Trends, Drivers and Challenges in Tall Buildings and Urban Habitat

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Summary

This paper outlines the major influences on tall building design in the early stages of the 21st Century. At this unprecedented time in terms of the scale and number of tall buildings being built globally, the paper charts some of the recent trends in tall buildings, and suggests some of the drivers. It also looks to the growing challenges in the future and, through design-research case studies undertaken by the author at the Universities of Nottingham, UK and the Illinois Institute of Technology, Chicago, suggests design responses to face some of these challenges.

Keywords: Tall Buildings, Design, Trends, Challenges, Sustainability

1. Tall Buildings Trends

We are certainly at an unprecedented time in terms of the development of the high rise typology. Though specific periods in the past 120 years have seen frenzied activity in terms of building tall (for example, late 19th Century Chicago, Art Deco New York, post-second world war western urban reconstruction and the Asian economic boom of the 1980's/90's), most previous periods have been concentrated both geographically and in timescale. What sets the tall building construction boom of the last decade or so apart is the geographical spread and the number and height of tall buildings being built. We are now seeing tall buildings being conceived, financed and built in virtually all corners of the globe, and cities with previously no connection to tall buildings are becoming serious 'hot spots' for the high-rise typology. The following elaborates on some of the specific trends:

1.1 Trend 1: Unprecedented Tall Building Construction

As Table 1 shows, in 1980 there were 324 buildings over 150 metres / 500 feet in height in existence globally (Binder, 2008). In 1995 this number was 820. By the end of 2008, it is expected that this figure will number 2922, an increase of over 350% in just over 10 years. It is clear that the past decade has seen an unprecedented boom in tall building construction.

Table 1: Number of Tall Buildings built over 150 metres / 500 feet. (Source: Georges Binder / Marshall Gerometta / CTBUH)

	1980	1995	2008 (estimated, including buildings under construction)
Americas	84.9%	64.5%	27.7%
Asia/Asutralasia	9.9%	31.2%	59.0%
Middle-East	0.0%	0.1%	9.8%
Europe	4.3%	3.7%	3.3%
Africa	0.9%	0.5%	0.2%
Total number of buildings	**324**	**820**	**2922**

1.2 Trend 2: Unprecedented Global Reach

As Figure 1 also shows, the locational spread of these tall buildings is changing rapidly. Whereas in 1980, almost 85% of these tall buildings over 500 feet were based in North America, by the end of 2008, it is expected that this figure will be only 28%. More than double this figure (59%) will be based in Asia/Australasia, and almost 10% will be based in the Middle East – a region that had virtually no buildings over 150 metres little more than a decade ago.

The unprecedented tall building construction boom of the past decade then has a far greater global reach than ever before, with cities with previously no connection to tall buildings becoming serious 'hot spots' for the high-rise typology; Shanghai, Dubai, Moscow, even European cities such as London. This has a knock-on effect to more established high-rise cities such as Chicago, New York or Hong Kong, which also see the need to build further tall buildings to compete on the global stage, and other cities in countries with high-rise cities. Thus in the US, for example, cities such as Miami, Seattle and San Francisco are building tall buildings in significant number to complement New York, Chicago and Los Angeles and in the UK, provincial cities such as Manchester, Leeds and Liverpool are also embracing the typology beyond the capital of London.

This wider geographical spread can also be seen in the CTBUH's annual 'Tallest 10 constructed' list. In 2007, of the tallest ten buildings constructed globally, four were located in the Middle East (including the tallest, Dubai's Rose Rotana Towers at 333 metres) and four in Asia. Only one of the tallest 10 was constructed in North America (see Figure 2).

