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Astronomical observations in the Inca Temple of Coricancha (Cusco)? A critical review of the hypothesis

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Abstract: Coricancha (Qurikancha, Qorikancha) was the most important temple in Cuzco, the capital of Tawantinsuyu, the Inca Empire. The Spanish Conquistadores had the opportunity to see her, and her legendary richness, in November 1533, after entering Cuzco. Coricancha was the place to worship the most sacred effigies of the Inca cult, including the figure of the Sun, called Punchao. From this early period, there are also references, unfortunately not very precise, related to a specific orientation of some elements of the temple providing reflection of the rising (or setting) sun on the aforementioned figure of Punchao. Based on these sources, and the analysis of the remains of the original Inca Coricancha, a number of hypotheses regarding the possible astronomical function of this temple were formulated. Of particular importance was the hypothesis of Zuidema and Aveni, according to which astronomical observations at Coricancha constituted the structural skeleton of a specific Inca calendar cycle of 328 days. This article presents a critical analysis of this hypothesis, based on long-term research and measurements carried out in the Coricancha by the authors of the text.

Keywords: Incas, Coricancha, Punchao, astronomic orientation, Inca calendar, metrology

Introduction

Since the beginning of the 20th century, several academics have researched the possible astronomical functions of some of Cusco's constructions and of those in the surrounding areas. Nevertheless, the authors, whose contributions were of great importance and gained recognition (at least in their time) were the Germans Roberto Lehmann-Nitsche and Rolf Müller¹. But in the 70s, it was Anthony F. Aveni and R. T. Zuidema who contributed in a more significant way to the development of studies in this field, presenting a series of proposals about the geographical location of some of these places designed to make astronomical observations that have been mentioned in historical sources. The structures to which these two scholars have paid special attention were the *sucancas* of the Picchu hill, which could be seen, according to an anonymous chronicler, on the horizon

¹ Cf. Lehmann-Nitsche 1928 and Müller 1972. The works of this last author, although published in 1972 by the prestigious German publisher Springer-Verlag, are based on the field experiences that Rolf Müller had during his stay in the Andes in the years 1928–1930 and interpreted according to certain methodological concepts already abounded at the time of the publication of his work. This was probably the reason why Müller's book has never been translated into another language and is relatively little known outside the German speaking countries.

west of Cusco; and the Coricancha temple. Another topic that has been studied by these authors is the possible astronomic role of some of the *ceques* (Zuidema 1977;1981; Aveni 1981)².



Fig. 1. The Inka worshipping the effigy of the Sun in the temple of Coricancha. Martín de Murúa, Galvin Manuscript (courtesy of Juan Ossio).

Inka adorujący wizerunek Słońca w świątyni Coricancha. Martín de Murúa, Galvin Manuscript (dzięki uprzejmości Juan Ossio).

Zuidema postulated that the Incas were particularly interested in observing eight critical moments of the 'route', or the apparently annual displacement, of the Sun:

1. The solstices: on **December 21st** and **June 21st**³.
2. The equinoxes: on **March 21st** and **September 23rd**.
3. The passages of the Sun through the zenith of Cusco, on **October 30th**, and **February 13th**.
4. The so-called '*passage of the Sun by the anti-zenith*' or nadir of Cusco – on **August 18th** and **April 23rd**. Anti-zenith, or nadir, corresponds to the point of the celestial sphere that is directly opposite the zenith and vertically downward from the observer. Of course, it is not possible to observe directly the transit of the Sun by the anti-zenith, but this moment, or rather the day, could be determined in the following way: observing the point on the horizon in which the sun sets on the day of its transit through the local zenith, and reversing this direction by 180 degrees, we get the sun's rise point on the day of its passage through anti-zenith (nadir). In the analogic way, we can fix the sun's sunset point on that day reversing the sun's sunrise direction on the day of its Zenithal transit (Fig. 2).
5. To this, it should be added that the observation of sunrise when the sun's rays cut through the axis of the Coricancha's main corridor would occur on two dates: **May 25th** and **July 18th**; according to Zuidema, these two dates were the key for organising the Incas' calendar cycle. (Zuidema 1981; 2010).

² It is noteworthy that over the years and the progress of the research, these authors, and Tom Zuidema in particular, modified their original hypotheses at various points, as revealed by the comparative reading of the first and the last works mentioned (Zuidema, 1982, 2008, 2011, 2014).

³ Dates are according to the Gregorian calendar. The dates according to the Julian calendar were in use by the Spanish administration (and the chroniclers as well) in Peru until 1584. They are earlier for 10 days, so, for example, the December solstice fell on the 10/11 of the month, etc.

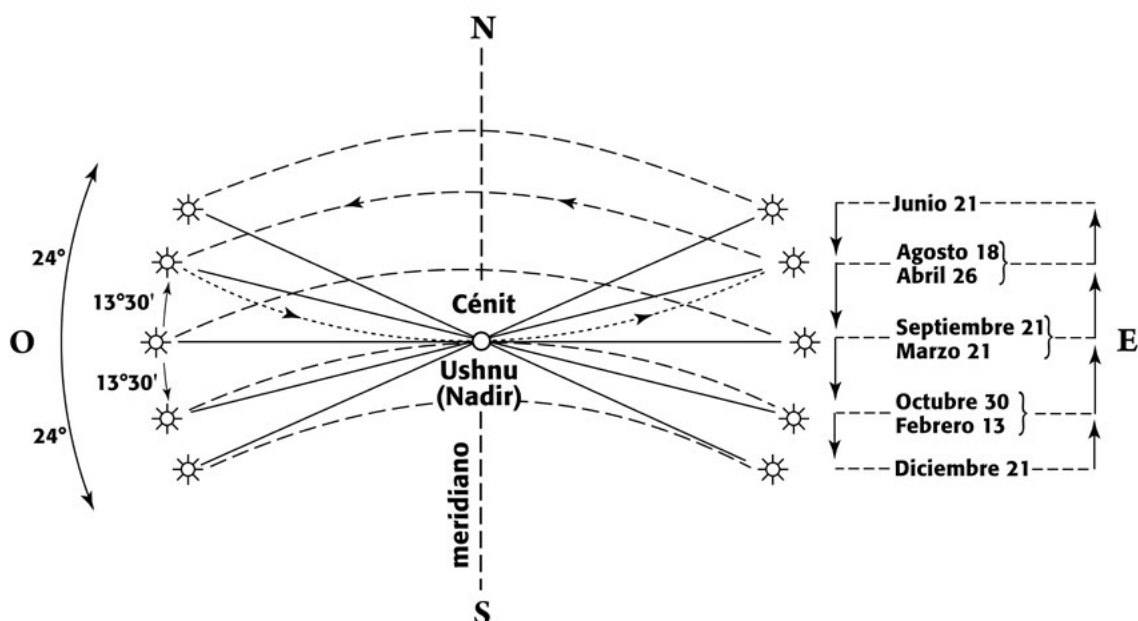


Fig. 2. The eight critical moments of the „route” or apparent annual displacement of the Sun, observed from the latitude of Cusco (Zuidema 2010).

Osiem tzw. „krytycznych” momentów w rocznej wędrówce Słońca po horyzoncie, obserwowanych na szerokości geograficznej Cusco (Zuidema, 2010).

Zuidema and Aveni’s works served as reference points for the investigations addressed later by other researchers, among which we can highlight Brian Bauer and David Dearborn. In 1995, both the authors published a valuable study entitled *Astronomy and Empire in the Ancient Andes*, in which they summarised a large part of what was known by then on the astronomical knowledge reached by the Incas (Bauer and Dearborn 1995). They conducted field prospections around Cusco, as well as studies of the historical sources, with the purpose of analysing, in detail, the hypotheses formulated by Aveni and Zuidema. In several points, the conclusions reached by Bauer and Dearborn differ significantly from the postulates of Aveni and Zuidema. In this study, we will follow the course drawn by Bauer and Dearborn, tackling in detail the topic of possible astronomical observations carried out in the main temple of Coricancha in Cusco, because of their particular importance for the structure and the functioning of the calendar-ceremonial system of the Inca Empire.

The Coricancha (Qurikancha)

This name is attributed to the main temple of Inka cult, located in the heart of Cusco, on a small hill at the junction of two streams (now covered). Its exact geographical coordinates are 13° 31' 12.3" S, 71° 58' 30.9" W, elevation 3391 m asl (Google Earth).

Before moving to the main topic of this article, that is, to the discussion about the possible astronomical functions of Coricancha, we must ask a question of particular importance, namely: to what extent the compound, as we see it today, corresponds to the form that Coricancha had, for example in 1530 AD, it means before the arrival of the Spaniards?

Without going into the details of this profusely debated subject⁴, let us remember some basic facts. The first historical news about this temple comes from 1533, in the context of the richness of its decoration in gold (in

4 Compare, among others: Santiago Agurto Calvo, 1980; Raymundo Béjar Navarro, 1990; Jorge Cornejo Bouroncle, 1942; Ian Farrington, 2013; Graciano Gasparini and Luise Margolies, 1977; John Hyslop, 1990; George Kubler, 1952; Roberto R. Lehmann-Nitsche, 1928; John H. Rowe, 1944; Max Uhle, 1930.

particular, the frieze of this metal), which was looted by the Spaniards⁵. In spite of this, eyewitnesses underline that even in mid-1537 the whole temple was apparently structurally intact, so it could, for example, serve as a prison for the brothers Pizarro captured by Diego de Almagro 'El Viejo' and his followers⁶.

The first somewhat detailed description of Coricancha dates from the early 1540s, from the chronicle of Pedro Cieza de León is as follows:

This temple had in circuit more than four hundred steps, all surrounded by a strong wall, all the building of excellent stonework with perfectly processed stones, precisely placed and settled, some of the stones were very large and impressive; they had no mortar of earth or lime, but only the bitumen with which they usually make their buildings, and these stones are so well carved, that it does not seem to be a seam or a joint between them. (...) The stones seemed to me to be something black and coarse and very excellent. There were many doors, and the facades very well carved; in the middle of the wall, a gold ribbon two hands wide and four fingers high. The facades and doors were covered with plates of this metal.

Further in were four houses, not very large, carved in this manner, and the inside and outside walls were plated with gold, as was the carpentry, too, and the roof was made with straw that served as tiles. There were two seats in that wall, which the sun illuminated on rising, and the stones [of the seats] were spottily perforated and in the holes, many precious stones and emeralds were embedded. In these seats [only] the kings sat, and if someone other did, he was punished with death.⁷

There, for the first time, an information appeared about a type of solar observations that had been realized in the temple for ceremonial events: '*... two seats in that wall, which the sun illuminated on rising ...*'

Bartolomé de las Casas, apparently based on the information of Cieza de León, presents a slightly different interpretation of this device:

In a part of the temple there was a piece as an oratory, to the part of the East where the Sun rises, with a large wall, from which came a roof six feet wide, and on the wall there was a niche where the image of the Sun was put, in the mornings, when the sun is rising. (...) and after noon they passed the image to the opposite part, in another lace, so the setting Sun faces the effigy.⁸

5 The earliest reference on the "houses of the Sun" (the name Coricancha, or "the Golden Enclosure", was given to this compound later) and their fabulous treasures came from Cristóbal de Mena relation, published in Seville in 1534 (Mena). Compare also the testimonies of others Conquistadores: Juan Ruiz de Arce, *Relación de servicios*, 1933 [1545], pp. 371–372; Pedro Sancho (1917 [1533], chap. XIV, pp. 185), Pedro Pizarro, ([1571], chap. 15)

6 *... y luego llevaron a Hernando Pizarro y a Gonzalo Pizarro a las casas del Sol por ser aposento muy fuerte poniendo con ellos un Capitan con treinta hombres para que los guardasen...!* "... and then they took Hernando Pizarro and Gonzalo Pizarro to the houses of the Sun, because it was a very strong compound, putting with them a Captain with thirty men to guard them..." (Anónimo, 1539: 114). Translation into English by the Authors.

7 *Tenia este templo en circuito más de cuatrocientos pasos, todo cercado de una muralla fuerte, labrado todo el edificio de cantería muy excelente de fina piedra muy bien puesta y asentada, y algunas piedras eran muy grandes y soperbias; no tenían mezcla de tierra ni cal, sino con el betún que ellos suelen hazer sus edificios, y están tan bien labradas estas piedras, que no se le parece mezcla ni juntura ninguna. (...)*

La piedra me pareció ser algo negra y tosca y excelentísima. Había muchas puertas, y las portadas muy bien labradas; á media pared, una cinta de oro de dos palmos de ancho y cuatro dedos de altor. Las portadas y puertas estaban chapadas con planchas de este metal.

Más adentro estaban cuatro casas no muy grandes labradas desta manera, y las paredes de dentro y de fuera chapadas de oro, y lo mesmo el enmaderamiento, y la cobertura era paja que servia por teja. Había dos escaños en aquella pared, en los cuales daba el sol en saliendo, y estaban las piedras sotilmente horadadas y puestas en los agujeros muchas piedras preciosas yesmeraldas. En estos escaños se sentaban los reyes, y si otro lo hacia, tenia pena de muerte. (Cieza, II p., Cap. XXVII: 105–107). Translation into English by the Authors.

8 *A una parte del templo había cierta pieza como oratorio, hacía la parte del Oriente donde nasce el Sol, con una muralla grande, de aquélla salía un terrado de anchura de seis pies, y en la pared había un encaje donde se ponía la imagen grande del Sol /.../. Esta ponían, cuando el Sol salía en aquel encaje, las mañanas, que le diese de cara el sol, y después de mediodía pasaban la imagen a la contraria parte, en otro encaje para que también le diese, cuando se iba poner, el sol de cara. /Las Casas, 1958, cap. CXXXI, pp. 451–452. Translation into English by the Authors.*

We will return to this topic in the final part of this study.

Going back to the theme of changes in the structure of the temple, we note that by 1570 AD it had undergone major changes due to its adaptation of the needs of the Convent of Santo Domingo that was installed in this precise place⁹. Until now, the convent has had its headquarters there, which has necessarily been the cause of several alternations and remodelling of the original Inca structures throughout the Colonial and Republican Period.



Fig. 3. Coricancha after the disastrous earthquake of 1950. Photo from the Oscar Ladrón de Guevara private archive (courtesy of César Ladrón de Guevara).

Coricancha po trzęsieniu ziemi w 1950 roku. Zdjęcie z prywatnego archiwum Oscar Ladrón de Guevara (dzięki uprzejmości César Ladrón de Guevara).



Fig. 4. Coricancha. The niche in the facade of the „Room of the Stars”. Left: situation by 1942. (Photo from the John H. Rowe private archive – courtesy Patricia J. Lyon). Right: the present day view after reconstruction by Oscar Ladrón de Guevara. (Photo Jacek Kościuk).

Coricancha. Nisza na elewacji tzw. „Sali Gwiazd”. Po lewej: stan z ok. 1942 roku (zdjęcie z prywatnego archiwum John H. Rowe dzięki uprzejmości Patricii J. Lyon). Po prawej: stan współczesny po rekonstrukcji przez Oscara Ladrón de Guevara (zdjęcie Jacek Kościuk)

Let us also point out two important natural events that have altered the structure of Coricancha: the disastrous earthquakes of 1650 AD and 1950 AD (Fig. 3). The last one gave an occasion to a project of a general reconstruction of the whole compound, in charge of the architect Oscar Ladrón de Guevara Aviles. In fact, several

⁹ Compare the short description by Fray Reginaldo de Lizárraga (Lizárraga, 1605 [2002], pp. 170–171), a Dominican friar (1545–1615), born in Spain who spent most of his life in America. His work ‘Descripción breve de toda la tierra del Perú, Tucumán, Río de la Plata y Chile’ finished in 1605, was not published until 1908. The description of Coricancha in it probably comes from the 1570, when Lizárraga visited several times Cuzco.

Inca architectural elements, which were hidden by the colonial constructions, have been uncovered. At the same time, a partial *anastylosis* of the Inca structures reconstructed several missing parts of the original walls.

To evaluate the importance of these interventions, just compare the photos of the famous niche in the east wall of the so called '*Enclosure of the Stars*' in 1944 with its current appearance (Fig. 4), after the aforementioned restoration works.

Anyway, according to both archaeological and historical evidence, it seems that the external appearance of this complex would not be much different from other Cusco *palaces*: a complex consisting of a number of *sheds* or rectangular buildings, covered with straw, located around a central patio. It was surrounded by a polished stone wall. The number of structures located inside the enclosure is still to be established. According to the current research, it appears that there were all together nine buildings, and of these, all, but one, were connected directly with the central patio (Fig.18)¹⁰.

The temple had a rectangular form, except for the western enclosure wall, which was curved, and higher than the others, because it rested on the side of a hill, giving it a *balcony* shape (Fig. 5 and 18).



Fig. 5. The curved wall of the 'balcony' of the Coricancha (photo Jacek Kościuk).

Fragment inkaskich murów Coricancha – zakrzywiona ściana tzw. „balkonu” (zdjęcie Jacek Kościuk).

In summary, the current form of Coricancha has been profoundly altered since the Inca times. Although the general layout and part of the walls of the enclosures as well as the famous curvilinear balcony are undoubtedly authentic, in other parts we are confronted with the presence of restoration effects and contemporary *anastylosis*. Therefore, any study of archaeo-astronomic character must be carried out with extreme caution and, preferably, based on undoubtedly pre-Hispanic vestiges.

Regarding the historical references about the disposition of certain elements within the Coricancha, which could be associated with astronomical observations of some kind, the only existing information is that about the '*... two seats on that wall, which the sun illuminated on rising...*'.

The hypothesis on the astronomical-calendric function of the Coricancha (Qurikancha)

The hypothetical astronomical function of Coricancha and the result of studies by different authors, particularly those mentioned in the introduction, have been summarized as follows by Ian Farrington:

¹⁰ This is what Farrington proposes, summarizing the existing evidence (Farrington, 2013: 166). Previously Gasparini and Margolies postulated that the Coricancha was formed by seven rectangular buildings: two larges on the south and north sides, two mediums on the west side, two smalls on the east side and one additional to the north-west (Gasparini, Margolies, 1977).

It is clear that certain solar observations must have been made from Qorikancha, particularly of the sunrises and sunsets thought to be critical to the inkas, such as solstice, zenith, and anti-zenith. Various scholars have speculated about what was observed. For example, Zuidema (1982: 214) argued that both the June solstice sunrise and the heliacal rise of Pleiades could have been viewed above the alcove wall from the doorway between R-3 and R-4. The December solstice sunrise could have been observed from the southern terrace. In terms of sunsets, Bauer and Dearborn (1995: 77–78) provided evidence that the December solstice sunset behind Killke mountain could have been viewed from the corridor between R-3 and R-4 as well as from Intipampa (Farrington 2013, p.).

In their first studies, Zuidema and Aveni postulated a special role of the so-called *ceques* or 41 symbolic lines that came from the Coricancha and its vicinity. They considered these perfectly straight lines, visualized on the ground by successive sanctuaries or *huacas* (Fig. 6).

Some of those lines were supposed to mark a specific orientation for astronomical observations at the horizon (Zuidema 1982b; 206)¹¹. Aveni and Zuidema suggested that from the Coricancha, with the help of the *ceques* lines, several solar phenomena could be observed, possibly a sidereal one.

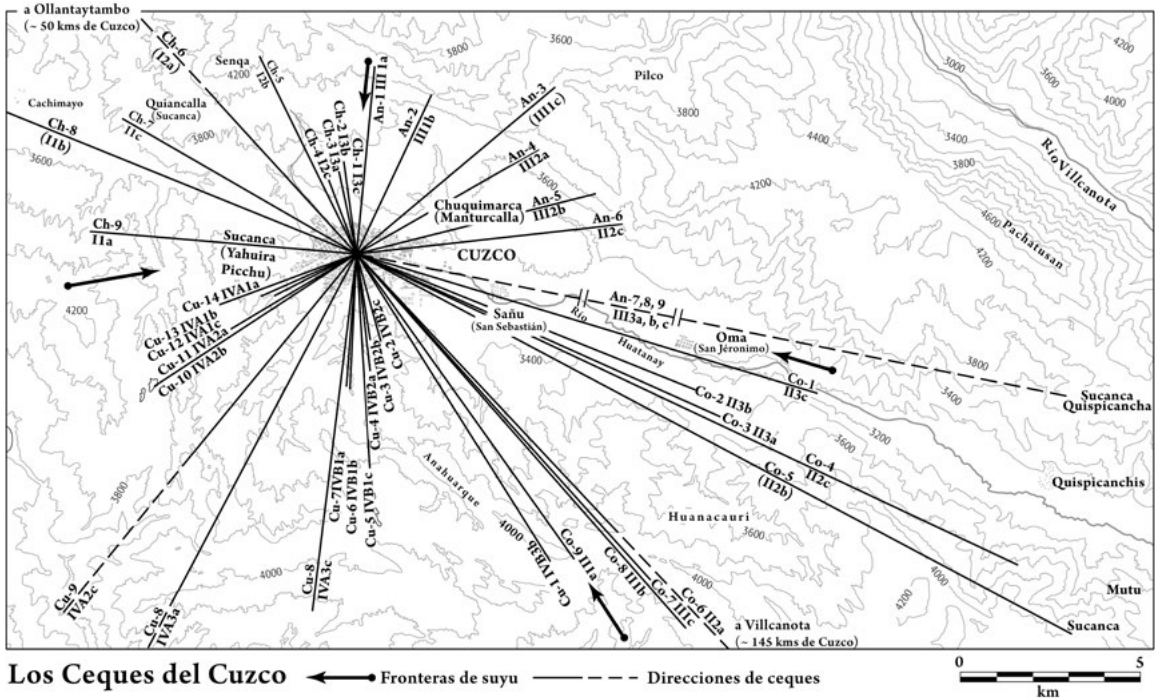


Fig. 6. The distribution of the 41 lines or *ceques*, according to R.T. Zuidema (Zuidema, 2010).

Rozkład 41 linii zwanych *ceques*, wg interpretacji R.T. Zuidemy (Zuidema, 2010).

We can summarize their hypotheses in a few points.

1. During the December solstice, the sunset could be seen from the Coricancha looking towards the *sucanca* located on the Chinchicalla hill (Cu-13:3): ‘the third [huaca], Chinchicalla, was a big hill with two markers which, when reached by the Sun, meant it was time to sow’ (Rowe, 1979:57).
2. According to Aveni and Zuidema, the east wall of the buildings on the terrace looks toward the azimuth angle 66° 44’. The azimuth is measured on the horizon and it is the angle between the North cardinal

¹¹ In his most recent works, Zuidema seems to have abandoned this idea, judging from the following statement: “... I already noted as an outstanding feature, that astronomical observation did not depend on the directions of the *ceques*...” (Zuidema 2010: 118).

point (origin) and the point established by the intersection of the heavenly body (in this case, the sun) with the line of the horizon. This angle is calculated clockwise. Therefore, the established point of $66^{\circ} 44'$ on Cusco's horizon would be the place of the sunrise more or less around the 25th of May Gregorian style (which would be the 15th of May according to the Julian calendar in the 16th century). This date would be of great importance in the Cusco's calendar according to the above-mentioned scholars¹². There is, however, no proof of the existence of any *sucanca* located on this part of the eastern horizon of Cusco, but the corridor axis corresponds, more or less, to the direction of the Ceque An-5 (Zuidema; ceque III, 2b).

3. This last alignment would be the one in the direction of the heliacal rising of the Pleiades – that is, when they appear in the sky, after being invisible since May, one hour before sunrise – between the 6th–9th of June according to the Gregorian calendar (27th–30th May, Julian style).

According to Zuidema, this relation is reinforced by the roles and attributions of the Ceque An-5 and, especially, of one of its *huacas*: Susumarca (An-5:8)¹³. We think that the first postulate, that the sunset was visible from Coricancha during the December solstice, is plausible because the sector of the horizon in which the sunset happens on the aforementioned date is undoubtedly visible from the temple, and it seems to match the location of one of the *sucancas*: [Cu-13:3] '*The third (huaca) Chinchicalla is a big hill, with two markers, that when reached by the Sun meant it was time to sow*' (Rowe 1979). Nevertheless, even though Zuidema gave a very detailed debate and analysis of all the historical sources about this *huaca* (Zuidema 2011: 148ff.), we lack archaeological evidence about the precise location of these 'markers', as well as the distance between them.

At this point, it is essential to ask the following question: what kind of supposed astronomical observations postulate Zuidema and Aveni for Coricancha? It is obvious that the practical observation of celestial phenomena, requires some, even rudimentary, devices, such as a gnomon or properly planned and oriented buildings. It should also be noted that, when discussing devices used for tracking the movement of celestial bodies, two different categories of arrangements are considered:

Those, due to religious and ceremonial reasons, aimed at an approximate orientation towards the rising or setting of the sun (or another celestial body) at some important moment in its annual transition across the horizon. In these cases, precision of astronomical observation is not so important but rather creating a visual effect for the masses of the faithful gathered in spacious plazas in the main ceremonial centres (Aveni 1981; Ziółkowski 2015).

Those, which may be called 'precise astronomical instruments', were intended for the use by a few priest-astronomers, as mentioned in some sources (Sarmiento de Gamboa, Anónimo 1906: 151–152).

Recently, two such 'precise astronomical instruments' located within the perimeter of the Archaeological Park of Machu Picchu, namely Intimachay and the Mirador de Inkaraqay, were unveiled. (Dearborn, Schreiber and White 1987; Ziółkowski, Kościuk, Astete 2013; Astete, Ziółkowski, Kościuk 2018).

Looking at the evidence referred so far by Zuidema and Aveni, it is very difficult to decide which of the aforementioned categories they postulate for the case of Coricancha. We don't precisely know the place, inside of the Coricancha's perimeter, where such observations of the sun could have been made. With respect to this point, Zuidema tried to compare the historical data that were available with the position of the Incan structures inside the Coricancha. Taking this analysis as a basis, he proposed the hypothesis that a window might have

¹² This was the *terminus post quem* that marked the beginning of one of the calendric cycles.

¹³ It can be possibly identified with Susurpuquio, the place where the future Inca Pachacuti had his famous vision (Zuidema 1976, pass.; 1982: 211, 212, 215–213). This *huaca* (and the direction of the *ceque*) was closely linked to the rituals dedicated to the Pleiades (ibid.).

existed in the curved side of the perimeter wall of the Coricancha, from where the sunset might have been visible during the winter solstice from a structure called Inticancha (Zuidema 2011:134ff.)¹⁴.

But, the same as in the case of the above-mentioned *sukanka*, these are assumptions, not evidence. In the absence of the latter, nothing specific can be said about the accuracy of such observations, or even about whether they were actually carried out.

The alleged 'calendar skeleton' – the solar dates of the 25th May and the 18th July

We think that the second theory by Aveni and Zuidema is much more interesting. The corridor between the two ceremonial buildings (together with their facades) pointed, from the western side of Coricancha's terrace, towards the sunrise on the 25th May and 18th July (Gregorian calendar). These dates (especially the first one) have been one of the key arguments from Zuidema to support his model of 'quipu-calendar', which would have had 328 nights/days represented by an equal number of *huacas* in the ceque system (Zuidema 1982; 2011; 131ff.; 2014: 859). The gap in days between the 25th May and the 18th July, determined by the successive appearances of the rising sun in the direction indicated by the aforementioned corridor was, according to Zuidema, an argument that supported the alleged ritual importance of a cycle of 55 nights/days, that equalled a 'double sidereal-lunar month' ($2 \times 27.3 \approx 55$), a theoretical construction of great importance for his model of 'quipu-calendar' (Zuidema 2011: 131ff.).

Critical analysis of Aveni and Zuidema's hypothesis

The aforementioned assertions have, for years, been accepted at face value, without anybody making an effort to check in situ if the measurements made by Zuidema and Aveni in 1976 and 1980 were correct, and therefore, check the reliability of the explicative models made by these two scholars. Let us look more closely at the measurements made in Coricancha and one that constituted the foundation for these authors:

Our transit measurements reveal that the western wall is pointing to the horizon, towards an azimuth of 66° 44' (the average of the two measurements taken in 1976 and 1980) of ±5', and that the eastern wall is looking towards an azimuth of 248° 13' (both measurements from 1980), with the same margin of error. Therefore, the walls are anti-parallel by 1° 29'. The eastern horizon is elevated 5° 36' above the real horizon. The sunrise during the June solstice of the year 1500 AD happened at 64° 20', or around 5 solar discs (27 days) to the left (North) of the alignment¹⁵.

These claims are illustrated with two figures to facilitate the demonstration that follows (Fig. 7 and 8). It is important to note that the scholars, apparently, did not make their own survey of this sector of Coricancha, but they took some plans that existed at the time for reference.

