

Typology for The Aesthetics and Top Design of Tall Buildings

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Received: 16.02.2009 Revised: 11.05.2009 Accepted: 05.06.2009

ABSTRACT

The morphological character and the top is the most important component of the tall building in terms of its impression in the city silhouette. Designers of attractive tall buildings, whose investors tend to create a symbolic image, mostly prefer tops with aesthetic expressions. However many tall buildings with slipshod tops create unidentified skylines as it is the case for many modern cities of today. In this paper, the particular issue of visual impact and tops of tall buildings are addressed and a historical category system of seven periods is proposed. Then each period is illustrated in a series of outline figures showing the comparative heights and profiles of leading examples within each category. As a result, it is recognized that tall building design is a holistic process, and it is impossible to consider formal and aesthetic principles in isolation without reference to technology of the era, as well as the investors' demands. The impact of tall building tops involves a consideration of social values followed by scale and traditional design principles versus contemporary expression of architectural design objectives.

Key Words: *Tall buildings, skyline, skyscraper, high-rise, aesthetic, urban context.*

1. INTRODUCTION

The visual impact of major buildings on the city scape has always been a matter of primary concern to architects and the community. Tall buildings, being one of these major building types, have a concessive situation among the others, since they create distinctive skylines due to their morphological character, especially by their form and top. The tops of the tall buildings offer a range of options to provide visible and distinctive skylines. Designers of attractive tall buildings, whose owners tend to create a symbolic image, mostly prefer tops with aesthetic expressions. However many tall buildings with slipshod tops create unidentified skylines as it is the case for many modern cities of today.

A tall building can be defined as a building that exhibits some elements of tallness according to relative height within the urban situation, proportion and technologies utilized. For instance, a 12-storey building may not be considered tall in New York or Chicago, where as it may be distinctly taller than the others in a traditional European city. In addition slenderness is an important parameter when determining the tall building in an urban context. There are numerous buildings which are not high, but are slender to give the appearance of a tall building. Conversely, there are numerous big / large

footprint buildings, which are quite tall but their size / floor area rules them out as being classed as a tall building. Also a building must contain technologies, which are attributed as being a product of 'tall', such as specific vertical transportation technologies, structural wind bracing, and etc., in order to be defined as a tall building.

Council on Tall Buildings and Urban Habitat (CTBUH) measures the height of a tall building according to different parameters, and makes different rankings of the tallest buildings of the world according to these parameters. For instance, "the architectural height" is measured from sidewalk level outside the main entrance to the top of the building, including spires, but excluding antennae, signage or flag poles. The second parameter is the occupied floor and in this category height is measured from sidewalk level of the main entrance to the highest continually-occupied floor within the building, not including maintenance areas. The third parameter is the top of roof and height is measured from sidewalk level of the main entrance to the highest point of the building's main roof level, not including spires or antennas. The fourth parameter when ranking the tallest buildings of the world is the height of the tip, which is measured from sidewalk level of the main entrance to the highest point of the building,

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irrespective of material or function of highest element, thus including antennae, flagpoles and signage.

The architectural forms and tops of tall buildings have undergone through many phases from the first examples in New York and Chicago to the latest examples in European and Asian cities. In each phase technological innovations, as well as fashionable trends, were the primary concern for the architects, who searched for a new style. This paper proposes a historical category system of seven periods of tall buildings and identifies the influence of architectural trends and technological innovations that affect the morphological character and top design of tall buildings for each period.

2. METHODOLOGY

In order to clarify the factors affecting the morphological character and top design of tall buildings, a historical category system of seven periods is proposed and aesthetic principles and technological innovations of each period are presented. The profiles of leading examples of the each period are also illustrated in a series of outline figures showing the comparative heights to make a comparison between each period.

3. VISUAL IMPACT OF TALL BUILDINGS ON A CITY'S SKYLINE

The visual impact of a tall building on the skyline is related with aesthetics and beauty, as well as power, prestige, image and visibility. These requirements must be accommodated in the design of a tall building. Also, the scale and profile of a tall building greatly affects one's sensibilities and the physiological process of viewing the building. A building viewed from a distance versus close proximity creates different visual perceptions. Another factor that will result in a certain visual impact is the context, as well as whether the building conforms or contrasts with the surrounding landscape in general and the aesthetic environment in particular [1]. Especially in large cities, such as New York and Chicago, a tall building is part of a cluster of high-rises. The overall visibility between its peers requires a different approach than the first building.

Tall buildings are the major components of the built environment, as well as creating the spectacular skyline. In respect to their effect on the environment and visual perception, all tall buildings should be composed of three distinct sections. The designer can use this information as a basis for an analysis of tall building design for an effective, pragmatic methodology. The classical viewpoint on this issue was outlined by L. Sullivan in 1896 as follows [2]:

Base, which is the part that is seen from street level, is contained within the 40° cone of vision. Depending on the depth of open space in front of the building, this section usually rises to a height of five to eight stories. Interfacing with the urban setting, it is a crucial determinant of the building's contextual quality [3]. The base, having little effect on the urban decoration, has significant impact on the scale and definition of the street and the humanizing effect of tall buildings [1].