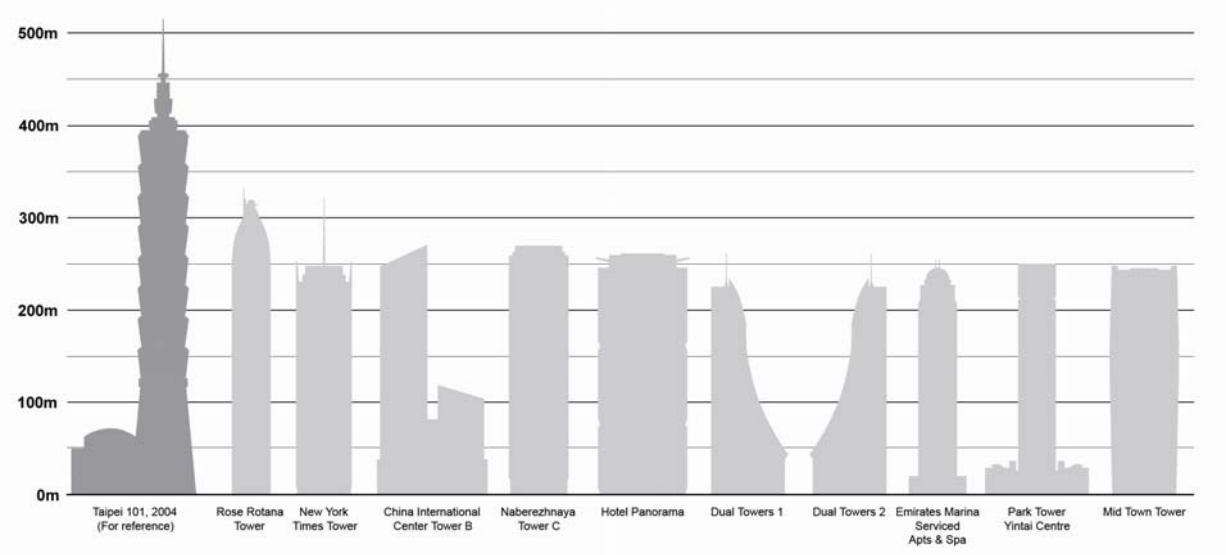

Fig. 2: Tallest 10 Buildings constructed during 2007 (source: Council on Tall Buildings and Urban Habitat).

1.3 Trend 3: Unprecedented Height

The world's tallest building currently under construction – the Burj Dubai – is a fascinating case study in what is currently being achieved with tall buildings. In pure height terms, as the graph in Figure 3 shows, the height increment by which buildings are now surpassing each other is increasing dramatically. For a little over a hundred years this height increment was an average of 35 metres and never surpassed more than 68 metres. Although a closely-guarded secret, the Burj Dubai upon completion in 2009 is expected to be more than 800 metres in height, some 300 metres taller than the world's current tallest, Taiwan's Taipei 101 at 509 metres. Without a shadow of a doubt, tall buildings are getting much taller.

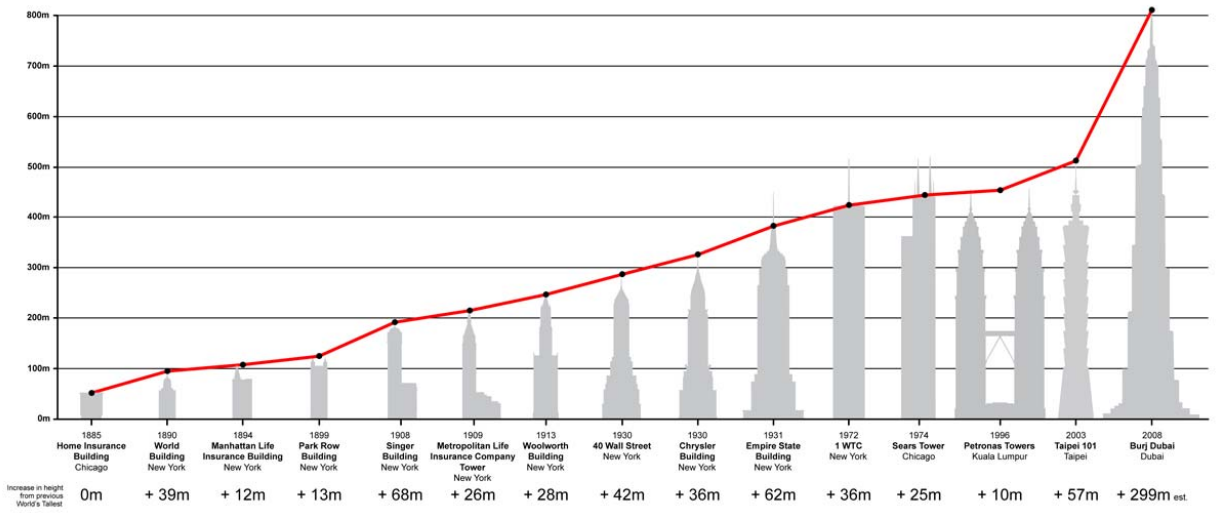

Fig. 3: Height incremental changes in the development of the world's tallest building historically (Source: CTBUH)

It is interesting to project this even further, to say what the tallest buildings will perhaps be in just a decade or two from now. Recent research by the CTBUH has projected the 'Tallest 20 in 2020', shown in Figure 4. Based on a selection criteria of these being "real" projects with information in the public domain (i.e. either built, currently on site, or a published proposal that has a developer and a full professional consultant team currently progressing the design beyond the conceptual stage), one can see that the world's current tallest---Taipei 101---actually stands 16th in the list. On this trajectory, one could easily believe that the dizzy heights of Frank Lloyd Wright's 1957 hypothetical "mile-high tower" is perhaps not that far from being realized.