Taking into account the dates used for this study (1976 and 1980), and some details that were unknown before the earthquake of 1950, which excludes the plan by Rowe made in 1944, then they had the following options:

- the plan (a little bit schematic), published by Gasparini and Margolies in their classic 'Inca Architecture' (Gasparini and Margolies 1977),

¹⁴ Zuidema identifies it as "Inticancha", in the north-western part of the enclosure, based on different assumptions, in turn, influenced by some descriptions of the Coricancha (Zuidema, 2010: 145, ff.). But the only archaeological evidence in support of his argument is limited to a re-interpretation of a piece of information from Max Uhle's visit to the Coricancha in 1905. Zuidema himself summarizes the original information of the illustrious German archaeologist (prior to the re-interpretation) in the following way: '... Uhle reported that the wall he saw (which no one ever saw again) was a front wall approximately 12 meters long, with two doors and a niche in the middle of them. Uhle placed it just behind the north wall, which is an unlikely solution ...' (Zuidema 2010: 146).

¹⁵ Zuidema gives the following reference to these data, saying that they are: '... the astronomical measurements that Aveni and I took in 1976 and in 1980...'; '... I continue his analysis taken from his 1980 notes (reproduced here with his permission)...' (Zuidema 2010: 129).

- and, possibly, the plan published by Oscar Ladrón de Guevara in 1967 (Ladrón de Guevara 1967), but only as a reduced version and not the original in the scale of 1:100 (Fig. 9).

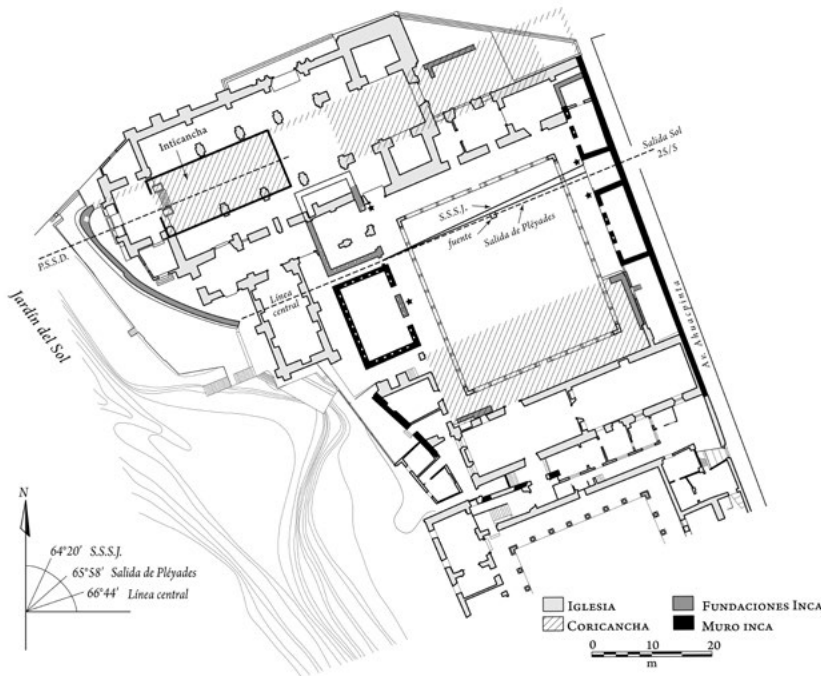


Fig. 7. The Coricancha and its astronomical alignments, according to the interpretation of A.F. Aveni and R.T. Zuidema. The authors apparently used as a basis for their analysis a published plan (Gasparini and Margolies, 1977).

Coricancha i jej astronomiczna orientacja według interpretacji A.F. Aveniego i R.T. Zuidemy. Jako podstawą do swoich analiz Autorzy ci ewidentnie posłużyli się wcześniej publikowanym planem Gasparini and Margolies, 1977).

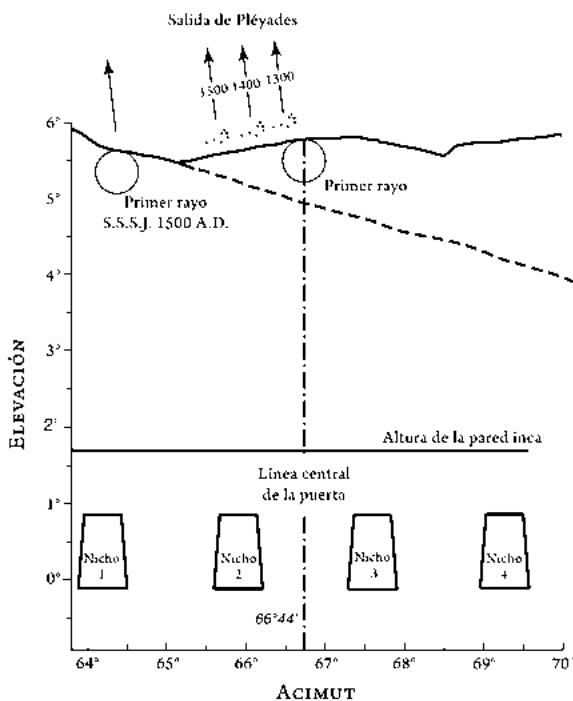


Fig. 8. Coricancha. Schematic reconstruction of the places of the sunrise of May 25 and July 18 (Gregorian) as well as the Pleiades.

Coricancha. Schematyczna rekonstrukcja miejsc wschodu Słońca i Plejad 25 maja i 18 lipca (daty wg kalendarza gregoriańskiego), wg modelu A.F. Aveniego i R.T. Zuidemy (Aveni, 1981; Zuidema, 2010).

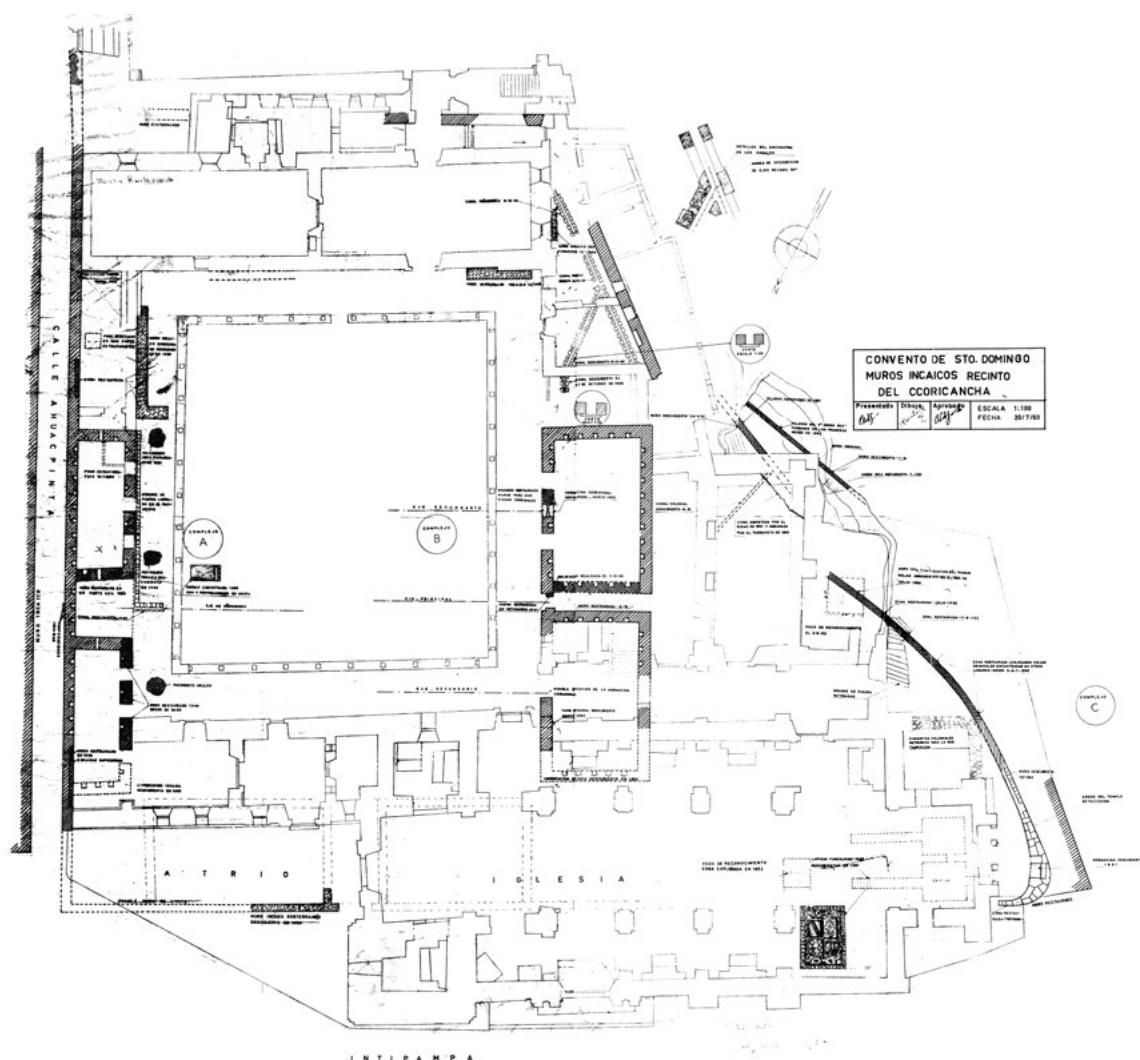


Fig. 9. Plan prepared by Oscar Ladrón de Guevara in July 1960 during his work on Coricancha restoration¹⁶.

Rzut sporządzony przez Oscara Ladrón de Guevara w lipcu 1960 roku w czasie prac rekonstrukcyjnych w Coricancha.

Before going any further, it is important to point out that due to surveying technics available at that time, none of the plans are accurate enough for precise archaeo-astronomical studies, particularly when it comes to the measurement of the angles between their constitutive elements (passageways, walls, etc.)

Having opted, apparently, for the plan by Gasparini and Margolies, Aveni and Zuidema proceeded to calculate their orientations through two solar observations – it is supposed in reference to some architectonic elements of Coricancha, easily recognisable on that plan. Nevertheless, there is still one doubt: where did they make their observations from? In other words: where did they place their transit instrument (theodolite) to observe the sun, determine the eastern horizon's height, etc.? These questions lead us to the following one: how would the Inca people make their observations of the sunrise in the directions (and on the dates) that were considered important for the Zuidema/Aveni model? Or, in other words: in which exact place would the Incan priest-astronomer have to be ready to observe sunrise and the Pleiades from the passageway between the two ceremonial structures situated on the western side of Coricancha's terrace?

¹⁶ We thank D. César Ladrón de Guevara for having granted us permission to consult and publish a copy of this important document, deposited in the personal file of his Father, the architect Oscar Ladrón de Guevara.

To answer these questions, we can only make some suppositions based on the schematic drawings published by the above-mentioned scholars to illustrate their hypothesis (Fig. 7 and 8). From these we can clearly state that they could have been hardly 'accurate' observations for two main reasons:

- first, the line of sight established by the above-mentioned passageway¹⁷ did not point at the horizon but to a point situated 3 degrees below,
- second, in that direction on the horizon, there is no natural object (prominent rock, etc.), nor information about the existence in the past of any artificial structure like a *sucanca*, that could have served as a reference point for the observations.

With these limitations, the only way to establish the more or less exact dates of the sun's transit through the aforementioned corridor would be by observing the shadow projected by the jambs of its eastern door at sunrise. However, this would have been an approximate orientation, much less precise than the one that could have been obtained with the astronomical equipment of Inkaraqay and Intimachay mentioned above.

Leaving aside, for the time being, the technical issue of the alleged observations and their practical goal, let us come back to the main matter, i.e. the orientation of these parts of the temple. In 2011 and 2012, as part of the architectonic documentation project of the Coricancha carried out by a group from the Centre of Pre-Columbian Studies at Warsaw University, a 3D scan of the whole ceremonial complex was done¹⁸. Based on that data, a plan of the whole Coricancha had been prepared and referenced to geographical North through 15 observations of the Sun disc made from the main court of the temple using a theodolite with a digital display. When it comes to the orientation of the Coricancha's structures, these new measurements differ widely from Zuidema and Aveni's ideas. To make it clearer, the debate about this critical topic is presented in several points.

The most significant difference is within the corridor of the western buildings¹⁹. This passageway is not oriented towards an azimuth of 66° 44' but of 67° 06'. This difference of almost 22 MOA means that the line postulated by Aveni and Zuidema doesn't point to the sunrise on the 25th May and 18th July but on the 23rd May and 19th July²⁰. Therefore, the time that lapses between the successive sun passages (at its rises) through the corridor axis, an event that was very important to Zuidema (Zuidema 2010: 131ff.) changes from 55 to 57/58 days. Digressing slightly, let us try to answer a basic question, which is: where are all these very significant differences coming from, at least in the archaeo-astronomical studies, between the results of Zuidema and Aveni and ours? Could an expert in archaeo-astronomy such as Aveni have been wrong in making observations about the sun? The answer is: no; his measurements, which served him as a reference, are accurate, they are almost the same as ours. The problem is down to the drawings that our colleagues used. That is:

1. As we have pointed out previously, because of time and logistical limitations, our colleagues did not have the opportunity of making their own survey of Coricancha (or, at least, of the temple's central patio and the corridor), but they used the already existing plan of Gasparini and Margolies from 1977.
2. To orientate this plan with exact geographical North, they took solar measurements, installing a theodolite on the roof of the Coricancha's church²¹, and like this, they concluded the exact orientation of the roof's axis, assuming that this matched exactly the one in the nave of the building at ground level. This theory was used as the basis of the final orientation of the plan. To reconstruct what is at the root of this method, we must remember that contemporary buildings east of Coricancha prevent direct observation of this section of the horizon directly from the corridor in question. However, the eastern horizon

17 By the way: with the observer located in which place of the corridor? At its western end, or on the contrary, on the east side, in the door leading from the patio?

18 The Centre is collaborating with the Authorities of the Convent of Santo Domingo of Cusco since 2006, carrying out a series of research works mainly in matters of diagnosis of the state of conservation of the historical patrimony of the Coricancha. The study of the architectural part was carried out in the years 2011–2013, within the framework of a project led by Sławomir Świeciochowski, who obtained for this purpose a grant from the National Science Centre of Poland. Specialists from several Polish scientific institutions took part in the project.

19 It is noteworthy that the expression "*the facade looks*" in this or that direction, means in practice that the line perpendicular to the facade points to a given place on the horizon. Without going into the details of this topic, note only that the new measurements differ a bit from those presented by Aveni and Zuidema: the eastern façade of the patio actually looks at 247° 47' (and not 248° 13'), whereas in case of the western one, the difference is smaller, 66° 41' instead of 66° 44'. See the following note.

20 That, considering the moment of departure of the star from the moment of appearance of its first rays on the horizon, as represented by Aveni in his reconstruction of the phenomenon (Aveni, 1981; Zuidema 2010: 131). In 1500 AD, these phenomena occurred, on dates of the Julian calendar, on May 14 and July 10, respectively (reconstruction carried out with the Cartes du Ciel 3.6 program and Stellarium 0.12.4).

21 Anthony F. Aveni confirms this in a personal communication (Aveni, letter from June 1, 2015).

is clearly visible from the relatively easily accessible roof over the main nave of the church. In turn, by analysing the plan of Gasparini and Margolies, it is easy to see that the axis of the corridor is practically parallel to the nave axis of the main church set between the northern and southern pillars of the nave²².

3. The rest of the orientations (the axis of the corridor on the west side of the terrace, etc.) were established based only on the analysis of the aforementioned plan.
4. What the 3D scan of the Coricancha and the plan based on it made in 2012–2014 have revealed is that the axis of the temple's roof does not match the axis of the nave at ground level. The difference between both is $0^{\circ} 22'$ (see Fig. 10 and 11)²³. In other words: projecting towards ground level the orientation established for the church's roof, the authors unwittingly introduced an error of $0^{\circ} 22'$ in the orientation of their plan of reference²⁴.
5. Other inaccuracies crept in while interpreting the aforementioned plan, whose precision, as we have already pointed out, was not enough for the goals of an archaeo-astronomical study.

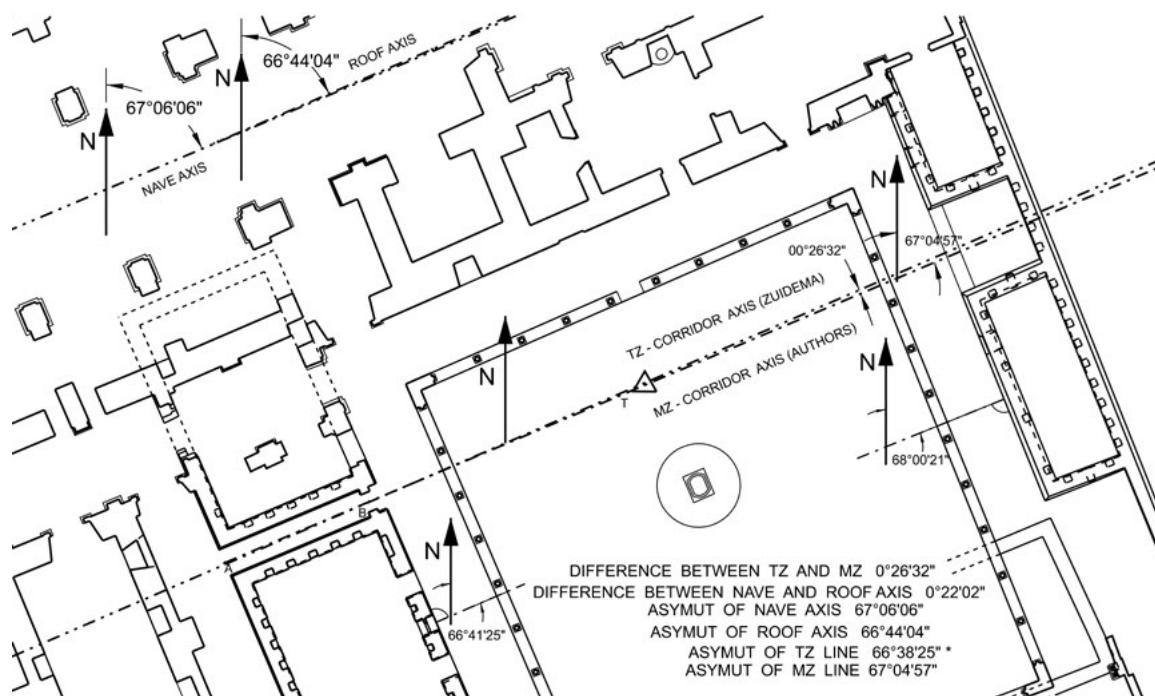


Fig. 10. Coricancha. Plan of the patio and the surrounding buildings with the orientations based on the new measurements taken in 2011–2012 and 2014. The precision of the orientations is of the order of ± 2 MOA. Note, that the axis of the corridor points to azimuth $67^{\circ} 06'$ and not $66^{\circ} 44'$ as proposed by R.T. Zuidema. The consequences of that are discussed in the text. (Prepared by J. Kościuk, B. Ćmielewski, M. Ziółkowski).

Coricancha. Rzut patio i otaczających je budynków zorientowany według nowych pomiarów z lat 2011–2012 i 2014. Dokładność orientacji rzędu ± 2 minut kątowych. Azymut osi korytarza to $67^{\circ} 06'$ a nie $66^{\circ} 44'$ jak sugerował R.T. Zuidema. Konsekwencje tej różnicy dyskutowane są w tekście. (Opracowanie: J. Kościuk, B. Ćmielewski, M. Ziółkowski).

²² This is confirmed by the results of our 3D laser scan from 2011–2012 – the difference in orientation between the two axes lies within $3'$.

²³ However, it should be admitted that this difference would be extremely difficult to grasp by classical measurement methods. It was revealed only by analysing 3D cloud of laser scanning points, representing the church's main aisle and the roof. The situation is further complicated by the fact that the pillars of the main nave of the church converge to the east at an angle of about 3 degrees.

²⁴ It is worth mentioning that in a more recent work, A.F. Aveni had modified the axis orientation of the corridor and gave it a value close to the one we obtained, that is, a bit more than 67° (Aveni, 1997), but R.T. Zuidema had apparently not taken into account this change, and continued using the previous value (Zuidema, 2010, 2014).

All this has some important consequences, because, as has been previously stated, the two key points of all the quipu-calendar model, namely the date – May 25th – as well as the time span of 55 days²⁵, lose their relevance²⁶. In short, this theoretical model remains without any archaeo-astronomical basis.

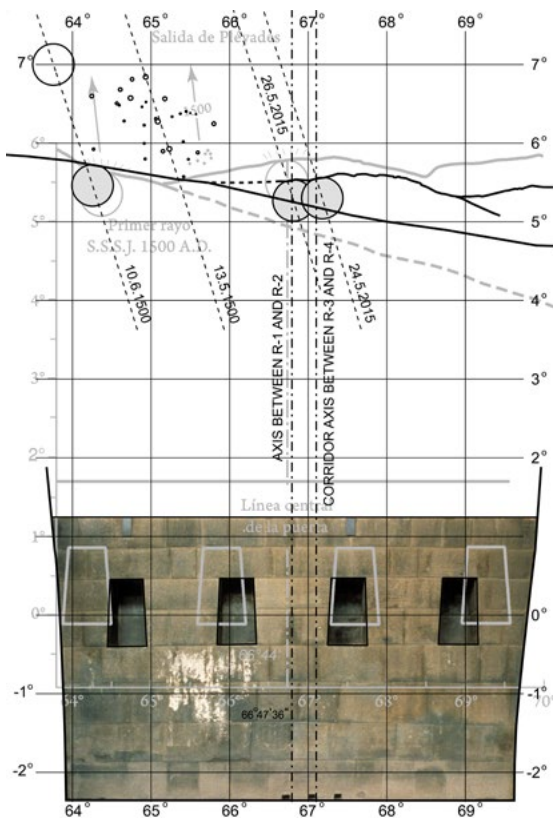


Fig. 11. Coricancha. Schematic reconstruction of the view towards the eastern wall of the patio and the horizon. In light grey – according to A.F. Aveni and R.T. Zuidema. In black and colour – according to J. Kościuk and B. Ćmielewski. Setting aside the difference in the orientation of 22 MOA between the two estimations, the corridor between R-3 and R-4 could not be used for precise astronomical observations (prepared by J. Kościuk, B. Ćmielewski, M. Ziółkowski).

Coricancha. Schematyczna rekonstrukcja widoku w kierunku wschodniej ściany patio i horyzontu. Linie jasno szare: według A.F. Aveniego i R.T. Zuidema; linie czarne: według J. Kościuka i B. Ćmielewskiego. Pomijając różnicę w orientacji rzędu 22 minut kątowych między obiema estymacjami, korytarz pomiędzy budynkami R-3 i R-4 nie mógł służyć do precyzyjnych obserwacji astronomicznych (opracowanie J. Kościuk, B. Ćmielewski, M. Ziółkowski).

The seats of the Inca (and the Sun)

The critical review of the hypotheses formulated about the possible function of Coricancha as a certain type of astronomical observatory gives somewhat disappointing results: either there are conjectures without a tangible archaeological basis, or, in the case of the hypothesis of 'quipu-calendar' the supporting arguments turned out to be rebuttable.

Let us then go back to the only historical reference, related directly to some device inside Coricancha, oriented towards the sun: the two 'seats of the Inca' (or, alternatively, of the effigy of the sun). As we have mentioned in the introductory part of this paper, the reference in question comes from two chroniclers of the 16th century: Pedro Cieza de León and Bartolomé de las Casas. Both authors speak of a wall, provided with two seats or niches, which were illuminated by the sun at a certain moment of the day. The difference between these testimonies is that Cieza de León speaks of two seats facing the rising sun: 'two seats in that wall, which the sun illuminated on rising'.

On the other hand, de las Casas talks about niches on both sides of a wall, one illuminated at the sunrise while the other at the sunset: '... and on the wall, there was a niche where the image of the Sun was put, on the mornings, when the sun is rising. (...) and after noon they passed the image to the opposite part'.

²⁵ Considered by Zuidema as the equivalent of 'two sidereal lunar months', see above in the text

²⁶ By the way, the rise of the Pleiades could have been observed from the aforementioned passageway in ca. 1500 AD, but only about 1 and a half degrees to the North of the corridor's axis.

Leaving Coricancha for a moment, let us check if a device of this type, and with this function, has been registered in some undoubtedly Inca construction? The answer is positive, although the structure in the question is very far away from Cusco: it is the Inca temple of Ingapirca, in Ecuador.

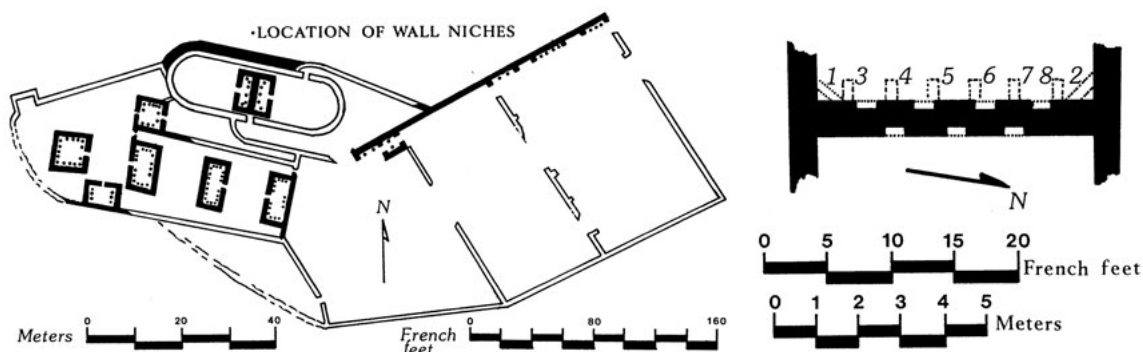


Fig. 12. The Castillo part of Ingapirca, according to Charles Marie de la Condamine. Left – the general layout of the compound. Right disposition of the niches in the transversal wall of ‘Cuerpo de Guardia’ (interpretation of the original La Condamine’s plan by M. Barnes and D. Flemming, 1989).

Kompleks zwany „El Castillo w Ingapirca, wg Charles’a Marie de la Condamine (1742). Po lewej: ogólny rzut zespołu. Po prawej: układ nisz w murze działowym budynku „Cuerpo de Guardia” (interpretacja oryginalnego planu La Condamine’a wg M. Barnes i D. Flemminga, 1989).

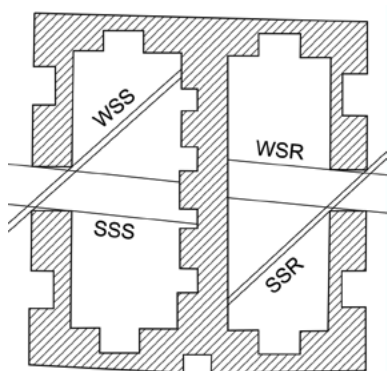


Fig. 13. The ‘Cuerpo de Guardia’ building with the representation of the alternative illumination of its rooms throughout the year (Ziółkowski, Sadowski 1991): WSS – December Solstice Sunset; WSR – December Solstice Sunrise; SSS – June Solstice Sunset; SSR – June Solstice Sunrise.

Rzut budynku „Cuerpo de Guardia” ze schematycznym przedstawieniem zmian w oświetleniu jego pomieszczeń w ciągu roku (Ziółkowski, Sadowski 1991): WSS – zachód Słońca w przesileniu grudniowym; WSR – wschód Słońca w przesileniu grudniowym; SSS – zachód Słońca w przesileniu czerwcowym; SSR – wschód Słońca w przesileniu czerwcowym.

The most notable building of the Ingapirca is the so-called ‘El Castillo’: a semi-elliptical platform, 36 m long and 4 meters high, with a stone wall erected with finely carved stones. At the top of the platform, in its middle part, there is a small building traditionally called ‘Cuerpo de Guardia’, or Guards’ Room. This structure consists of two rooms without any communication between them, separated by a dividing wall. Both rooms are adorned, in their interior and exterior walls, with trapezoidal niches of various sizes.

The platform and the building above it have been the object of intense reconstruction and *anastylosis* works. Fortunately, we have a quite detailed plan of this compound, made already in 1746 by the French astronomer Charles Marie de la Condamine. This valuable document presents even the original arrangement of the niches in the transverse wall (Fig.12).

In the 1980s, a detailed archaeo-astronomical study of this temple was carried out by one of the Authors, in collaboration with the astronomer Robert M. Sadowski (Ziółkowski, Sadowski 1991). According to the results of this study (Fig. 13), it seems that the orientation of ‘Cuerpo de Guardia’ has been conceived in such a way that the two rooms of the building serve alternately during the year depending on the illumination of the central part (and niches) of the transverse wall by the rays of the Sun. The Eastern Room was illuminated by the rays of the rising sun in the period close to the December solstice (the orientation of the axis corresponding to the sunrise on November 13th and January 30th) whereas the Western Room was illuminated by the setting sun in a period close to the solstice of June (the axis indicating the position of the sun on May 16th and July 28th).

