# CTBUH Journal

International Journal on Tall Buildings and Urban Habitat

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

**Kingdom: Creating a One-Kilometer High Tower**

Skyscraper Reborn in Venezuela

Vertical Universities

Fire Safety in Hong Kong

The Year in Numbers: 2012

Talking Tall on Saudi Arabia

Debating Tall: How High Should We Go?

Council on Tall Buildings and Urban Habitat

# This Issue



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*Front cover: Kingdom Tower © AS+GG*
*Back cover: Kingdom Tower – Main entrance © AS+GG*

Maybe this story sounds familiar. The original plan for the London project was scrapped because the client thought it too unconventional. It was also a design that could not be built in phases and the funders didn't have the money to develop it in one go. The architect responded, changing the proportions of the building and abandoning the spire and reducing its height. In fact, he changed the design completely.

A story ripped from today's headlines? No, you have to go back more than 300 years for this tale – I'm talking about St. Paul's Cathedral, which remained London's tallest building until 1962. The debate over St. Pauls' protected views has shaped the nature of high-rise buildings across London for decades. It serves as a bold reminder that the discussion about heritage and modernity is not straightforward; indeed they can be the same thing, just at different times!

In June, London will play host to the CTBUH International Conference, the Council's return to the UK capital for the first time in 12 years. And what a time it has been since the last London conference in 2001 for tall building development in the city, with a new array of towers punctuating the skyline and tip-toeing around ancient streetscapes. It is the perfect time and place for the conference theme: *Height and Heritage – The Unique Challenges of Building Tall in Historic Cities.*

Against a backdrop of two decades of unprecedented tall building development across the world, the European skyscraper provides a whole different set of issues. Their height statistics may be tame in comparison to towers around the world, but their vital statistics are potent – those about efficiency and effectiveness, particularly in design, cost, fitness for purpose, and sustainability. Their performance exhibits a large range of value, illustrating the results of a variety of architectural and engineering solutions.

The European skyscraper has a lot to teach us about how a tower interacts with a city and the people involved in that city, in every way. The challenge of building tall in Europe – the need to prove quality and appropriateness at every hurdle – takes time, requires a significant investment of resources, and creates uncertainty. It also encourages a well thought-out solution, even if not everyone agrees with the answer. The different approaches to reconciling the protection of heritage and the maintenance of a world class, competitive city drives the peculiar skylines of London, Paris, Moscow, Frankfurt, and others. And historic cities that are fast accelerating economically, such as Istanbul, have begun to grapple with these issues.

Last weekend I took my family to The View at the top of the Shard and witnessed a gamut of people all talking about the building and the unprecedented 360 degree panorama of the city hundreds of meters below. It was a powerful reminder of the unique fabric of London, one that is marrying the old and the new in an extraordinary way.

Personally, having been based in London my entire working life and leading Davis Langdon/AECOM's Tall Buildings Group for seven years now, the opportunity to help welcome the high-rise community to London for the 2013 conference which I am certain is going to be a seminal event, is unbelievably exciting.

Already there is an impressive list of confirmed speakers and panelists, a variety of subjects under the over-riding theme, some fascinating venues for the social events and a quite amazing day of technical tours that will take in not only most of the towers either recently completed or heading for completion, but also a day of Peter Rees' time (the City Planner), who has kindly agreed to give a walking tour of the city in the morning followed by commentary onboard a river cruise in the afternoon.

I cannot wait.

I hope to see you there.

Steve Watts
*CTBUH Trustee / Co-Chair London Conference Steering Committee / AECOM Davis Langdon*

# Inside



20

26

38

> “The fact that Torre David is a continually changing, evolving organism is perhaps its least unexpected feature. The only truly static element in Torre David is the concrete structure – everything else is in flux.”

Brillembourg et al., page 32

# The Pros and Cons of Reaching for the Sky

This issue's cover story on Kingdom Tower details the latest quest for the industry to reach new heights. However taller doesn't always lead to better. This month's debate topic, "Should buildings go taller?"

## NO

**Sharon McHugh**

*U.S. Correspondent, World Architecture News*

Buildings like Kingdom Tower are indeed technological tour de forces with much to be admired. But as buildings grow ever taller, those who bring such projects to fruition should carefully consider the impacts of building tall on the people, the community, and the environment. While tall buildings can indeed put cities on the map, drive tourism, and spark urban regeneration, they can also adversely impact those who live in and around them and disrupt the "urban stasis" – the delicate balance that cities depend on to work efficiently on all kinds of levels. For every argument in favor of building tall there is an equally compelling argument against it.