Shaft, which extends from the base upward, becomes the prominent form of a tall building. It is critical in altering the quality of interaction between the building and surrounding conditions. This section is potentially detrimental since it alters the patterns of air movements in its surroundings. The configuration of the shaft is critical in determining whether the building's scale is perceived as imposing or considerate, overwhelming or accommodating. In most of the large cities the shaft is just one of the many trunks in the wood. For this reason the top of the skyscraper becomes more important.

Top rarely affects the surrounding conditions, but significantly impacts the city's skylines. Ali and Armstrong [1] state that, there exists a dialectical relationship between the tall building's base and its top, which is similar to discourse between two languages - individual at the top and more utilitarian at the base. Tall buildings assume the role of high-level icons for the city, and can create an epic-scale skyline. At the tall building's top, the architect has greater opportunities for aesthetic expression. A tall building without a skyline identity might be an impressive stack of floors in space.

Following Sullivan's "base-shaft-top" definition of the tall building in 1896 [4], contemporary architects emphasized more on these three segments and this distinction became more obvious [1,5]. This design approach becomes more meaningful when the building reaches enormous heights in a dense urban setting. According to Kohn [6], the base is of high importance since it establishes relation with the pedestrians at the street level. The shaft, which is properly articulated depending on the architectural style and the structural form, constitutes the principal element of the tall building. The top is the most important component of the tall building in terms of its impression in the city silhouette.

The key for generating architectural coherence from these three sections lies in the morphological transformations from one to another. The geometric rule must be drawn from the context, and the urban environmental conditions. The more the contextual considerations are applied, the more responsive the building is to its urban settings [7]. Whereas the base of the tower forms a part of the cityscape, the top is seen from a far distance, so it is a significant design criterion, since it is a junction between the building and the sky [8].

4. MORPHOLOGICAL DEVELOPMENT OF TOPS

The morphologic development of tall buildings can be broadly divided into seven periods, beginning with the innovative engineering accomplishments in Chicago. Each period faces advances in structural systems and construction technologies, as well as reflecting deep ideological differences among architects and their clients.

4.1. Functional Period (1880 – 1900)

The social transformation and innovative engineering accomplishments in Chicago and New York initiated

the functional period of tall buildings, which can be characterized by functional orientations. The examples of this era reflect advances in structural engineering [9,10] (Figure 1). Before the widespread use of steel skeletal construction in this period, architects were restricted with the structural capacity of load-bearing masonry walls for buildings. Typically these buildings

were large and monumental in scale and were limited in height. Advancements in structure and construction technologies affected the form and stylistic image of the buildings. During this period, architects attempted to adapt existing building types, most notably the palazzo, to new heights allowed by the elevator technology [1].

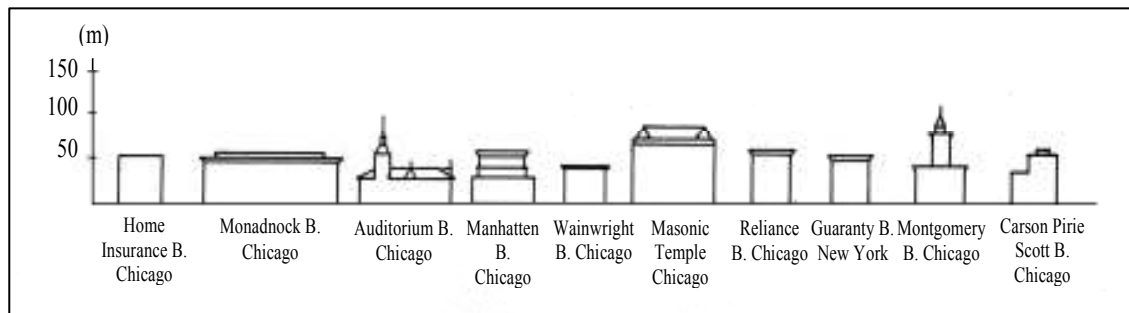


Figure 1. The buildings of the Functional Period (1880-1900).

William Le Baron Jenney's Home Insurance Building (1885) initiated the innovative use of the structural steel frame, which characterized much of the tall buildings of the era [11]. Louis Sullivan was the first to give architectural expression to the steel-frame tall buildings. He developed and perfected his system in two famous buildings – the Wainwright Building (1891) in St. Louis and the Guaranty Building (1895) in Buffalo [10]. The two buildings accepted the repetitive treatments in their facades. The ground floor and the mezzanine were articulated to form a base to the tower, and the composition was terminated by the top floor with cornice ornamentation unique to Sullivan. However, Carson Pirie Scott department store (1904) in Chicago emphasized the structural elements in the façade, ending with a flat roof at the top.

The Reliance Building (1895) designed by Burnham and Root, expressed its metal-frame structure and was sheathed entirely in glass. The transparency of the surface and the formula of the building composed of base, shaft and top, denominated the building to be a skyscraper [12]. One of the striking designs of the period, the Montgomery Building (1899) in Chicago, combined the functional Chicago School structure with Italian Renaissance ornamental motifs. The most remarkable feature of the building is the imposing square tower. The pyramidal roof, which was tiled in gold terra cotta panels, generated the most interest among Chicagoans [12,13]. The Masonic Temple (1892) by Root represented the historical forms by its

top design. To accommodate the meeting rooms of the Masonic Lodge on the top floors, Root added steeply sloping roof with dormer windows [1].

