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High Rise Building: The Mega Sculpture Made Of Steel, Concrete and Glass

Alicja Stefańska [1], Daniel Załuski [1]

[1] Department of Urban Design and Regional Planning, Faculty of Architecture, Gdansk University of Technology, Poland

alicja.stefanska@pg.gda.pl

Abstract. High rise building has transformed from providing not only the expansion of floor space but functioning as mega sculpture in the city. The shift away from economic efficiency driven need is only expected to grow in the future. Based on literature studies; after analysing planning documents and case studies, it was examined whether the presumption that gaining the maximum amount of usable area is the only driving factor; or if the need for the creation of an image for the city provided a supplementary reason. The results showed that forming high rise buildings as three-dimensional sculptures is influenced not only by aesthetics, but also marketing. Visual distinction in the city skyline is economically beneficial for investors gaining not only functionality but art, enriching the cultural landscape. Organizing architectural competitions, public debates and following the latest art trends is therefore possible due to large budgets of such projects.

1. Introduction

Since antiquity one could observe buildings that, besides being functional, were created to demonstrate the power and wealth of the investor. Such demonstrations of extraordinary objects could significantly impact not only the immediate vicinity, but also neighbouring lands. The seven wonders of the world were some of the most famous buildings in those days. Those seven buildings were being visited by legions of tourists, which generated significant revenue for the surrounding area. The Pyramid of Cheops (approx. 140 m) and the Lighthouse of Alexandria (approx. 120 m) would now be considered high-rises. They were not only exceptionally high, their form could also be considered special. Such distinct objects in the cityscape were highly desirable and appreciated afterwards as well. The landscape was then dotted with, columns, statues, triumphal arches which were superseded by, churches, town hall towers, vast domes and finally other, ever more complex structures such as, the Eiffel tower, reaching a height of about 320 m. Municipal ambitions were high and with them came the image of a city symbolizing power. At present it is becoming increasingly more common, in addition to pursuing innovative form, to engage in a number of marketing activities in order to distinguish the investment against a background of other buildings. Due to the immense budget of such investments, additional promotion in the form of announcing an architectural design contest, worldwide advertising or using celebrity images does not represent, proportionately, a large additional cost.

As a result, creating buildings with substantial foregrounds, including waterfronts or buildings in the form of city gates, is synonymous with projecting power in an urban space. The need to create or

inspire, something distinct and noticeable on the world map is the realization of extraordinary projects with the aim of attaining iconic landmark status. These icons of architecture are there to astonish, astound and stand out from a multitude of other buildings not only due to their form, but also thanks to their innovative technological solutions. As a result, quoting Horace, projects „ higher than the Pyramids' regal structures" are being realized, although they are not made of bronze, but of steel, concrete and glass, they can serve as monuments just as well.

High-rises owe their beginnings to the invention of the passenger elevator in 1852 [1]. Since that time it has become possible to multiply the usable space of a small plot. That idea turned out to be particularly relevant in the most valuable parts of cities, resulting in the emergence of many high-rise buildings in cityscapes. They are currently not a single phenomenon, and thanks to their number in some districts, they are almost common. Due to a number of factors, building high-rises is a way to drastically increase a city's density, allowing it to grow without expanding outwards beyond its current limits. At the beginning these buildings were shaped simply and mainly by their function, in accordance to a repeatable steel framework. Recently however, a more complex form of competition has been emerging, which manifests, among others, in more extravagant, freely shaped forms of new skyscrapers [2].