Take, for example, the benefits of living in tall buildings. While having a room at the top often comes with bragging rights and unobstructed views, living the "high life" is not always all it's cracked up to be. There is vertigo to deal with and concerns for safe egress in emergencies. And living at the top does not come cheap; just ask anyone in New York, where a buyer recently plunked down US$90 million to live on the top floors of One57, a new 90-story luxury condominium.

Beyond the building occupants, tall buildings can adversely impact their surroundings. Big buildings require bigger bases and mile-high buildings will require even larger plinths. Accommodating these bases will result in the demolition of large swathes of urban fabric and lead to a loss of countless structures that are in perfectly good condition and contribute to the diverse character of cities. One has to question whether this approach is environmentally friendly or energy conscious.

As supertall buildings cast large shadows, taller buildings will cast even larger ones which will be a challenge. Also of concern is the increased densification that comes with high occupancy buildings and how to deal with it effectively and humanely. Putting more people on the streets will add stress to a city's infrastructure – sidewalks, public transportation, and utilities that are not designed to handle the increased capacity.

While tall buildings can indeed contribute positively to our cities their impacts should be considered. The potential effects of a mile-high building need to be carefully studied and weighed. More planning and guidelines are needed to govern their location and prevent the harm they may cause.

## YES

**Bart Akkerhuis**

*Associate, Renzo Piano Building Workshop*

Living in our ever more fragile world, we have a great responsibility to build in a sustainable fashion. Building tall in our fast-expanding urban centers is the way forward. Around the world we find cities where low density, single family housing has become the standard. With more than half of the world's population living in cities this is not justifiable.

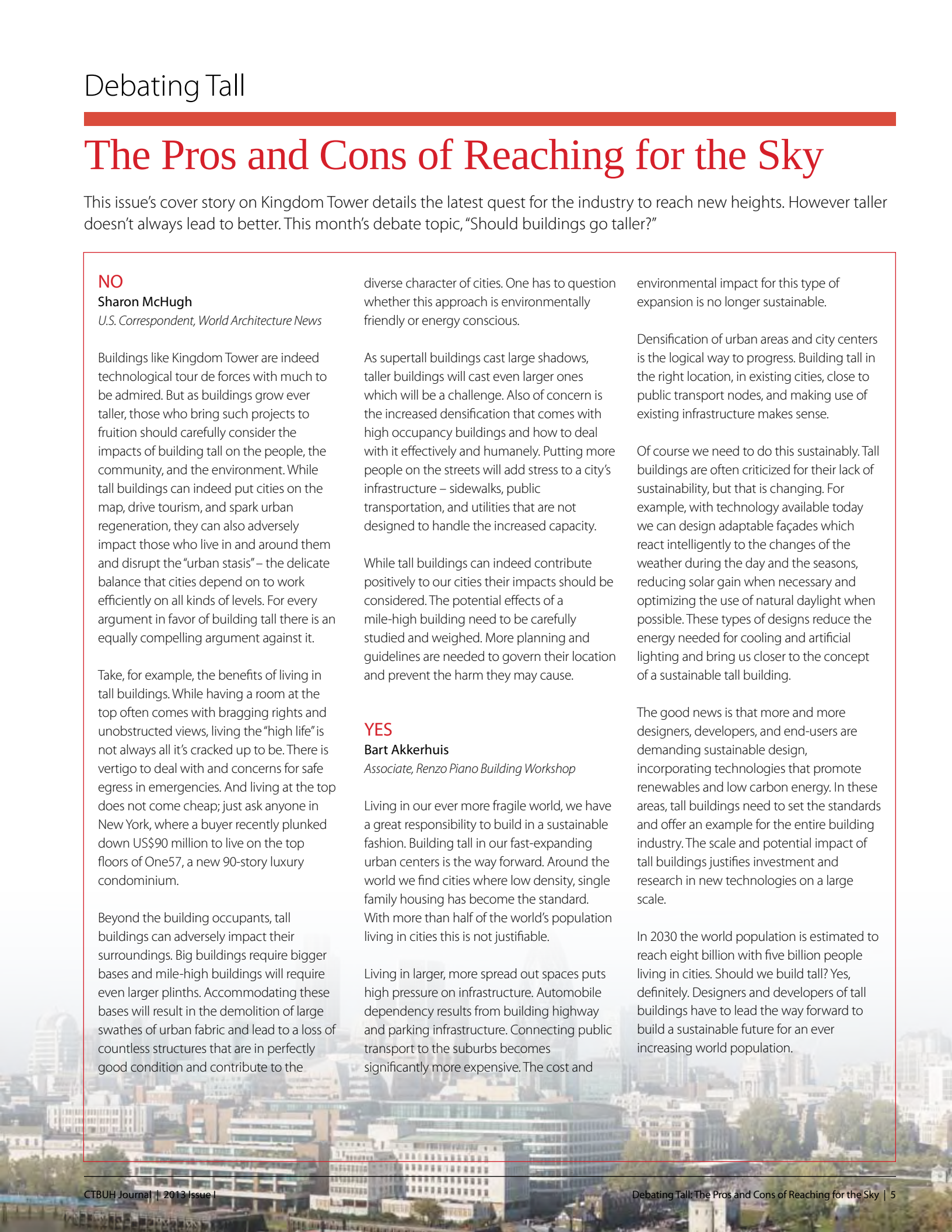
Living in larger, more spread out spaces puts high pressure on infrastructure. Automobile dependency results from building highway and parking infrastructure. Connecting public transport to the suburbs becomes significantly more expensive. The cost and environmental impact for this type of expansion is no longer sustainable.