Typically the buildings of this period were large and monumental in scale and were limited in height, especially by the standards of tall buildings that would follow. These buildings are significant since they demonstrate how the architects of the era can merge the three parts of the building. The classical tripartite organization of the tall building into base, shaft and top was addressed in these early examples. The tops, influenced by the renaissance motifs, were generally flat or articulated with triangular forms, and emphasized the last story with distinctive ornaments from the midsection of the building.

4.2. Eclectic Period (1900-1920)

The eclectic period presents aesthetic solutions through the application of historical models [9,10]. Architects of this period adapted the verticality of Gothic forms to taller skyscrapers, such as Le Brun's Metropolitan Life Tower (1909) and Cass Gilbert's Woolworth Building (1913). They were both proclaimed the "cathedrals of commerce" (Figure 2). A remarkable masterpiece of the eclectic period, the Woolworth Building had a square tower rising with several setbacks. The top is a crown with pinnacles and gargoyles, one of which represents a Cass Gilbert holding model of his building [14].

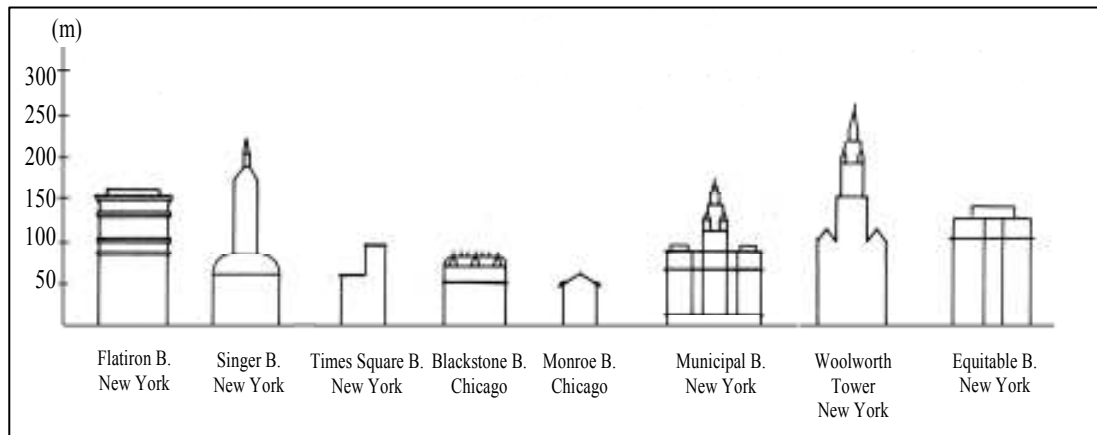


Figure 2. The buildings of the Eclectic Period (1900-1920).

Whereas the application of classical principles led to sculptural forms, such as Burnham's Flatiron Building (1903), the buildings of this era seem to have had the influence on both the expression of structure and the façades of modern architectural design. However, New York approved a more self-conscious corporate image comprised of conservative styling and innovative planning, such as it has been in Singer Building (1908). Several successful tall buildings of the 1920s combined the functions and images of business and institutions. The implied purpose was to soften the corporate image of the commercial tall building by evoking civic and religious architectural images [15]. In contrast to strictly classical buildings, Gothic revivalism found popularity. Beginning in 1907, Holabird and Roche designed a number of buildings that combined the direct expression of structure with a convincingly executed historical style, among them which is the Monroe Building (1910) in Chicago.

Typically the tops of the tall buildings of this era are predominantly articulated with Gothic and Renaissance motifs, which were transferred from European models. Although topped with a flat roof, Flatiron Building is also an attractive example of its period, since it constitutes a transition between the functional and eclectic period.

4.3. Art Deco Period (1920 – 1940)

The late 1920s and early 1930s witnessed a struggle for height. As an extension of the eclectic period, Art-Deco

style presented more imagination power, attractive and exaggerated decorations, and combined all the cubism, futurism and expressionism as well as the Asian motifs (Figure 3). After the end of World War I, Chicago abandoned uniform cornice line and followed Gothic examples with Graham, Anderson, Probst & White's Wrigley Building (1919) and Raymond Hood's Tribune Tower (1925). Hood kept the verticality with buttress-like setbacks and crowning spires in the Tribune Tower [1]. Holabird and Root's Palmolive Building (1927), Graham, Anderson, Probst and White's Straus Building (1924) were the remarkable examples of the period that were completed before the Great Depression of the 1930s.

The new zoning ordinances, such as New York zoning law of 1916 and Chicago zoning law of 1923 were the most significant factors affecting the shape of tall buildings in this period. New York's 1916 law encouraged the "wedding cake" setbacks, often topped with a thin central tower. The Chicago zoning law permitted a tower to rise above the old height limit, but restricted its total volume. Two new formal types evolved from this regulation: a composite big base and tiny tower, and an integrated base-and-tower scheme. As buildings took characteristic forms from the local laws and land use, skylines also changed. In distant views, Manhattan looked like mountains and pinnacles, whereas Chicago seemed more like a flat terrain with a few isolated, truncated towers [16].

