

# Built environment of the tall housing buildings in Poland

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**Abstract:** This article is an introduction of the research, about creating high-rise buildings and an attempt to summarize 70 years of shaping the built environment, created with the use of these buildings in the Polish cities. The assessment of the built environment refers to the qualitative and quantitative changes which occurred after the economic transformation period in Poland. Changing the cities by complementing them with tall buildings, caused a necessity to define their identity in a new created cultural landscape. In conclusion, the author refers to the importance of high-rise buildings in a modern city in the world.

**Keywords:** built environment; tall and high-rise buildings; Poland.

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## Introduction

Since more than 25 years, Polish cities have been changing their faces. Social and economic transformations are directly reflected in the way of space shaping. New buildings rising next to those traditional, very often historical ones, created not only a new aesthetic experience, but also a new quality of built environment.

Changes in the structure of the cities are reflected in:

1. creating multi-functional buildings,
2. more compact development of central districts,
3. access to modern technologies and building materials,
4. social participation of inhabitants in the investment process and their impact on the living environment,
5. aesthetics improvement and illumination of public space,
6. quality improvement of urban public spaces,
7. revitalization of districts and whole cities,
8. renovation and reconstruction of monuments.

Created living environment of Poles – as users and residents of the cities, makes us spend less time in a house or a flat. Creation of the right conditions for comfortable living, combined with comfort of public spaces in modern cities is a challenge not only for architects or urban planners<sup>1</sup>. [1]

This article is a summary of part of the research related to assessment of the living environment in tall buildings created in Poland. High-rise housing in Polish conditions is a relatively new phenomenon. Most of the tall residential objects built so far were overwhelmingly limited to 11-story buildings and associated with tight flat surfaces, devastation of stairways and lifts or disappointing thermal insulation of curtain walls.

Impetuous progress of real estate developers on Polish housing market, caused creation of new, individual buildings, as complements to the urban space (very often in city centers).

<sup>1</sup> Please note the importance of financial participation of the state, communities and residents themselves. The basic form of public participation can be an example of participatory budgets as a significant influence on the space shaping.

Huge, several-thousand housing complexes built in 70s-80s in the cities suburbs fell into oblivion. Contemporary Polish skyscrapers appear in large cities, in downtown locations and their usability and aesthetic qualities define the success and popularity among users.

## Formal, legal, locational, building and constructional conditions of high-rise buildings shaping

In many countries there are various definitions of tall buildings or skyscrapers. Usually, they are much more diverse in countries with significant achievements in the field of their construction. The Asian countries and the United States are leading this way. The basic criterion is their height.

A very important issue is the method of measuring the height of a tall building. The Council of Tall Buildings and Urban Habitat (CTBUH) introduced three classifications of tall buildings depending on the measurement of their height [2]:

1. to the roof level,
2. to the level of the highest utility storey,
3. to the highest point of the building, eg a mast.

In terms of height, CTBUH classifies buildings as:

1. high-rises – buildings with a height between 100–199 m.,
2. sky-scrappers – buildings with a height between 200–299 m.,
3. super-talls – buildings with a height of 300–600 m.,
4. mega-talls – buildings with a height of over 600 meters.

Polish building law distinguishes between two types of tall buildings. These are:

1. tall buildings with a height of 25,00 to 55,00 meters above the ground level or residential with a height of 9 to 18 floors above the ground level,
2. high-rise buildings with a height of over 55,00 meters above the ground level.

According to this law, residential buildings aside from the height, need to comply with additional condition, related with the number of storeys. Medium-high buildings have from 4 to 9 floors. The interdependence between medium-high and tall objects is the need for elevators (as in buildings up to 3 floors it is not required).

Another law determines considerations related to location and direct neighbourhood of other high-rise buildings. The main case is overshadowing those objects. The distance between buildings intended for people's stay, should provide a steady flow of natural light in the interiors. It can be considered fulfilled when between the arms of angle  $60^\circ$ , set in the horizontal plane, with vertex located in the inner face of the wall on the axis of the overshadowed room window, there is no shading part of the same building or other overshadowing object at a distance of less than:

1. amount of overshadowing – for shading objects with a height of no more than 35 m,
2. 35 m – for shading objects with a height of more than 35 m [3].

With reservation that this distance can be reduced by half for downtown development, what is an usual locating condition for those buildings. These strict legal requirements can often cause many locating problems, related to the overshadowing time of adjacent lower compact building.