2. High-rises in artistic visions

High-rises, unique in both form and idea, have over the years been inspiring not only architects, but artists as well. In the first stage, painting was most influential, as it was first to revolt against academic art and new solutions were emerging from there [3]. Artists following new styles and fashion were inspired by the idea of building the world up and up. They were creating sketches of buildings or works that in turn inspired architects over the years. Some of their ideas were so bold that there was no technological possibility of realization at the time of their inception. Finished projects have been prepared, however by contemporary architectural studios, one cannot overlook the similarity between, for example, Arne Hosek's building from City of the Future (1928), and the Petronas Towers project in Kuala Lumpur (1997)[4], which was designed by Cesar Pelli Associates. Entirely futuristic at its inception, Frank Lloyd Wright's one-mile tall skyscraper drawing is almost identical to the Jeddah Tower in Saudi Arabia, designed by Adrian Smith and Gordon Gill. Although the building is set to reach just over one kilometer instead of one mile, it still pushes limits set by material and technological capabilities.

Inspired by the movement in the art, Antonio Sant'Elia created sketches of the futuristic city of La Citta Nuova (1914) and described ways in which the presented ideas worked. They made use of technical novelties such as synthetic materials, which were to replace stone, wood and brick. In his commentary on the sketches he foresaw that cities would develop in a multilevel manner, having strong communication links across numerous platforms and a variety of transport machinery. He assumed a complete departure from ornaments in favor of lines, planes, and striking simplicity [5]. His ideas were and still are an inspiration for modern architects, just as Piet Mondrain's works have been inspirational since 1917. He proposed new, purified abstract forms that were to be universal and ensure harmony. Together with Kazimierz Malewicz they gave rise to geometrical abstraction in European art [6]. They strived for balance between vertical and horizontal planes and between light and shadow. The same scheme was easy to translate into architecture, especially in small mansion projects.

Many ideas which carried with them geometric solutions small and large (eg, the Voisin Plan, 1922), were also strongly ideological, utopian in this case. That entire project was criticized by all political parties, left and right, and was also called a manifestation of unreality and megalomania [7]. In subsequent times, based on inspirations drawn from art, traditional solutions were often being rejected. As a result, solutions favored for thousands of years such as: sloping roofs, supporting walls,

columns, arches and decorations, were being abandoned in order to create something completely new, as seen in, modernism for example. This introduced another, dynamic approach to architecture, which has become an international style. It completely deprived the outer wall of its structural function, which was particularly useful in high-rises, whose elevation could entirely become an artistic expression in a large format. Individual expression was accepted to such an extent that a continuous variation in the final shape of the building that was shaped by user preferences was assumed. The building with a large amount of glazing in the curtain wall was equipped with shutters, which, due to light, and as required, were rolled up to any height, as seen in the case of Lake Shore Drive skyscraper by Miles van der Rohe (1955) [8].

3. High-rises in the visions of engineers

Due to rapid discoveries and technological progress it was possible to abandon the use of solid stone walls in high-rises in favor of steel framing, as seen in the Pulitzer building in New York (1889). It was Chicago however, that most experimentation occurred, one aspect of which was shaping a new image of facades, which have lost the structural function. It was suggested that they should carry none or scant architectural detail, restraint of form was practiced, whilst at the same time boasting advanced structural solutions and maximization of performance. The transition to a steel framework alone has enabled saving of a lot of valuable space. Calculations at the time suggested that, in a 12-storey building, a usable area equivalent to one full floor was being saved [9]. Due to the universality of these solutions, such buildings were erected all over the world, usually lacking distinguishing features.

Skyscrapers were erected relying extensively on the straight angle and unified building materials had little diversity. Such unification however, was not a barrier for engineers, as the technology allowing for their customization, the ability to easily transport them to construction sites even in the most crowded city districts and safely assemble them at great heights have enabled experimentation with new ideas and solutions. As a result, most potential hazards such as uneven ground subsidence, plastic material deformation and temperature-induced changes were possible to predict and safeguards against them could be put in place, where possible.