Now let us go back to Coricancha: is there an architectonic element, similar in structure and function to the transversal wall (with niches) of 'Cuerpo de Guardia'? Let us remember that a special, portable, object of worship was kept in the Coricancha, which reflected the sun's rays: it is the figure called Punchao, the principal effigy of the solar cult of the Inca Empire. Punchao fell into the hands of the Spaniards in 1572 during the final attack on the last Inca redoubt of Vilcabamba and was later sent to Spain. Fortunately, we have a description, although short, of this effigy: 'The idol punchau is made of casting gold (...) it had a way of small shields of gold around it, so when the rays of the Sun reflected from them, they [the worshipers] could never see the idol but the radiance ...'²⁷. The information about the ceremonial importance of the radiance, produced by this solar image at the moment of being illuminated by the rays of the sun is confirmed by other sources²⁸.



Fig. 14. The image of Punchao represented in a drawing by Guamán Poma de Ayala, entitled *Pressure of Tupa Maru Inqa, infant, king*. He is held prisoner with his crown by Captain Martín García de Loyola (Guamán Poma, fol. 449 [451]). The king walks barefoot, with his symbols of power. Another Spanish takes a small statue, above which an aureole of rays is represented. It indicates, that this is an effigy of the Sun, protector of the Inca dynasty. From the description in the letter of Francisco de Toledo (see in the text) it turns out that this was certainly the figure of the Punchao.

Przedstawienie *Punchao* na grafice Guamán Poma de Ayala zatytułowanej *Uwięzienie Tupa Amaru Inqi, infanty i króla*. Prowadzi go uwięzionego i z koroną kapitan Martín García de Loyola (Guamán Poma, fol. 449 [451]). Król idzie boso dzierżąc symbole swojej władzy. Jeden z Hiszpanów niesie mały posążek nad którym widać aureolę światła wskazująca że jest to wyobrażenie Słońca – protektora inkaskich dynastii. Opis zawarty w liście Francisco de Toledo (patrz w tekście) potwierdza że jest to przedstawienie *Punchao*.

With this evidence in memory, we now return to Cusco and the Coricancha. Are there elements within this temple similar to those described by Spanish chroniclers? Trying to answer this question we must remember that only two buildings (Fig. 18; R2 and R3) are extant (although partially reconstructed) to the degree, which allows us to interpret their detailed layout. For another two (R 1 and R4) the northern perimeter walls are missing and their exact plan can be deduced only by analysing still preserved foundations (R4) or comparison with dimensions of the neighbouring one (R1). The only remains for other five structures (R-A ÷ R-E) are partially preserved foundation walls – just enough to propose the general outline and position of these buildings, but nothing to judge about details of their exterior and interior arrangement.

The most inspiring description of Pedro Cieza de León tells us about '... two seats in that wall, which the sun illuminated on rising ...'. The only walls, which are eastwardly orientated are the ones of R-3 and R-4 forming ca. 30.25 m long section (Fig. 18). Its left (southern) part corresponds to R-3, while the right part (belonging to R-4) is only partially preserved. In the centre of the former one, a niche is extant with evident traces of fittings (Fig. 4) meant to receive covering by gold plates, well attested by Spanish chroniclers. Oscar Ladrón de Guevara

27 The English translation we provide is an abbreviation of the somewhat longer original description: "El ydolo punchau que quiere dezir dia y es el del sol que dio las leyes del culto desde la la ciudad del Cuzco a todo el reyno (...) es de oro baziado con vn corazon de massa en vna caxica de oro de dentro de el cuerpo del ydolo y la massa de polvos de los corazones de los yngas pasados (...) tenia vna manera de patenas de oro a la redonda para que dandoles el sol relumbrasen de manera que nunca pudiesen ver el idolo sino el rresplandor ...)" (Francisco de Toledo, Carta al cardenal Sigüenza, Chicacopi, 19 octubre 1572 in: Roberto Levillier, 1924, t. IV, pp. 501–502).

28 The most important is that of the chronicler Juan de Betanzos, who also confirms the modest dimensions of this effigy: 'the size of a one-year-old child' (Betanzos 1987, p. I, Chap. XI, pp. 51–52). Compare also the drawing and a short description of the effigy by Guaman Poma (1615/1616 fol. 449–450 [451–452]). – Pierre Duviols carried out a detailed analysis of the existing historical relations about this figure, as well as about the possible modifications that were made on it during the reign of 7 or 8 Inca sovereigns (Duviols, 1976). See also the discussion on this matter in Ziółkowski, 2015, pp. 94–99.

Aviles when preparing drawings for partial *anastylosis* of this wall decided to place the corresponding niche also in the northern section of this wall, which has finally not been reconstructed (Fig. 15). The similarity with the account of Pedro Cieza de León is striking – among still preserved or at least theoretically reconstructed architectural details of Coricancha these two niches are the only items, which might fit his description.

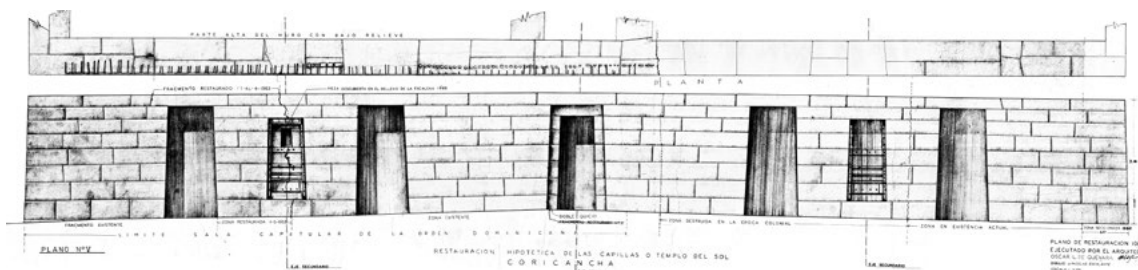


Fig. 15. Reconstruction of eastern façade of R-3 and R-4 prepared by Oscar Ladrón de Guevara Aviles during his work on Coricancha restoration in 1963.

Rekonstrukcja wschodniej elewacji budynków R-3 i R-4 sporządzona przez Oscara Ladrón de Guevara Aviles w 1963 roku w czasie prac konserwatorskich w Coricanchy.

Table 1. Table 1. Reconstruction of the position of the Sun above the eastern horizon as seen from the Coricancha Temple on 10.06.1500 AD (Julian date).

Rekonstrukcja pozycji Słońca obserwowanego ze świątyni Coricancha 10.06.1500 n.e. (wg kalendarza juliańskiego) nad wschodnim horyzontem.

	h [°]	V [°]
The first ray of the Sun	64°228	5°724
The centre of the solar disk on the horizon	64°168	5°737
The entire solar disk visible above the horizon (the center of the solar disk)	64°077	6°021
The centre of the solar disk above R-1 and R-2 roofs and sun's rays roughly perpendicular to the eastern façade of R-3 and R-4 (ca. 1 month before and 1 month after the June solstice)	ca. 66°7	ca. 11°5

Only right side of the famous niche of the so called '*Enclosure of the Stars*' is fully preserved, while the left side has been only partially reconstructed leaving two holes in the central part. There is rather no doubt that there has been another stone block, now missing, filling the lower gap. The upper hole is a window well attested by the shape of the small lintel missing on the photo from 1942 (Fig. 4 – the photo on the left side) but found in 1960 by Oscar Ladrón de Guevara in a backfill of the staircase (Fig 15 – Oscar Ladron annotation above the lintel).

What might have been its function? There are two possibilities: to illuminate the interior of the room R-3 during a specific period of the year and moment of the day, or to observe, from the inside of the room, a specific part of the (night?) sky.

But for what purpose? With regards to the first possibility, certainly not for illumination of some objects in the niches in the inner, western wall of the room. It would only be possible with a flat eastern horizon, and this isn't the case. Since the sills of the niches are on the same height as the lower part of the discussed opening, the sun's rays will never illuminate the niches (see fig. 16 and table 1). Taking into account the roofs of the buildings located on the eastern side of the patio, the sun's rays will illuminate only the part on the wall below niches, or the floor or the room R-3. For the purpose of precise observations of the rising Sun some additional structural elements inside this room would be necessary e.g. markers (lines?) on the wall and / or the floor.

It is worth noting here that the chronicler Sarmiento de Gamboa mentions the existence in the area of Cuzco of a gnomonic device with such characteristics:

... considering where the sunlight fell through those holes at the time of fallowing and planting, he made marks on the ground [...]. And as he had adjusted these posts precisely, he put for permanence in their place some stone columns with the [same] measurements and holes as the posts, and all around he ordered the ground paved, and on the stones made certain leveled lines conforming to the movements of the sun which entered the holes [...]. And he delegated people to take charge of these clocks... (Sarmiento de Gamboa 1906, Chap. 30 [1571] – English translation according to Bauer and Dearborn 1995: 37).

We postulated the existence of similar observation system in the case of the observatory at El Mirador de Inka-rayay (Astete, Ziółkowski, Kościuk, 2016/2017, pp. 20–21).

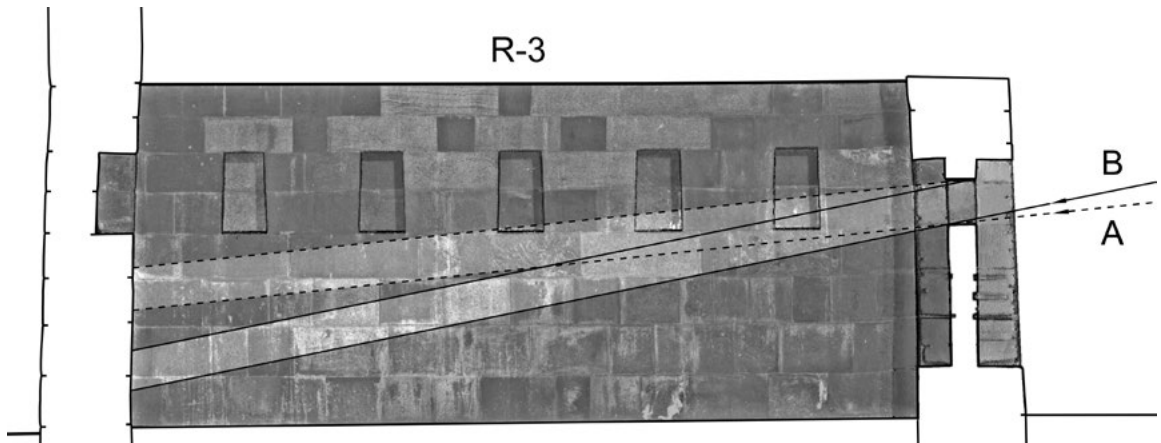


Fig. 16. E-W section across R-3 building with the simulation of sun rays on the day of the June solstice. A – the theoretical direction of the sun's rays at the moment of rising above the horizon, B – the actual direction of sunlight taking into account the existence of roofs over R-1 and R-2. Angular data according to Table 1. (Prepared by J. Kościuk).

Przekrój W-Z przez budynek R-3 z symulacją padania promieni słonecznych w czasie przesilenia czerwcowego. A – teoretyczny kąt padania pierwszych promieni słonecznych w momencie wschodu słońca nad linią horyzontu. B – faktyczny kąt padania pierwszych promieni słonecznych biorący pod uwagę dachy nad budynkami R-1 i R-2. Dane kątowe według Tabeli 2. (Opracowanie J. Kościuk).



Fig. 17. Theoretical reconstruction of PUNCHAO placed in the niche of the eastern façade of the so called 'Enclosure of the Stars'. (Prepared by J. Kościuk. Fragment of Oscar Ladrón de Guevara Aviles reconstruction used as a background)

Teoretyczna rekonstrukcja figurki PUNCHAO umieszczonej w niszy na wschodniej elewacji tzw. „Enclosure of the Stars”. (Opracowanie J. Kościuk. Fragment rekonstrukcji autorstwa Oscara Ladrón de Guevara Aviles użyty jako tło).

On the other hand, it seems very likely that the niche in the R-3 facade (and the alleged second one, in the R-4 façade), both covered with gold plates, served to achieve already mentioned radiation effect, so desired from the ceremonial point of view. Looking for places which might fit Pedro Cieza de León description of ‘... *two seats...*’ this might be the best choice. Perhaps not inside the niches, but rather in front of them since the niches are too narrow and too shallow for humans to seat comfortably in²⁹. What might, however, fit well into the seats **in the niches**, is mentioned above the statue of PUNCHAO – the effigy of Sun attested by many sources as being kept in Coricancha (Fig. 17).

The most spectacular effect of PUNCHAO and niches radiating in sun-light will be when sun rays are nearly perpendicular to the wall surface. The normal to the wall in question is at the azimuth 66° 41' 25" (Fig. 11), so the niches will be in full, perpendicular sun-light for at least one month before and one month after the June solstice, roughly one hour after the astronomical sun rise due to R-1 and R-2 roofs obscuring the eastern horizon.

Still remains the critical analysis of the second account – that of Bartolomé de las Casas describing ‘... *a niche where the image of the Sun was put, in the mornings, when the sun is rising. (...) and after noon they passed the image to the opposite part, in another lace, so the setting Sun faces the effigy...*’. Although the existence of similar niches is attested by the quoted above Ingapirca example (Fig. 13), there is no room for such the arrangement within the perimeter of Coricancha (Fig. 18).

Let us now consider the second possibility, i.e. the observation of a specific part of the night sky from inside of the room R-3. Of course, the observed section of the sky changed, depending on the place where the observer stood (or rather sat) inside of the room. Reconstructing the situation at the beginning of June 1500 AD, we note that an observer, sitting at the foot of the inner western wall of the R-3 room, a little bit S of the axis of the window, could have seen, close to the inner left border of the window, the rising Pleiades at a height of about 10 degrees above the horizon, it means, above the roofs of buildings on the eastern side of the patio. However, the problem what could be observed through this window in the night sky, requires further analysis.

Conclusions

Let us then return to the question already asked in the title of this paper: are there evidences that accurate astronomical observations have been performed within the Coricancha Inca compound? And if so, of what kind? We can answer this question in points:

1. As we have shown above, in the preserved remnants of the original, indisputably Inca buildings of Coricancha, we do not find elements, but one (see below p. 5), that could be used for precise astronomical observations, nothing similar to the well documented observatories of Intimachay and El Mirador of Inkaraqay (both in the Park National Machu Picchu)³⁰
2. The hypothesis of A.F. Aveni and R.T. Zuidema that the corridor between buildings R-3 and R-4 on the west side of the central patio filled this kind of function (compare Fig. 7) can't stand criticism. First, the line of sight established by the above-mentioned passageway did not point at the horizon but to a point situated 3 degrees below. Second, in that direction on the horizon, there is no natural object (prominent rock, etc.), nor information about the existence in the past of any artificial structure like a *sucanka*, that could have served as a reference point for the observations. Finally, the direction designated by the corridor axis does not correspond to the dates postulated by Aveni and Zuidema of the sunrise on May 25 and July 18, the key for the calendar part of their hypothesis related to the presumed 328-day quip-calendar cycle.
3. Of course, one can't exclude the possibility, that such a kind of accurate observations were performed from an unidentified place of the western part of the Coricancha, for example in the relation with a *sukanka* erected in an adequate place on one of the hills to the West of the temple. However, there are no archaeological evidences that could firmly support this hypothesis.
4. On the other hand, the information provided by the Spanish chronicler Pedro Cieza de León, about the existence in Coricancha of two ‘seats’ lit by the rising sun seems to be confirmed. The finely decorated

29 For their exact dimensions see Table 5 in the Appendix at the end of this paper.

30 See Dearborn, Schreiber and White, 1987; Ziółkowski, Kościuk, Astete 2013; Astete, Ziółkowski, Kościuk 2018).

niche in the façade of the building R-3 fits well this historical description. The second such a niche/seat may have been positioned in the northern part of this wall, now unfortunately destroyed, of the building R-4 (Fig 16). However, it should be emphasised that even in this case it is difficult to talk about precise astronomical observations, but rather on a visual effect (blinding glare), a performance important within the frame of the Inca solar cult (Fig. 15).

5. The only existing original architectonic element, that can be used for more precise observations, is the window in the niche in the façade of the building R-3. It should be noted that a window so small in size could not be placed by builders in such a special place without a precise and specific purpose. The observation function seems very likely here. Two, not mutually exclusive, hypotheses can be considered: it was either for gnomonic observations of the Sun's rays falling into the room at sunrise, or observations from within the building R-3 of a specific fragment of the night sky. However, both hypotheses will require further research to determine, what kind of event and/or celestial bodies were indeed subject to observation.

Final remarks

What we have presented in the present paper is only part of a multidisciplinary study on Coricancha, whose results we hope to publish soon. However, it seemed important to present to the public an alternative view of the supposed astronomical function of this temple, a hypothesis extant for many years in the literature of the subject, and widely accepted without prior critical evaluation of its bases.

But it is to be emphasised that our predecessors, with the means available at that time, made a careful study, formulating an interesting hypothesis about the Inca sky-lore and calendric. If with the passage of time, the new data are forcing us to review the previous postulates, this does not reduce the importance of the scientific contribution of the aforementioned scholars. They opened a research path, which others are now following.

Acknowledgements

The research described above was carried out in several phases between 2011 and 2017. In the years 2011–2013, laser scanning of the entire complex and the basic archival and bibliographic query were financed under the grant of the National Science Centre of Poland³¹ for the research project '*Qorikancha – a complex historical and architectural study of the former Temple of the Sun in the capital of the Inca state, Cusco (Peru)*' headed by architect Sławomir Świącchochowski, PhD, associate researcher of the Centre for Precolumbian Studies of the University of Warsaw (OBP UW). In subsequent years, i.e. 2014–2017, the researches were sponsored within the BST funds of the OBP UW. The research team also used the infrastructure and equipment of the *Centre for Andean Studies of the University of Warsaw in Cusco* (CEAC) as well as of the *Laboratory of 3D Laser Scanning and Modeling* of Wrocław University of Science and Technology (LabScan3D) – both sponsored under the SPUB grants by the Ministry of Science and Higher Education of Poland.

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31 Grant number N527 228140 (contract no. 2281/B/T02/2011/40 – '*Qorikancha – kompleksowe studium historyczno-architektoniczne dawnej Świątyni Słońca w stolicy państwa Inków -Cusco (Peru)*').

Annex. Preliminary observations on Coricancha metrology

As a conclusion of a methodological nature, it is important to underline the importance of new technologies, such as 3D laser scanning, particularly for the study of complex architectural structures like the Coricancha Temple. Beside precise measurements giving a good starting point to verify earlier surveys, it results in the abundant amount of data which might be used also for metrological studies.

Table 2. Comparison of Coricancha main walls dimensions.

Porównanie długości głównych ścian świątyni Coricancha.

Our measurements ^A		Farrington data ^B	
wall	length [m]		length [m]
N1	84.58	N	74.30
N2	87.61		
E	70.57	E	41.90
S1	41.03	S	?
S2	85.61		
W1	69.34	W	85.60
W2	87.70		

A According to the results of our 3D laser scanning project. Please note that $N2 + E + S1 + W2 = 286.91 \approx 400$ single steps (of ca. 72 cm) mentioned by Pedro Cieza de León in his description of Coricancha (Cieza, II p., Cap. XXVII: 105–107)

B Farrington 2013, p. 170.

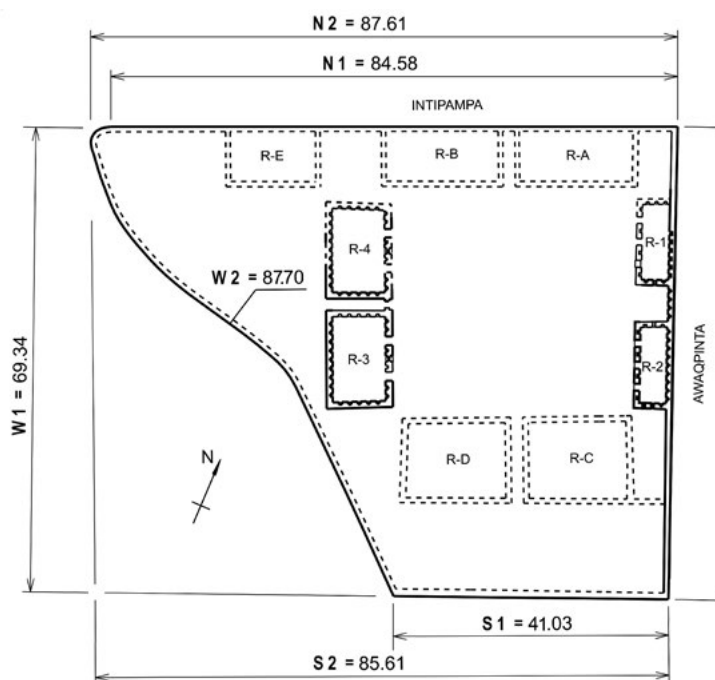


Fig. 18. Coricancha enclosure dimensions according to 3D laser survey. Lettering corresponds with Farrington naming convention (prepared by J. Kościuk).

Wymiary muru obwodowego Coricancha według wyników laserowego skanowania 3D. Oznaczenia literowe zgodne z konwencją nazw przyjętą przez I. Farringtona. (Opracowanie J. Kościuk).

According to the archaeological and historical data, “it is estimated that the temple enclosure dimensions were north side, 74.3 m (46r); west, 85.6 m (53r); and east, 41.9 m (26r)” (Farrington 2013, p. 170).

At this point, we must admit that there must be apparently a confusion between dimensions of particular walls given by Farrington. The following table (Table 2) and the plan (Fig. 18) illustrate the differences we noticed. The plan is based on an original drawing of Oscar Ladrón de Guevara (Fig. 9) kindly provided to the

Authors by his son D. César Ladrón de Guevara and adjusted according to the results of 3D laser scanning project done in 2011–2014³². It should be stated however that results presented in Table 2 depend greatly on the way the measurements were taken – at the foot of the wall, at a certain height above the ground or on the foundation level.

Following the presented above measurements of different parts of Coricancha, we are tempted to summarize these observations from the metrological point of view. Although our general study on Coricancha metrology is still not finished, some primary observations can be already offered, especially that they might be useful for any further archaeo-astronomical studies on Coricancha where not all the walls and details are fully preserved.

To begin, we can analyse the already quoted Coricancha main walls dimensions (Table 2). In his Cusco publication, Farrington gave dimensions of main Coricancha walls both, in meters and *rikra* (Farrington 2013, p. 170). Following these data, one arrives at the averaged *rikra* length of 1.614 m (Table 3). Using an analogous procedure in relation to our measurements we get *rikra* of 1.649 m. At this point, however, we must remind that none of these measurements was taken on the foundation level where possibly one could trace the original measurement units used by Inka builders. This may explain differences in reconstructing the length of the original measuring unit (*rikra*) – so, these results should be not considered as conclusive.

Table 3. Estimation of *rikra* length based on dimensions of Coricancha main walls.

Estymacja miary *rikra* na podstawie długości głównych ścian świątyni Coricancha.

Farrington data ^A				Our measurements ^B			
Wall	Length [m]	n	<i>rikra</i> [m]	Wall	Length [m]	n	<i>rikra</i> [m]
N	74.30	46	1.615	N1	84.58	51	1.658
				N2	87.61	53	1.653
E	41.90	26	1.612	E	70.57	43	1.641
S	?	?		S1	41.03	25	1.641
				S2	85.61	52	1.646
W	85.60	53	1.615	W1	69.34	42	1.651
				W2	87.70	53	1.655
average <i>rikra</i>			1.614	average <i>rikra</i>			1.649

A – Farrington 2013, p. 170.

B – According to the results of after mentioned 3D laser scanning project.

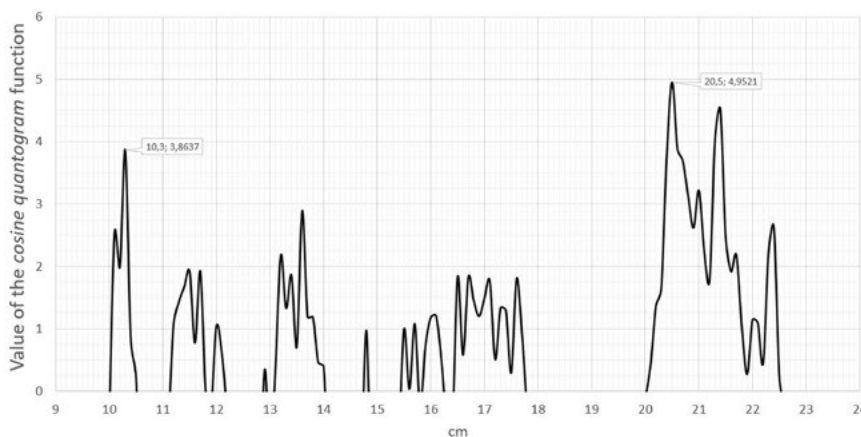


Fig. 19. Estimation of *quanta* for Coricancha main walls.

Estymacja quanta dla głównych ścian Coricancha.

³² The project has been executed in 2011 by Janusz Janowski and Marta Bury of the Institute of Archaeology of the University of Warsaw with Leica ScanStation 2 facilitated by the Institute of Archaeology of the University of Warsaw and completed in 2012–2014 by Jacek Kościuk and Bartłomiej Ćmielewski from the Department of History of Architecture, Art, and Technology of the Wrocław University of Science and Technology (Poland) with Leica ScanStation C10.

It is intriguing, that *rikra* equal to 1.649 m corresponds with our reconstruction of *rikra* length based on niches spacing and dimensions of original (not reconstructed) walls of Coricancha, where a much larger set of measurements has been analysed³³. The *cosine quantogram* method (Kendall 1974; Pakkanen 2001) was used for these estimations (Fig. 19). Two local maxima of *cosine quantogram* function were detected. The first (10.3 cm) is corresponding with incaic unit *yuku*, the second (20.5 cm) fits well with another unit – *k'apa*.

Since the system of ancient incaic units seems to be based on multiplication by factor 2 (Agurto 1987; Baudin 2003; Rostworowski 1978; Rowe 1946), therefore we can attempt to reconstruct the whole system using the first two items of the series. The length of *rikra* reconstructed in this way will be around 1.64 m (Table 4).

Table 4. Reconstruction of *rikra* length based on *cosine quantogram* estimation for Coricancha main walls.

Rekonstrukcja miary *rikra* metodą *cosine quantogram* na podstawie długości głównych ścian świątyni Coricancha.

Unit	Length [cm]
<i>rikra</i>	164
<i>sikya</i>	82
<i>khocok</i>	41
<i>k'apa</i>	20.5
<i>yuku</i>	10.3

Table 5. Reconstruction of *yuku* length based on dimensions of the so called „Enclosure of the Stars” niches.

Rekonstrukcja miary *yuku* na podstawie wymiarów nisz w tzw. „Enclosure of the Stars”.

	Width at the bottom [cm]	Height [cm]	Width at the top [cm]	Depth [cm]	Height of the window above the bottom of the niche [cm]
EASTERN NICHE	94.5	210.5	83	43.5	145.5
WESTERN NICHE	93	211.7	84.5	32	145
<i>yuku</i> as calculated from the dimensions of the eastern niche	10.5	10.5	10.4	10.9	10.4
<i>yuku</i> as calculated from the dimensions of the western niche	10.3	10.6	10.6	10.7	10.4
averaged <i>yuku</i> [cm]	10.4	10.6	10.5	10.8	10.4
average [cm]			10,5		

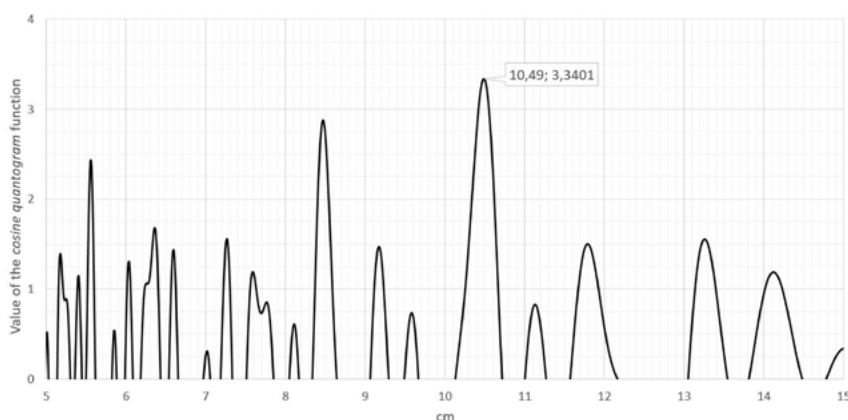


Fig. 20. Estimation of *quanta* for the so called ‘Enclosure of the Stars’ niches.

Estymacja *quanta* dla nisz tzw. „Sali Gwiazd”.

33 This study is however still in progress and will be published separately.

Further on, we can continue with already mentioned, far more precise³⁴ measurements of the niches in the east wall of the so called 'Enclosure of the Stars'. Using 25 measurements of both, the eastern and the western niches we are ending with the average length of *yuku* as 10.5 cm (Table 5). This, can be also verified by *cosine quantogram* method. The result of 10.49 cm (Fig. 20) confirms our previous estimation.

Using again multiplication by factor 2, the length of reconstructed in this way *rikra* will be around 1.68 m (Table 6) – the value already suggested by Maria Rostworowski de Dies Canseco (Rostworowski, 1978).