Densification of urban areas and city centers is the logical way to progress. Building tall in the right location, in existing cities, close to public transport nodes, and making use of existing infrastructure makes sense.

Of course we need to do this sustainably. Tall buildings are often criticized for their lack of sustainability, but that is changing. For example, with technology available today we can design adaptable façades which react intelligently to the changes of the weather during the day and the seasons, reducing solar gain when necessary and optimizing the use of natural daylight when possible. These types of designs reduce the energy needed for cooling and artificial lighting and bring us closer to the concept of a sustainable tall building.

The good news is that more and more designers, developers, and end-users are demanding sustainable design, incorporating technologies that promote renewables and low carbon energy. In these areas, tall buildings need to set the standards and offer an example for the entire building industry. The scale and potential impact of tall buildings justifies investment and research in new technologies on a large scale.

In 2030 the world population is estimated to reach eight billion with five billion people living in cities. Should we build tall? Yes, definitely. Designers and developers of tall buildings have to lead the way forward to build a sustainable future for an ever increasing world population.



# 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:* ***http://news.ctbuh.org***

## Europe

The race for the title of tallest building in Europe attracted headlines late last year, when construction of the 75-story **Mercury City Tower** in **Moscow** surpassed the height of The Shard, topping out at 339 meters.

The 306-meter **Shard** officially claimed the title of tallest in Europe when it opened to visitors this February, but the **London** project will likely only hold the title for a short time. In addition to Mercury City, the 360-meter **Federation Towers** in Moscow is expected to complete during 2013.

But for now the Shard is the project currently drawing the spotlight. The glass and steel tower was officially opened to the public on February 1 and tickets for the first two days of access to the viewing floor quickly sold out, despite a £24.95 price tag, the London media reported. The first visitors were taken to the viewing area on the 72nd floor, which offers dynamic views of the city from 243 meters above the street, as well as the executive loo on the 68th floor, which also offers expansive views of the city, according to local press reports.

The Shard is only one of several projects making news in London. In January, City of London planners granted approval to the £500 million (US$800 million) Kohn Pedersen Fox-designed skyscraper already known as **"The Scalpel."** U.S. insurance company W. R. Berkley is expected to begin construction of the 38-story tower later this year. Officially known as **52–54 Lime Street,** the 190-meter tower resembles an upright blade – hence, "The Scalpel" – and will be about 10 meters taller than its neighbor, 30 St. Mary Axe, a.k.a. the Gherkin.

Not far away, a developer has proposed building a 239-meter tower in the east London area known as Isle of Dogs. If approved by local planning officials and built, the project known as **Columbus Tower** would be the third tallest building in the United Kingdom, ranking behind the Shard and One Canada Square.

But the biggest tall building headlines in London so far this year were the result of a tragic accident. On January 16 a helicopter crashed into a crane atop the unfinished 49-story **St. George Wharf Tower,** killing the pilot and a pedestrian.

The British Airline Pilots Association laid some of the blame for the crash on the proliferation of tall buildings along the Thames, claiming over-development has created a risky flight environment. In the wake of the accident London Mayor Boris Johnson called for a re-examination of tall building safeguards in the city.

## Middle East

The tallest building in Jordan is on track to finish within a year. In December, Dubai-based Damac Properties announced the topping out of **The Heights** in **Amman**. The 35-story, 110-meter residential tower is part of Al Abdali, the new downtown district of Amman. Another tall building, the 188-meter **Amman Rotana Hotel,** is also under construction in the Jordanian capital.