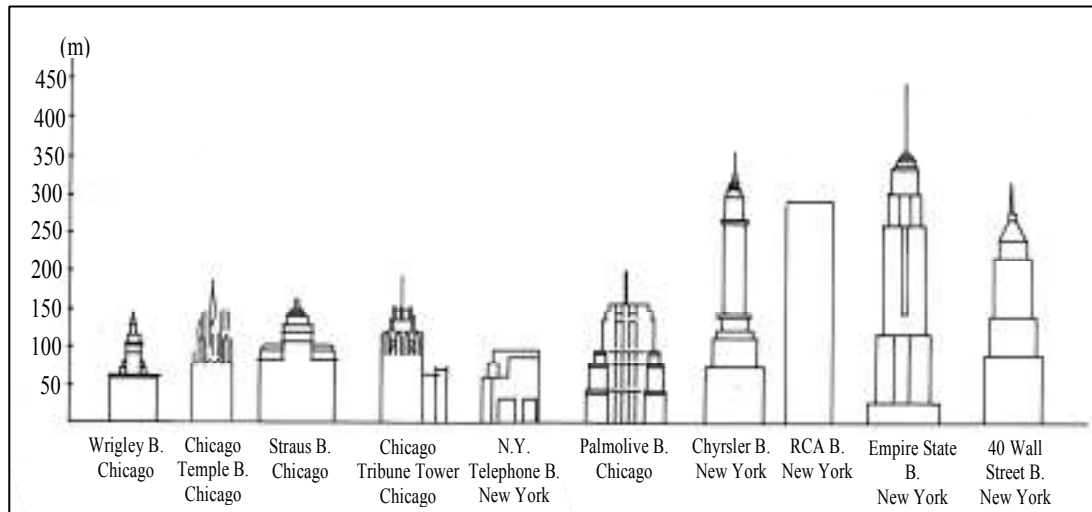


Figure 3. The buildings of the Art Deco Period (1920 – 1940).

A stylistic example of this period is the Chrysler Building by William Van Allen in 1930. The building has been referred to as Art Deco and, with the Empire State, dominated New York City's skyline for about half a century. The Empire State Building was a masterpiece and became the most influential and sustaining image of New York. Its shaft rose above a five-storey base, its mass broken by indentations running the full height, topped by a crown of setbacks culminating in a gently rounded tower. The Empire State Tower remained three-quarters empty for a decade after its opening in 1931, and did not turn an annual profit until 1950. According to Carol Willis, this isolated tower, far from the clustered high-rises, was extra-ordinary in its size and sitting, but in every other way a standard speculative development. It was a direct translation of a real estate scheme of the period and demonstrated the principle of *form follows finance* better than many skyscrapers [16]. Some other major buildings of this period are New York Telephone Building (1926), RCA Building of Rockefeller Centre (1932) and 40 Wall Street Building (1930) in New York (Figure 3).

4.4. International (Modern) Period (1950 – 1970)

With the Great Depression and the World War II, there was a decline in tall building construction until the 1950s. Following the World War II, the advent of computers in conjunction with a boom in the construction industry, facilitated the development of new structural systems and forms. It was now possible to analyze and investigate different structural systems and components with the aid of the computer, which had never been possible before. Conventional rigid-frame systems were the prevalent structural systems for tall buildings until then. Fazlur Rahman Khan developed and refined the revolutionary tubular building concept. Here the building skeleton comprises closely spaced perimeter columns that provide greater resistance than it is obtained with conventional systems because of the three dimensional response of the

building to lateral loads. The framed tube offered the traditional architectural articulation for exterior window treatment on the building façade. So structural expression of the façade was possible. Modified versions of the basic framed-tube form, such as bundled tube, braced tube, composite tube, and tube in tube, appeared on the building scene. The architects of this period rejected ornamentations and historical reference, and embraced a more technological and rational expression of building form. The buildings of this period are distinguished by simple, stereometric shapes; unitary volumes wrapped in a thin, weightless skin of glass, plaster, or similar material; or no ornamental details [17]. Characterized by functionalism and direct expression of materials and structure, the international style buildings were monolithic boxes. They were functionally defined by the economy of leasable floor area, and core-to-exterior-wall relationships. The classical tripartite definition of base, shaft and top was all but absent. Typically the entire building was raised on columns, and the tops of the buildings were flat, such as it has been in Lever House (1952) and the Seagram Building (1958) in New York, as well as the 860 Lake Shore Drive Apartments (1952) and IBM Building (1969) in Chicago (Figure 4). The stereometric shape of these buildings, clad with glass curtain walls, expressed their vertical continuity from base to shaft and top with little articulation and variation. The Xerox Centre (1980) and the 333 South Wacker Drive Building (1983) in Chicago can be both regarded as the latest examples of the international period or symbols of a transition to the next generation of tall buildings. They both have curvilinear facades, which are designed under the boredom of the box-shaped buildings of modernism. The rounded form of these buildings made an impressive statement. Especially the top of the 333 South Wacker Drive –the setback from the building's curve, formed a signature on the sky and sets the building apart from the box-shaped towers of the period. The Marina City Towers of Chicago (1967), designed by Bertrand Goldberg are also remarkable

examples of the period being two cylindrical residential towers [11]. The reinforced concrete towers expressed the plasticity of the structural material; however they

represented no significance with their flat roofs, such as their peers do not as well.