Table 6. Reconstruction of *rikra* length based on *cosine quantogram* estimation for the so called 'Enclosure of the Stars' niches (Fig. 4).

Rekonstrukcja miary *rikra* metodą *cosine quantogram* na podstawie wymiarów nisz w tzw. „Enclosure of the Stars” (Fig. 4).

Unit	Length [cm]
<i>rikra</i>	168
<i>sikya</i>	84
<i>khocok</i>	42
<i>k'apa</i>	21.0
<i>yuku</i>	10.49

To sum up all this information we can conclude that the most likely length of *rikra* was between 1.64 and 1.68 m. Dividing these values in succession by 2, we will get lengths for the remaining units of the metrological system which might have been used by Coricancha builders (Table 6).

Bibliography

Anónimo

1906 *Discurso de la sucesión y gobierno de los Yngas*, in: *Juicio de límites entre el Perú y Bolivia*, ed. Victor Maurtua vol. 8, pp. 149–165, Lima.

Agurto Calvo, Santiago

1980 *Cusco: la traza urbana de la ciudad inca*. Cusco, Proyecto Per 39, UNESCO, Instituto Nacional de Cultura, Cuzco.

Astete Victoria, Fernando; Mariusz Ziółkowski and Jacek Kościuk

2016/2017 *On Inca astronomical instruments: the observatory at Inkaraqay – El Mirador (National Archaeological Park of Machu Picchu, Peru)*, Estudios Latinoamericanos, Sociedad polaca de Estudios Latinoamericanos, Warszawa, vol. 36/37 (2016/2017), pp. 9–25.

Aveni, Anthony F.

1981 *Horizon Astronomy in Incaic Cuzco*. In: *Archaeoastronomy in the Americas*, edited by Ray A. Williamson, A Ballena Press/Center for Archaeoastronomy Cooperative Publication, Los Altos – College Park, pp. 305–318

1997 *Stairways to the stars: skywatching in three great ancient cultures*, J. Wiley, New York, pp. 305–318.

Barnes, Monica and Fleming, David

1989 *Charles-Marie de La Condamine's Report on Ingapirca and the Development of Scientific Field Work in the Andes, 1735–1744*, Andean Past: Vol. 2, Article 10. Available at: https://digitalcommons.library.umaine.edu/andean_past/vol2/iss1/

Bauer, Brian S., and David S.P. Dearborn

1995 *Astronomy and Empire in the Ancient Andes*. University of Texas Press, Austin.

34 It must however remember that the left (southern) edge of this niche has been reconstructed by Oscar Ladrón de Guevara in March 1963.

Béjar Navarro, Raymundo

1990 *Arquitectura Inka: El templo del Sol o Qorikancha*, Consejo Nacional de Ciencia y Tecnología, Cuzco.

Betanzos, Juan de

1987 *Suma y narración de los Incas*, prólogo, transcripción y notas por María del Carmen Martín Rubio, Ediciones Atlas, Madrid.

Cieza de León, Pedro

1986[1550] *Crónica del Perú, El Señorío de los Incas*, p. II, Pontificia Universidad Católica del Perú, Lima.

Cornejo Bouroncle, Jorge

1942 *El Ccoricancha*, Revista Universitaria, vol. 31, nr 83, Cusco, pp. 74–84.

Dearborn, David S. P.; Schreiber Katharina J. and White Raymond E.

1987 Intimachay: A December Solstice Observatory at Machu Picchu, Peru. *American Antiquity* 52 (2), pp. 346–352.

Duviols, Pierre

1976 *Punchao, Ídolo mayor del Coricancha. Historia y tipología*, Antropología Andina, n° 1–2, Cusco, pp. 156–183

Farrington, Ian

2013 Cusco. Urbanism and Archaeology in the Inka World, University Press of Florida.

Gasparini, Graciano and Margolies, Luise

1977 *Arquitectura Inka*, Universidad Central de Venezuela, Caracas.

Guaman Poma de Ayala, Felipe

1980[1615/16] *El Primer Nueva Coronica y Buen Gobierno*, edición crítica de John V. Murra y Rolena Adorno, Siglo Veintiuno Editores, México.

Hyslop, John

1990 Inka Settlement Planning, Texas University Press, Austin.

Julien, Catherine

1996 Documentación presentada por la ciudad del Cuzco sobre el terremoto de 1650, Revista del Museo e Instituto de Arqueología, t. 25, Cusco pp. 293–373.

Kendall F.R.S., David George

1974 *Hunting quanta*, Philosophical Transactions of the Royal Society of London. Mathematical and Physical Sciences, 1974, A 276, pp. 231–266.

Kubler, George

1952 Cuzco: Reconstrucción de la Ciudad y Restauración de Sus Monumentos, Informe de la Misión enviada por la Unesco en 1951, UNESCO, Paris.

Levillier, Roberto

1924 *Gobernantes del Perú*, t. IV, Buenos Aires

Ladrón de Guevara A., Oscar

1967 *La Restauración del Coricancha y Templo de Santo Domingo*, Revista del Museo e Instituto Arqueológico, no. 21, UNSAAC, Cusco pp. 29–95.

Lehmann-Nitsche, Roberto R.

1928 *Coricancha, el templo del Sol en el Cuzco y las imágenes de su altar mayor*. Revista del Museo de La Plata. v. XXXI, pp. 1–260

Lizarraga, Reginaldo de

1968[1605] *Descripción breve de toda la tierra del Perú, Tucumán, Río de la Plata y Chile*. Biblioteca de autores españoles, vol. 216, Ediciones Atlas, Madryt.

Mena, Cristóbal de

1967[1534] *La conquista del Perú* [in:] *Las relaciones primitivas de la conquista del Perú*, ed. by Raúl Porras Barrenechea, Instituto Raúl Porras Barrenechea, Universidad Nacional Mayor de San Marcos, Lima, pp. 79–101.

Müller, Rolf

1972 *Sonne, Mond und Sterne über dem Reich der Inka*, Springer-Verlag, Berlin-Heidelberg-New York

Pakkanen, Jari

2001 *Deriving ancient foot units from building dimensions: a statistical approach employing cosine quantogram analysis*, in: Burenhult, G. and J. Arvidsson (eds.), *Archaeological Informatics: Pushing The Envelope*. CAA2001. *Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 29th Conference, Gotland, April 2001*, BAR International Series 1016, Archaeopress, Oxford, pp. 501–506.

Pizarro, Pedro

1978[1571] *Relación del Descubrimiento y Conquista del Perú*, Pontificia Universidad Católica del Perú, Lima.

Rostworowski de Diez Canseco, María

1978 *Mediciones y Cómputos en el Antiguo Perú*, Cuadernos Prehispánicos No 6, Seminario Americanista, Universidad de Valladolid, Valladolid.

Rowe, John H.

1944 *An Introduction to the Archaeology of Cuzco*, Papers of the Peabody Museum of American Archaeology and Ethnology, vol. 27, nr 2, Harvard University, Cambridge Massachusetts.

1979 *An account of the shrines of ancient Cuzco*, Ñawpa Pacha, vol. 17, Berkeley, pp. 1–80.

Ruiz de Arce, Juan

1933[1545] *Relación de servicios en Indias de Don Juan Ruiz Arce, Conquistador del Perú*, Boletín de la Real Academia de la Historia, 102, Madrid, pp. 327–384.

Sancho de la Hoz, Pedro

1962[1572] *Relación de la Conquista del Perú*, Bibliotheca Tenantitla 2, Ediciones José Porrúa Turanzas, Madrid.

Sarmiento de Gamboa, Pedro

1906 [1571] Segunda Parte de la Historia General Llamada Índica. In *Geschichtedes Inkareiches von Pedro Sarmiento de Gamboa*, edited by Richard Pietschmann. *Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Philologisch-Historische Klasse, Neue Folge, Band VI n° 4*. Weidmannsche Buchhandlung, Berlin.

Uhle, Max

1930 *El Templo del Sol de los Incas en Cuzco* [in:] *Proceedings of the XXIII International Congress of Americanists in New York in 1928*, New York, pp. 291–295.

Urton, Gary

1981 *At the Crossroads of the Earth and the Sky*, University of Texas, Austin.

Ziółkowski, Mariusz

2015 *Pachap Unancha. El calendario metropolitano del Estado Inca*. Ediciones El Lector – Sociedad Polaca de Estudios Latnoamericanos, Arequipa.

Ziółkowski, Mariusz and Sadowski, Robert

1991 *Investigaciones arqueoastrómicas en el sitio de Ingapirca, Prov. de Cañar, Ecuador*, in: *Archeologia e Astronomia, Colloquio Internazionale, Venezia 3–6 Maggio 1989*, A cura di Manuela Fano Santi, Rivista di Archeologia Supplementi, 9, pp. 151–162.

Ziółkowski, Mariusz, Jacek Kościuk and Fernando Astete Victoria

2013 "Astronomical Observations at Intimachay (Machu Picchu): A new approach to an Old Problem" In *Ancient Cosmologies and Modern Prophets. Proceedings of the 20th Conference of the European Society for Astronomy in Culture*, edited by Ivan Sprajc and Peter Pehani, pp. 391–404. Slovene Anthropological Society, Ljubljana

2014 *Inca Moon: Some Evidence of Lunar Observations in Tahuantinsuyu*, in: *Handbook of Archaeoastronomy and Ethnoastronomy*, edited by Clive L.N. Ruggles, pp. 897–912. Springer Science+Business Media, New York.

Zuidema, R. Tom

1974–1976 *La imagen del Sol y la huaca de Susurpuquio en el sistema astronómico de los Incas en el Cusco*, Journal de la Société des Américanistes, Paris, vol. 63, pp. 199–230.

1977 *The Inca Calendar*, in: *Native American Astronomy*, Aveni A. F. (ed.), Texas University Press, Austin, pp. 219–263.

1981 *Inca Observations of the Solar and Lunar Passages Through Zenith and Anti-Zenith at Cuzco*, [in] *Archaeoastronomy in the Americas*, edited by Ray A. Williamson, A Ballena Press/Center for Archaeoastronomy Cooperative Publication, Los Altos – College Park. pp. 319–342

1982a *The sidereal lunar calendar of the Inca*, in: *Archaeoastronomy in the New World*, Aveni A. F. (ed.), Cambridge University Press, Cambridge-London-New York, pp. 59–107.

1982b *Catachillay. The Role of the Pleiades and the Southern Cross and Centauri in the Calendar of the Incas*, in: *Ethnoastronomy and Archaeoastronomy in the American Tropics*, A. F. Aveni y G. Urton (ed.) Annals of the New York Academy of Sciences, vol. 385, New York, pp. 203–229.

2008 *The Astronomical Significance of Ritual Movements in the Calendar of Cuzco*, in: J. E. Staller (ed.), *Pre-Columbian Landscapes of Creation and Origin*, Springer Science+Business Media, LLC 2008, pp. 249–267.

2010 *El Calendario Inca. Tiempo y Espacio en la Organización Ritual del Cuzco; la Idea del Pasado*, Fondo Editorial del Congreso del Perú / Fondo Editorial Pontificia Universidad Católica del Perú, Lima.

2014 *Ceque System of Cuzco: A Yearly Calendar-Almanac in Space and Time*, in: *Handbook of Archaeoastronomy and Ethnoastronomy*, Ruggles C.L.N. (ed.), Springer Science + Business Media New York, pp. 851–863.

Streszczenie: Coricancha (Qurikancha, Qorikancha) była najważniejszą świątynią w Cuzco, stolicy Imperium Inków Tawantinsuyu. Hiszpańscy Konkwistadorzy mieli okazję zobaczyć ją, i jej legendarne bogactwa, w listopadzie 1533 r., po wkroczeniu do Cuzco. Coricancha była miejscem kultu głównych świętych przedstawień inkaskiej religii, w tym figury Słońca, zwanej Punchao. Z tego wczesnego okresu pochodzą też wzmianki, niestety niezbyt precyzyjne, o specyficznej orientacji niektórych elementów świątyni, w celu uzyskania odbłasku wschodzącego (lub zachodzącego) Słońca m.in. na wspomnianej figurze Słońca. Na tej podstawie źródłowej, oraz w oparciu o istniejące jeszcze fragmenty oryginalnej inkaskiej Coricancha, sformułowano szereg hipotez dotyczących możliwej astronomicznej funkcji tej świątyni. Szczególne znaczenia uzyskała hipoteza R.T. Zuidema i A.F. Aveniego, zgodnie z którą obserwacje prowadzone w Coricancha stanowiły strukturalny szkielet specyficznego inkaskiego cyklu kalendarzowego, liczącego 328 dni. W niniejszym artykule przedstawiona jest krytyczna analiza tej hipotezy, na podstawie długoletnich badań i pomiarów przeprowadzonych w Coricancha przez autorów tekstu.

Słowa kluczowe: Inkowie, Coricancha, Punchao, orientacje astronomiczne, inkaski kalendarz, metrologia

Lighting policy as an integral part of sustainable urban planning

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Abstract: The aim of the paper is to describe an evolution of approaches to regulation of artificial light in urban areas and present examples of existing practices in this regard. The authors introduce the theoretical debate on the lighting pollution phenomenon and outline the contemporary arguments for lighting planning as an element of broader urban policy. Presented examples of comprehensive approaches to urban light planning have been based on the results of international inquiry carried out in 2018.

Key words: urban lighting, illumination masterplan, light pollution, comprehensive sustainable urban planning, lighting policy

Introduction

Modern cities are drowning in a sea of artificial light. The phenomenon of a 24-hour city has been labelled in scientific literature as the an end of the night [Bogard 2013] or even a nyctophobia of western cities [Ederson 2015]. Merely 150 years of electrical lighting has made humanity accustomed to the comfort of brightness after dark. A change in the urban lifestyle has already become evident in the city nightscape and the brightness of urban spaces have grown into one of the highest values for urban communities. Public space has become accessible at any time without any restrictions and for everyone, giving a psychological comfort and a democratic sense of security [Brandt, Geissmar-Brandt 2007]. The real value of artificial lighting is the possibility to individualize one's lifestyle and remain active during the time of natural darkness. This phenomenon has been named "a time sprawl" and in the Polish literature is also known as "the night-time urbanization" [Rozwadowski 2007].

Recent decades have brought about the development of an outdoor lighting at an unprecedented scale. Light is no longer used solely to maintain the public space or improve its accessibility after dark, but also to aestheticize and commercialize it, by expanding its visual attraction, improve orientation and stress identity of places [Martyniuk 2014]. Lighting still plays a dominant role in road lighting, becoming more and more intense as urban technical infrastructure develops. Light is also used to strengthen the subjective sense of security through private outdoor lighting of workplaces, apartments or industrial plants.

The increase of the night-sky brightness, as a result of urbanized areas expansion, reflects not only the scale, but also the approach to lighting planning of such areas [Walker 1977]. Artificial brightness has quickly become a symbol and a determinant of distinction between cities and provinces, however, the problem of light pollution is severe even for relatively small settlement units [Kyba et al. 2017].

Acknowledging the role and value of electric lighting, which is one of the most important motors of our civilization, it is necessary to admit that the need to establish basic principles for its use is stronger than ever. Cities have to face a problem of lighting excess and visual effects no longer dominate the discussion of urban

lighting policy, including today also the issues of energy efficiency or dark sky preservation. Therefore lighting regulations become more and more precise and turn into an integral part of sustainable city planning.

Overabundance of artificial light and definition of light pollution

Although the widespread usage of artificial light at night is strongly associated with high quality of life, safety and modernity, the average global increase of artificial brightness is estimated at 6% per year [Holker 2010]. The first widely known reports about the harmfulness of light excess had already been noted in the 1970s [Ścieżor 2010]. Meanwhile, the rapid evolution in lighting technology and massive access to electricity combined with its falling prices, have contributed to the increasingly unreflective use of light, and thus – successive brightening of the night. The phenomenon was defined as light pollution. Initially, the term was adopted by astronomers, when the lights started to make observations impossible in previously useful locations. The term also began to infiltrate to biological sciences, where the phenomenon was known as photopollution [Ścieżor 2010] and meant the negative impact of artificial lighting on living organisms. Initially, both terms were used separately but later, the light pollution became widely used, signifying the general nuisance caused by improper or excessive use of light.

Inaccuracies concerning outdoor lighting may directly affect residents and urban space users, also causing harm to urban ecosystems. The negative effects are most commonly generated by:

- light trespass – the spill of light from areas intentionally illuminated to those that do not require or need it;
- glare – emitting too strong light stream affecting badly one's sight; particularly harmful to pedestrians, drivers and animals causing physical and psychological discomfort; may also endanger the road safety;
- light clutter – excessive concentration of light sources or their thoughtless distribution, e.g. light advertisement, which disrupts spatial order and orientation in the night.

Moreover, each lighting fixture that directs light above the horizon, contributes to its dispersion in the lower atmosphere, forming the so-called sky glow. Improperly directed light is noticeable with a naked eye and can be even more severe on foggy and cloudy nights. The nuisances caused by incorrect lighting can be related to various factors [Kolomański 2015]:

- intensity – when the lights are brighter than necessary or recommended in a given place, used in too a great quantity or operating even when it is completely useless;
- direction – when the light is incorrectly focused: it shines upwards or sideways, beyond the verges of a surface intended for illumination (e.g. street lamps illuminating not only the road and the sidewalk, but also bedroom windows);
- inadequate parameters – when the emission spectrum (color temperature) of lamps is incorrect, which affects the living organisms¹.

Arguments for lighting regulations

There are places where the problem of excessive light has already been recognized and where various form of sorting it out have been implemented focusing on its various aspects. Some regulations apply to protection of the sky darkness, other to promotion an effective, but sustainable forms of city lighting. Mostly they are a reactionary responses to specific problems or to the citizen's initiatives in a given areas and their scope and strength depend on the location, demographic and economic circumstances and the level of social awareness.

Currently, the most common motivation for applying the regulations in the field of urban lighting is an intention to reduce energy consumption. However, the modernization carried out solely for the sake of cost reduction can be a threat to the lighting quality. There is a risk that the adoption of the cheapest solutions

¹ Often the spectrum is assessed only as a visual category by the unaware users and designers while the cool blue color of the light disturbs the circadian rhythm the most, the red – the least [Stevens, Zhu 2015].

focused only on meeting technical standards² will effect e.g. in installation of sources of a too cold color temperature and being schematically (carelessly) placed. Yet, the scientific researches indicate that as much as one-third of lighting expenses can be saved only through appropriate lighting direction [IDA 2011]. In recent years the environmental factors come to the fore in the debate on conscious urban lighting, above all a postulate of maintaining balance in urban ecosystems, but also the energy cut leading to reduction of a carbon footprint. Additionally the advocates of advertent urban lighting raise arguments of protection of human health and issues of the circadian rhythm disturbance of both humans and animals. Also the cultural-sensual aspect is being heard, what stands for the preservation of the starry night landscape. The latter relates especially to astronomical observations areas, both for scientific or hobby activity, as well for development of astrotourism.

In the actions related to pro-savings regulations, the self-governments play the most important role. Another category of interventions, which cities are more willing to decide on, is an intentional creation of nightscapes and images with light. However, it is worth noting that more and more often at the initiatives of urban lighting transformation are rooted in the individual and societal initiatives and interventions. They are most often focused on eliminating direct nuisances, that origin from lighting environment, addressing the problems of visual comfort, safety and aesthetics of public space lighting, pointing out the "lighting terror" of commercial activity in the space, such as aggressive light signs and advertising or architectural objects illumination.

In most places the city lighting regulation is not yet an element of statutory planning and not even a standard practice. In common modernization plans, it is difficult to find examples of interdisciplinary and comprehensive approaches and technical-economic orientation to light planning too often results in over mechanistic and replicable selection and deployment of light sources.

The actions aimed at establishing outdoor lighting principles, present two basic approaches [Nawalkowski 2013]. The first aims at darkness protection of particular areas and mainly propose preventive actions maintaining the excellent quality of the night sky measured by the brightness levels and visibility of the stars (especially by visibility of the Milky Way) (Fig. 1.). Such areas are often incorporated into the nature and landscape reserves boundaries and their protection often requires buffer regulations in the neighborhood zones to limit the possibility of adverse effects of their lights. The second approach aims at darkness restoration and applies to areas where it has been decided to minimize already perceptible pollution. The night sky quality in these areas does not have to be perfect, but significantly better than an average. The goal of undertaken actions is to reverse the negative effects of irrational lighting policy, thus are mainly carried out in urbanized areas: whole cities, their selected districts or rural and suburban areas, however there is not much evidence so far that such attempt cover the whole areas of big cities.

Representatives of such areas already form world-wide cooperation networks such as the International Dark Sky Communities, certified by the International Dark Sky Association or the Urban Star Parks in Canada [RASC 2016] (Fig. 2.).



Fig. 1. Aoraki Mackenzie International Dark Sky Reserve [photography by Fraser Gunn].

Międzynarodowy Rezerwat Ciemnego Nieba „Aoraki Mackenzie” [fot. Fraser Gunn].

2 Standards [PN-EN 13201] relating to the road lighting, that currently dominates an urban space.

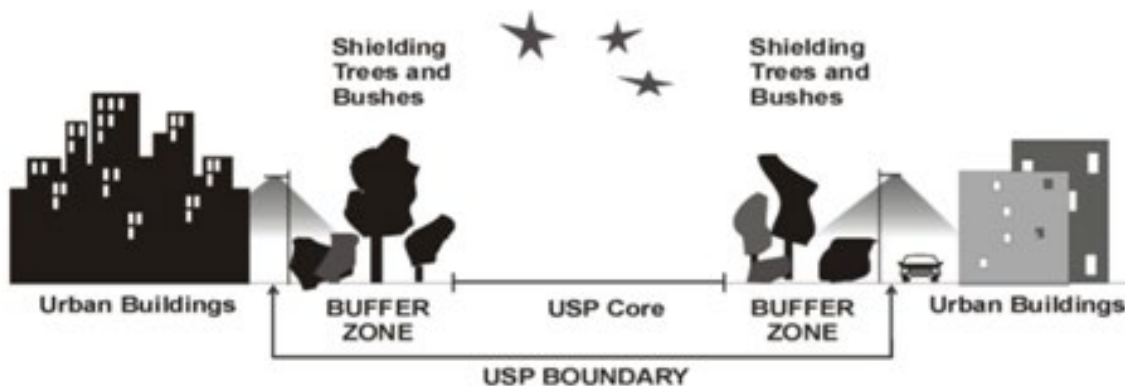


Fig. 2. Urban Sky Park layout [Guidelines for Outdoor Lighting 2016, Royal Astronomical Society of Canada].

Schemat Miejskiego Parku Nieba [Guidelines for Outdoor Lighting 2016, Royal Astronomical Society of Canada].

Technical regulations of excessive and improper lighting

Presently, no uniform method of urban lighting planning and regulation exists. The instruments used depend on the type, motives and competences of entities implementing projects, also on the sources and forms of financing, legal standards and even social attitudes. The lighting projects may take a form of broader urban plans aimed at systemic transformations in the longer perspective, or strictly technical documentation targeted at the “here and now” fragmentary tasks. However, regardless the project nature, they have a common basis in the form of generally recognized international guidelines and recommendations, including most commonly used standards and publications by International Commission on Illumination [CIE 2003, 2017], Institution of Lighting Professionals [ILP 2011], International Dark-Sky Association [IDA 2011] or International Astronomical Union [IAU 2009]. Apart from technical standards like the photometric parameters, space brightness thresholds etc., they offer a set of simple rules and recommendations for proper lighting planning, i.e. rules for lighting direction, color of temperature or zoning.

One of the first steps towards the comprehensive urban lighting plan, is a reduction of light emission above the horizon. This is an effective way to reduce the urban glow and the light trespass, some research show that if only 1% of lighting devices emit light above the horizon this can cause up to 100% rise of a glow [Mohar]. It is also estimated that at least 80% of pollution caused by the emission of light to the upper hemisphere, can be reduced in a manner imperceptible to humans (in terms of change in the brightness level of illuminated spaces). To control the direction of light it is necessary to properly select and install the luminaires which prevent its spilling and shorten the route of diffusion in the atmosphere. The awareness of this mechanism grows, for example, the lamp manufacturers already provide their products with an appropriate ULOR indicator (Upward Light Output Ratio), which helps making right planning decisions. The height and distance of the light sources should be carefully adjusted to the illuminated surfaces and the lamps can be equipped with power reducers, timers and, in justified cases, motion detectors. This allows for differentiation of lighting, depending on the needs and functional requirements of a given areas which is particularly important in places where lighting causes spatial conflicts but also in architectural illuminations which often diffuse powerful beams of light high above the city silhouette. Relevant illuminance is also important, but most of existing legal regulations indicate only minimum luminance levels while lighting brightness should be adjusted to the type of place and the activities it serves to. Next to the lighting device and intensity parameters also the light color is just equally important. Scientific research indicates that lighting should have as low as possible light emission in the blue and violet range of spectrum [IDA 2010]. The healthiest, in many respects, is the color temperature below the value of 2700 K, i.e. the perceptible colors of warm white to orange. But not only the argument of proper circadian rhythm matters in this respect: it has already been noticed that replacement of traditional light solution into LED drastically increases the brightness of a city space [DW 2017]. The wave with the length responsible for blue tones, tend to be more easily scattered in the atmosphere, intensifying the hostile phenomenon.

Lighting master plans as an urban policy tool

The technical rules for limiting the phenomena of light excess are relatively simple, however the comprehensive urban lighting plan must take into account not only technical aspects, but also social, legal, technological or image-related factors. Therefore it is not only a compliance of recognized norms but much more challenging planning endeavor.

The '**Capital Illumination Plan 2017–2027**' [NCC 2017] is an example of comprehensive approach to urban lighting planning which covers the central area of the Canadian National Capital Region on both sides of the Ottawa River – connecting Quebec and Ontario. The main intention of the plan was to create a coherent image of the city after dark, because of a noticeable gap in the perception of the day- and night-time city space as a result of lighting chaos. The outdated technology delivered additional arguments for urban lighting reorganization, however the emphasis was placed on its quality, in particular in public spaces.

The plan regulates, among other things, the color of light and its operating time. The most recommended color of light is, simply, white, especially warm white tones for the street lighting, green areas and waterways. For compositional reasons, warm white is also favored for the foreground, and cool white for the background of urban panoramas (Fig. 3.). According to the concept, the use of colour lighting is limited to areas of innovation and art, nightlife zones and temporary illuminations. Also, light flashing and the use of lighting for commercial and marketing purposes are unwelcomed.



Fig. 3. Existing conditions (upper) and visualization of conceptual future panorama of Gatineau [Capital Illumination Plan 2017–2027, National Capital Commission 2017].

Obecne uwarunkowania (na górze) i wizualizacja koncepcji przyszłościowej panoramy Gatineau [Capital Illumination Plan 2017–2027, National Capital Commission 2017].

The key instrument used in the plan is the delineation of balanced lighting zones of illumination and dark, for which separate guidelines have been elaborated (Fig. 4.). The illumination zones concentrate around the central part of the Ottawa River, and are divided into the inner and outer loop of the boulevards and their close

and distant landscape setting. For the two central illumination parts, where particular focus should be placed on heritage objects and national symbols, the amber and warm white tones of light (2200–3200 K) are preferred. Plan also recommends to turn off the internal office lights outside working hours, and to create visual connections along the roads leading to the indicated nightlife areas. For the ‘background’ zones, in turn, warm tones of light were designated for historic buildings while neutral white (3500–4000 K) for contemporary buildings. The cool white (4200 K +) is reserved for other architectural landmarks and details specified in the plan. Their choice needs to be justified by, i.a. significance for the cultural landscape of the city, relation with public space and limitations of facade materials in terms of physical response to light. Also, the light beams of such illuminations are recommended to be directed to impenetrable elements of the objects, i.e. walls or cornices. In accordance with the plan, ground lighting cannot contribute to pedestrian glare – all the public lighting will be equipped with opaque lamp covers limiting the beam of light to a maximum angle of 80 degrees. The waterways areas (along with their 10-meter buffer) and green areas (parks and shorelines) are considered to be dark zones. The argument for diminish the lights was to minimize their harmful effects on fauna and flora but also to provide the contrast necessary to highlight central illuminated places and selected dominants.



Fig. 4. A concept of illumination and dark zones [Capital Illumination Plan 2017–2027, National Capital Commission 2017].
Założenie stref iluminacji i stref ciemności [Capital Illumination Plan 2017–2027, National Capital Commission 2017].

In the dark zones, the plan assumes keeping the lighting levels on minimum, except for the designated places, such as landmarks, most visited paths, intersections of transport routes and places important for tourism, like monuments and cruises routes. The lamps cannot contribute to the light trespass, therefore its luminaires need to be shielded and the warmest colors of light are recommended (up to 3000 K). Also, the intensity of light should be reduced at the watersides, because its brightness is intensified by reflections, similarly in the case of snow cover in winter. The plan recommends protection of green spaces, favouring subtle lighting at night, even allowing the use of dense foliage plants shrubberies as a barrier.

