh.org

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