In Qatar, the Lusail Real Estate Development Company announced plans to restart work on the 112-story **Doha Convention Center Tower,** two years after its initial launch. The 551-meter tower designed in 2009 by Murphy/Jahn, includes offices, a hotel, penthouse residences, and a 60-meter-tall glowing glass helix at the top.

There are also signs that Dubai's stalled construction market may soon restart. Dubai ruler Sheikh Mohammed bin Rashid al-Maktoum recently announced plans to build a US $10 billion development as his namesake, including 100 hotels, parks, art galleries, and the world's largest mall. The Dubai leader is also planning a US$2.7 billion five-theme park leisure complex.

But many analysts questioned the logic of the construction projects, given that the emirate is still US$100 billion in debt from its 2008

Mercury City Tower, Moscow. © Frank Williams & Partners

The Shard, London. © Phillip Oldfield

The Scalpel, London. © KPF

# Meeting the Challenges of a One-Kilometer Tower



Peter Weismantle



Alejandro Stochetti

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**Peter Weismantle** is responsible for overseeing the technical development of the firm's supertall projects from concept to completion. He works in collaboration with the project team to develop the design of such technical elements as the building envelope, vertical transportation and life safety systems, and to assure compliance with applicable building codes and standards. He is currently working on the Kingdom Tower as well as Wuhan Greenland Center, China.

Before joining AS+GG, Peter was an Associate Partner in the Chicago office of Skidmore, Owings & Merrill LLP, where he served as senior technical architect on several supertall towers, including Shanghai's 88-story Jin Mao Tower and the 162-story Burj Khalifa, currently the world's tallest building.

He is currently the Chairman of the CTBUH Height Committee, past-Chairman of the Chicago Committee on High-Rise Buildings CCHRB, President of the Board of Directors of the Safety Glazing Certification Council SGCC and was named a Fellow of the American Institute of Architects AIA in 2010.

**Alejandro Stochetti** leads teams in the design of site-conscious, efficient, and user based buildings. His work involves the understanding and integration of all disciplines to create highly efficient performance based buildings.

Before joining AS+GG, Alejandro was a senior designer at Skidmore, Owings & Merrill LLP, where he was involved in the design and development of Burj Khalifa, Las Vegas Tower, Wind and Garden Tower in King Abdullah Economic City in Saudi Arabia, the KAEC master plan, and the Suzhou Convention and Exhibition Center in China. His experience also includes work in the Middle East, Europe, Asia, North America, and his native Argentina.

Kingdom Tower in Jeddah, Saudi Arabia, will be the tall building to go where no building has gone before – beyond 1,000 meters. For the first time, the team at Adrian Smith + Gordon Gill Architecture discuss at length the process that went into designing a one-kilometer-tall tower, as well as specific details about the structure and configuration.

## Introduction

During the spring of 2009, Adrian Smith + Gordon Gill Architecture began working on a prototype of a mile-high tower. With an eye to the future, AS+GG's interest was to understand the potential and challenges of creating a tower that was substantially higher than the tallest man-made structure at that time, the 828-meter Burj Khalifa. The questions were: How do we get to a substantially taller building? Is there a new typology? What about elevators? What about structure? And, above all, what about daily life in such a building?

The exercise turned out to be not merely theoretical. AS+GG was then invited to participate in a competition to design the world's new tallest tower at a height of at least one kilometer. The location was Jeddah, Saudi Arabia, and it would be the centerpiece of a master plan that would cover an area of 5.3 million square meters. The invitation was also extended to other international architectural firms, including Foster + Partners, Pelli Clarke Pelli, Kohn Pedersen Fox, Pickard Chilton and SOM. The competition brief asked teams to design a multi-use tower serving a five-star hotel, serviced apartments, and office and residential units. The proposed design would take Kingdom Tower to the highest position in CTBUH's three categories for maximum heights; firstly, it would have the highest occupied floor (currently, Burj Khalifa Level 154 at 584.5 meter). Secondly, it would achieve the highest architectural top (currently Burj Khalifa at elevation 828 meter). Lastly, it should have the highest tip (also currently Burj Khalifa at a height of 829.8 meter). The design competition was scheduled to last one month, after which a winner would be announced.

It is important to note that one of the criteria for the winning scheme was the tower's "constructability potential and efficiency."