An important part of sustainable lighting is the ability to adjust levels and time of lighting operation. The master plan recommends the light sources operating time, attributing the appropriate limits to given groups of lighting sources (Tab. 1.). At the same time, an individual approach to each place in agreement with the interested parties is advised. For the low-traffic spaces, a suggested solution is a motion activated lighting (such as parking lots, backyards, parks, recreational paths, etc.).

Table 7. Lighting Curfew Parameters [selected representative modes from Capital Illumination Plan 2017–2027, National Capital Commission 2017].

Parametry wygaszania oświetlenia [wybrane reprezentatywne tryby z Capital Illumination Plan 2017–2027, National Capital Commission 2017].

Mode	Description and Potential Uses	Recommended Parameters
Permanent Functional Lighting	Functional lighting requiring activation for the entire night (e.g., streets, major pathways, public places, health and safety services and so on).	<ul style="list-style-type: none"> ■ Activation at sunset. ■ 50% reduction in intensity from midnight to 5 am.
Public Transit System Lighting	Lighting related to public transit networks (stations and associated infrastructure).	<ul style="list-style-type: none"> ■ Activation at sunset. ■ 50% reduction in intensity during off-peak hours. ■ Fully deactivated when public transit services end.
Illumination Lighting	Illumination to enhance the nighttime landscape (e.g. buildings, commemorative monuments, public art and so on).	<ul style="list-style-type: none"> ■ Activation at sunset. ■ Lower intensity and reduced amount of lighting, if not total deactivation, starting between midnight and 2am (based on location and use). ■ On a case-by-case basis for the most important elements of the nighttime scenery, as identified in the illumination concept (see Chapter 5): ■ Activation at sunset. ■ Illumination in “night mode” starting at midnight (“night mode” involves a specific lighting design that lowers light in a gradated operation or by partial deactivation).
Dark Zone Lighting	Lighting dedicated to areas identified as dark zones (see Section 5.2.1).	<ul style="list-style-type: none"> ■ Activation at sunset. ■ Lower intensity and reduced amount of lighting, if not total deactivation, at 10 pm.

The plan stresses that energy efficiency and lighting quantity cannot take precedence over its quality, and that lighting should always correspond with the individual features of each location and surroundings.

Another example of comprehensive document on lighting planning is the ‘**Collier County Lighting Standards**’ from 2017 [CCLT 2017]. It provides supplementary guidance to the existing fragmentary legal regulations and presents an integrated approach to the illumination in Collier County, Florida. The main objective of the plan is to enhance a sense of comfort and security in public space and to respect natural environment and the dark sky.

One of the basic concepts of Collier Lighting Standards is the adoption of lighting zones that represent ‘the desired ambient light levels of a community’ [CCLT 2017, p. 11]. This approach introduces an element of flexibility to fairly restrictive regulations. Based on definitions taken from recognized standards [IDA MLO 2011], all areas and objects owned and maintained by the County, have been categorized into specific zones. Zone “0” is the most rigorous and its users have to accept the adaptation to total darkness. Another – zone “1”, of low ambient lighting – provides lighting only for safety or comfort and allows lack of brightness continuity. Zone “2” is an area of human activity of a moderate light levels. The last zone, “3” includes moderately high level of brightness, where the lighting is spatially continuous and usually uniform. Even though the 2nd and 3rd zone allow the cooler light tones (up to 3500 and 4800 K), it is recommended that the users voluntarily use the lamps of a color temperature below 3000 K, leaving the cold light only for sensitive areas (Tab. 2.).

The document contains information and recommendations related not only to the parameters, but also to installation and placement of light sources. In particular it draws attention to areas that require special care in preventing the effects of light spill-off onto unwanted surfaces, glare and sky glow. They include, among

others, the residential and landscape zones as well as the surroundings of architectural illuminations. It is recommended to direct illumination fixtures downward to reduce its intensity and use full shielding.

It is worth noting that the approach to the minimum levels of lighting is different, from those known i.a. in Poland: the standards clearly indicate that outdoor lighting should not exceed the minimum levels specified by photometric characteristics. This may be considered as too much stringent mechanism, yet Collier vision is to become a state and national leader in applying lighting standards for the community.

Table 8. Lighting Zone Classification and Lighting Zone-Based Restrictions [Collier County Lighting Standards 2017, Collier County Government]

Klasyfikacja stref oświetleniowych i odpowiadające im ograniczenia [Collier County Lighting Standards 2017, Collier County Government]

Lighting Zones	Site and Structure Classification		
LZ0 No Ambient Lighting	Beaches; Boat Launch Sites; Cemeteries; Nature Trails & Pathways; Parks – Neighborhood; Preserves; Remote Utility Stations; Wellfields.		
LZ1 Low Ambient Lighting	Campuses – Rural; Fueling Stations – Rural; General Office Buildings; Landfills; Museums; Recycling Centers; Outdoor Swimming Pools; Parking Lots & Garages – Urban; Parks – Community; Roadways – Local, Rural Collectors; Water Parks – Rural.		
LZ2 Moderate Ambient Lighting	Airports – Rural; Corrections Facilities – Rural; Fueling Stations – Urban; Master Pump Stations; Parking Lots & Garages – Urban; Parks – Regional; Roadways – Rural Arterial, Urban Collectors; Temporary Events – Rural; Water & Wastewater Plants – Rural; Water Parks – Urban.		
LZ3 Moderately High Ambient Lighting	Airports – Urban; Campuses – Urban; Corrections Facilities – Urban; Roadways – Urban Arterial; Temporary Events – Urban; Water & Wastewater Plants – Urban.		

Lighting Zones	Color Temperature CCT Allowed Range	Light Reduction R = Required / V = Voluntary	Maximum Light Output Percentage
LZ0	1900–3000 K	R – 1 Hour after close of business	25%
LZ1	1900–3000 K	R – 1½ Hours after close of business	25%
LZ2	1900–3500 K	R – 2 Hours after close of business	50%
LZ3	1900–4800 K	V – 2 Hours after close of business	50%

Conclusions

The approach to urban lighting has already gone far beyond sole utility and nowadays the attention is more and more being paid to the issues related to its overabundance. The first reaction to the nuisance resulting from light pollution was establishing a set of rules for the proper lighting use and the corresponding parametric standards. Initially, the dark-sky protection was considered as a priority issue, but ongoing improper use of lighting resulted in identification of many lighting-related conflicts in urbanized spaces. The first attempts to implement comprehensive lighting regulations already appear in urban planning practice, however the complexity of the issue may be proved by the fact that such plans so far not covered areas of large cities.

Minimizing light pollution becomes significantly complicated in perspective of the requirements and rights that must be applied in populated areas – introducing substantial changes is difficult there, both for formal as well as social reasons. However, the lighting modernization opens an opportunity for cities to substantially improve quality of life standards by better adjustment of spaces to the needs of the users, while at the same time minimizing the bad impact on the environment and cost cutting.

The question: ‘what exactly compose a high quality of urban lighting?’ has not been resolved definitively and universally yet, but with no doubt it is a multidimensional issue. The most advanced and coherent form of searching for the city lighting quality are illumination master plans. Such projects not only aim to provide

conditions for visibility, safety and aesthetics of the night space, but also respond to global problems, postulating reduction in electricity consumption and seeking a balance between the light and dark spaces. Already known practices in urban light planning differ substantially regarding methodological approaches, hierarchy of priorities and policy implementation instruments. Currently, most of regulations seem to be limited to public spaces, but also they include good examples and an some form of incentives to apply regulations in the private sector. As technology develop and social awareness continue to grow, such urban policy tools can be expected to become more popular as the integrated element of urban policy in the near future.

References

- [1] Bogard P., 2013: *The End of Night: Searching for Natural Darkness in an Age of Artificial Light*. Hachette UK.
- [2] Brandi U., Geissmar-Brandi C., 2007: *Light for cities. Lighting design for Urban Spaces. A Handbook*. Birkhauser, Basel, Switzerland.
- [3] CCLT, 2017: *Collier County Lighting Standards*. County-Wide Lighting Team. Collier County, Florida.
- [4] CIE, 2017: *Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations*, 2nd Edition. Publication no. 150, Vienna, Austria.
- [5] DW, 2017: LED-technology increases light pollution across the night sky. Deutsche Welle. <https://p.dw.com/p/2o7jA> (21.08.2018).
- [6] Ederson T., 2015: The gloomy city. Rethinking the relationship between light and dark. *Urban Stud.* 52(3), 422–438
- [7] Holker F. et al., 2010: Light pollution as a biodiversity threat. *Trends Ecol. Evol.* 25(12), 681–682.
- [8] IAU, 2009: Resolution B5 in Defence of the night sky and the right to starlight. XXVIIth General Assembly, Rio de Janeiro, Brazil.
- [9] IDA, 2010: *Visibility, Environmental and Astronomical Issues Associated with Blue-Rich White Outdoor Lighting*. International Dark-Sky Association, Tucson-Washington.
- [10] IDA 2011, *Light Pollution Wastes Energy and Money*. <http://darksky.org/light-pollution/energy-waste/> (21.08.2018).
- [11] IDA-IES, 2011: *Joint IDA-IES Model Outdoor Lighting Ordinance (MLO) with user's guide*. International Dark-Sky Association/Illuminating Engineering Society
- [12] ILP, 2011: *Guidance notes for the reduction of obtrusive light*. Publication no. GN 01. Institution of Lighting Professionals.
- [13] Kołomański S., 2015. Zanieczyszczenie światłem i ciemność. *Prace i Studia Geograficzne* 53, 29–46.
- [14] Kyba Ch.C.M. et al., 2017: Artificially lit surface of Earth at night increasing in radiance and extent. *Sci. Adv.* 3(11).
- [15] Martyniuk-Pęczek J., 2014: *Światła miasta*. Marina, Wrocław.
- [16] Mohar A., 2018: Causes of light pollution. Managing security, ignorance, profit, corruption. LightPoll 2018, The First Vobanista Workshop on Light Pollution. Fruska Gora, 26.05.2018, Serbia.
- [17] Nawalkowski P., 2013: Problem zagrożenia światłem. *Dzikię życie*. 11(233), 11–13.
- [18] NCC, 2017: *Capital Illumination Plan 2017–2027*. National Capital Commission. Ottawa, Canada.
- [19] RASC 2016: *Guidelines for Outdoor Lighting in Urban Star Parks (RASC-USP-GOL)*. Royal Astronomical Society of Canada Dark Sky Preserve Program. .
- [20] Rozwadowski T., 2007: Time sprawl: czy zagraża nam urbanizacja nocy? *Urbanista*. 5(53), 27–29
- [21] Ściężor T. et al., 2010: Zanieczyszczenie świetlne nocnego nieba w obszarze aglomeracji krakowskiej: analiza pomiarów sztucznej poświaty niebieskiej. *Wyd. Polit. Krak.* Kraków.
- [22] Stevens R.G., Zhu Y., 2015: Electric light, particularly at night, disrupts human circadian rhythmicity: is that a problem?." *Phil. Trans. R. Soc. B* 370.1667 (2015): 20140120.

Lighting policy as an integral part of sustainable urban planning

Streszczenie: Celem artykułu jest opisanie ewolucji podejścia do regulacji sztucznego światła na obszarach miejskich oraz przedstawienie przykładów istniejących praktyk w tym zakresie. Autorki prezentują teoretyczną debatę na temat zjawiska zanieczyszczenia światłem i przedstawiają współczesne argumenty przemawiające za planowaniem oświetlenia jako elementu szerszej polityki miejskiej. Przedstawione przykłady kompleksowego podejścia do planowania oświetlenia miejskiego zostały oparte na wynikach międzynarodowej kwerendy przeprowadzonej w 2018 roku.

Słowa kluczowe: oświetlenie miejskie, masterplan oświetleniowy, zanieczyszczenie światłem, zrównoważone planowanie miast, polityka oświetleniowa.

Optical properties of opaque and light-transmitting photovoltaic systems in architecture and their influence on architectural form

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Abstract: Energy-harvesting systems installed on facades have an immense influence on the perception of architecture. Technologies at various stages of advancement are currently used. Apparent (clearly visible) PV elements (e.g. old-generation applied solar panels) are being replaced by technologies that integrate those systems into the building's envelope using miniaturization, lamination and surface mounting (e.g. BiPV). In the current application of PV, three distinct trends can be observed: (i) the integration of energy-collecting elements into the shell and (ii) their deliberate display and use as, for example, shading, cladding or other forms of decoration, or (iii) the development of "invisible" PV systems. The research question is how the development of these systems affects architecture. Does the process of integration enrich the building's architectural expression or negatively affect the perception of the building's transparent surfaces?

Keywords: PV architecture, BiPV, PV cells, façade design,

Introduction

Architects express emotions through form by sculpting the architectural volume and using proper materials. Such a process requires flexibility so that it can absorb new technologies and respond to sustainability and low-energy issues. One such issue, which exerted unprecedented pressure on building technology and induced formal changes in architecture, involves the application of photovoltaic systems. While all energy-harvesting systems influence architecture in some manner, PV systems are explicit because of their spatial form and surface properties. Thus the issue of PV integration in architecture has become a known problem in architecture. This paper describes the possibilities for integrating PV systems and examines their optical properties. These properties are of utmost importance to architects as they condition what PV elements look like and how they impact the appearance of architecture.

Architectural integration of photovoltaics

Photovoltaics (PV) can be integrated into buildings using one of the following two methods:

- **Building-Applied Photovoltaics (BAPV)** – PV devices that are added to the building solely for energy purposes do not function as architectural components. Aesthetically, they tend to disrupt the harmony and composition of the building envelope (its form, texture, color). This approach is not considered as "true" integration.
- **Building-Integrated Photovoltaics (BiPV)** – by integrating PV technology into the building structure and its elements solar devices can simultaneously generate electricity and function as building materials

and elements. Multifunctional BiPV are an integral part of the architectural concept. This promising technology provides innovative tools for designers.

Different areas of a brightly sunlit envelope are suitable for integration with PV elements. These include fragments or entire surfaces of:

- roofs (flat, tilted, curved),
- facades (vertical, inclined, curved),
- external devices (canopies, sunshades, balconies, parapets, etc.).

To produce maximum power, panels should be tilted at an angle equal to the latitude of the location, although, in the case of BiPV installations, multi-functionality and aesthetics may be more important than their efficiency.

The currently used technologies are at various stages of advancement. Evident (clearly visible) PV elements (e.g. old-generation applied solar panels) are being replaced by technologies that integrate those systems into the building's envelope using miniaturization, lamination and surface mounting. If architecture and solar technology are to coexist, the latter must offer flexibility in the choice of materials and structural solutions. This applies to PV modules in particular as they are the basic visible elements in building installations. PV systems also affected architectural transparency, because they benefit from daylight, just as windows do. Apparently, different elements of the building are now starting to compete for access to the Sun. Classical PV systems were arranged like "windows in the wall" and simply replaced the cladding in "non-visual" parts of the façade. On the other hand, the contemporary, partially transparent solutions are problematic in this respect as they tend to replace fragments of the "visual" (light-transmitting) part of the envelope.

Design strategies

It is difficult to define the aesthetic aspects of PV integration as the problem is complex and subjective. The biggest challenge for BiPV is to find a balance between the formal aspects and the technical requirements of the energy-harvesting system. In the IEA PVPS Task 7 research program (1997–2001) architects identified the following basic criteria for a good BiPV design [Prasad, Snow 2005]:

- naturally integrated,
- architecturally pleasing,
- well-composed (colors and materials),
- well-harmonized (the dimensions of the PV system match the dimensions and the grid of the building),
- well-contextualized (the PV system matches the context of the building),
- well-engineered,
- innovative new design.

Currently, there are three main tendencies in BiPV architecture:

- Harmonious integration – the building design and PV elements form a symbiotic or even synergetic system;
- Exposition – the PV technology somewhat dominates in the overall design, e.g. through contrast with other materials or by ensuring that panels are appropriately angled towards the sun. Eye-catching solutions are used for promotional or educational purposes;
- Invisible application – barely visible PV components play a secondary role in the architectural design. By using special solutions BiPV elements become undistinguishable from the rest of the building envelope (e.g. imitating traditional forms and materials) or are located out of the observer's sight [Prasad, Snow 2005; Cronemberger et al 2014].

Some PV system manufacturers specialize in custom-made materials, e.g. tailored cladding to fit a particular building's cladding, to such an extent that the final system is almost unnoticeable yet perfectly integrated into the building.

The possibilities of shaping PV in buildings

The visual appeal of standard PV modules is limited by technical requirements and economy, which is why such elements rarely suit the needs of architects. Special products that match a building's design in a satisfactory way have been developed. Standardized, mass-produced elements – e.g. photovoltaic glass, replace conventional materials and are compatible with traditional mounting systems. The most advanced (and expensive) custom-made PV modules offer maximum flexibility in terms of design options.

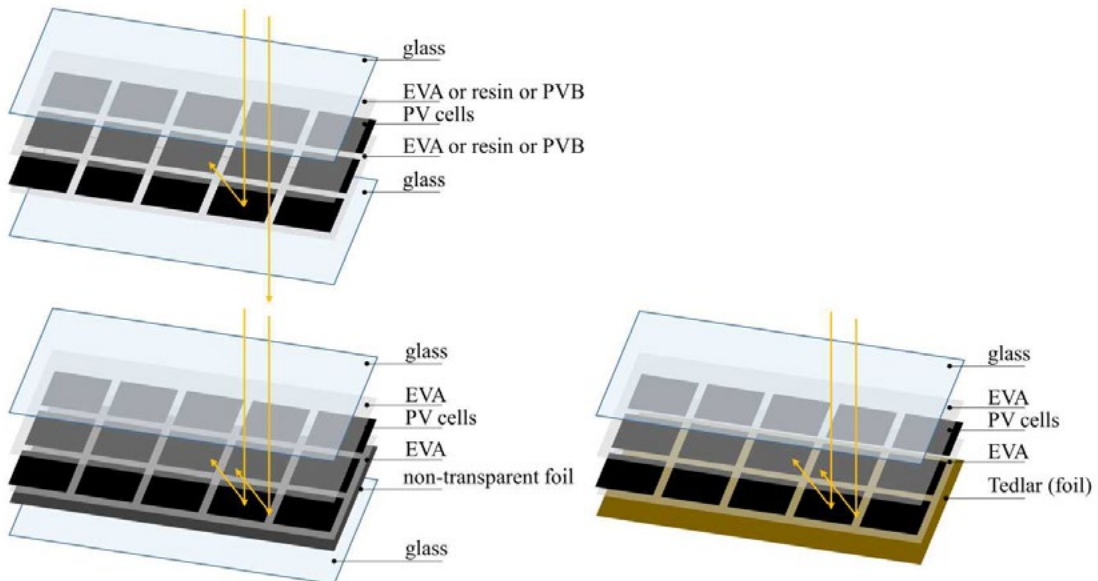


Fig. 1. Crystalline Silicon PV module schematic diagram of 3 different technologies: a) glass-glass semitransparent module, b) glass-glass opaque module c) glass-foil opaque module. Diagram by M. Brzezicki

Every PV module consists of various components on separate layers, all visible at the same time (Fig. 1). Different factors determine the overall appearance. In terms of materials, it is possible to customize the appearance and properties of individual elements, which results in a multitude of combinations. The options include:

- the material of solar cells,
- the color and composition of electrical contacts
- the arrangement of solar cells in a module,
- the shape and size of the module,
- the material of the front/back cover (structure, color, flexibility),
- the framing
- the encapsulant material,
- additional coatings,
- the level of transparency (solar cell/module level).

The most important factors are discussed in detail below:

Material of solar cells

The material of solar cells plays a particularly important role in the perception of the architectural surface. In practice most of the crystalline cells are dark blue or black. Standard monocrystalline (m-Si) have an almost homogeneous texture, while polycrystalline (p-Si) are less uniform – the visible structure of individual crystal grains creates a flickering effect depending on the lighting conditions and the direction of observation (Fig. 2). Many designers consider the shiny bluish aspect of crystalline cells boring or even unacceptable. For architectural purposes manufacturers produce colored cells (yellow, red, green, silver, or pink) but these are still niche products due to their higher costs and lower energy efficiency.



Fig. 2. Possible use of different types of cells on facades: a) monocrystalline (m-Si) cell used in the building in Punkthäuser Wilmersdorfer Straße, Freiburg (arch. Rolf + Hotz architekten, 2001, b) polycrystalline (p-Si) used in the building in SMA building nr 6, Niestetal (arch. HHS Planer+Architekten AG, 2002) – photographs by M. Muszyńska-Łanowy.

A typical feature of thin-film PV is its dark, homogeneous structure. The color depends on the semiconductor material and on the structure of the substrate. Amorphous silicon (a-Si) cells on glass are reddish brown, whereas the same a-Si cells deposited on steel strips are dark blue with purple-violet reflections at the edges. Cadmium Telluride (CdTe) glass modules are black with a greenish sheen. The aesthetics of smooth black Copper Indium Selenide (CIS) and Copper Indium Gallium Selenide (CIGS) modules are considered particularly attractive for architecture [Muszyńska-Łanowy 2010] (see Fig. 3). In thin-film laminates, the color can be changed by the type of tinted glass used as the external layer of the module.



Fig. 3. Black Copper Indium Gallium Selenide (CIGS) cells used on the façade of the Solteure Headquarters, Berlin-Adlershof (arch. Rainer Girke, 2009) – photographs by M. Muszyńska-Łanowy.

Arrangement of solar cells in the module

Crystalline wafer-based cells are opaque, round or square/rectangular in shape and approx. $10 \times 10 \text{ cm}$ – $15 \times 15 \text{ cm}$ in size. For technical reasons, series of interconnected cells are arranged regularly in parallel lines at minimal intervals from each other (approx. 2–10 mm). Depending on the shape and layout of the cell, various motifs can be created – for example by extending them over a longer distance or arranging them in irregular pixel-like patterns. Sometimes dummy modules are also added, i.e. modules with unconnected cells (Fig. 4). This is done only for aesthetic purposes, usually to maintain the visual rhythm of the entire system.



Fig. 4. The example of the use of dummy glass-glass module. Cell in trapezoid module visible of the figure are not connected to the grid. (Optisol®, manufactured by Scheuten) – photographs by M. Muszyńska-Łanowy.

Module shape, size and flexibility

PV modules are usually rectangular. Glass panels (glass-foil, glass-glass modules and laminates) are manufactured in the form of typical building glass. Their surface area is typically 1.0–2.0 m², however, PV modules can be smaller (e.g. to match the shape of roof tiles) or in XL format. The size of thin-film materials depends on manufacturing methods and the substrate. In the roll-to-roll process, the width of the metal sheet or plastic strip is fixed but its length can be up to several hundred meters.

To accommodate for different façade designs and geometries, manufacturers produce circular, triangular, trapezoidal, and polygonal modules (quite rare and expensive). These unconventional shapes, however, can complicate the interconnection of cells and increase the costs. An increase in the inactive surface in a module decreases the energy efficiency. To solve this problem, dummy substitutes can be used. [Weller et al 2010, Farkas 2013].

Tailor-made elements better fit the geometry of the building. The size and shape of PV elements should correspond to the parameters of the original building materials that these elements are replacing [Munari, Probst, Roecker 2012, Farkas 2013]. Large panels are preferred as they need fewer electric connections, have better efficiency and make surfaces more homogeneous and smoother.

Most PV modules are flat and rigid glass elements. Curved glass or acrylic panels with embedded cells offer new aesthetics solutions. Other types include flexible thin-film laminates. Lightweight steel sheets or plastic films are robust and can be glued on both convex and concave materials, such as textiles, membranes, etc.

Front/back cover material

In order to increase efficiency, the sunlit side of a PV module must be highly transparent. Usually the cover is made of extra-clear, low-iron glass. Flexible modules are made of transparent plastic film. The latest technologies enable the embedding of a special coating on the inner side of the front glass, resulting in a uniform color or pattern visible from the front. There is a wide choice of finishes available for the back cover (visible from the inside of the building) and all layers on the rear side of PV cells – colors, prints or patterns. In glazed structures (e.g. facades, canopies) tinted and/or transparent backgrounds are used to create decorative effects visible from both sides. It is also possible to change the color of the encapsulant material (EVA, PVB) and thus influence how it is perceived (see Fig. 5).

Optical reflection depends on the material that covers the module. It is different for glass and plastic materials. Some of them reflect images faintly, others behave like a mirror. The reflection is also a function of the angle of incidence. Most PV modules use a smooth glass covering similar to window-like surface. Sparkling p-Si cells, a silver color of electrical contacts and aluminum frames can enhance the shiny effect. Optical reflection should be minimized to increase efficiency and avoid glare. When flat, smooth glass reflects too much sunlight, anti-reflective coatings are applied. Another option is to create surface roughness by using a special type of patterned clear glass. This treatment does not affect the color but neither does it create a matte finish [Weller et al 2010]. Matte appearance can be achieved e.g. by sand-blasting, but, since rough surfaces tend to accumulate

more dirt, this type of surface is not very popular. Prototypes of different structures and different reflexivity were tested in PVACCEPT (2001–2004) and BiPV-CIS (2004–2007) research projects [Muszyńska-Łanowy 2010].



Fig. 5. The glass PV module with color PVB resin shading element at Parc de Can Rigoal, Barcelona (arch. Claudi Aguiló Riu, Eva Pagès (arquitectos – AMB, 2012) – photographs by M. Muszyńska-Łanowy.

Framing

Metal frames are used to increase the mechanical stability and to protect the edges of solar modules. Most of them are made of anodized (natural, colored) aluminum (Fig. 6). This typical silver color is visible, especially in contrast with dark cells. When many PV panels are arranged into a pattern, their frames create a regular grid. Frameless elements (called laminates) are considered better for architectural integration because they appear more homogeneous. The problem of delamination may occur along the edges, which leads to discoloration and increases dirt or mold deposition.

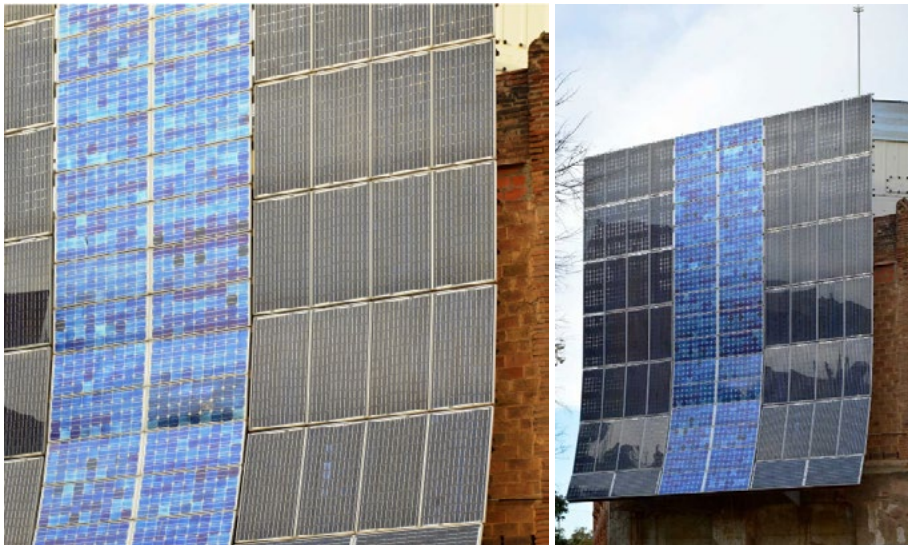


Fig. 6. Framed modules with resulting distinct grid. La Fàbrica del Sol, Barcelona (arch. Antoni Solana, 2009) – photograph by M. Muszyńska-Łanowy.

Transparency level

Non-light transmitting (opaque)

Opaque systems are characterized by 100% light absorption, which – in architectural terms – means that the system functions as a shading element and completely blocks the view. Light transmission through a PV module can be blocked by using densely packed opaque crystalline cells or an opaque backing layer. When using opaque systems, the cladding, spandrels, parapets, etc. are made of standard glass-foil modules because

these are the most popular and thus the most cost-effective. Glass-glass modules and laminates are used less frequently, although, in recent years, thin-film laminates have been appearing more and more often – e.g. CIS (CIGS) glass modules in cold façades (Fig. 7).