Constructions of high-rise buildings are selected in accordance with individual solutions adopted by designers. However, the most common technical problems are:

1. ceilings and cores weight – largely affecting increase of vertical forces – reduced by using lightweight concrete or steel-reinforced concrete,
2. dynamic loads – in the form of wind loads – dependent on location, surrounding buildings and height of the object, where the quantities specified by standards are very often insufficient and it is necessary to do additional tests to determine them.

Construction designs of tall buildings are subjected to thorough static analysis. It is required to determine accurately factors, such as: the impact of the deviation on level of forces and torsional moments, deformations caused by compression forces, differentiation in axial twisting, reduction of stiffness due to cracking and research resulting from horizontal forces action. [4]

## Shaping the built environment of high-rise buildings in Polish conditions

In US, the first high-rises were built in the end of the XIX th century. Although their height was not impressive, because it reached about 10 storeys, they were an important step in the development of this building form.

The first non-sacral tall building in Poland was a high-rise PASTa in Warsaw, created in the beginning of the XX<sup>th</sup> century. It had only 8 floors and height of 51,00 m. Despite the modernist qualities, its form harked back to the historical buildings. Skeleton construction was made form reinforced concrete and filled with cement brick. Although this building was incorporated into the street frontage, it became an architectural dominant and distinguished by windows detail or elaborate, decorative cornice.

**Table 1.** The list of 10 highest residential buildings in Poland, built after the II World War – idea “higer & higer”.

The tallest buildings in Poland after The II World War						
No.	Building name	Building function	Building location	Height to the roof [m]	Number of floors	Year of construction
1	PKiN	culture	Warsaw	188	42	1955
2	Zgoda 13	residential	Warsaw	78	24	1969
3	Swietokrzyska 35	residential	Warsaw	78	24	1969
4	Novotel	hotel	Warsaw	106	33	1974
5	Intraco	office	Warsaw	107	39	1975
6	SDM	residential	Lodz	78	26	1976
7	Stars	residential	Katowice	81	27	1978
8	Oxford Tower	office	Warsaw	140	42	1978
9	Red Tower	office	Lodz	76	22	1978
10	SDM	residential	Lodz	78	25	1979

Next realization, built much later, in 1929 in Wroclaw was General Post Office (Poczta Glowna) building. The style of this object was classified as north German brick expressionism. It had 11 floors with the height of 43,00 m.

Another tall building was Prudential in Warsaw built in 1933, with 17 storeys and height of 66,00 m. It was designed as a multifunctional, office and residential object. At that time it distinguished by its height and technical design, created with metal, welded skeleton construction, filled with structural clay tile. There were also high-rises build in another Polish cities, like Cracow and Chorzow.

After The II World War, Warsaw felt acutely the destruction of buildings. The capital of Poland was almost totally razed to the ground.

In those conditions, the first high-rise which was built in Warsaw after the war, was a free-standing building of the Culture and Science Palace (Palac Kultury i Nauki) at the Parades Square (Plac Defilad) in the city center. It was meant to be a gift from Soviet people for the Poles. Built in the style of socialist realism with many sculptures and colonnades at the ground floor level, was coated in ceramic elements imported all the way from the Ural.

During creation, its monumentality could enrapture, but in nowadays it is a strange form for surrounding buildings of the square and Marszalkowska Street on the west side. Since the object was built in 1955, it has as many supporters as opponents. With its spire, for a very long time it was considered as the tallest building in Poland. In 2007 it entered in the national register of historical monuments.

The building can be seen as isolated on a square approximately 400×600 m, which just seems to be too big for it. In designers opinion it should be integrated into the city fabric and become a part of the capital. That is why was born the idea to surround PKiN with other buildings. Following the assumptions, designed buildings, streets and squares should reach the object in the future. The concept envisages locating them in the direct neighbourhood, with a respect to the historical building. [5]

In the end of the 70s of the XX th century redevelopment of the city center was started. That time the Eastern Wall was built, as a buildings complex expressing a monotonous design of long department stores facades and rhythm of vertical accents at an interval of 220 m. Between those department stores and residential buildings was created the first urban passage. [6] As the vertical dominants, created to oppose the scale of PKiN, were designed 3 residential high-rises in the streets: Zgody 13, Swietokrzyska 35 and Chmielna 35

Their height was to be fitted to the side wings of the PKiN and refer to the historical PASTa building. Only by creating these tall objects, the concept could refer to the scale of the palace.

Another building in the neighbourhood from 1974, which was a reconstruction of the crossroad of Marszałkowska Street and Jerozolimskie Avenue, was 33-storey Novotel. At the same time it was the second building after PKiN, which exceeded the height of 100 m. Its construction was a monolithic reinforced concrete skeleton with lateral load-bearing walls, longitudinal in the corridors and continuous ceilings. Curtain walls – facades were prefabricated.