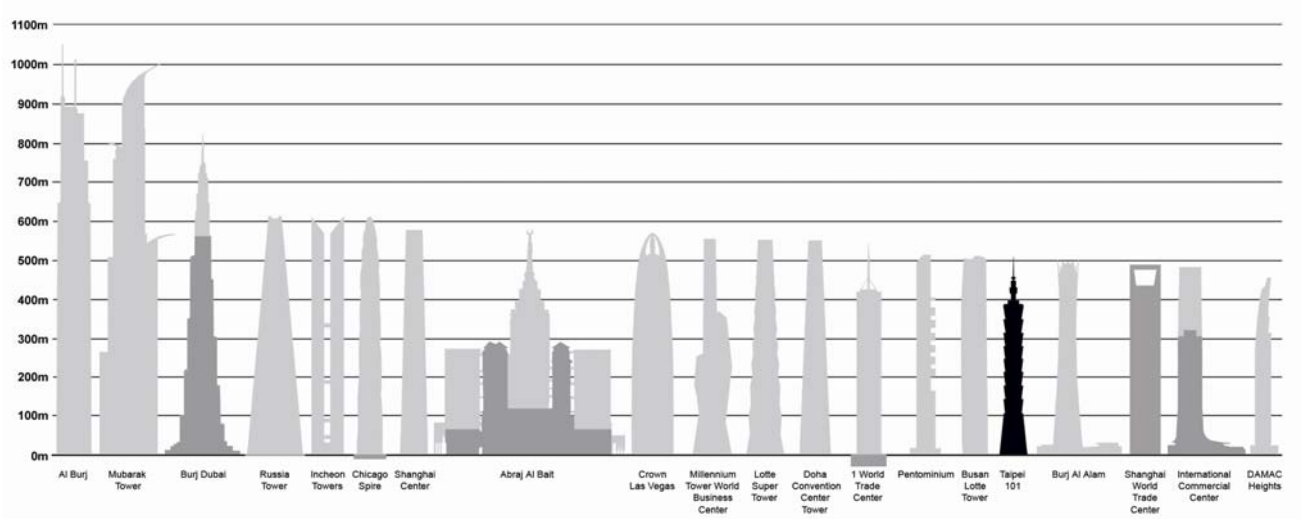

Figure 4: The projected "Tallest 20 in 2020" (copyright: CTBUH).

1.4 Trend 4: Changes in Function

As well as major changes in height and geographical location, there is also a trend in tall buildings to a change in primary function. As Table 2 below shows, whereas in 1980 almost 85% of all tall buildings over 150 metres / 500 feet contained primarily office function, by the end of 2008 this is expected to have fallen to only 47%. There has been a major shift in the past two decades towards residential function (up from 5% to 35%) and mixed-use function (up from 5% to 11%). Part of this can be attributed to the increasing desirability of living at height, part to the push for re-population of city centres away from the suburban ideal of the US and UK, and part to the conversion of inner-city office towers into residential provision which has also been a growing trend in western cities in the past decade or so. The trend towards more mixed-use towers can be partly explained by the desire for owner-developers to have a greater spread of financial risk within a development, and partly through the desire to enrich both buildings and cities through greater cross programming.

Table 2: Primary function of Tall Buildings built over 150 metres / 500 feet. (Source: Georges Binder / Marshall Gerometta / CTBUH).

	1980	1995	2008 (estimated, including buildings under construction)
Office	84.7%	78.3%	47.3%
Mixed-use	5.2%	6.6%	11%
Residential	5.2%	9.6%	35.3%
Hotel	4.9%	5.5%	6.4%

1.5 Trend 5: Changes in Structural Material

Of the world's tallest 10 buildings in existence in 1978, all 10 were located in North America and all 10 were of steel primary structure (Binder, 2008). Of the 10 tallest buildings currently in existence today, only 2 are all-steel structures, 1 is an all-concrete structure, and 7 are of mixed / composite structure. Despite the fact that the world's next tallest building currently under construction – the Burj Dubai – is an all-concrete building (other than the steel spire), this trend for a mixed steel-concrete primary structural system looks set to continue.