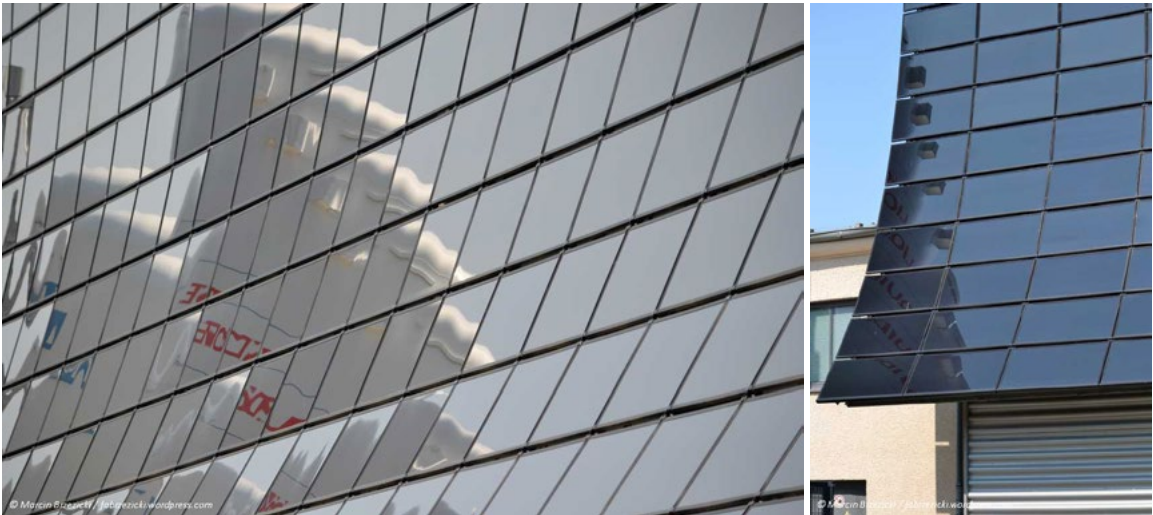


Fig. 7. Opaque CIS PV module installed at Ferdinand Braun Institute, Berlin-Adlershof (arch. MSP Architekten, 2006) – photographs by M. Muszyńska-Łanowy.

Light transmitting

One of the main advantages of PV/BiPV materials is their semitransparency, which can be obtained by the following methods:

- **Binary** – by increasing the distance between opaque cells to let the light pass through the transparent covering,
- **Binary (micro level)** – by perforating different patterns on the surface of the cells with a laser,
- **Homogeneous** – by coating or de-coating the active thin-film module during the manufacturing process.

For high transparency, transparent electrical contacts can be used. The practical transmittance of modules is approx. 10–30%. It should not exceed 50% because efficiency diminishes proportionally to the inactive surface area. Higher transmittance is one of the most important goals in PV research. Scientists are developing new generations of OPV, e.g. Polysolar is working on organic polymer solar cells that can be used as fully transparent colorless PV windows [Guide to BIPV. Building Integrated Photovoltaics, 2015]. Semi-transparent PV (STPV) are used in windows, glass roofs and façades, skylights, sun shading systems, balconies or as decoration.

Semi-transparent modules

Binary systems

From the perspective of the proposed typology, binary systems are composed of (i) light-transmitting and (ii) opaque areas. Opaque areas do not transmit light at all, while in crystalline materials the spaces between opaque cells are large enough for the light to pass between them. The cell layout of the binary system is created by properly scattering individual cells on the pane, whereas its transmission properties depend on their exact location (Fig. 8). Cells can be arranged in different rhythms and packing densities. This binary transparency can be obtained in different ways: by cutting perforations in crystalline cells using laser technology and by partially coating or decoating the active thin-film module during the manufacturing process.



Fig. 8. Binary modules visible from inside Mont-Cenis Academy, Herne (arch. Jourda et Perraudin, 1999), and from outside in GDF Suez, Dijon (arch. Atelier Phileas, 2013) – photographs by M. Muszyńska-Łanowy.

If this system is applied in visual sections of the façade, it obstructs the view. To solve this problem, energy harvesting system are applied “locally” by positioning them at the parapet level of on non-visual parts of the façade.

Another consequence of using a binary system is a scattered shadow that is cast by energy harvesting elements, according to their arrangement. This effect is similar to the shadows cast by Venetian blinds on the working surface. This shadow sometimes affects human cognition by making it very difficult to recognize the surface. As mentioned above, this can also reduce the solar gains. Individual PV cells function as markings on the glass. The combination of unoccupied transparent and opaque zones forms unique patterns in the building interior. Crystalline PV produces a checkered pattern of lights and shadows depending on the arrangement of cells. These systems can be used in common, recreational areas but are not recommended in workspaces.

Homogeneous systems

From the optical perspective, the homogeneous PV cell partially absorbs and partially transmits light. So far none of the available PV technologies allows complete transparency, so the effect of dematerialization in architecture will be not as strong as in conventional glass structures [Muszyńska-Łanowy 2011]. STPV (semi-transparent PV) improves visual performance due to light-transmission and color rendering index. The relationship between the interior and exterior is of great importance in architecture [Guide to BIPV. Building Integrated Photovoltaics 2015].

In general, the transparent PV cell is a peculiar paradox, as light energy (photons) is supposed to be transformed into electrical energy, not transmitted. Despite being technologically advanced, the performance of these systems, ranging from 2% to 4%, is rather low in comparison to the 18,2% performance of opaque systems (e.g. Polysolar’s PS-MC-SE Series panels). Light-transmitting layers used in homogeneous systems require higher manufacturing standards, advanced technologies of coating deposition, dye screen print, organic compounds (e.g. polyphenylene vinylene) or thin film.

There are many technologies for manufacturing transparent PV cells. Some products are marketed as “photovoltaic transparent glass” (Onyx uses a-SI and CIS/CIGS to achieve this level of transparency). Polysolar offers new Cadmium Telluride-based PS-CT panels [Guide to BIPV. Building Integrated Photovoltaics, 2015]. Colourless panels are rare on the market and usually have a greyish tint. Polysolar manufactures a-SI based panels with an amber tint.

Semi-transparent thin-film modules

Thin-film materials become partially transparent in the manufacturing processes when the cells are deposited directly on a transparent substrate, usually glass, and on flexible plastic foil. The level of transparency and the visual appearance depends on the laser etching process, which creates different patterns to achieve a

semi-transparent effect. Semi-transparent thin film modules provides a uniform daylighting pattern, a sort of grey veil, without creating high contrasts between light and shade (Fig. 9). The entering visible light can be changed by colour, additional coatings and module structure.



Fig. 9. Homogeneous systems thin-film semitransparent module in insulating glazing applied in the visible part of the window. Photographs by M. Muszyńska-Łanowy.

Dye-sensitized solar cells

The technology of dye-sensitized solar cells (DSSC), called “artificial photosynthesis”, transforms sunlight using dye molecules. Photo-electrochemical cells are very promising for architecture as they offer the highest levels of transparency and unlimited colours. Instability and low energy efficiency are the major problems that limit their wider use. The new Swiss-Tech Convention Center in Lausanne in Switzerland (arch. Richter Dahl Rocha & Associés, 2014) features a glass façade made of dye-sensitized solar cells that generate electricity (Fig. 10). “Apart from being translucent, the angle of incidence of light makes no difference to the cells, which can be vertically deployed without any loss in performance. In addition to generating electricity from renewable sources, they protect the building from direct sunlight and thus reduce the necessity for using cooling energy.” [Richter Dahl Rocha... 2014] The formal result is more that pleasing, as the arrangement of light-transmitting PV cells resembles “stained glass”, producing an interesting visual effect through backlighting and casting colourful shadows on the floor.



Fig. 10. Swiss-Tech Convention Center in Lausanne in Switzerland (arch. Richter Dahl Rocha & Associés, 2014) – photographs by M. Brzezicki.

Emerging technologies

Almost completely transparent PV cells (with VIF/h above 45 ± 30%) can be manufactured using two technologies which are currently in the prototype stage and which employ spectrally-selective filters and layers. The first one uses a PV cell that transmits the visible spectrum while using ultraviolet and infrared waves to generate electricity. The result is outstanding, as the PV cell resembles a clear pane of glass. Two similar technologies were developed: (i) a technology based on “small-molecule compounds” at MIT in 2011 [Lunt, Bulovic 2011], and (ii) an analogous polymer solar cell with almost 4% of power conversion at UCLA in 2013.

The second technology incorporates luminescent powders and luminophores into an optical epoxy layer, which provides a certain percentage of photo-induced re-emission of absorbed photons. These re-emitted UV and IR photons travel inside the pane of glass in a manner similar to how light is transmitted in optical fibers. These reflected photons are then used to generate electricity in the PV cells that are mounted along the edges of the glass pane. This area is relatively small but special heat-mirrored coatings could be applied to enhance the fiber-optics phenomenon, and – by increasing the efficiency of the PV cell – produce satisfactory gains. Recent research produced a “remarkable result of routing in excess of 20% of the total radiation energy reflected off its back coating towards the PV modules”, which translates into a PV efficiency of 3,8% [Alghamedi et al 2014] with VIF/h as low as 45%.

Conclusions

It can be concluded that the final visual effect depends mainly on the composition of the layers in the PV module. In opaque glass-foil modules, where regions of the back covering (usually Tedlar) are visible from the front, a contrasting or uniform appearance can be achieved. It is also possible, though technically difficult, to connect differently-colored cells in one PV panel.

The visual appearance is also affected by the type and intensity of daylight. During the day, at a certain distance, PV viewed from the exterior can appear quite uniform: like colored glass, whereas at night the artificial illumination from the inside reveals its semi-transparent features. The change of sunlight intensity and viewing angle produces different visual effects, such as shine, reflections and colors. The distance and position of the viewer is also very important – the closer the observer, the more details of the PV module are visible (e.g. electrical contacts). The same module seen from different angles– e.g. in semi-transparent glass facades – may look completely different.

Many different products with fewer technical constraints are currently available but new ideas and further research is still needed, i.e. colored, patterned, flexible materials with higher levels of transparency. Quality and aesthetics are important, improved design can increase the acceptability of PV technology.

Acknowledgment

The part considering transparent technologies is based on the paper by Marcin Brzezicki titled “Light-transmitting energy-harvesting systems. Review of selected case-studies”.

References

- [1] Alghamedi R., Vasiliev M., Nur-E-Alam, M., Alameh, K., 2014: Spectrally-selective all-inorganic scattering luminophores for solar energy-harvesting clear glass windows, Scientific Reports 4, Article number: 6632 (2014), For more information see: <http://www.nature.com/articles/srep06632>
- [2] Brzezicki M., 2017: Light-transmitting energy-harvesting systems. Review of selected case-studies, Powerskin Conference Proceedings, Auer T., Knaack U., Schneider J., eds. TU Delft Open, 2017
- [3] Colton R. D., 2015: Assessing Solar PV Glare In Dense Residential Neighborhoods, Solar Industry, vol. 7, 3, p. 1–6, For more information see: http://solarindustrymag.com/online/issues/SI1501/FEAT_02_Assessing-Solar-PV-Glare-In-Dense-Residential-Neighborhoods.html

- [4] Cronemberger J., Almagro Corpas M., Cerón I., Caamaño-Martín E., Vega Sánchez S., 2014: BIPV technology application: Highlighting advances, tendencies and solutions through Solar Decathlon Europe houses, *Energy and Buildings* 83 (2014) 44–56.
- [5] Farkas K. Ed., 2013: *Designing Photovoltaic Systems For Architectural Integration. Criteria and guidelines for product and system developers*, Report T.41.A.3/2: IEA SHC Task 41 Solar energy and Architecture 2013: Available at: <http://task41.iea-shc.org/publications>
- [6] Guide to BIPV. Building Integrated Photovoltaics 2015: Available at: <http://www.polysolar.co.uk/>
- [7] Lunt R.R, Bulovic V., 2011: Transparent, near-infrared organic photovoltaic solar cells for window and energy-scavenging applications. *Applied Physics Letters*. 98 (11).
- [8] Munari Probst M.C., Roecker C. eds., 2012: *Solar energy systems in architecture. Integration criteria and guidelines*, Report T.41.A.2: IEA SHC Task 41 Solar energy and Architecture, Available at: <http://task41.iea-shc.org/publications>
- [9] Muszyńska-Łanowy M., 2010: Czarne fasady – fotowoltaiczne okładziny CIS (in Polish). *Świat Szkła* nr 7–8,
- [10] Muszyńska-Łanowy M., 2011: Ekologia dla oczu. Estetyka powłoki BIPV (in Polish). cz.1, *Świat Szkła* 7–8,
- [11] Polysolar 2015: Thin-film Photovoltaic Glazing for BIPV solutions, For more information see: <http://www.polysolar.co.uk/Technology/thin-film>
- [12] Prasad D., Snow M. eds., 2005: *Designing with solar power. A Source Book for Building Integrated Photovoltaics (BIPV)*, Earthscan, London.
- [13] Richter Dahl Rocha Develops Innovative Façade for SwissTech Convention Center 2014: For more information see: <http://www.archdaily.com/491135/richter-dahl-rocha-develop-innovative-facade-for-swisstech-convention-center>
- [14] Weller B., Hemmerle C., Jakubetz S., Unnewehr S., 2010: *Detail Practice: Photovoltaics: Technology, Architecture, Installation*, Edition Detail, Birkhauser Verlag, Basel, Switzerland.

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.

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 planners¹. [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).

¹ 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° , 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 XXth 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 m². 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.

References

- [1] Gawel D.; Trends shaping of contemporary urban recreational areas,[w] St.Wehle-Strzelecka: The modern city as a human environment integrated with nature, pp.11–17. Kielce University of Technology, Kielce 2015
- [2] <http://www.ctbuh.org/LinkClick.aspx?fileticket=zbw8MY6N98s%3d&tabid=446&language=en-GB>
- [3] Obwieszczenie Ministra Infrastruktury i Rozwoju z dnia 17 lipca 2015 r. w sprawie ogłoszenia jednolitego tekstu Rozporządzenia Ministra Infrastruktury w sprawie: warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie. Dz.U.2015 poz.. 1422.
- [4] Pawlowski A.Z.:Cala I.; Budynki wysokie, Oficyna Wydawnicza Politechniki Warszawskiej, p 120, Warszawa 2013
- [5] Warschau Mitte, School of Architecture, Design and Civil Engineering, Hochparterre AG, pp .23–24, Zurich 2015
- [6] https://pl.wikipedia.org/wiki/Lista_najwy%C5%BCszych_budynk%C3%B3w_w_Polsce
- [7] Goldzamt E.: Szwidkowski O.: Kultura Urbanistyczna Krajów Socjalistycznych, Arkady/, pp. 366–368, Warszawa 1987
- [8] Gawel D.: From a megalopolis to a smart city- determinations of spatial transformations of Chinese cities (w:), Future of the cities – cities of the futures, Mongraphy 454,Wydawnictwo Politechniki Krakowskiej, vol 4, pp. 92–101, Kraków 2014,
- [9] Jasinski A.: Znaczenie budynków wysokich i wysokościowych we współczesnej urbanistyce (w), Przestrzeń i forma , Szczecińska Fundacja Edukacji i Rozwoju Eddytywnego, , vol. 10, pp. 233–244 ,Szczecin 2008
- [10] Smith A.: Tall buildings and sustainability [w] R. Beaver: The Architecture of Adrian Smith , SOM , Toward a sustainable Future, , p.132, Victoria 2007
- [11] Małachowicz E. Konserwacja i rewitalizacja architektury w środowisku kulturowym. Oficyna Wydawnicza Politechniki Wrocławskiej, p.349, Wrocław 2007

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.

Features of housing sanation in the historical architectural environment

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Abstract: In Ukraine, one of the main problems in the field of architecture and construction is an outdated housing stock with low energy efficiency indicators. The total housing stock of Ukraine is 1031.7 million m², of which more than 4.8 million m² is an outdated and emergency stock, 11% of residential buildings need repairing, and 9% – reconstruction. Its significant part (72 million m² or 23%) is morally outdated buildings of the first mass series of 1950–1960, which have a number of structural deficiencies and do not fit to current norms [11].

Most of the existing housing are in the historical environment, therefore, in addition to traditional approaches to the formation of energy-efficient housing, there are special approaches associated with a number of restrictions on the compositional, stylistic, and coloristic integrity to the architectural environment with increasing energy efficiency of housing. This problem needs to be solved in a complex way, using thermo-modernization, thermo-reconstruction, sanation. An analysis of these approaches has shown that sanation is the most effective, as measures for the rehabilitation of multi-apartment buildings allow to increase energy efficiency of housing and preserve historical architectural heritage within the existing housing stock.

Key words: sanations, housing, architectural environment, energy efficiency.

Survey of research

Problems of energy saving in architecture and construction in Ukraine were researched by: O.V. Bumazhenko, M.O. Brodsky and O.M. Pechenyk, who study the influence of city-planning methods on the change of architectural environment in order to reduce the negative climatic influences and increase the level of energy saving of urban development; O.V. Serhiychuk, which modeled the physical processes in optimizing the form of energy-efficient buildings; V.L. Martynov, who explores the geometric parameters of individual components of energy-efficient buildings; T.O. Kashchenko, who deals with the optimization of the form of energy-efficient homes; L.O. Shuldan, who investigated the problem of building energy-efficient buildings, in particular schools, I.P. Kozyatnik, L.P. Khokhlova, G.F. Chernykh, N.V. Shilkin, G.G. Farenyuk and others.

The stylistic solution and the harmonious introduction of new housing in the historical environment are considered in the works of A. Ikonnikov, O. Becker, V. Vechersky, E. Vozdvytsky, V. Lavrov, S. Regame, T. Tovstenko, T. Cherkasova, and others. From abroad, examples of rehabilitation of existing housing in Germany, the Czech Republic, Latvia, Estonia, Republic of Poland were analyzed. In Germany in 1990 a state program of sanation of dwelling houses was established, the main task of which was – “healing” of houses built from prefabricated panels. It included repairing of the roof, supporting elements of the building, increasing of thermal insulation, introduction of heating systems with individual regulation of heat supply, improvement of adjacent territories,

etc. In Poland, too, the problem of outdated housing began to be dealt with in the 90's of the twentieth century. By the moment, 50% of the apartment dwelling has been renovated – they consume less energy due to constructive and engineering measures, and also have a modern attractive appearance due to architectural, planning and stylistic-compositional measures. Examples of cities where the massive rehabilitation dwellings were: Gdynia, Katowice, Wroclaw, Warsaw [1,2].

Scientific methods

Studying the problem of an outdated housing stock and its sanitation were applied method of retrospective analysis, the method of morphological analysis, the method of compositional analysis, the method of stylistic analysis, the method of artistic and aesthetic analysis, the method of conceptual analysis of the formation. When working with outdated housing stock, there are the problems of increasing energy efficiency of housing and the problem of preserving the historical architectural environment where the existing housings are located. To solve these problems, it was proposed to apply: thermo-modernization, thermo-reconstruction, sanitation.

Thermo-modernization is a complex of constructive means for the thermal insulation of the building's shell (external walls of the building, basement, roof renovation, replacement and repair of windows, balcony blocks and entrance doors to the building) in order to bring its energy efficiency indicators in line with modern requirements without changing the engineering equipment, a typical design solution and a three-dimensional compositional solution of the building, but with partial re-planning and restoration of the operational qualities of the building.

Thermo-reconstruction is a complex of repair and construction works related to the increase of thermal engineering indicators of fencing constructions, rebuilding of the building and its engineering equipment with the change of the structure of apartments without changing the building volume or with a change of volume of the building at the expense of the annex, a multi-storey superstructure or an extension of the building to improve the energy efficiency of the building.

Sanitation [10] – besides increasing energy efficiency by constructive, engineering and architectural-planning methods, considering ecological, economic, social, psychological, aesthetic aspects, improving the microclimate, improving the comfort level of individual apartments and the whole building, improving the volume-spatial house compositions and surrounding buildings. The sanitation of the living environment is carried out in order to obtain housing with improved living conditions that meets all modern energy efficiency standards and takes into account the environment. It is the best method for providing energy efficiency to residential buildings.

Research of existing housing

For legislative regulation of energy efficiency issues in Ukraine, exist the Law of Ukraine "Energy saving", "The complex reconstruction of neighborhoods (districts) of an outdated housing stock", "Energy efficiency of buildings", which determine the legal, socio-economic and organizational principles of activities in the field of energy efficiency buildings and aimed at reducing energy consumption in buildings [4]. In order to effectively implement energy-efficient construction solutions in Ukraine, the "warm loans" program was adopted as one of the mechanisms for ensuring energy efficiency. The program is developed for co-owners of multi-dwelling housing (ACMHs). ACMHs – are a form of management of residential buildings. The movement for the creation of ACMHs began in Ukraine about 10 years ago and in some cities it covers up to 90% of the housing stock. In Poltava, in particular, the creation of ACMHs began 3 years ago, and currently, ACMHs cover only 10% of residential buildings, but their creation is growing rapidly. Also, IQ Energy program has been introduced in line with European standards, a financial instrument for promoting energy efficiency improvements in the residential sector of Ukraine [5]. The rehabilitation of multi-apartment residential buildings is a promising way of solving the energy efficiency problem of residential development and allows to prolong the life cycle of buildings, improve the quality of housing, improve the quality of engineering equipment, increase their energy efficiency, operational reliability, durability, and save the historical environment of the central parts of Ukrainian cities.

To implement sanitation in the historical environment, it is first necessary to investigate the types, styles, construction periods, constructions and materials of buildings subject for rehabilitation. In this article is presented an analysis of existing housing stock, means aimed at increasing energy efficiency, energy efficiency of buildings during rehabilitation are presented. Housing stock for periods of construction, the prevailing style can be divided as follows:

1. XVII century – XVIII century. The prevailing style is the Baroque, in particular Mazepa Baroque. The architecture of this style has a high aesthetic value. Examples of baroque houses are houses and mansions of the nobility.
2. The middle of the XVIII century, The middle of the XIX century. The prevailing style is classicism. Classicism has a high aesthetic value, and is widely used in the architecture of residential buildings, both historical and modern.
3. The beginning of the XX century. The prevailing style is modern or Art Nouveau, including the European Modern, Ukrainian Art Nouveau. The European Art Nouveau is distinguished by the bright artistic expressiveness of the image of the building. In the facade decoration there are almost no straight lines and sharp corners, natural bends of lines, resembling images of nature are used.
4. The end of the 1920s – the mid-1950s. Pre-war Soviet constructivism and postwar Soviet style – neoclassicism. Pre-war constructivism is characterized by rigor, geometry, concise forms and monolithic appearance.

The post-Soviet style – neoclassicism can be divided into two subtypes – erected by individual projects for the head staff “nomenklature” and typical projects for the workers. “Nomenclature” buildings stand out from the background of a high ground floor (sometimes with a colonnade), bright décor, an elevated surface (more than 5 floors). Houses have large halls with 2–4 apartments on the floor. The facades of the buildings are plastered and decorated with stucco decoration. In typical designed buildings was the utilitarian architecture. There is almost no vivid decor image on the facades. They are made of red or silica brick or plastered. The number of storeys of such buildings does not exceed 5 floors. The height of the floor of the buildings is 3–4 m, brick walls in thickness from 0,65 m and more, wide entrances, wide stairs. On one floor situated 2–4 apartments with separate bathrooms and separate rubbish pipelines.

5. The post-war period of 1955–1990. This kind of housing were basically a massive brick houses built by typical projects. On the city periphery were built low-rise buildings, in the central regions there was a mass introduction of prefabricated high-rise buildings (block, panels), mass implementation of standard projects. Such reforms in the field of architecture and construction allowed to overcome the growing crisis in housing construction and to return the status of a style-making trend on a global scale to the Soviet architecture [6]. The first designs of the facades of blocks and large-panel houses were solved with the help of the following artistic-compositional techniques: decoration of blocks in the form of large quadrants, illusory cutting of blocks into small elements (“diamond rust”), two-row cutting of a wall with decoration of blocks, pitched roofs. But over time, the architecture of residential buildings of this style was reduced due to the prevalence of economic criteria. Compositional solutions were optimized according to the rationality and utilitarianism: the replacement of pitched roofs to the flat, the refusal of the facade decoration, reducing the height of floors, reducing the area of support facilities, the transit rooms. The buildings were built with a small reserve of strength and some of disadvantages: a small living space, a small height of rooms (2.5 m), small kitchens and corridors, transit rooms and combined bathrooms.

At the same time, prefabricated panel houses appeared (1950–90). This group includes panel houses built in the previous period, typical panel houses, improved typical Soviet panel buildings and panel houses of the 1990s from reinforced concrete or expanded clay concrete. All these buildings present mass housing from inexpensive materials, to the advantages of which can be attributed the high quality of individual panels of exterior walls with possible decoration (in factory conditions) with different mosaics, tiles, etc. The disadvantages of this technology include the presence of joints between the panels, which potentially can form heat bridges. The buildings of this group were built up from 3 to 22 floors, had walls with insufficient resistance to heat transfer, four or more apartments on the floor, the height of rooms is 2.5–2.75 m.

6. End of XX-beginning of XXI century. The modern stage of the formation of the architecture of the living environment. Modern buildings are being built according to typical projects and appear a lot of buildings built according to original projects with individual planning. The architectural stylistic solution of buildings

varies from ultramodern to styling to historic architecture. For the historical styling is used the main artistic and compositional techniques of those historical above-mentioned styles, which have the greatest influence in this environment. The prevailing height of modern houses is from 4 to 25 floors, the height of the floor is 3–3,3 m, and the area of apartments is from 18 m² to 100 m² and more. These buildings have modern communications, the necessary infrastructure for life, autonomous utilities and services.

The analyzed housing development of historical cities of Ukraine has shown that residential buildings of the 20th and 21st centuries dominated by typical projects and buildings with individual planning from the last decades, and examples of buildings of the 19th and 18th centuries are less common.

Analysis of measures by enhancing energy efficiency of existing housing

Depending on the time period, location, technical condition, historical value of the building and the desired work result, it is selected a list of possible ways to improve the energy efficiency of the building – thermo-modernization, thermo-reconstruction, sanation. The thermomodernization of residential buildings without changing the building volume does not require significant material costs and is 25–40% of the restored value of a residential building, with a change in the structure of apartments – 35–50%. The calculations show that when the sanation that the floor addition significantly increases efficiency of the solutions. Thus, in case of mansard floors addition, the cost of work does not exceed 60–65% of the new construction, and the construction of additional floors reduces the cost per unit area by 25–30%. When performing works on the thermoregulation of residential buildings, special attention should be paid to improving operational characteristics and, in the first place, reducing energy consumption by increasing the thermalinsulation parameters of fencing structures, introducing a system for automatic regulation of heat consumption and its accounting, as well as utilization of heat of ventilation emissions. In carrying out the rehabilitation of residential buildings in order to provide regulatory requirements for energy efficiency, it is necessary to take into account the features of city-planning and architectural composition of the surrounding building, characteristic composite features of the prevailing styles, as well as the degree of historical value of the territory. The main feature of the sanation is that the buildings are considered as part of the historically formed environment with its structure, regularities, color, and other characteristics. The sanation covers a wide range of measures to bring the indicators of comfort of a residential building up to standard ones. The rehabilitation can be carried out as well as with a change in the volume of the building (add-on glazing of balconies and loggias, re-equipment of the cold attic), and without changing the volume (insulation of opaque fencing structures, replacement of transparent fencing structures, repair or replacement of communications, water supply systems and drainage, ventilation and air conditioning, the use of energy-generating units for the renewable energy sources). In the historical context, it is necessary to take into account compositional constraints and to be guided by the principle of harmonization of the environment, to conduct sanation in whole using such measures as conservation, restoration, and ongoing repairs. The rehabilitation includes various approaches to improving the overall level of comfort and providing buildings with a standard energy efficiency indicator in particular, and cares about preserving the historical environment.

The study of the technical condition of residential buildings of different time periods of construction has shown that classical buildings are in a satisfactory technical condition. During rehabilitation, a minimum number of energy-saving measures are required. Buildings in the Art Nouveau style also have a satisfactory technical condition, while the sanation needs a minimum amount of energy-saving measures. Neoclassical residential buildings have a satisfactory technical condition, there are slight deviations from the regulatory requirements for heat engineering indicators. Typical building of 1950–1980 are in the worst technical condition among considered housing buildings and require carrying out of urgent complex measures on sanation and increase their energy-saving properties. The most widespread series of mass housing construction in Ukraine are 1–438 and 1–480 series [8], as well as buildings with large-frame frameless, transverse bearing walls of the series 1–464; large-panel buildings with an internal full or incomplete frame of a series 1–335; frameless buildings with walls of artificial materials or large blocks with three longitudinal bearing walls of series 1–434, 1–447 (“three-wall” buildings) [9]. The main disadvantages of these houses are planning solutions with small area of kitchens, combined bathrooms, inadequate area of the anterooms, passage rooms, technical and technological issues of construction, deficiencies in construction, careless maintenance of buildings, unsatisfactory operating

conditions (external enclosing structures, hydro, – thermal insulation, joints of walls with window blocks, glazing of window blocks, constructions of balconies, canopies above entrances, roofs), and as a result, the losses more than 70% of thermal energy in buildings.

Research of the existing housing foundation of the city of Poltava

In the central part of the city of Poltava predominate houses of the nineteenth and first half of the twentieth century, which have a high historical value. Their characteristic features are:

Typical form of multi-apartment buildings are:

- “point” (square in plan);
- the corner.

Typical floors numbers of multi-apartment houses are:

- low-rise (1–2 floors);
- intermediate floors (3–5 floors);
- multistory (7 floors).

Typical orientation of apartment buildings in the center of Poltava are:


- square in the plan buildings are located at an angle of 45° to the axis of South-North; – meridional (with a deviation from the axis of South-North to 30°);
- latitudinal buildings (with a deviation from the axis of South-North to 30°);
- corner buildings with an outer angle to the South, North, East or West.