There was no longer any reason to hide the building's structure. Miles van der Rohe believed that the double-T bar was a modern counterpart to the Doric column [10]. He used it repeatedly as an architectural detail both visible from the outside and in the hidden within the structure, e.g. in the Seagram Building in New York (1958). Some of his projects owed their acclaimed architectural expression to the ingenuity of the design, and almost always resulted directly from it. An example of this is the Pirelli Building designed by Giò Ponti and Pier Luigi Nervi. Static calculations for this design would be too complicated, so a model was used. It was experimentally tested to ensure that the building was properly constructed, including verification of how stable it would be [11].

Louis Sullivan anticipated the dominant role of the building was its utility. This resulted in his creation of the universal building model. This placed heating equipment and other machines serving the building in underground levels. The ground floor and the first floor were intended for services. Subsequent floors contained repetitive floors and identical rooms resembling honeycomb cells in a beehive, which were supposed to reflect the main function of the building. The last floor contained administrative space. Until this day supplementing buildings with systems making them independent from external conditions is readily done, not only to create favorable conditions for people, but also to save energy by using heat or water recovery systems.

4. High-rises as a sculpture

Since antiquity several functions of sculpture have been recognized alongside decorative, commemorative and cultural, there was also architectural. It was not only small sculptured elements that were a work of art in the case of architectural objects, entire buildings can be considered

sculptures due to their form and expression. It is difficult, however, to set boundaries between architecture as an art and construction as a craft. As a result, the reception of a building as outstanding and its classification as art is in the eye of the beholder, as it is often based on personal preferences and an individual system of values, however some iconic landmarks exist, due to their outstanding form and are recognizable internationally. In addition to being fully functional buildings, they can be considered a mega sculpture. Buildings such as 30 St Mary Axe in London, Taipei101 in Taipei or the Chicago Sears Tower, for example, represent a specific set of associations or values that not every resident or tourist agrees with. Due to the scale in which they appear, sometimes unexpectedly, in many views of the city as they are a permanent feature in any cityscape. As a result, such a grand sculpture can be received positively, neutrally or negatively not only in its immediate vicinity, but in large parts of a city.

Some buildings turn away from the mainstream on purpose by using forms completely different than those previously known. The easiest way to describe those is by using comparisons due to the lack of links to existing architecture, as with the Kisho Kurokawa - Nakagin (1972) capsule building in Tokyo [12]. In such cases it is difficult to predict how a building will be perceived by the general public. There is a low probability that buildings which evoke strong emotions or generate mixed feelings, such as the Brazilian parliament building in Brasília by Oscar Niemeyer, will be demolished at some time in the future. While questioning the value of specific buildings is entirely justified, as is any criticism of architecture, there is no way to avoid witnessing poor or provocative art at that scale, as would be the case with smaller exhibits.

Typically, the final composition is the result of a creative process that is bound by rules and laws which arise partly from localization constraints, pre-existing conditions and are partly accidental. In addition to composition and form, information given to the public also plays an important role as it allows for a better understanding of the artistic message of the building. It is from the message sent to the public that one can meet the intention of the project, such as “a landmark for the new identity" for the Gateway Arch in Incheon, or "a city within a city" for Crystal Island, Moscow [13]. If the local community does not agree with the assumptions that guide the project, it will be difficult for the project to be positively received and constitute a favorable development in the shaping of the city.

5. Shaping the image of the city with high-rise buildings

The image of a city is shaped as part of a long-term process, which usually consists of a historical layer and the current actions of local authorities. An expressive image may determine the direction of further development of the city, bringing with it a greater interest in the city, especially when compared to other, less recognizable or more neutrally perceived cities. Although the image itself is an amalgamation of subjective feelings, it can be influenced. This is possible in many aspects, including spatial - by shaping the fabric of the city. In this way it is possible to permanently associate a city with certain qualities, for example, a center of prestige.

High-rises are usually associated with modernity, worldliness, progress, success and prestige. Thanks to their height, and as a result, visibility in the city, they are an important part of building a city’s image. As long as they represent the type of image that a city wants to project, their impact is seen as strongly beneficial and they are a good tool in its reinforcement. For this reason, localization decisions are usually made in a way that not only maximizes potential benefits but also minimizes losses caused by any unintended impact on the perception of historical assumptions and views of the most important buildings.