Other 2 high-rises in Warsaw are office buildings. Intraco skyscraper can be classified as a typical rectangular shape, without any individual characteristics, but it is a negative example of 70s architecture. Fascination of simple geometry combined with the glassed facades is the best example of progressive globalization in architecture. Another similar building is Intraco II, now called Oxford Tower. The location where it was built, was defined as the Western Wall. The space between the Eastern and Western Walls was supposed to specify the exact center of the capital. The most important asset of its design was the height of 140 meters to the top of the roof.

The end of the 70s was a very good time for a quick, even spontaneous development of high building. High-rises were built not only in the capital. A city that was able to take this advantage was industrial Lodz. It is a place, where next to a typical XIX th century architecture, new residential and office buildings appear. That is how the Red Tower was created. Its main asset is the central location in the Piotrkowska Street. The main structural element was a reinforced concrete core with 4 lift shafts and 2 staircases. Its height is 76,00 meters, what makes it 22-storey building.

In the same city as a base for vigorously growing industry, tall residential buildings were created. The Downtown Residential Quarter (Śródmiejska Dzielnica Mieszaniowa – SDM) – defined as Lodz Manhattan (Lodzki Manhattan), is a complex of high-rise buildings in a slab and column skeleton construction, located in a city center. The architectural design was completed with asbestos-cement prefabricated curtain walls (which were ultimately dismantled in the 90s during the overhaul).

Residential buildings in Katowice – the capital of the mining and heavy industries were designed as a large complex consisting of 7 high-rise buildings in the shape of eight-pointed stars. Their height is 81,00 meters, what corresponds to 27 storeys. Built-up area is only 12%, while the plot ratio is 1,96 there. [7]

The 80s in Poland were consolidation of dynamic development of high building principle. Some changes in approach to the objects form could be noticed. Increasingly they began to give up the rectangular shapes for more dynamic forms changing their sizes and shapes with increasing height of the object. Buildings started to be also multi-element and in the ground floor emerged the so-called bottom plate in the form of low part of the building adjacent to the high part.

## Contemporary built environment of residential high-rises in Poland

After 1990, there were many high-rise buildings built in Warsaw. Their location was not related to the center. Buildings were created very quickly, often basing on a specially prepared local spatial management plans. Districts where those objects were located are more and more distant from the center, what directly affects the expansion of the city skyline and greater spatial clarity of outlined silhouettes.

Currently the tallest building in Poland is Warsaw Spire, located in the Wola district. The complex comprises 3 units – buildings located around the inner square with a well composed greenery and urban detail. Under these

object was designed a car park for 1000 parking spaces on 5 underground floors. The main element seems to be additionally covered with openwork facade, which gives the building interesting asymmetry and lightness.

Till 2012, Sky Tower in Wroclaw was the tallest building in Poland. As the previous one it consists of 3 basic parts: 4-storey bottom plate, 19-storey sail, which creates a diagonal cascade and 51-storey tower.

This object was designed as multi-storey residential, office, commercial and recreation complex. In the vicinity was planned to locate another high-rises, but so far Sky Tower raises a lot of reservations because of its height. Second tall building in Wroclaw – Crayon (Kredka), located in the city center at the Grunwaldzki Square (Plac Grunwaldzki), has only 23 floors. It is an example of collective residential building – student dorm. Lack of social acceptance of this object is mainly due to its height, which is incommensurable with the surrounding environment.

Zlota 44 was designed as a luxury apartment building with a height of 182 meters and 52 storeys. The object is equipped with a computer and the entire network of devices control, including air conditioning, blinds, heating or lighting, ordering a meal from restaurant service. Each of the residents has a personalized magnetic card, which allows to get with elevator only on that floor, where the owner's apartment is located. The construction was designed as a reinforced concrete shaft with a metal finial. In the case of outer curtain wall, for the first time in Poland was used a modular triple-glazed façade, which has a low coefficient of heat transmission and very good acoustic insulation.

Another city determined to have a high-rise was Gdynia. Sea Tower is a building with residential, office and warehouse function, consist of two towers with 29 and 38 storeys. Communication between floors is provided by seven high-speed elevators, running to the garage level. On the last floor there is a viewing terrace, exclusively destined for the residents of the building.

Lucka City is a typical apartment building, including 342 apartments, with a surface from 37 to 243 m<sup>2</sup>. On the upper floors were located apartments overlooking Warsaw. On seven underground and three aboveground levels there is a parking, on the next five floors we can find office and warehouse areas.