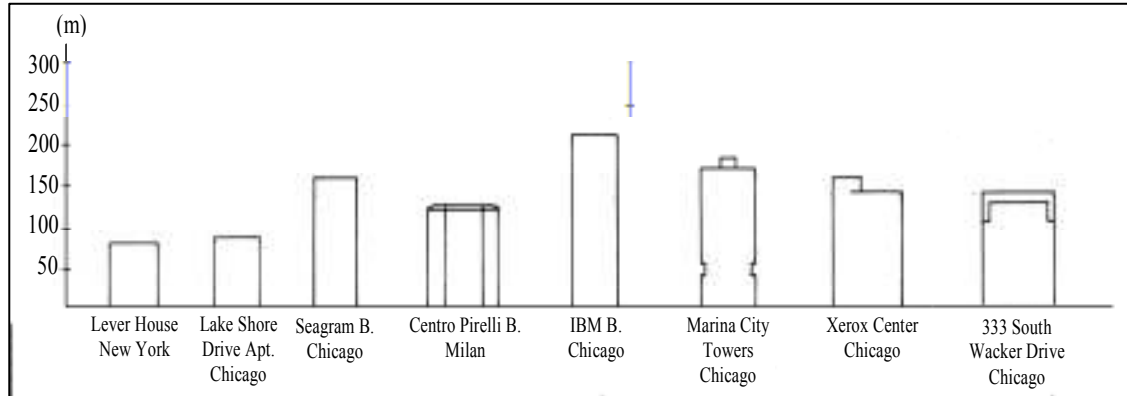


Figure 4. The buildings of International (Modern) Period (1950 – 1970).

4.5. Super-High Period (1965-1980)

1960s witnessed the awakening of tall buildings as symbols of economic assurance and power of commercial enterprising. Beyond the buildings that were constructed by advanced technologies in the modern phase, this era presents super-high buildings, such as John Hancock Centre (1969), Amoco Building (1974), and Sears Tower (1974) in Chicago, the collapsed World Trade Centre Twin Towers (1972) and Citicorp Centre in New York, and Transamerica Pyramid in San Francisco, which all emphasize the advancements in design and construction technology. Although many of them present the international style characteristics, high-rises, such as the John Hancock Centre and Sears Tower were the pioneers of structural expression. The John Hancock Centre had a tapered shaft with structurally expressed X braces cutting across the exterior façade. Goldberger [18] criticizes its rich

contextual response to the city skyline. He also finds the Sears Tower most exciting and admiring. Its structural system –bundled tube, which is developed by F. Khan, enables the designer to shape the mass in various forms. The tubes stop at different heights, giving the building varied, stepped-down profile. In making a direct allusion to the elaborate tops of tall buildings of the 1920s and 1930s, Khan reinforced the direct and logical expression of the building’s structure. Perhaps, the Transamerica Pyramid of San Francisco is the most prevailing building of the skylines in this period. It is among today’s most imaginable, easily remembered buildings with its unusual shape. Although many examples of this period have flat roofs and tops with no characteristic features and influenced by the international style, each of the high-rises mentioned above have interesting and attractive top forms (Fig. 5). The expression of the structure has become a new art form independent of architecture in this period.

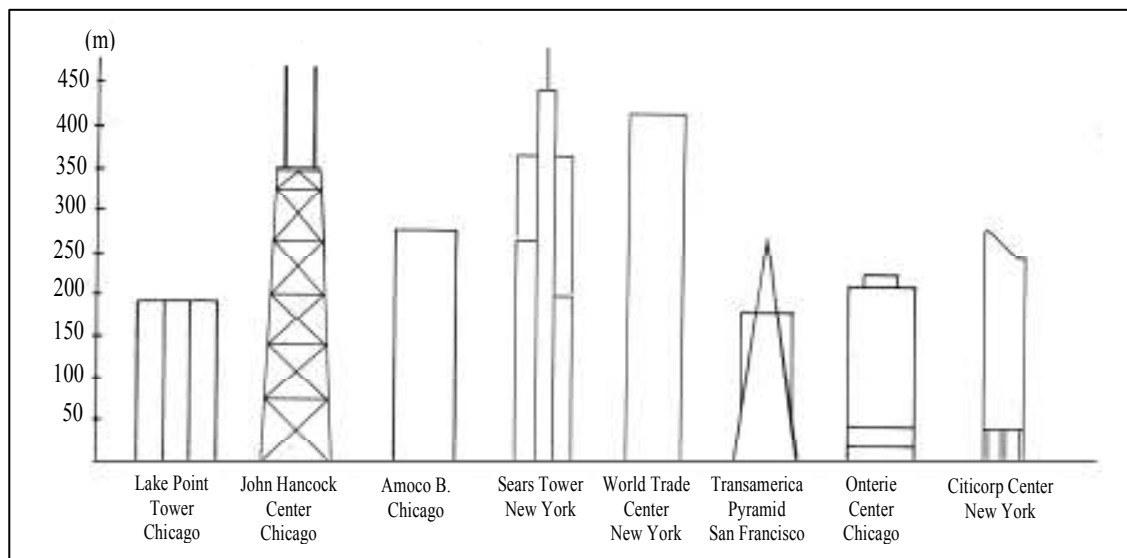


Figure 5. The buildings of Super-High Period (1965-1980).