## The Competition Entry

With Kingdom Tower, the goal was to advance the innovations of Burj Khalifa and discover what could be done better. The team also knew what had worked very well on the Burj, and which could be taken into account in the design.

One of the earliest studies done, leading to the overall form (see Figure 1), shows part of the process that helped to create the tower's final massing configuration. One of the original challenges was to build extremely tall without adding too much area to the final building. The competition brief called for 290,000 square

meters gross floor area (GFA) for the tower and podium. The diagram illustrates how for the original competition program area a simply extruded square plan would not reach a significant height. The next drawings show how going from square to circle to triangular form helped, but not enough. The following diagrams show how the tapering of such shapes extended the potential height of the tower. Finally, for a variety of reasons, the tapered "Y" shaped plan was chosen. As a further step toward reaching greater heights, the carving applied at the balcony areas removed GFA from typical floors and pushed it further up.

These design decisions helped to provide the client, Jeddah Economic Company, with a streamlined, highly performative design (see Figure 2).

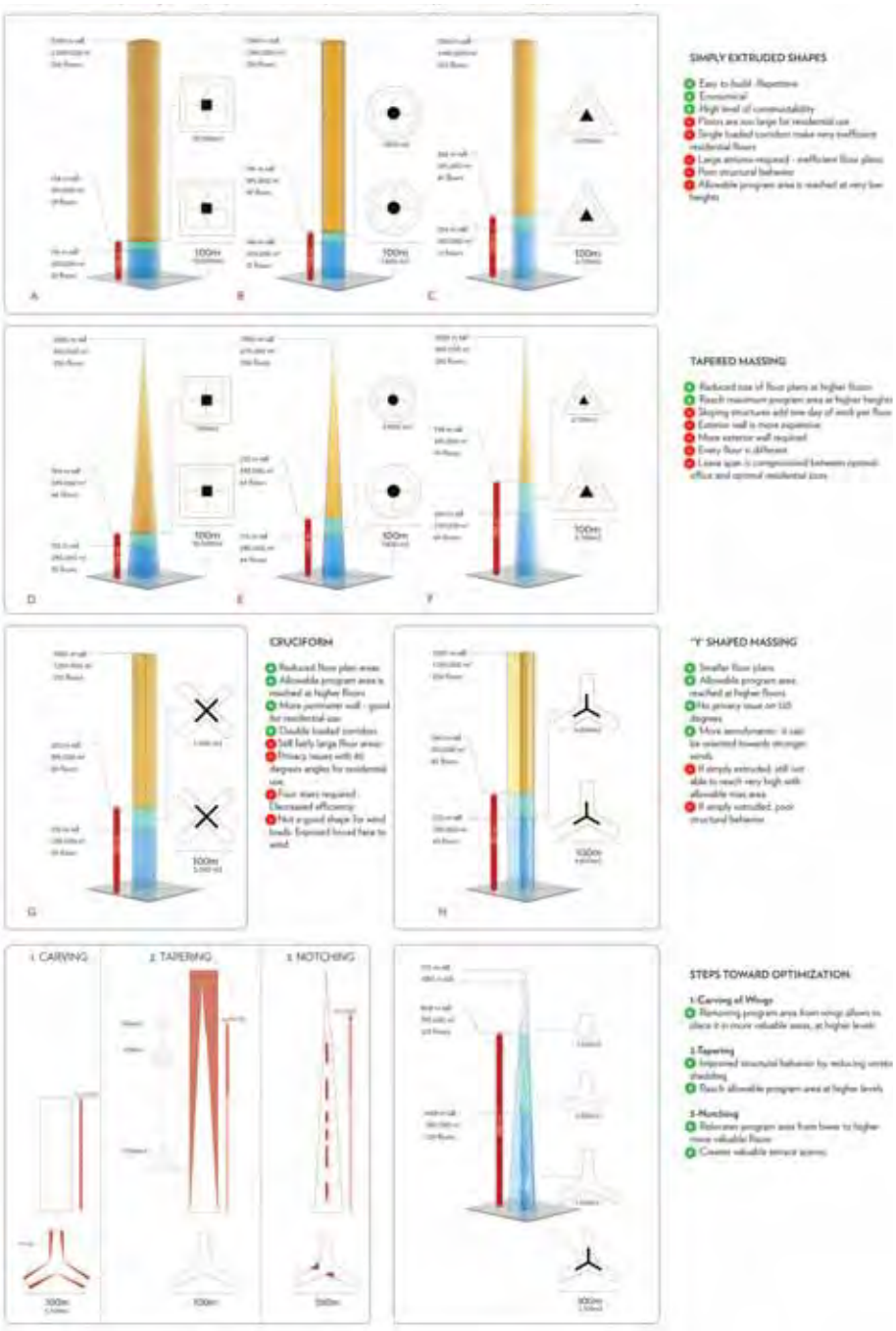



Figure 1. Typology study. © AS+GG

## Supertall Buildings and Wind

The Y-shaped plan forming the base of the design offered several advantages. A 120-degree separation between wings allows for views to be expansive but not directed toward adjacent units, which would have created privacy issues. A Y-shaped plan would provide a higher ratio of exterior wall to internal area, which would maximize the residential units' views and exposure to light (see Figure 3).