A city policy permitting to shape the city-line by building high-rises is intentionally an agreement to standing out. It is one of the ways that a city can use to become unique, to create a brand recognizable by tourists or even a symbol. It is a way to become recognizable, even on a global scale.

An image such as this is remembered not only by tourists and entrepreneurs, but even by residents from remote city districts most distanced from the city center. This allows city dwellers to easily identify with a given city without the need for frequent appearances in the center. As a result, the influence of high-rise buildings on the image of a city is the greater, the less historic development it has.

6. Contemporary methods of localizing high-rises

The location of high-rises is increasingly less random - no longer determined solely by the location of the plot available for development. Due to the fact that skyscrapers dominate cityscapes and city skylines, larger cities usually prepare analyses of locations eligible or excluded from high rising development. Such research is conducted either city-wide or for a protected area and less often so for specific plots that are of interest to investors. Although this is not a formal requirement, because of the mistakes made in determining the locations for such objects so far, there is a need for methods more accurate than perspective sketches when determining the perceptual consequences of their development.

The spatial planning unit in Gdańsk, Poland, prepared a document in 2008 that was based mainly on functional and spatial analyses. Within it a direction for future development was set by establishing five types of zones in the city: designated, recommended, permitted, inadvisable and excluded from high-rise development [14]. The method used for their designation included, among other things, the applicable regulations, historical and natural values, the cultural landscape and the spatial policy of the city. As a result, about 42% of the city area was excluded from high-rise development due to legal restrictions, and a further 46% due to other premises. The areas where this type of development was allowed were verified based on a set of control points taken from a pre-existing document defining spatial policy and local development rules. These points were naturally occurring locations in the landscape. Some of them were important in the context of the entire city while others carried more importance locally and were used to gauge impact on districts or neighborhoods. The impact on the landscape has been analyzed in this manner. It was decided that other aspects such as, the impact on real estate prices and shading of public spaces would be analyzed on demand, at a later date. Work on the document was accompanied by: public consultations, online surveys, a debate, an ideological student competition for drawing up the concept of a high rising object in Gdańsk, workshops for NGOs and a conference.

More technologically advanced methods are used by other cities in the same country, including Szczecin or Kraków [15, 16], to support landscape analyses, for eample in the context of city panoramas, they use city models created using LIDAR point clouds. Such aerial laser scanning allows for generating coordinates of planar points and their height. After generating a 3d model on a basis of collected data, it is possible to check the extent and visibility of planned objects which allows for modification of the target location or adjustment of height and form to acceptable standards [17]. This method can be used not only to protect key city panoramas, both their backgrounds and foregrounds, there is no obstacle for using the same method to weaken the negative impact of a skyscraper in the view from specified point.

7. Contemporary methods for determining the form of high-rises

Depending on the country in which the high-rise is being built, restrictions other than the designer's imagination often apply, such as the local law. In special locations such as Manhattan, the law concerning the plot, on which an investment is to take shape, is a compromise negotiated with the city based on New York's Zoning Resolution. This means that the final height and shape of the building are a compromise between the interests of the investor and the city [18].

In the example of Poland, the possibilities of local authorities determining a form of high rise

buildings that would be in line with the public interest have been analyzed. Determining the purpose of sites, localization of public serving investments and setting site development conditions is included in the local spatial development plan. This is an act of local law, in which it is obligatory to set, among others: principles of protection and shaping of the spatial order, principles of protection and shaping of the landscape, rules concerning the shaping of buildings and indicators of land use, restrictions on land use, also including any restrictions or bans concerning construction [19]. As a result, the basis of normative acts, the ability to determine the form of new buildings, including skyscrapers, is limited to setting the following: the maximum and minimum intensity of development as an indicator of the total area of the building in relation to the area of the building plot; the minimum percentage of biologically active area in relation to the area of the building plot; the maximum height of the building; the dimensions of the planned development; coloring of buildings, roofing and roof geometry and the location of buildings in relation to roads and other publicly accessible areas and to the boundaries of adjoining properties [20].