**Table 2.** The list of 10 modern residential high-rises buildings in Poland.

The highest residential buildings in Poland					
No.	Building name	City	Height to the roof [m]	Number of floors	Year of construction
1	Sky Tower	Wroclaw	206	50	2012
2	Zlota 44	Warsaw	192	54	2013
3	Cosmopolitan	Warsaw	160	46	2014
4	Sea Towers	Gdynia	125	36	2009
5	Lucka City	Warsaw	106	30	2004
6	Babka Tower	Warsaw	96	28	2002
7	Corncoobs	Katowice	82	27	1988
8	Platinum	Warsaw	85	22	2009
9	Stars	Katowice	81	27	1978
10	CapitalTower	Rzeszow	80	25	2014

Babka Tower is a rectangular building built in 2002, with residential, office and warehouse space. The building consists of a tower (114 apartments) and a block (185 apartments). It also has 675 parking spaces.

The last object in this group of residential buildings is the Capital Tower in Rzeszow. The location is not random, as the city is a significant center in the Podkarpacie region, because of many listed companies which determine the level of city wealth. This is the city which transformed from neglected center into an interesting, growing place in Poland, with adequate economical and human potential. It is worth noting that in recent years Rzeszow (besides Warsaw) remains the only city where the number of inhabitants is not decreasing. No wonder that with a growth of the city area, we can notice qualitative progress of living space, resulting in creation of modern residential and business complexes. The CT was designed as a multi-purpose complex, with

office space, apartments and comfortable hotel. That complex includes the tallest building in Rzeszow with 25 storeys (about 80 meters), the second one – slightly lower – 18 storeys (54 meters), three 8-storey objects and one 4-storey.

To summarize this analysis of tall residential buildings, it should be noted that the objects:

1. are being created in different cities – often outside the capital,
2. are being designed as multi-functional, consisting of several different units,
3. more and more often are being created as multi-elements, with common, integrating spaces,
4. have larger and larger dwellings and apartments (with appropriate spatial standard and finishing elements),
5. function as complexes and expanded, multiple developments with associated services,
6. are being created higher and higher (approximately about 150–200 meters high),
7. are being designed with attention to the surrounding landscape,
8. show the highest level of cooperation between designers and their knowledge.

## Vision of the future city with the use of high building

Despite many accidents related to the exploitation of high-rises in recent times (the destruction of the WTC towers in 2001 or the fires of the Torch building and the Address in Dubai in 2015), this has not caused the decline of popularity and further development of this buildings form. Recently, most high-rises have been built in China, United States or United Arab Emirates. These countries are still competing for the title of the highest buildings in the world. It seems that the future designers' rivalry will be based on the construction of the tallest objects. Although eco-friendly and high tech buildings are being created, this is still a negligible number.[8]

In most of the cities, tall buildings are concentrated in the limited area of the center or separated peripheral area. Such a phenomenon should be seen as positive.

Skyscrapers will no longer be designed as mono-functional ghettos or business districts, on the contrary – there will be found different cooperating functions in them. High-rises will be located in areas with potential defending tall building, well communicated, where planning regulations permit high intensity of development and it is possible to maintain required distances from neighbouring buildings.[9]

Adrian Smith (designer of Burj Dubaj) believes that high-rise building should be concentrated on a small, limited area, in the form of single objects or complexes of multifunctional buildings that simultaneously provide daytime light and are equipped with energy-efficient technologies. They should be integral with the context, adapted to the local customs and needs of inhabitants and 'speak the language of the place'. [10]

The future of the city related to the high-rise buildings construction should not raise as much doubts as it was in the case of historic cities. Caring all the time about cityscapes and balance between urban dominants like high sacral and secular buildings, some of the places refuse to locate high-rises in their areas. In some cases, it is justified as a protection of the historical environment, but the resistance to locating any investments is incomprehensible. Creating ever higher buildings within the city center caused changes in the silhouettes and panoramas of historical cities. The lack of appropriate law regulations regarding the creation of protection zones and the historical environment of historical dominants caused the necessity of individual designation of the protected area for each new location of the high building.[11] Great metropolises (Paris with La Defense, Milan with Porta Nuova or Canary Wharf in London) decided to create in their area dedicated zones with tall modern buildings, without creating a threat to spatial and historical landscape readability.

As presented analysis revealed, the high-rises construction is being created by contemporary objects, which are part of the modern sustainable development formula. However, it does not mean, that the cities where those objects operate, immediately become sustainable.

## Conclusions

In summary, it was decided to emphasize the most important aspects of this comparative research – functioning tall buildings in Poland.