2. Tall Building Drivers

2.1 Driver 1: Collapse of the World Trade Center Towers

Perhaps the most far-reaching event to have occurred in the last half-century or more, the collapse of the World Trade Center towers drew a big question mark over the tall building as an acceptable proposition for future cities: should we continue to build tall in the post 9/11 world? Six years after that terrible event, to judge by the number of tall buildings being built and proposed, it seems the answer is a resounding yes---but why? The event induced perhaps the largest introspective analysis of tall buildings ever, while focussing attention on the typology. This is resulting in better designed, safer buildings that relate to our urban centers better than ever before. Governments, city authorities, financers, and developers have become increasingly aware of these benefits through the global re-examination of the typology.

2.2 Driver 2: Land Prices

Land prices have always been a significant driver for tall buildings, but increasingly so now as many cities, especially in countries like the US and UK, seek to re-populate their urban centres with residential-recreational compliments to the predominantly commercial-retail Central Business District stock. These relatively new markets are helping drive up city centre land prices, which makes building tall for investment return increasingly necessary.

2.3 Driver 3: Global Icons

Building super-tall has never been just about increasing the commercial return on a development. On the contrary, there are many that believe that, over a certain height, the economics just do not, literally, stack up. The creation of an architectural icon to soar above the city has always been a factor in the history of the world's tallest building, but now the focus has changed; tall buildings are increasingly being built to project the vitality of a city on a global scale---creating skylines with brand recognition on an international level. This shift from corporate to city (or even government) ambition is reflected in the very titles of the world's tallest buildings; formerly we had icons such as the Chrysler Building or Sears Tower, now we have Taipei 101 or Burj Dubai, where the building itself takes on the responsibility of helping promote the city on the world stage. This also, of course, works on a regional scale: country's tallest building, city's tallest building etc.

2.4 Driver 4: Sustainability

The threat to the planet through climate change and the need for more sustainable patterns of life to respond to this is now generally accepted. Denser, more concentrated cities are seen as an essential part of this more sustainable way of life since they reduce energy consumption and climate-change emissions by reducing the suburban spread of cities, transport, and infrastructure networks. Tall Buildings are a key factor in creating denser cities by accommodating more people (for work or live) on smaller footprints of land. In addition, the investment in every tall building project--- both financially and professionally---gives it the opportunity to embrace sustainable design and technologies that could lead the way for other, smaller, building types. For more on the Sustainability of Tall Buildings, see Wood, 2008.

3. Challenges for the Future

There is a tendency, given this rosy picture of a worldwide tall building construction boom, to consider that tall buildings have progressed to their most advanced state. This is not, in the author's opinion however, the case. There are a number of distinct challenges that tall buildings need to face in design terms:

3.1 Challenge 1: Become Fully Sustainable Towers

While sustainable design approaches and technologies are beginning to be incorporated into tall buildings, there is a long way to go before tall buildings can be considered as truly sustainable. The embodied energies (and carbon emissions) in constructing materials at height, combined with the high operating energy consumption through air-conditioning, lighting, and vertical transport, means that tall buildings have to take every opportunity to both reduce energy consumption and generate energy. The potential of energy harvesting at height---through wind, solar, other--- cannot be denied. A minimum goal for future tall buildings should be for zero net energy consumption. A better goal would be true carbon neutrality by creating an energy surplus to eventually offset the embodied energy/carbon during construction (and destruction).

3.2 Challenge 2: Beyond the Icon: Relate to Place

A second challenge for the tall building is to develop in design terms, and especially in its relationship to its urban location. Many tall buildings historically seem to have been designed as either vertical extrusions of an efficient floor plan (the hyper-economic model), or stand-alone pieces of high-rise urban "sculpture" (the iconic model). In both cases, the only relationship with the urban setting is a visual one, with the tall building usually dominating. This has led to the syndrome of tall buildings as "isolationist" architecture: stand-alone, non-site specific models that are readily transportable around the cities of the world. This has served to create an alarming homogeneity across global urban centres: a creation of a "one size fits all" skyscraper "mush." Future tall buildings need to relate to their specific location beyond just becoming synonymous with that location. Their design needs to be inspired by both the physical and environmental aspects of place.

3.3 Challenge 3: Incorporate More Diversity of Function

The third challenge for tall buildings lies in their functional programmes. To create a truly vibrant, mixed-use facility within both the building and the city, tall buildings need to innovate beyond the standard functions---office, residential, hotel---that make up perhaps 95 percent of tall buildings worldwide. At the CTBUH and through its affiliate division, the Tall Buildings Teaching and Research Group (Tall Buildings TARG, 2008), research into alternative design approaches has resulted in a number of not only innovative tall building forms, but also tall building functions: vertical urban farms to help alleviate environmental problems of imported agriculture (and consequential food miles); sporting functions where façade solar shading doubles as a rock climbing wall or swimming pools serve as mass-tuned dampers; vertical 'aquifers', maximising rainwater capture and recycling to help address the growing global calamity of reducing water resources; vertical urban solar and wind farms, etc. See Figures 6-9. For more on these and other projects, see Wood 2004.