In the absence of a local spatial development plan, the requirements for new development and site management are being determined by a separate administrative decision. It is created on the basis of an analysis of the functions and characteristics of the development and development of the immediate area. As a result the following are determined: the line of development; the size of the development area in relation to the area of the plot or land; width of the front elevation; height of the top edge of the front elevation, its cornice or attic; roof geometry, inclination angle, ridge pitch, and roof pitch [21]. Indicators determined by the analysis may differ from the average or the maximum in the area, but this must be justified by the analysis in question.

8. Results and discussions

Realization of high rise buildings is still undoubtedly a controversial undertaking, which has its supporters and opponents. Cities shape their spatial policy in a manner that can escalate or limit appearance and the height of these buildings. A competently shaped policy in this regard, can serve them on many fields. Through directed modeling of the city's image, creating a tourist brand and local icons of architecture, it is easier and more efficient to promote the city itself. There is a risk however, that newly built high rise building is characterized by low architectural quality, which is beyond the regulations of the site's law. In such a case, due to its scale, the criticized object is not only present in the city fabric, but also well exposed.

High-rises are more frequently presented as symbols, bearing certain values and meanings. It seems that the final outcome and form of the building is dictated by aspirations to create something extraordinary, which is also economically justified. The function of the building is extremely significant in this case. Commonly used technologies allow the building to be often multifunctional, but the building life cycle still matters. An office building or a hotel is always flexible, remaining in good shape as it must be attractive for new tenants and guests over the years; however for residential buildings the aim is to sell each apartment as soon as possible. The most important moment for their condition is just after the completion of the building, when it's being sold flat by flat. The aging cycle and the use of outdated solutions, is no longer essential for the investor, as it doesn't influence the profit anymore. The costs of future modernizations or possible demolition do not constitute a contradiction or an element that limits the contemporary designer's fantasy.

When building high to shape the cityscape, it is crucial to remain attentive about decisions around future localizations of the high-rises, even if accurate computer simulations are available and being used. Taking into consideration the complexity of the problem of their localization, it is a good practice to additionally examine in detail the external conditions for the plot due to dynamic overlapping processes in the city.

9. Conclusions

Over the millennia iconic architecture, including that of above-average height, commonly associated with power and prestige, had been recognized for its uniqueness. Not all exceptional ideas were realized right away, some of them had to wait for the appropriate technological advancements. New styles in art also influenced the architecture of high-rise buildings, often with a shift of several years. As a result, a great variety of high-rise objects have been created, some of them conforming to unified standards and some reaching far beyond – becoming mega sculptures. Although their main purpose is still to provide a large amount of usable space on a small plot, their form follows the trends in engineering and art, which is facilitated by large budgets commonly associated with the construction of high rise buildings.

Investing in carved buildings with advanced technical systems and sophisticated forms seems to be profitable not only from the perspective of the investor, who finds it easier to advertise the venture and reap the benefits but the cities themselves who compete against each other, which may result in more favorable local law. Due to skyscrapers which have a chance to become iconic and recognizable worldwide, cities can attain their own goals, including economic ones. This can contribute to shaping the image of a city as a prestigious center. The impact of such objects on the image of a city may be the greater, the less characteristic historical buildings it has. This makes it even more important to refine methods of defining skyscraper forms in order to achieve an end result that is in line with the public interest.

With the scattered and often almost random shaping of urban planning, it seems extremely important to further discuss where and in what form the realizations of such buildings should be allowed within a modern city. Regarding a long-term vision for a city's image, it is not inconceivable that demolitions or other means of reducing high-rise dominance could be considered, should they have a negative general influence in a particular case.

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