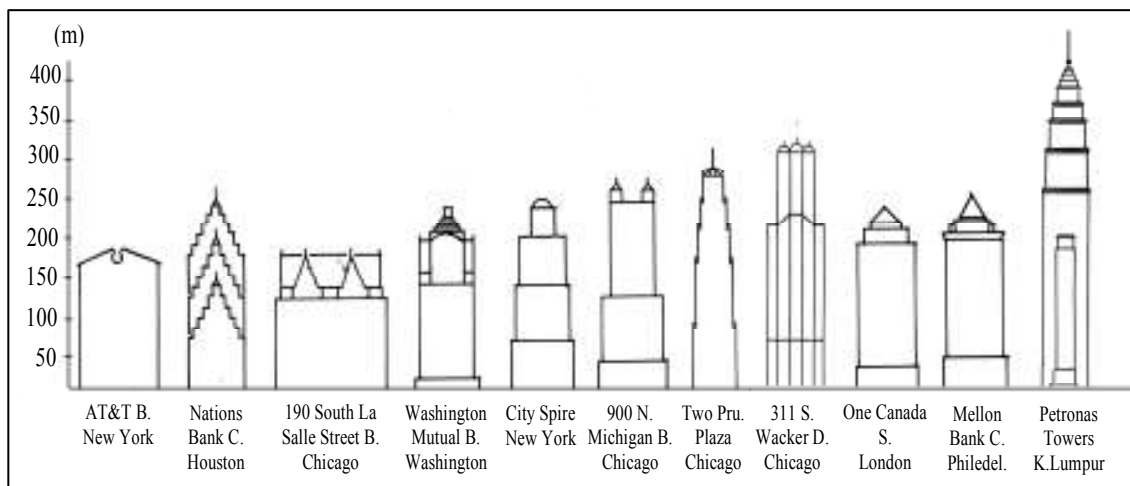
4.6. Post Modern Period (1980 - ...)

Due to the continued boredom with the international style that emphasized glass and metal grids, some architects initiated a movement known as post-modernism in the early 1970s. The buildings of this trend have the characteristics of setbacks, horizontal angles, slopes, curves, notches, and other novel geometric shapes. Obviously, this architecture was a sensitive reaction to the glass-box structures of the cubism period [19]. The post-modern buildings drew attention through a radical departure from traditional architecture by enacting varied forms, particularly varying rooflines that stand out in the flat-top cityscape. These new rooflines were created by assigning domes, pyramids, asymmetric sloped roofs, or a combination of these.

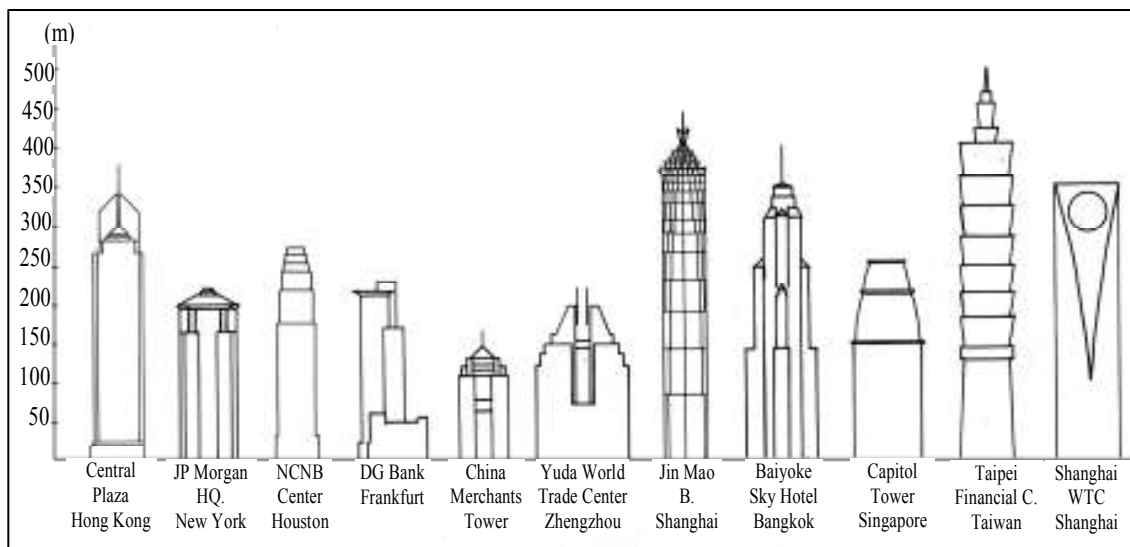
Post-modern high-rise buildings are likely to have clearly defined divisions of base, shaft and top. The tops of the

buildings tend to be distinctive points, spires or stepped forms (Figure 6a-b). While utilizing modern materials and construction techniques, the shafts are often articulated with ornamental details and polychromatic colours derived from the component materials themselves.