The "Y" shape also allowed the spreading of the base of the tower without increasing the depth of the lease-span. This means that the building can still maintain a reasonable 10:1 height to width ratio without having a large amount of unusable deep internal space. The "Y" shape also helps develop a clean and simple structural diagram in which every element participates in both gravity and lateral support. If one considers the shape as being similar to a wide flange beam with its mass of structural material at the end of each wing (the "flanges") where it is most optimally

Figure 2. Kingdom Tower, Jeddah. © AS+GG

# Global Tall Building Completions Drop, But Uptick Expected in 2013

Report by Kevin Brass, Antony Wood & Marty Carver, *CTBUH*

**Note:** Please refer to "Tall Buildings in Numbers: 2012 A Tall Building Review" in conjunction with this paper, pages 46 – 47

For the first time in six years the number of tall buildings completed annually around the world declined in 2012, as the consequential effects of the 2008/2009 global financial crisis became evident in tall building construction in many Western countries. Sixty-six buildings taller than 200 meters were completed during 2012, the third most in history, but down from the 82 finished in 2011. This number of completions was slightly lower than expected, with some projects under construction delayed or stalled. However, several of the projects forecast to finish in 2012 are now expected to complete in 2013 and 2014, with global completion numbers expected to rise again next year.

The year also saw several important milestones:

- Makkah Royal Clock Tower Hotel was completed in Saudi Arabia, at 601 meters now the second tallest building in the world. It is only the world's second megatall, defined by the CTBUH as a building of more than 600 meters.
- Four of the six tallest buildings completed in 2012 were in Dubai, including the world's tallest hotel, the 355-meter JW Marriott Marquis.
- The title of Tallest Residential Building exchanged hands twice in 2012, with both recipients located in the Dubai Marina.
- Fast-growing China finished 22 buildings taller than 200 meters in 2012, 33 percent of the global number.
- Mecca was the city with the most 200 meter+ completions in the world, with five.
- The United States completed only two buildings over 200 meter, including the 257-meter Devon Tower in Oklahoma City.
- Canada added four buildings taller than 200 meters, the most Canada has ever completed in a single year.
- Twelve of the 66 buildings completed in 2012 broke onto the list of the 100 tallest buildings in the world, representing a 12% change in the tallest 100 in a single year.

With the addition of 66 buildings in 2012, the global number of buildings taller than 200 meters has almost tripled since 2000, increasing from 263 to 756 at the end of 2012. The recent slowdown in the West was partially offset by tall building construction in the Middle East and Asia, particularly China. In total, 35 buildings taller than 200 meters were completed in Asia in 2012 and 16 in the