Typical urban placement of quarters in the center of Poltava are:

- perimeter buildings;
- multi-storey perimeter buildings with central passage;
- one-sided perimeter variety of buildings;
- homestead buildings.

Conducting research in the city of Poltava showed that the following buildings presented in Table 1 are typical for the city Poltava (used materials of the site <http://domofoto.ru/cities/119/>):

Table 1. Typical dwelling houses in the city of Poltava.

№	Types	Example		
		Number of floors	Characteristic	Photo
1	Project until 1920	2–3	Brick facade plastic, wooden floor covering	

2	Project 1920–1941	2–5	Brick walls, details of the facade, decoration, rust on the ground floor facades	
3	Project 1941–1957	4–5	Decoration of facades, sloping roofs	
4	Typical projects and projects reused for a series of brick houses	4–14	Brick houses by typical projects	
5	Block houses	5		
6	1–439A-40	5	Optimization of compositional solutions, subordination for the rationality and utilitarianism: flat roofs, lack of facade decoration, transit rooms. small living space, low room height (2.5 m), small kitchen, combined bathrooms.	
7	124–87–107 Panel house of mass series	10		

8	87 – a brick house	5–14	<p>Modern buildings according by typical projects, It is prevailing modern houses from 4 to 25 floors; height of a floor is 3–3,3 m, and the area of apartments are from 18 m² to 100 m² and more. There are modern communications, infrastructure, autonomous utilities.</p>	
9	1–447C–48	9		
10	1–438–20	5		

On the periphery of the city dominating buildings which are built on typical projects. These are block, panel, brick houses from 5 to 14 floors. A wide range of sanation means can be applied to massive building houses. Houses built before 1957 need an individual approach with the choice of necessary sanation means that do not destroy the existing urban planning, architectural, planning, compositional and stylistic structure. Architectural techniques include expansion of the building towards the yard, floor addition of the attic floor, change of the planning solution of the house – placing stairs inside the house (with the upper natural light), temperature zoning of apartments (with a thermal core and a buffer zones), insulation of enclosing structures, replacement of engineering communications. Modern residential buildings located both in the central part and in the peripheral districts of the city of Poltava have a satisfactory technical condition, may have slight deviations from the regulatory requirements for heat engineering indicators due to the recent updating of the regulatory framework for energy conservation requirements [3].

Conclusions

Sanation for the providing a normative indicator of energy efficiency in existing buildings presents a wide range of possibilities. In the absence of a historical environment limitation the shape of the building, its planning structure, materials, engineering and technical equipment may vary. During the housing sanation in the historical environment next requirements are taken into account: stylistic, compositional, rhythm-metric features of the facades of existing buildings; the silhouette of the building; the presence of architectural monuments and their influence on the surrounding buildings; the scale, dimensions, configuration; the surface of the existing buildings; the size of the house space; ventilation and shadowing of the territory of the yard and on the basis of the research the sanitation measures are selected. The renovation requires about 30% of the cost compared with the new construction, so it is economically more profitable than building a new home. At

the same time, the cost of saving energy for heating during the renovation of the housing stock is up to 85%. A wide range of sanation methods allows it to be used in the conditions of an existing housing stock and is relevant, promising and cost-effective. Sanation provides broad opportunities for realization in the conditions of existing development, providing energy resources saving and increasing the comfort of living in residential buildings, including taking into account the researches carried out on the historical environment for each particular city with its architectural, planning, spatial and stylistic-compositional features.

References

- [1] Agata Warchalska-Troll. Progress in the rehabilitation of large residential estates in Katowice (Poland). – Hungarian Geographical Bulletin 62 (1) (2013) 102–112.
- [2] Michal Dmitruk. Problemy budownictwa wielkopłytowego z lat siedemdziesiątych XX wieku i sposoby ich rozwiązania na przykładzie z polski i innych krajow europejskich. – TEKA Architectural Comission, Urban Studies and Visual Studies. Tom XI / 1–4. Lublin 2015. p.16–24.
- [3] Avdiyenko O.P. Reconstruction of housing at the present stage / O.P. Avdiyenko // Reconstruction of housing. – 2007. – Issue 8. – P.13–18.
- [4] Electronic resource. Access mode <https://www.gov.ua/>
- [5] Electronic resource. Access mode <http://www.iqenergy.org.ua/ru>
- [6] Electronic resource. S.O.Khan-Magomedov, Khrushchevki – good or evil ... <http://dwg.ru/pub/26>
- [7] Malyarenko V.A., Orlova N.A. The state and ways of renovation of the housing stock of past years. Energy saving • Energy • Energy audit №9 (91) 2011. – Kharkov.
- [8] Onishchuk G.I. Technical aspects of the reconstruction of residential buildings in Ukraine / G.I.Onishchuk // Reconstruction of housing. – 2012, vol. 13.
- [9] Pylypenko V. Features of reconstruction of residential areas of industrial development of the last century. September 16, 2005 [Electronic resource]. Access mode: <http://ais.by/story/560>
- [10] Recommendations for the selection of progressive architectural and technical solutions for the reconstruction of residential buildings of different design systems. – Kiev Nora Print, 2001.- 262p.

Hypothetic Reconstruction of The Development of The Defensive Structures of The Middle Town of Rohatyn in 15th–17th Centuries

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Abstract: On the Rohatyn example we want to demonstrate:

- a) how the battles, assault and destruction of the town influenced the character of its urban and architectural development (as shown by the example of the Battle of 1509 and the events of World War I);
- b) how important the fortification element was in the past in towns of Halychyna region;
- c) what methodology can be used to reconstruct the stages of development of urban fortifications, given that today they are almost completely lost;
- d) the importance of a thorough analysis of the current state of the territory and the town's relief, the study of historical documents, analysis of cartographic materials and iconographic sources for the theoretical reconstruction of stages of development of fortifications.

The town of Rohatyn belongs to the oldest urban locations that existed according to the German (Magdeburg) law in the territory of Western Ukraine. The great chronological depth of the town's urban structure has been often mentioned by researchers. However, academic literature does not yet fully cover the changes made to the planning of the town's structure during the 15th–17th centuries. Similarly, the stages of development of the town's defensive lines were not identified, although historical documents contain many references to the existence of fortifications around the middle town and the castle. Existing documentation only describes the urban changes in general terms, with researchers not yet having organized them into specific planning schemes. In our present work, we set our goal as the reconstruction of the different stages of development of fortifications of the original walled medieval town of Rohatyn. We use the following methodology: analysis of the town's planning structure based on both historical and contemporary maps; studies of the remains of fortifications in the current landscape; comparison of field studies with data from cartographic analysis to references to the defensive objects found in historical documents; studies of analogical landmarks; and graphical reconstruction of stages of development of fortifications. According to our research, the fortification history of the town can be divided into four main stages.

1st stage – between 1415 AD (date of the town's founding) and 1509 AD (complete demolition of the town as a result of the attack of the Wallachian-Turkish army).

2nd stage – from 1509 AD to approximately 1539 AD. The town within the walls of the surrounding fortification is restored on the basis of new royal privileges given in 1523, 1535 and 1539. The town is able to develop, with new fortifications being built around the residential and commercial districts of the town and the castle.

3rd stage – from 1539 AD to the end of the 16th century. A new district called the "New Town" was created to the west of the old walled town, with a new belt of earth bastion fortifications. At the end of this period, the bank form of the defenses was modernized into the bastion forms.

4th stage – the 17th century. The town's fortifications continue to be maintained in good condition and upgraded. The territorial expansion of the town to the south led to the emergence of new residential neighborhoods and the creation of additional bastion fortifications to the east and south of the borders of the New Town.

Our research has shown that Rohatyn is a unique town in aspects of the development of fortification systems in the 15th and 17th centuries in Ukraine.

Keywords: town of Rohatyn, fortification, earthen ramparts, basteja (bastia), bastion, 15–17th centuries.

Introduction. Research relevance

Rohatyn is a town in western Ukraine that was twice destroyed almost completely. The first time it happened in 1509, during the incursion of the Wallachian-Turkish army. The second time the town was destroyed in the First World War. After the first destruction, the town was revived, paying much attention to the construction of fortifications.

In our present work, we try to reconstruct the stages of development of the town's fortifications by means of the identification of the planning structure occurring at different times based on our experience in this field (M.Bevez, 1996, 1997, 1998, 2000, 2002, 2004). We consider this problem to be relevant because in the works of predecessors [J.S. Zubrzycki, 1911; F.D. Wąsowicz, 1879; Matsyuk O., 1997; Melnyk V., 1991; Pankiv B., 1995; Yasynskyi M., 2004] due attention was not paid to the presence in the town's planning structure of remnants of fortifications lines – including bastion fortifications – that belong to different stages (fig. 1).

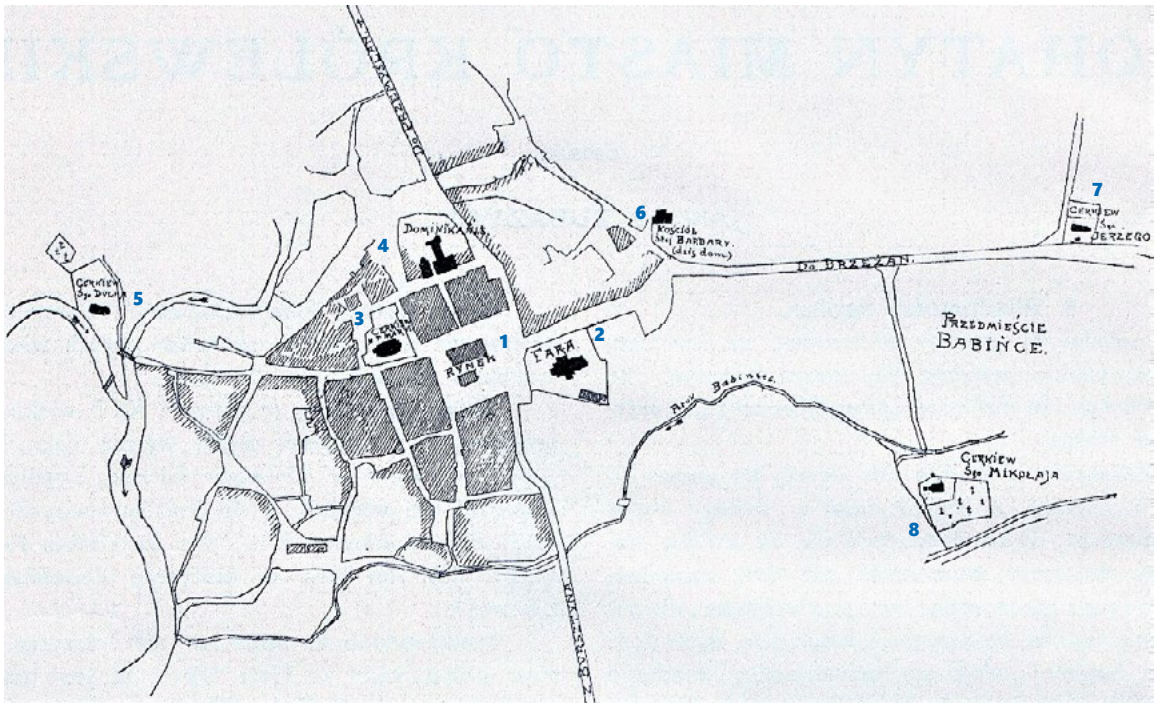


Fig. 1. The plan of the town of Rohatyn at the beginning of the twentieth century by Jan Sas Zubrzycki [J.S. Zubrzycki, 1914, s. 5]. Marked: 1 – Rynek Square, 2 – St. Nicholas Church, 3 – Tserkva of the Nativity of the Virgin Mary, 4 – Dominican Church and Monastery, 5 – wooden Tserkva of the Holy Spirit, 6 – St. Barbara Church, 7 – St. Yurii Tserkva, 8 – wooden Tserkva of St. Mykola.

In 1992–1993, a plan based on historical and architectural studies of Rohatyn was developed. The authors determined the zone of defensive rampart location around the medieval fortified town and made the hypothesis that medieval Rohatyn had two gates – Lviv and Halych Gates – which were located in the western and eastern curtain walls of the fortifications [R. Mohytych, 1995; 1996]. Subsequently, in 2007, a new historical and architectural plan of Rohatyn was developed. Unfortunately, this research and project documentation also did not detail the identification of defensive lines and planning changes in the town plan during the 15th–17th centuries (Fig. 2).

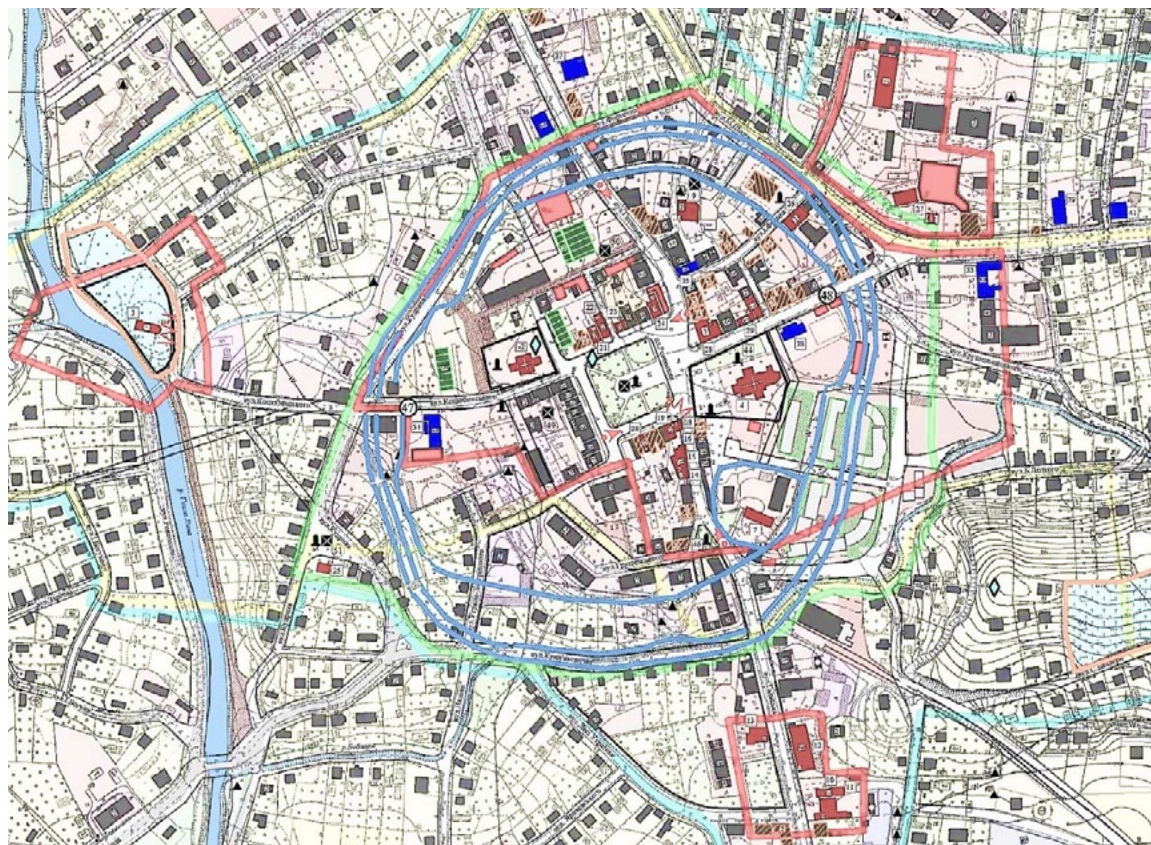


Fig. 2. Plan based on historical and architectural studies of the town of Rohatyn (fragment). UDNPI "Dipromisto", 2007, authors Shumin I., Shubelyak N., Senchak Z. Three concentric circles indicate the probable lines of fortifications around the city center, as well as the location of the castle.

In the writings of historians who described the architectural and urban development of Rohatyn, the stages of urban changes were presented only in general context without reconstructing them into specific planning schemes [J.S. Zubrzycki, 1914; F.D. Wąsowicz, 1869; A. Czołowski, 1930; Melnyk V., 1991]. For example, the architect J.S. Zubrzycki mentioned the existence of fortifications around the middle town, fixed individual residues of the ramparts on the site, but did not reinforce this information by planning schemes (Fig. 1) [J.S. Zubrzycki, 1914]. Reconstructions of the planning structure and developmental stages of the middle town fortifications were performed by several more authors. In 1996, a version of the town's planning in the late 16th – early 17th century was published by R. Mohytych (Fig. 3). According to the hypothesis of the author, the middle town was surrounded by a defensive rampart in a circle with two gates – in the western and eastern parts – and with a wicket in the southwestern part. The defensive towers on the rampart were not marked by the author. According to his layout, the castle was located in the middle of the town, but it had its own rampart line closed in a small circle with a gate from the church side. There was only one palace building in the castle. The author mistakenly indicated the location of the New Town district to the north of the middle town. In fact, there were ponds and mills, and the new district was located to the west and to the south of the Lviv gate.

Very "bold" is the reconstruction of the middle town planning by M. Yasynskiy (Fig. 4), made under supervision of associate professor O. Rybchynskiy [M. Yasynskiy, 2013]. However, the form of masonry towers and walls for the period of 16th–17th centuries which were proposed by the authors is not consistent with historical documents which mention wooden fortifications of the town during this period.

Our analysis of the modern plan of the town's central part showed the presence of planning elements (quarters and street network) of triangular shape (Fig. 10, 7). The middle town is distinguished by a well-planned regular rectangular grid of streets. We believe that these irregular quarter and street planning forms should be linked with a sketch of previous fortifications.

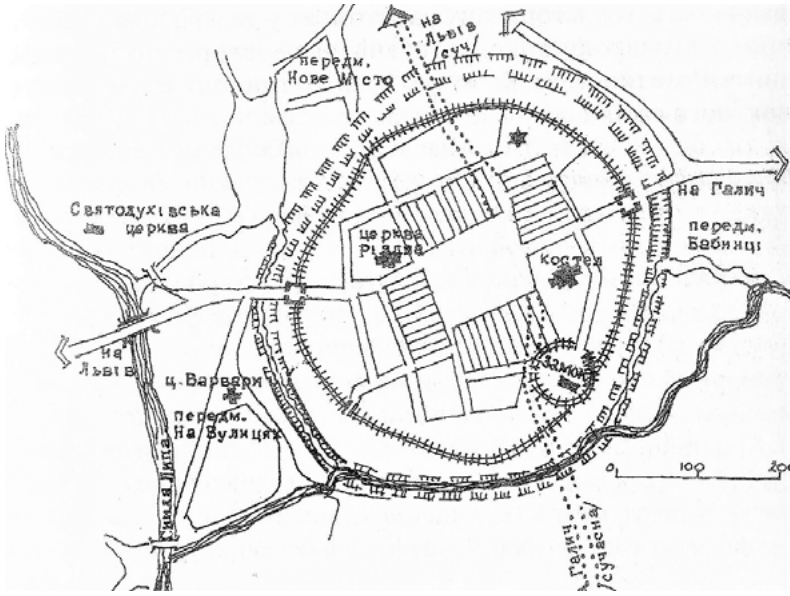


Fig. 3. Hypothetical reconstruction of planning structure of Rohatyn (XVI – early XVII century) by R.Mohytych [Mohytych R., 1996].

Presentation of the main material. An outline of the historical stages of the development of the middle town of Rohatyn

Many historians mentioned the great chronological depth of the town structure, attributing Rohatyn to the oldest cities in Halychyna [J.S. Zubrzycki, 1914]. The town received a locational privilege from Vladislaus II of Opole in 1415 [Tsariova N., 1995]. It was a privilege for a private location. The founding of the town is associated with the noble Volchko Presluzhych. At that time, such founding was realized through the expansion of a fortified middle town with ramparts or masonry walls with a square or rectangular market square in the middle. In the case of Rohatyn, this square has survived to this day. Instead, the lines of fortifications are completely lost and their location is rather problematic, since archaeological research of their remains has not yet been carried out. The remnants of ramparts, in particular, are recorded in the historical and architectural key plan of the town, but without clear stylistic or temporal identification of these remnants (Fig. 2).

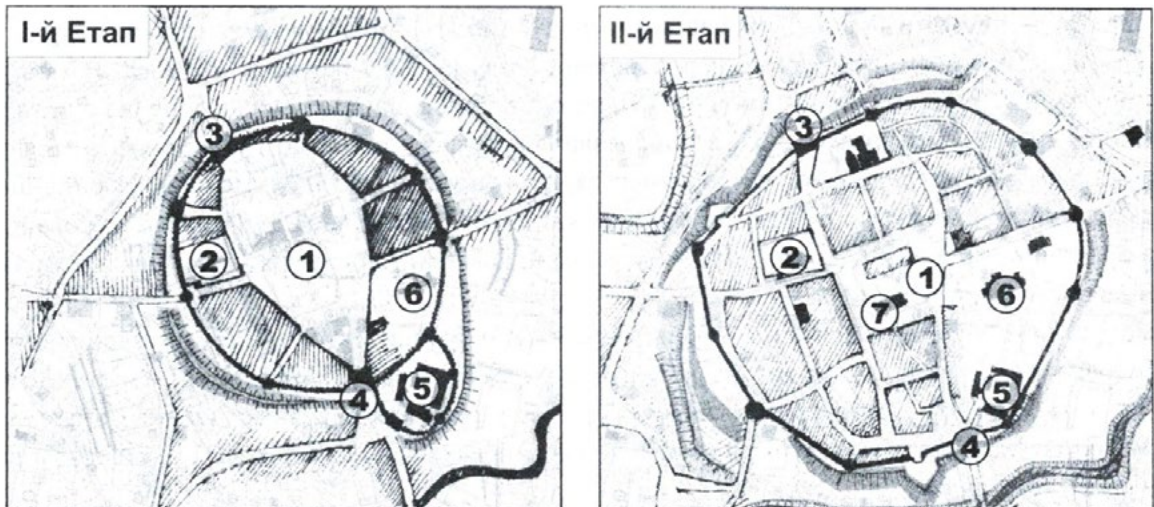


Fig. 4. Hypothetical reconstruction of two stages of development of planning structure of town of Rohatyn (at the end of XIV and at the beginning of XVII centuries) by M. Yasynskiy under the direction of O. Rybchynskiy [M. Yasynskiy, 2013].

According to the results of the analysis of historical works, the development of defensive structures of Rohatyn can loosely be divided into four main stages. For each stage, we implemented a hypothetical scheme of the planning structure of defensive lines.

First stage 1415–1509. From the very beginning, the middle town had a rectangular market square and a rectangular outline of the quarters around it. This rectangular planning scheme of quarters and streets surrounding the market square has survived to this day. The fortification girdle around the middle town repeated this rectangular planning scheme of quarters, encircling the middle area with a rampart along the perimeter. The argument proving our hypothesis is that already in the location privilege of the town the moats around the middle town were mentioned, from which “town’s grounds were to be measured” [Tsariova N., 1995].

Construction of the defensive rampart at the beginning of the 15th century should have been – in our opinion – of a *basteja* type (in German – *Bastei*, in Italian – *Bastia*, in Polish and Ukrainian – *Basteja*: a squat fortification, designed for the use of firearms, whose shape and placement were associated with the development of siege artillery. A small form of semicircular and multifaceted shape was erected forward of the curtain of the defensive wall to defend it against a flank fire. The first *bastejas* appeared at the end of the 14th century with the commencement of the use of firearms. The using of *bastejas* is well described by Albrecht Durer [<https://de.wikipedia.org/wiki/Bastei>]).

Due to the small size of the middle town, *bastejas* could only have been arranged in the corners of the defense perimeter. The shape of the *bastejas* was either rectangular or semi-circular (polygonal) in the plan. The fortification consisted of a low rampart, on the top of which there was a wall built of wooden logs a little higher than the height of a person. At certain intervals in the wall openings for the fire of small arms were cut. Externally, the rampart was surrounded by a moat. This form was typical of the wooden and ground fortifications in the 15th century. Such fortifications were called the battle fence [J. Naronowicz-Naroński, 1659] (fig. 5-a). The wooden fence as the fortification of Rohatyn was mentioned somewhat later, in 1509, in documents related to the storming of the town by the Wallachian-Turkish troops [A. Czołowski, 1930]. Since we do not have any historical mentioning of masonry walls at this time, it is logical to assume the existence of such wooden and ground fortifications.

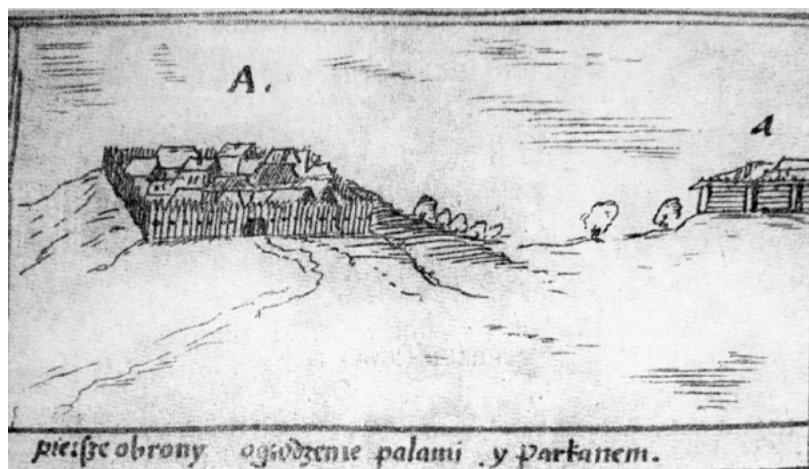


Fig. 5. Two old types of defensive walls of the city, which were built using wooden logs and piles: **A** – fortifications from sharpened, vertically dug piles; it was built on the top of an earthen rampart (so-called “Tyn”); **a** – fortifications from horizontal logs and piles (so-called “Fence”); as a rule had loopholes and roof; was built on the top of the earthen rampart (from the treatise by J. Naronowicz-Naroński, 1659 [J. Naronowicz-Naroński, 2016, s. 12]).

The use of this type of fortifications is confirmed also by the layout of the middle town (see schemes in Fig. 3, 4). Separate elements of such fortifications could be masonry – for example, gates, towers or *bastejas*. However, we think that there were no towers erected in Rohatyn, since it was irrational to build them from wood at that time as the enemy artillery could easily destroy them. As for the architecture of the gates, despite the fact that there are no direct references to the material from which they were erected, one can assume that they were made from stones and bricks. The masonry type of gates would also be more suitable for building a draw bridge. We know from the analysis by the historian A. Czołowski that during the siege of the town in 1509 it did not have sufficient means for defense. He mentioned only the wooden battle fence on the ramparts and the gates with draw bridges [Czołowski A., 1930]. In fig. 6, we present our hypothetical version of

the planning structure of the middle town and its defensive girdle at the time after the town was founded in 1415. The main argument in favor of our scheme is the presence of an original rectangular planning structure in the middle of the town.

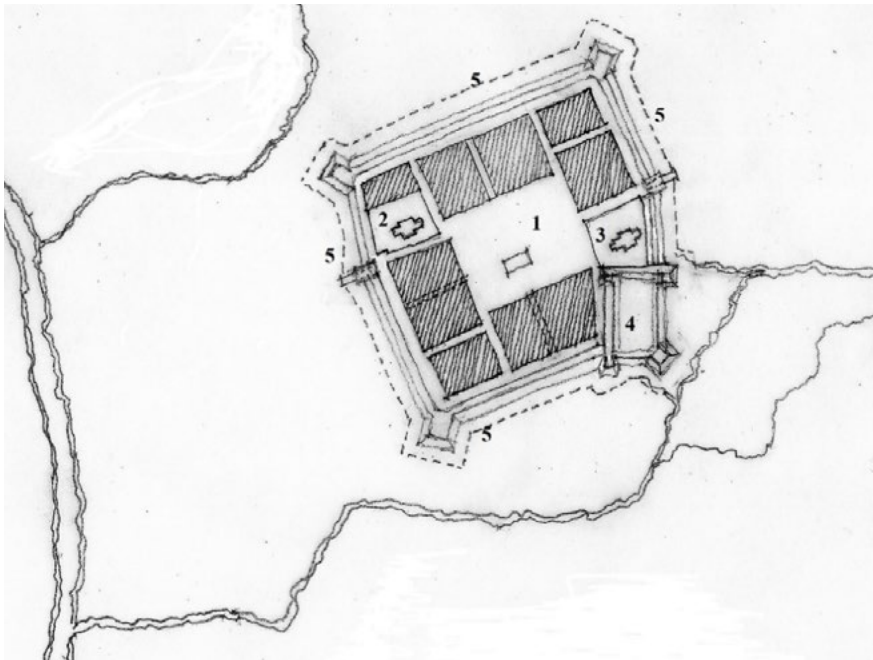


Fig. 6. Hypothetical scheme of the planning structure of the Middle town and its defensive zone at the period 1415 and to 1509 (by M. Bevz). Marked: 1 – market square, 2 – Tserkva of the Nativity of the Virgin Mary, 3 – wooden church of St. Mykola, 4 – castle, 5 – defensive shaft with wooden palisade (tyn) with corner towers and two gates. Author: M. Bevz, 2017.