The most attractive buildings of this period use sculptured tops with glass pyramids, and globes, pitched copper roof pinnacles, historical motifs, and other similar features. For example the AT&T Building (1982) in New York and 190 South La Salle Street Building (1987) in Chicago altered the public's impression of what post-modernist high-rise architecture ought to look like. Both buildings restored the tripartite relationship of base, shaft and top. They evoke historical imagery and represented a conscious realignment of modern architecture with historical principles.



(a)



(b)

Figure 6. (a) The buildings of Post Modern Period (1980 - ...) (b) The buildings of Post Modern Period (1980 - ...).

Not only the American and European cities, but Asian cities also competed with each other and the West to build taller structures by the introduction of 1980s. However, according to Georges Binder [20], with few exceptions, the Asian skyline did not see a post-modern era comparable to American cities in the 1980s. The high-rise buildings in cities such as Hong Kong, Singapore, Shanghai, Kuala Lumpur and Tokyo were generally designed following a contemporary vocabulary, which created distinctive skylines. Ali and Moon [21] states that, the most significant trend of tall buildings constructed in various Asian countries is that, they use their own regional architectural and cultural traditions as main design motivations. This trend can be easily seen from notable tall buildings such as the Landmark Tower (1993) in Yokohama, Jin Mao Building (1997) in Shanghai, Petronas Twin Towers (2003) in Kuala Lumpur and Taipei 101 (2004) in Taipei. For example the Jin Mao Building tapers to a point, resembling a pagoda or a stem of bamboo. The building is designed around the number 8, which the Chinese consider fortuitous. In addition to being 88 stories high and opening on 8/8/98, the form of the building is divided into segments of 8 [22]. As well as combining art deco lines reminiscent to the New York's Chrysler Building with the tapered form, the stainless steel, aluminium and glass tower rises with setbacks, culminating in a shimmering spire, so it creates a striking presence over the urban landscape with its top design.

Similar with the Jin Mao Building, Petronas Twin Towers also carry cultural features. The floor-plate design of the tower is based on geometric patterns, which are common in Islamic architecture. It is composed of two rotated and superimposed squares with small circular infills. Each tower tapers in six gradations and their verticality ends with pinnacles, making the towers the tallest of the world at the time of completion [11,23]. Although the designer Cesar Pelli, proposed a pointed but pinnacleless top, the clients preferred a Malaysian design, one not derived from skyscrapers or church steeples [24]. The geometric figures have been described by architects as symbolizing unity, harmony, stability and rationality –all important principles of Islam. Although the overall character of the building is high-tech and international, it is obviously and distinctively Malaysian.

Shanghai World Financial Centre is also a significant example when mentioning the significance of tops in tall buildings. The circular topping at the top of Shanghai World Financial Centre was conceived as a grand architectural response to the ending of the super-tall structure.

4.7. Ultimate Technology Period (1985 - ...)

It is apparent that tall buildings have developed to their present forms passing through technological innovations and rationalistic modernism. They have reached a comparable state, in which exuberant trends and liberal tendencies have outstripped their design tradition and conception of forms. Beyond the traditional images of the tall buildings are the products of technological innovations. For example, a popular movement called “high-tech” manifested itself in big cities throughout the world, such as Frankfurt, London, Hong Kong, Shanghai

and Kuala Lumpur [25]. As a remarkable example, Hong Kong and Shanghai Bank, which is located in the heart of Hong Kong's central district, is organized as a series of suspended floors, each heaving an uninterrupted view of the Harbour. It is primarily recognized visually for its unique form and design. Ending with two towers at the top, the building distinguishes Hong Kong's skylines from the other Asian cities. Also, Bank of China, standing with HSBC Bank Building, is one of the most memorable tall buildings due to its height, unusual shape and pyramidal top (Fig. 7). In Architectural Record [26] the building is described as “a stunning exercise of architectural geometry”. The building's architect, I. M. Pei, conceived it as a cube, rising out of the ground, and divided diagonally into quadrants. As the structure moved upward, the mass is diminished one quadrant at a time until it is reduced to a single, triangular prism at the top.

The contemporary generation of super-tall buildings is characterized by lightness, resulting in reduced massing, and slender structural forms. These features enable the designers to create dissimilar super high-rise buildings, such as Menara Mesiniaga (1992) of Kuala Lumpur, Al Faisalah Complex (2000) of Riyadh and Swiss Re Headquarters (2004) of London.