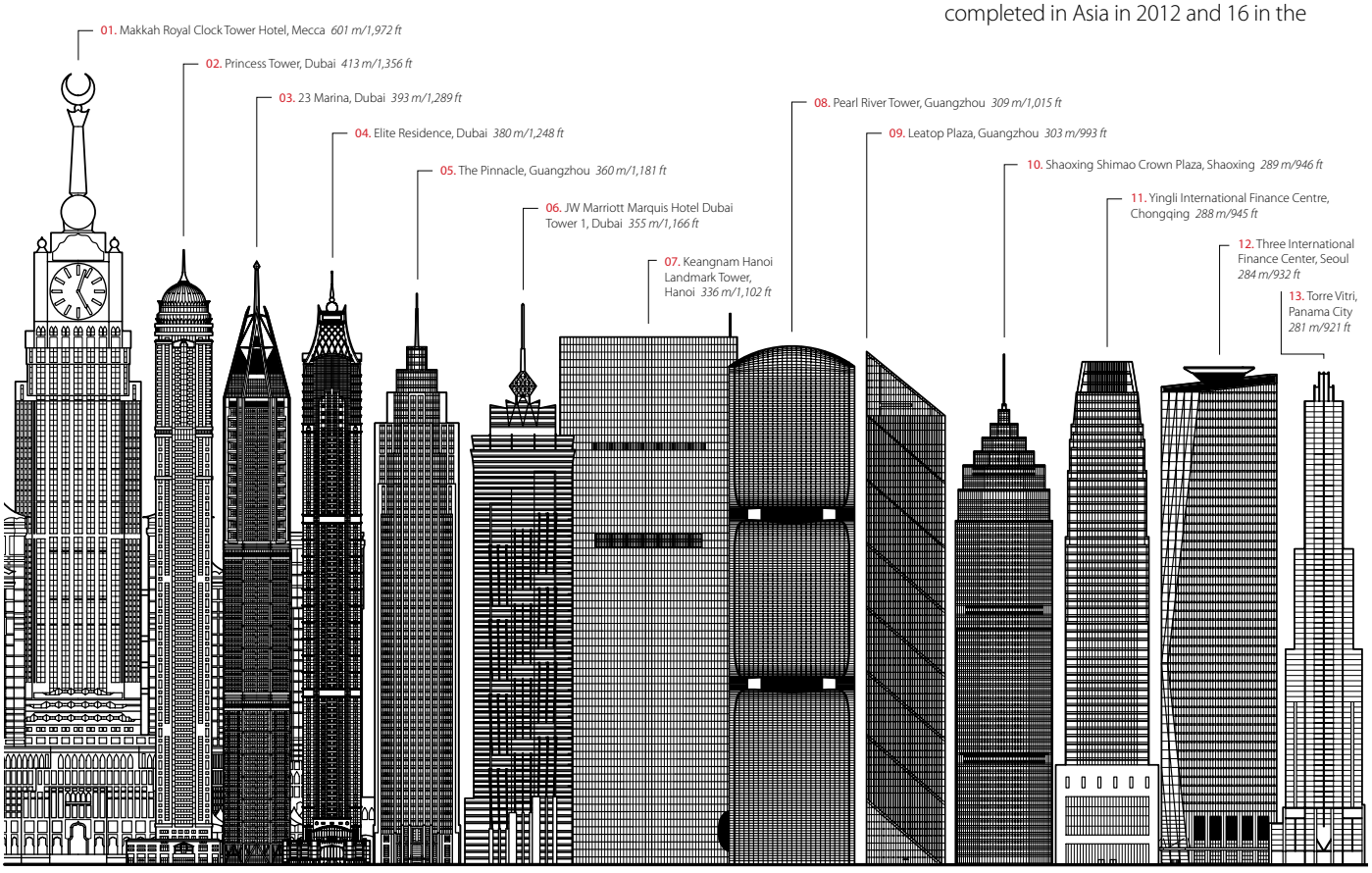



Figure 1. The tallest 20 buildings completed in 2012, including Makkah Royal Clock Tower Hotel, only the second megatall building ever completed.

Middle East. In contrast, six were completed in North America, including only two in the United States, which once dominated tall building development.

Several factors are spurring this move toward taller development. The limited availability of land in urban centers is driving up prices and prompting developers to build taller to recoup their investments. Several countries, including China, are also in the midst of a dramatic shift from rural to urban economies. In addition, new technologies and building systems are increasing the efficiency of tall buildings, allowing developers to cost-effectively create taller projects.