Nowadays, high-rises have ceased to be perceived as the only way to secure the right amount of usable surface or dwellings in the places with highest population density. Their present form, shape, function, location, used technologies of construction and building equipment, as well as management of those objects, may indicate that these modern buildings are part of sustainable urban development.

**Table 3.** The list of 10 tallest contemporary buildings in Poland – idea of the regional and ecologist buildings.

The tallest contemporary buildings in Poland						
No.	Building name	Function	City	Height to the roof [m]	Number of floors	Year of construction
1	Sky Tower	multifunctional	Wroclaw	206	51	2012
2	Zlota 44	residential	Warsaw	192	54	2013
3	PKiN	culture	Warsaw	188	42	1955
4	WarsawT,T	office	Warsaw	184	43	1999
5	Cosmopolitan	residential	Warsaw	160	46	2013
6	Rondo 1	office	Warsaw	159	40	2006
7	Intercontinental	hotel	Warsaw	154	45	2004
8	Finanse	office	Warsaw	144	34	1998
9	Mariotte	hotel	Warsaw	140	40	1989
10	Oxford	office	Warsaw	140	42	1979

**Table 4.** Built environment of the tall housing buildings in Poland – summary of components.

No.	Construction time	Object shape	Building material	Structure	Location in city	Idea of building
1	until 1945	simple	wall	longwall	center	modernism
2	from 1945 to 1990	simple and cuboid	steel	shaft building	downtown	higer and higer
3	after 1990	multipart complex	beton and steel	shaft and composite building	whole city	regional and ecologist

Contemporary high-rise construction allows for creation of many interesting objects in urban space, starting from strong urban dominants (e.g. skyscrapers with their individual characteristics of extended form), through buildings integral with cityscapes (most often combining many trends) to those with ecological values (skilfully combining technique with natural vegetation cover).

Recently dominating global features of shaping this kind of buildings (completely devoid of the place context) were replaced by designers with forms characterized by sophisticated, individual aesthetic values. Probably this effect was achieved thanks to some kind of competition among designers in creating more and more interesting (and less and less geometric) forms.

The function of newly designed Polish high-rises is limited to: office, commercial and housing. However, in recent times they are more often multifunctional buildings, combining administrative and office or commercial and residential spaces. It can be explained by economics of design and costs of building exploitation, in economical use of the object. It was all possible, because of the development of modern building materials and construction technologies. The intelligence of skyscrapers, their new forms, construction systems and pro-ecological activities will determine the direction of research and creation of even more impressive projects in the future.

More and more often Polish cities are well prepared for the allocation of tall buildings and skyscrapers in their area. It is preceded by local spatial management plans, analysis and rigorous urban studies. Unfortunately, the process and spatial education, which results in the social acceptance of this form of buildings – in Polish

conditions lasted quite long. It seems that Polish cities were not sufficiently ready for the rapid development of tall buildings.

The basis of the shaping and organization of the public space created with high objects (giving it certain characteristics and acceptance) are the rules ordering that space and combining its forms into structure.

This is why these are not only the skyscrapers themselves, but the relations between them, so the mechanisms of ordering the environment.

Research shows that multi-element and multi-functional objects require adequate shaping, to create additional spatial relations and integration places in conjunction with the urban environment. The skyscrapers are easily fit into the current trends in contemporary design. It is difficult to imagine functioning of today's cities or huge megalopolis without individual tall buildings or whole districts with high-rises. In addition to their aesthetic and functional qualities, these buildings identify the aspirations of people to realize their dreams by living in the clouds and looking at the surrounding us city from the top. Creating the visions of the city we have the subconscious impression that there should be the high-rises.

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## Środowisko zbudowane mieszkalnych budynków wysokich w Polsce

**Abstrakt:** Artykuł ten stanowi wstęp do rozpoczętych badań nad kreowaniem mieszkalnych budynków wysokich, jest też próbą podsumowania 70 lat kształtowania środowiska zbudowanego, tworzonego z wykorzystaniem tych budynków w polskich miastach. Ocena środowiska zbudowanego odnosi się do zmian jakościowych i ilościowych jakie nastąpiły po okresie transformacji ekonomicznej w Polsce. Zmieniające się miasta poprzez uzupełnienie zabudowy budynkami wysokimi, musiały określić swoją tożsamość w tworzonej nowym krajobrazie kulturowym. W podsumowaniu autor odnosi się do znaczenia budynków wysokich we współczesnym mieście w Polsce oraz w świecie.

**Słowa kluczowe:** środowisko zbudowane; wysokie budynki; Polska.