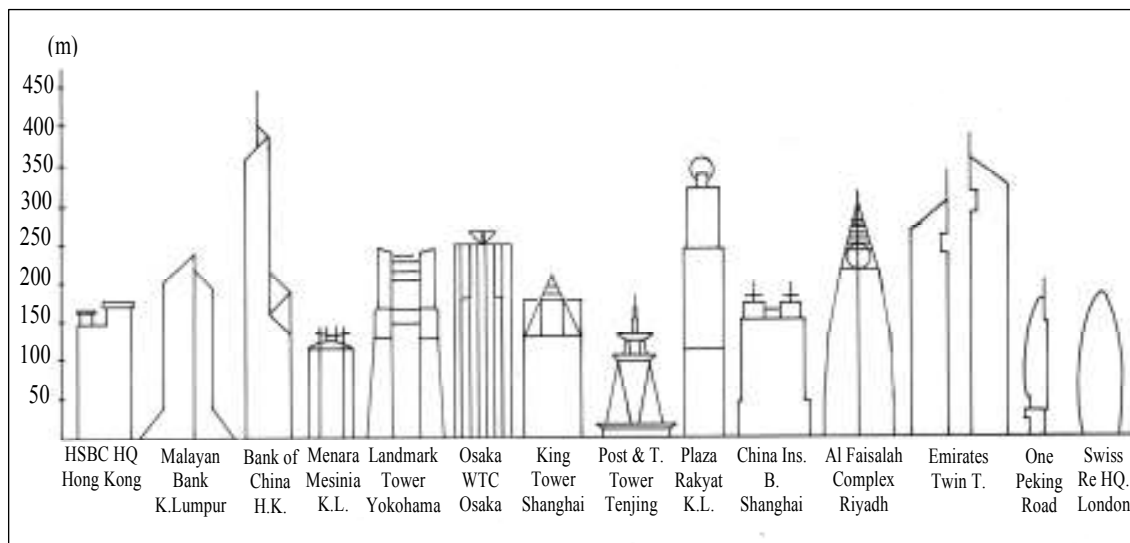


Figure 7. The buildings of Ultimate Technology Period (1985 - ...).

A number of remarkable examples of this era do not comply with the tripartite definition of the base, shaft, and top, such as it has been in Swiss Re Headquarters of London, the Shanghai World Financial Centre of Shanghai, the Al Faisalah Complex of Riyadh and the Burj Dubai of Dubai. The forms of the buildings are designed as a whole and the top is an extension of the shaft (Fig. 7). However, it is obvious that many stylistic approaches of the past decades run in parallel in this period also, and architects still prefer designing flat rooftops when economic efficiency is the primary concern of design.

In fact, the iconic tall buildings of this era are designed according to the architects' motivation, environmental impacts and etc., such as the twisting forms, as well as the Burj Dubai in United Arab Emirates. The previous fashions and styles are no more design trends for the contemporary tall buildings, except for a few examples, carrying post-modernist lines, such as the Plaza Rakyat (1998) of Kuala Lumpur, Emirates Twin Towers (2000) of United Arab Emirates and the King Tower (1996) of Shanghai, as well as the international towers, such as the Osaka World Trade Centre (1995) of Osaka.

5. DISCUSSION AND CONCLUSIONS

Debates on the rights and wrongs of building tall has intensified over the last 20 years as the global economy requires larger buildings through which to conduct its operations and rising land values in central urban areas impose immense pressures to maximize plot ratios and develop upwards. The structural and servicing technologies of tall buildings have become increasingly complex, such that the vertical limits of what can be built are effectively determined less by constructional feasibility than by political, financial, planning, and social constraints.

Every tall building has an impact on the city's skyline due to its morphological character, especially by its top. Tall buildings with their forms and decorative tops not only act as symbols, but also announce the character of the city. There are important urban consequences that

arise from the shaping of the tops of tall buildings. Obviously, the tops of tall buildings impose their profiles on the urban landscape of the skyline. The box forms of the 1950s and 1960s imposed an ordinary skyline on many American cities. Since tall buildings are essentially large boxes of volume with repetitive floor plates, the bottom and top of these buildings offer opportunities for architectural design.

The conventional approach to tall building design is to limit the forms of tall buildings to rectangular prisms. There is a definite need to develop a form that will lead to an efficient structural system, resulting in substantial savings in cost. Since tall buildings involve millions of dollars, a careful coordination of the structural elements and the shape of the building may offer considerable savings as well as creating aesthetic forms.

The challenge for the future is to create tall buildings that have dignity and are intended to serve people as well as improving the urban fabric. By the 21st century, it is likely that more innovative high-rises will be built utilizing the latest technology that facilitates the analysis and construction of structural systems of varied forms and configurations. With the advent of these technological advancements, designers of the future have many possibilities to produce distinctive and unique designs that will dominate the skylines with overall forms and top designs. Making future tall buildings efficient and aesthetically pleasing is the principal goal. Architects and engineers can rise to this challenge only if they collaborate and if they care about people, who are the ultimate critic of what they design and build.

It is important to recognize that tall building design is a holistic process, and it is impossible to consider formal and aesthetic principles in isolation without reference to technology and construction. The relationship of tall building forms and tops to the city's skyline involves a consideration of social values, followed by scale and traditional design principles versus contemporary expression of architectural design objectives.

ACKNOWLEDGEMENT

The author is grateful to the referee for their valuable suggestions for this article.

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