Figure 6: The 'next generation of tall buildings? High Rise Villages proposal (Source: Eva Young / Antony Wood, CTBUH)

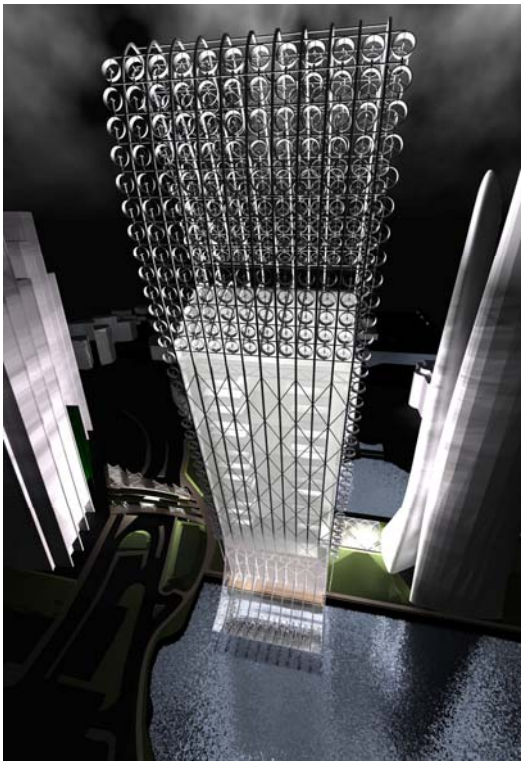

Figure 7: Wind Farm proposal (Source: Adam Chambers & Alex Dale-Jones / A Wood, CTBUH)

Figure 8: Vertical Farm proposal (Source: Darran Oxley & Paul Foster / Antony Wood, CTBUH)

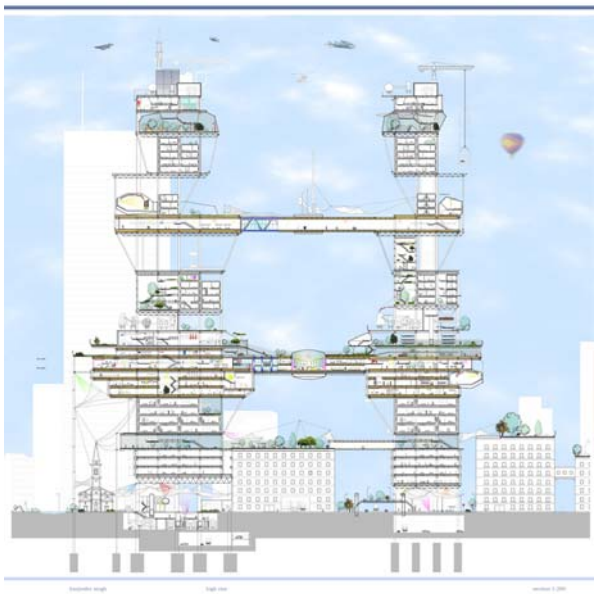

Figure 9: Skybridges / connected towers proposal (Source Harjinder Singh / Antony Wood, CTBUH)

4. Conclusion

This paper has touched on some of the trends, drivers and challenges associated with tall buildings. In terms of trends, if one had pointed to the world's next tallest building during the 1980s or before, one would have assumed quite safely that it would be located in North America, of steel construction, and accommodate office function. Today, almost the exact opposite is true: the world's tallest buildings are more likely to be located in Asia, be of concrete or composite construction, and accommodate predominantly a residential function. This is certainly the case with the world's tallest currently under construction---the Burj Dubai.

In terms of tall building drivers, it seems that the traditional motivations of maximising financial return on land development and creating a corporate icon/brand are being supplemented (in some cases supplanted) by the desire to brand cities in a global market, and to find more sustainable patterns of life due to the immense challenges of climate change. Tall Buildings and denser cities are seen as one part of the solution.

In terms of challenges, the tall building as a typology needs to evolve beyond its predominantly isolationist stance to be more in tune with its location in terms of both sustainability and design. In doing this, not only can it contribute to more sustainable cities through reducing suburban spread/infrastructure, embodied / operating carbon and harnessing renewable energy, it will result in cities defined by the quality of their urban realm, rather than defined by their set up disparate global icons. Tall Buildings have evolved exponentially in technical terms in the past half century. They now need to evolve socially, functionally and materially to meet the pressing needs of the 21st Century and beyond.

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