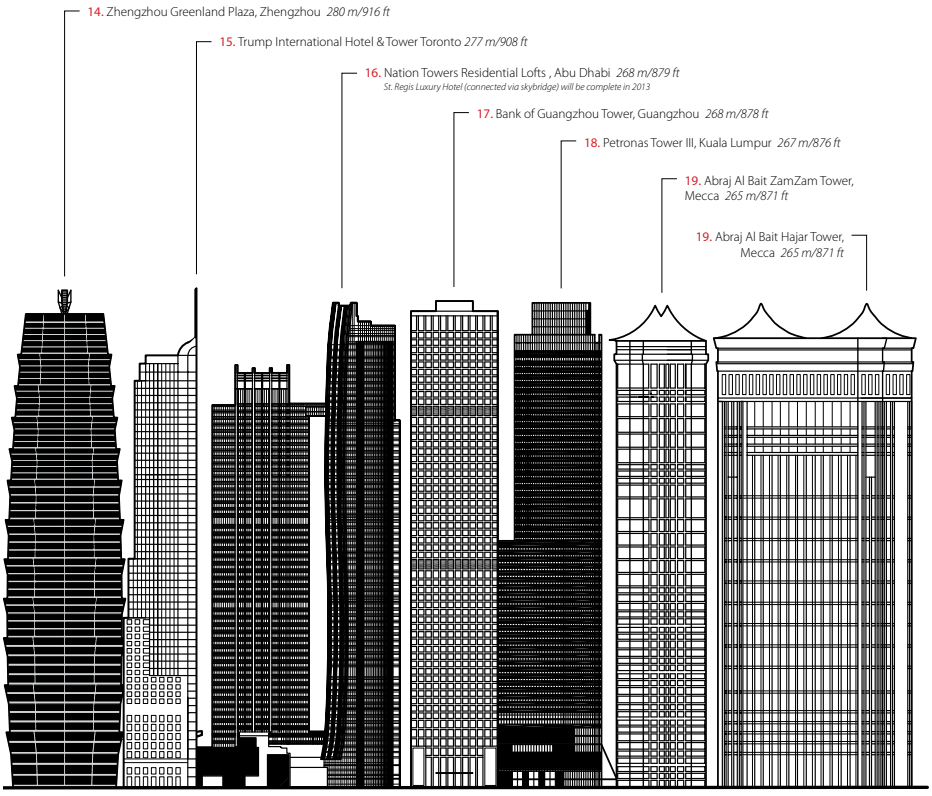
But the biggest factor, in some cities, is a sharp increase in prices for luxury apartments. In New York, a full-floor apartment in One57, a project still under construction, sold for US$90 million in 2012. Forty-one of the tallest 100 projects completed in 2012 featured a residential component. Early in 2012, 23 Marina earned the title of world's tallest residential building at 393 meters. A few months later the 413-meter Princess Tower completed construction, taking the title of world's tallest all-residential building. The four tallest residential buildings in the world are now located in Dubai.

Snapshots of key markets around the world:

## China

The 22 buildings completed in China in 2012 were spread around 13 cities; Guangzhou was the busiest, completing four projects. Notable projects completed in 2012 include the 309-meter Pearl River Tower in Guangzhou, a Skidmore, Owings & Merrill-designed tower hailed for its energy efficient elements. The project includes wind-turbines to generate energy for the building, as well as a double façade curtain wall, radiant ceilings, solar panels, daylight harvesting, and an underfloor ventilation system.

Far from slowing, China's tall building boom will continue in the next few years. Projects far along in construction include the 660-meter Ping An Finance Center in Shenzhen, the




## World's Tallest 100: Analysis

In recent years the industry has seen a dramatic shift in why, where, and how tall buildings are built, a trend that continued in 2012.

In 2000, 85 of the 100 tallest projects were office buildings; in 2012 only 49 of the tallest 100 were offices.

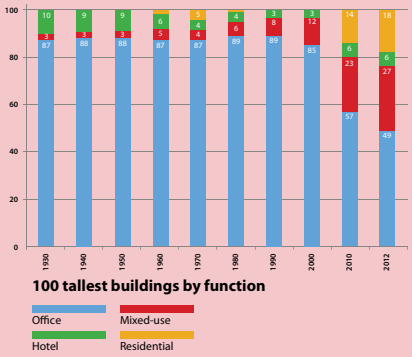



Figure 2. World's tallest 100 buildings by function.

Tall building construction was once dominated by North America. However, by the end of 2012 only 23 North American buildings made the list.

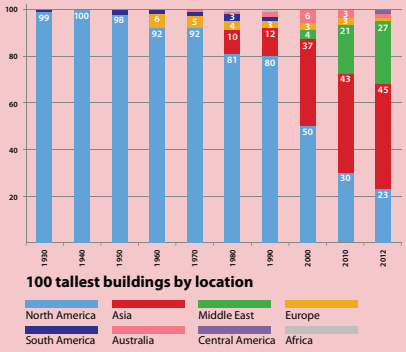



Figure 3. World's tallest 100 buildings by location.

By the end of 2012, only 17 of the tallest 100 tallest buildings were made of steel, once the dominant construction material for tall buildings.

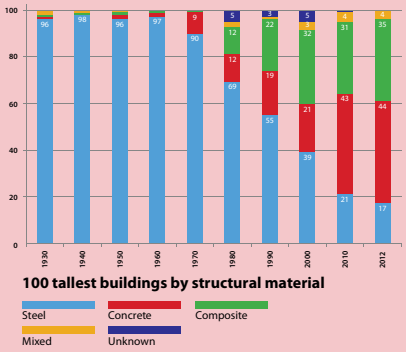



Figure 4. World's tallest 100 buildings by structural material.

# 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.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