The second period 1509–1550s. The key events for Rohatyn of 1509 will be presented on the basis of thorough research by Alexander Czołowski (“Rohatyn’s Catastrophe in 1509 Historical Sketch” [Czołowski A., 1930, 15 s.]). The historian briefly described the events of the Wallachian-Turkish-Polish War of 1509, but the events related to the town of Rohatyn he considered in sufficient detail.

The basis of the war was clearly the territorial claims of Turkey, which provoked the conflict through their vassals. Events unfolded as follows. The Voivode of Moldavia, Bogdan, having collected a military force from the Wallachians, Tatars and Turks, decided to raid Pokuttya. The king of Poland, Zygmunt I, issued an order to raise militia on August 1 in Horodok near Lviv, but this reaction was too late. The main goal of Bogdan was to capture the castle of Halych and to secure Pokuttya and a part of Podillia. With considerable strength, he conceived the attack not as a small strike, but as a broad military campaign. In mid-June, his troops crossed the Dnister River near Khotyn and on June 17 they reached Kamyanets-Podilsky. However, without being able to lay a long siege to the impregnable and well-fortified castle and town, he withdrew the unsuccessful siege and went deep into Rus. Over the course of several days, the troops besieged the cities of Pokuttya – Sniatyn, Kolomyia, Tlumach, Cheshybis (Yezupil) – and subsequently also the Castle of Halych [Czołowski A., 1930].

The castle of Halych, the defense of which was led by starosta Otto Chodecki, managed to prepare for the siege. In addition, its high location did not allow the Wallachian troops to effectively bombard its towers and walls with artillery. Moreover, an active way of defense and counterattack against the attackers allowed the starosta to even capture a part of the artillery, which was unwisely brought closer for the bombardment of the castle. Forced to leave the siege, Bogdan, ruining everything on his way, went through Khodoriv to Lviv and on July 1 stood under the walls of the town. Having burned the Gothic Catholic Church of St. Stanislaw in the Krakowian Suburb, he began the bombardment of the Low Castle and the middle town from the territory near it [Czołowski A., 1930]. But his efforts were useless here as well. The town defended itself successfully and also counterattacked, as a result of which Bogdan’s troops suffered considerable losses. Inability to capture the town and knowing about the approach of the militia from Horodok, the Voivode retreated, burning to the ground the Halychian and the Krakowian suburbs. He marched his forces along the road to the south-east to the crossing across the Dnister River near Cheshybis.

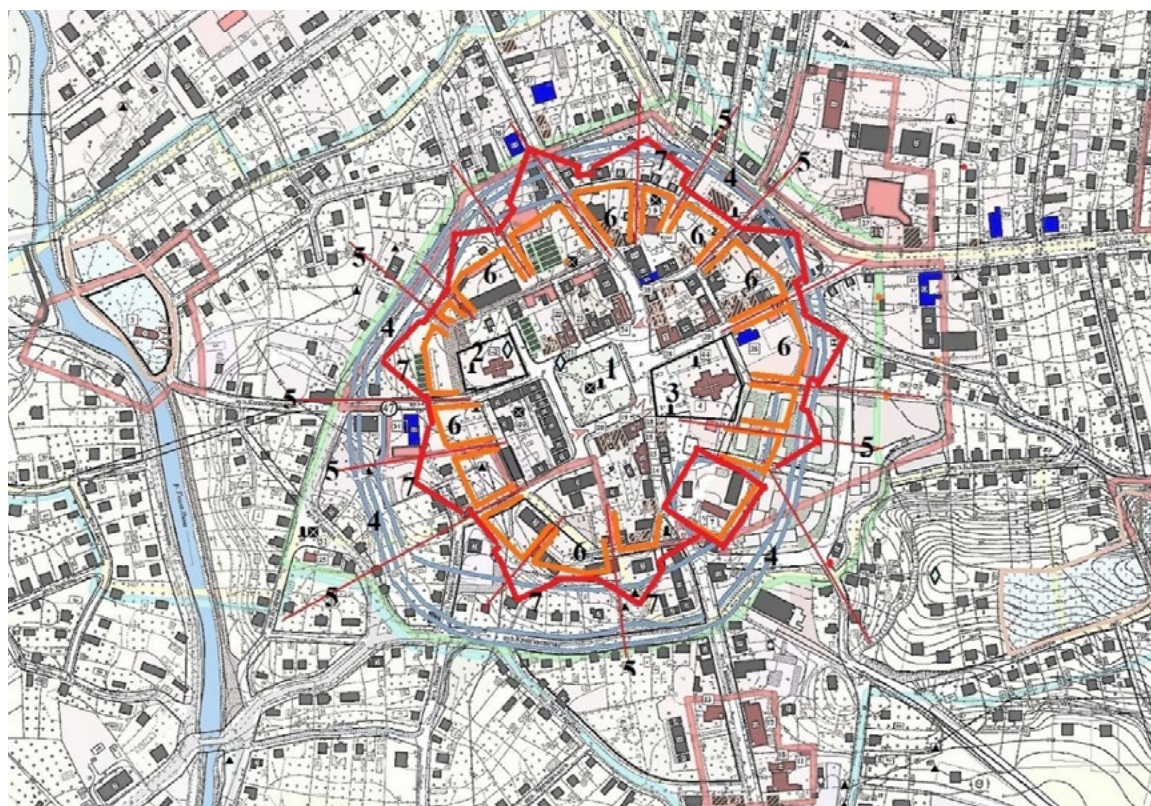


Fig. 7. Scheme of elements of planning structure of center of Rohatyn, indicating a change in the concept of its development at the beginning of the 16th century (reconstruction of the destroyed town after the devastating attack of 1509). There are streets of a radial nature in relation to the Rynok Square (pos.5), the configuration of the quarters varies from rectangular to irregular forms (item 6), a hypothetical line of “defensive fence” on new shafts (item 7). It is also marked: 1 – Rynok Square, 2 – Tserkva of the Nativity of the Virgin Mary, 3 – St. Nicholas Church, 4 – lines of defensive fortifications according to the plan of UDNPI “Dipromisto”, 5 – radial character of the axes of new streets. Author: M. Bevz, 2017.

Rohatyn stood on the enemy’s road. At that time it was one of the richest towns in Rus’. Historian A. Czołowski pointed out that the town was very successful in trade and crafts [Czołowski A., 1930, p. 3]. The town, which was founded in 1415, was planned according to the requirements of the Magdeburg Law, and was fortified with ramparts and a moat around the middle town. At the end of the 15th – in the beginning of the 17th century, the town was owned by the wealthy Chodecki family. The middle town of Rohatyn “was well built, surrounded by a rampart with a fence through which the defensive gates led” [Czołowski A., 1930, p. 5].

Here it is necessary to make a refinement to the version of A. Czołowski – the so-called battle fence in the 15th–16th centuries was built from rough wooden logs with slits for firearms. The method of building fortifications from the lines of a wooden fence at the top of the rampart was called “tyn”. The name of the town indicates that perhaps the most oldest way of strengthening the town was the rampart-tyn (Roha-tyn) technique. It presupposed the construction of deep-drawn vertical pillars.

New tipe “parkan” presupposed the construction of deep-drawn vertical pillars at intervals of several meters only, between which the logs were laid horizontally. In the logs, at the height of a person, cut-outs were made. From the outside, the rampart with a fence has a moat with a breastwork (made of clay and soil, sometimes of wooden logs). For artillery, somewhat elevated positions in the form of triangular or polygonal bastejas were made at some intervals in the line of fence fortifications. Their construction was carried out in the same way. Inside of such ramparts behind the fence was located the middle town of Rohatyn, and the defensive castle of the owners that was connected with it. Inside, behind the town fortifications were also two masonry shrines. The oldest was the town Tserkva of the Nativity of the Virgin Mary, built by the Presluzhych in the Byzantine-Gothic style and the catholic church of St. Nicholas (the original was erected in 1440 by Mikołaj Parawa from Chodcz [Czołowski A., 1930, p. 6]). The church bell tower had the largest bell in Rus’.

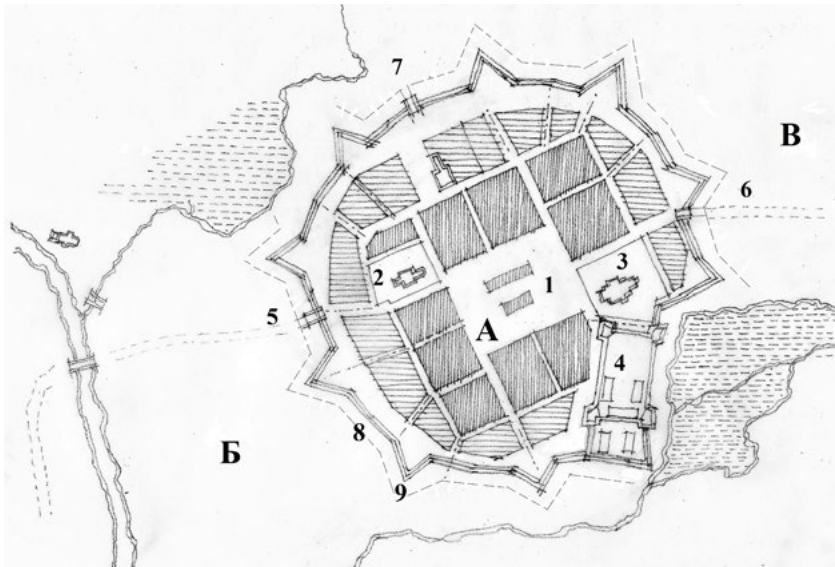


Fig. 8. Hypothetical reconstruction of the scheme of fortifications of Rohatyn at the middle of the 16th century. Marked: A – the middle town; Б – Halytske suburb; B – Babint-sy suburb; 1 – Rynok Square, 2 – Tserkva of the Nativity of the Virgin Mary, 3 – St. Nicholas Church, 4 – Castle, 5 – Halych Gate, 6 – Berezhany Gate, 7 – Lviv Gate, 8 – Curtain Wall of the Defensive Wooden Fence, 9 – Triangular wooden bastejas (bastei) of a defensive fence; Vertical strokes mark the original quarters of the 15th century; Quarters of the 16th century are marked with horizontal strokes. Author: M. Bevz, 2017.

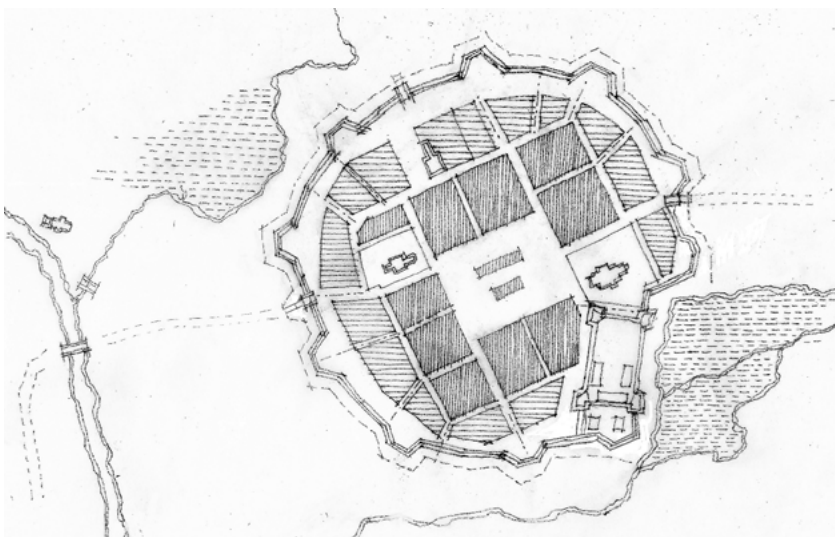


Fig. 8a. Hypothetical reconstruction of the scheme of fortifications of Rohatyn at the middle of the 16th century. Second version based on polygonal bastejas.

On July 6, 1509, the Moldovan Voivode began the siege of the town. Though the town had the fortifications described above, they did not give hopes for a long-term defense. The enemy had artillery for the siege, and the town did not have enough defenders. Two owners of the town – Rafal and Piotr Chodecki – were in the castle and nevertheless organized the defense. The inhabitants endured the first hostile assaults. But the artillery bombardments and the prevailing enemy forces put the defenders into an uneasy situation. After a few days of defense, the owners, understanding the hopelessness of the situation, decided to surrender and opened the gates of the town. As a result, the attackers mercilessly robbed the town, and Bogdan appropriated the treasures of the two churches, jewels and liturgical utensils, including the bells. The town was completely burned down, and all the inhabitants were captured. Shrines were also burned. In one day, Rohatyn was turned into a deserted, scorched ruin. It is this attack with which the legendary story of Roxelana (Anastasia Lisowska, daughter of a local priest, later known as the wife of Suleiman the Magnificent, the Sultan of the Ottoman Empire [<https://uk.wikipedia.org/wiki/Rogatyn>]) is associated.

Only a month and a half later, in September, militia was gathered near Hlyniany (in Vyzhniany) for a campaign and revenge for the Wallachian-Turkish attack. This trip to Wallachia ended with a complete victory and captivity of more than thirty Wallachian nobles. In November, the war was completed by the signing of a peace treaty, which envisaged the return of all the looted property to Rohatyn, release of captives and granted them

the right to return to the town. Only the eldest of the Chodecki brothers, Rafal, returned to Rohatyn, whereas Piotr died in captivity [Czołowski A., 1930, p. 6].

Upon his return, Rafal started the restoration of the town. This reconstruction probably lasted more than a decade. The relative of the owners – Halychian starosta Otto from Chodecz (Chodecki) – actively participated in it. His military experience was probably used to rebuild the old and to build new fortifications. In 1523, the owner of the town gave permission to hold a weekly meat trade in Rohatyn each Saturday from Easter to Baptism of St. John (June 24) [Balinski M., 1844, p. 702–703]. This privilege allowed to increase the town's profits and to use the funds to improve its defense capability.

In 1533, Otto Chodecki made the town over to the King [Besidecki F., 1936, p. 2]. In 1534, the town formally became the king's property. According to the decision of Zygmunt I, in 1535, Rohatyn received a new confirmatory locational privilege, the right to a weekly public market and a coat of arms (a reindeer horn and letter "B") [J.S. Zubrzycki, 1914]. At that time, it was starosta Ivan Boratynsky who administered the affairs of the town. This event served as the basis for the rapid development of the town, which soon began to compete with Lviv [https://uk.wikipedia.org/wiki/Рогатин].

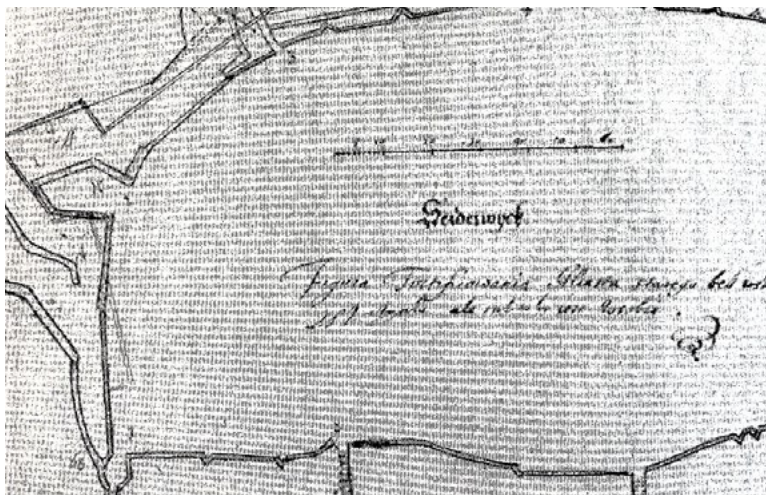


Fig. 9. Example of modernization projects for the fortifications of the old town of Herderwyck in the Netherlands, early 17th century. The old line of fortifications, consisting of a triangular bastion, is replaced by a bastion line. On separate sites, the old belt of fortifications had two parallel lines of bastions with triangular base. The distance between the bastions was between 10 and 20 Dutch rods, which equals to 46.23–92.46 m. There are 6 variants of a more perfect configuration of a new bastion line, which is planned not on the site of the old fortifications, but creating a new line from the outside (an illustration from the book of J. Naronowicz-Naronski, 1659 [J. Naronowicz-Naronski, 2016; p. 124]).

As part of the privilege of 1535, king Zygmunt I exempted the town from a part of their tax obligation forever; allowed people to cut trees in the forests, so that they could be used for the needs of the town; and imposed a one-year tax on the production of alcohol, as well as a one-year tax on immovable property, proceeds from which were used for the construction of fortifications. The privilege included the following words: "... considering the fact that the town is exposed to frequent hostile attacks and was destroyed several times, we impose a one-year tax on the production of alcohol, as well as a one-year tax on immovable property, called 'szos', proceeds from which will be used (for the construction) of fortifications" [Balinski M., 1844, p. 703].

This served as an impetus for the construction of new fortifications. A defensive line consisting of a rampart and a fence on it, which encircled the middle town, was restored. The rampart had a moat from the outside, and there were bastions located a small distance from each other; the rampart encircled the middle town along a closed perimeter (Fig. 8, 9, 10). This new defensive girdle differed significantly from the previous one in terms of configuration. The middle town became bigger and received a so-called star-shaped fortification girdle with a rampart and a fence with bastions (Fig. 11).

Fortifications of the neighboring town of Berezhan, where Old and New Town were surrounded by a rampart with a wooden fence and triangular and five-pointed bastions, were made in a similar way [Kuśnierz K., 1984, p. 54]. In Berezhan this girdle of fortifications was built in the 1580s. At that time, defensive lines consisting of a rampart, a fence, and bastions were built in other towns of Western Ukraine as well, for example, in Uhniv, Belz, Olesko, Olyka, etc. Fortifications in Lviv were also built in this way, forming the third defensive girdle around the middle town with bastions and beluards. Here, however, an earth rampart and bastions were surrounded by a masonry wall.



Fig. 10. Handwritten Plan of Rohatyn; 1846 (Central State Historical Archive of Ukraine in the city of Lviv). The consolidated version of the plan [<http://rohatorynjewishheritage.org/en/maps/1846-cadastral>].

It took several years to increase defense capability of Rohatyn. A new privilege granted by King Zygmunt I in 1539, proclaimed "in order for the town to grow, and so that it can be surrounded by walls, we allow people to build a town hall and a building for cutting broadcloth on the market, the proceeds from which, as well as the proceeds from vodka, shall be used for *maintaining town fortifications in proper condition*" [Balinski M., 1844]. The privilege explicitly declared the need to build more powerful masonry fortifications: "in order for the town to grow, and so that it can be surrounded by *walls*..." [Balinski M., 1844].

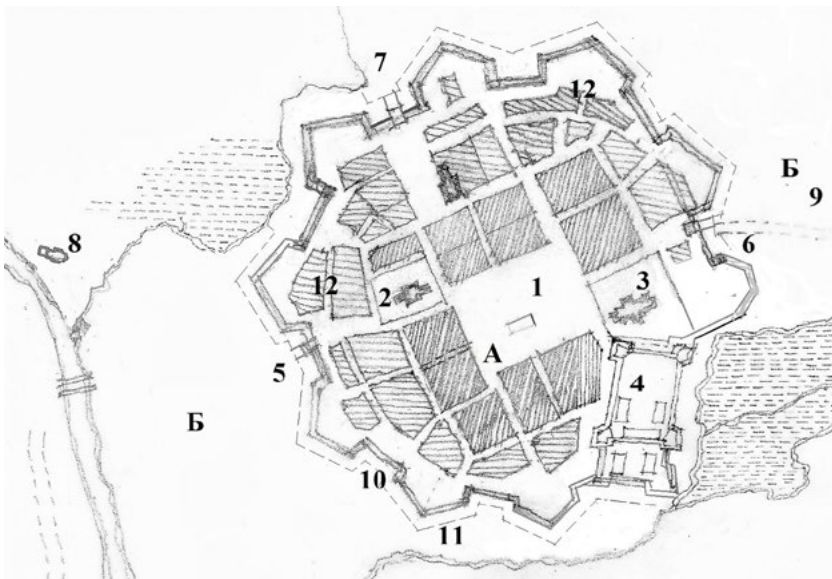


Fig. 11. Hypothetical reconstruction of the scheme of fortifications of Rohatyn at the end of the 16th – early 17th century. A – the middle town; Б – suburbs; 1 – Rynok (Market) Square, 2 – Tserkva of the Nativity of the Virgin Mary, 3 – St. Nicholas Church, 4 – castle, 5 – Halych gate, 6 – Berezhany Gate, 7 – Lviv Gate, 8 – Tserkva of the Holy Spirit in the western suburbs, 9 – St. Barbara church in the eastern suburb. 10–11 – bastion fortifications; 12 – area of buildings "On the shafts", a new district of the middle town created with the construction of the new plan of fortifications. Author: M. Bevz, 2017.

works were performed at the gates and bastejas which had to be adapted to the new artillery weapons. For some time, curtain walls could still be in the form of an old wooden fence.

In Rohatyn we still have an example of such a low defensive wall with loopholes in the form of a keyhole, which surrounds the territory of the Tserkva of the Nativity of the Virgin Mary. It is quite possible that this wall is not authentic and was erected in the 18th century using the material obtained when dismantling fortifications. But in any case, stone blocks with loopholes in the form of a keyhole are elements of masonry defensive walls and direct evidence of the fact that such fortifications existed in Rohatyn.



Fig. 13. The plan of the town of Rohatyn on the Austrian map of the 2nd Military Description of Galicia (Halychyna) since 1861 ([http://mapire.eu/en/map/second_survey/1861]); using lines we marked the remains of shafts on the plan. We marked also: 1 – the church of St. Nicholas, 2 – trapezoidal bastion near the church, 3 – the upper court of the castle is surrounded by a shaft with bastejas, 4 – the lower courtyard of the castle had bastions, 5 – the remains of the shafts of the western bastion line. To the south-west of the middle town is a large rectangular new market square, located in the “New Town” district.

We believe that the preserved defensive wall near the church must be studied in more detail, and its elements should be an example for reconstructing lines of fortifications in the middle town at the end of the 16th century. J.S. Zubrzycki pointed out that Lviv and Halych gates lasted until the end of the 17th century. He also stated that there were several suburbs in Rohatyn in the 16th century – Babyntsi, Zavoda, Na Vulytysakh, New Town – without going into detail about their location and role in the system of town fortifications.

According to the register dated 1572, 115 bourgeois (courtyards) and 18 storekeepers resided in the Old Town surrounded by a defensive fence [Slownik, 1888, p. 693]. The record from the register about the fact that there were 36 more houses in the “On the Rampart” district is very important. In our opinion, this fact shows that lines of fortifications in the middle town were expanded, forming a completely new line. “On the Rampart” district emerged in place of the “old rampart”. In our opinion, five-pointed bastions were erected for the new line. Fortifications were modernized gradually, and in 1572, there were probably still old fortifications consisting of a rampart and a fence in a considerable part of the middle town.

In the town, in addition to the parochial St. Nicholas Church, there was also catholic St. Barbara Church, two masonry churches and two wooden churches, the Dominican monastery, a monastery of sisters from the Order of Saint Basil the Great (it was later transferred to Slovita in 1769) [Besjadecki F., 1936, p. 3]. There were 8 guilds in the town. Somewhere at the end of the 16th century, migration of Jews from Silesia, Poland, and Hungary to Halychyna began, and a Jewish community was formed in Rohatyn [<https://uk.wikipedia.org/wiki/Рогатин>].

In addition to the record about the “On the Rampart” district, records about the Old and New Towns are also very important when speaking about the register dated 1572. The record indicates that the town was already expanded as at 1572. Along with the old fortified urban complex, a new one (the new town) emerged, which logically also had defensive structures. According to the data contained in the register, there were 100 courtyards and 11 storekeepers in the New Town [Slownik..., 1888]. This means that this district was not smaller than the middle town, where 115 courtyards were recorded.



Fig. 14. Photo of the defensive wall around the Tserkva of the Nativity of the Virgin Mary in Rohatyn with a loopholes for muskets, which are arranged with an interval of 6–7 m.



Fig. 15. Photo of a fragment of the defensive wall of the Tserkva of the Nativity of the Virgin Mary in Rohatyn with a key loophole for muskets. Bricks in the wall have dimensions characteristic for the beginning of the 17th century.

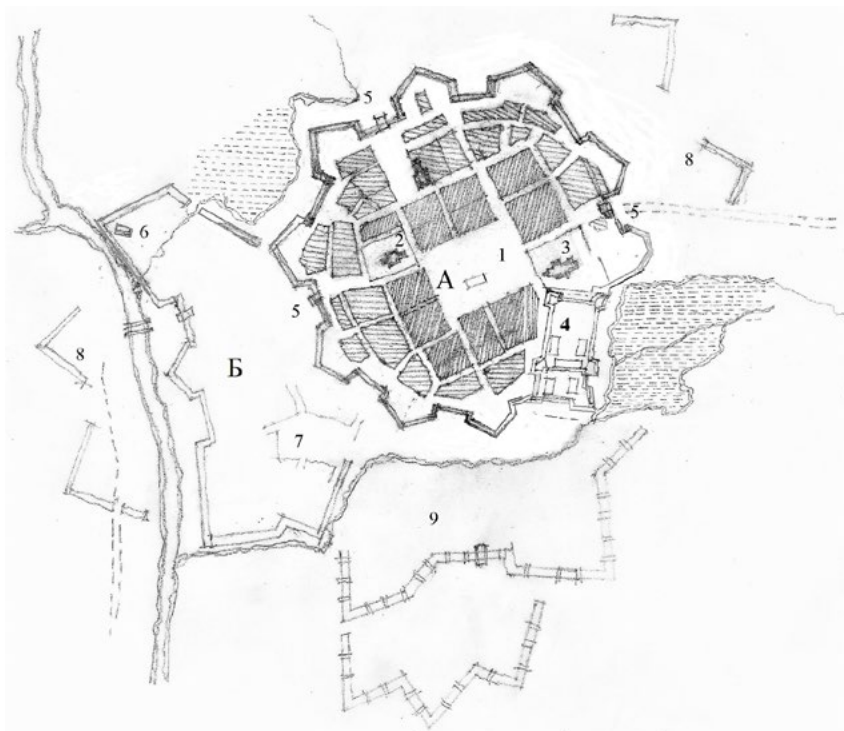


Fig. 16. Hypothetical reconstruction of the scheme of fortifications of Rohatyn at the 17th century. Marked: A – the Old Town; Б – New Town; 1 – Rynok Square, 2 – Tserkva of the Nativity of the Virgin Mary, 3 – St. Nicholas Church, 4 – castle, 5 – Halych and Lviv gates, 6 – Wooden tserkva of St. Spirit in the New Town, 7 – trade square in the New Town, 8 – hypothetical external shafts on the approaches to the town, 9 – a hypothetical scheme of a line of fortifications since the beginning of the 17th century. Author: M. Bezv, 2017.

We should also emphasize this important feature of Rohatyn's urban development – between 1539 and 1572, a new district called the “New Town” emerged here. We identify this district with the territory located southwest of the middle town. We came across Novomiska (*New Town*) street a little to the west of the Tserkva of the Nativity of the Virgin Mary even on maps that date back to the beginning of the 19th century [http://www.rohatynrg.org/home/geography/townmaps/RohatynResearchGroup].

Our analysis of the planning structure of the New Town shows that there was also a line of fortifications along the perimeter of this district (Fig. 16). However, configuration of the lines of these fortifications clearly indicates the existence of bastions which were probably erected or reconstructed later, in the 17th century. Circumstances of the emergence of this New Town, identification of its boundaries, and its development must still be studied in detail. When it comes to urban processes of the 16th–17th centuries, it was quite common to form new middle towns not far from the old ones and to even grant them individual privileges with regard to location in accordance with the Magdeburg Rights. Neighboring Berezhany (Fig. 17), where there were as many as three middle towns close to each other, each of which was formed in accordance with its own Magdeburg Rights, can serve as an example of this. Two of them were surrounded by a shared fortification bastion girdle [M. Bevz, 2000; K. Kuśnierz, 1984].

Thus, we can conclude that there was significant urban development in Rohatyn before 1572, a new town district was built, but it was not granted a separate self-governing status. Location of this new town is confirmed by historical documents. In particular, there is a reliable record of the New Town district dated 1616. In Fig. 16 we provide a hypothetical layout of the boundaries and fortifications of the New Town.

In the register dated 1663, there were 36 houses in the New Town and 6 wooden log cabins on the Ramparts [Słownik ..., 1888]. The latter is very interesting and important. First of all, it shows that there were ramparts in the New Town. There is no concrete information about these log cabins that were located on the ramparts, but it is important that they are connected to the ramparts. Therefore, we have arguments which confirm that the New Town district, just as the Old Town, was also surrounded by ramparts, and the aforementioned number of log cabins could be indicative of the number of bastions in the structure of the defensive girdle.

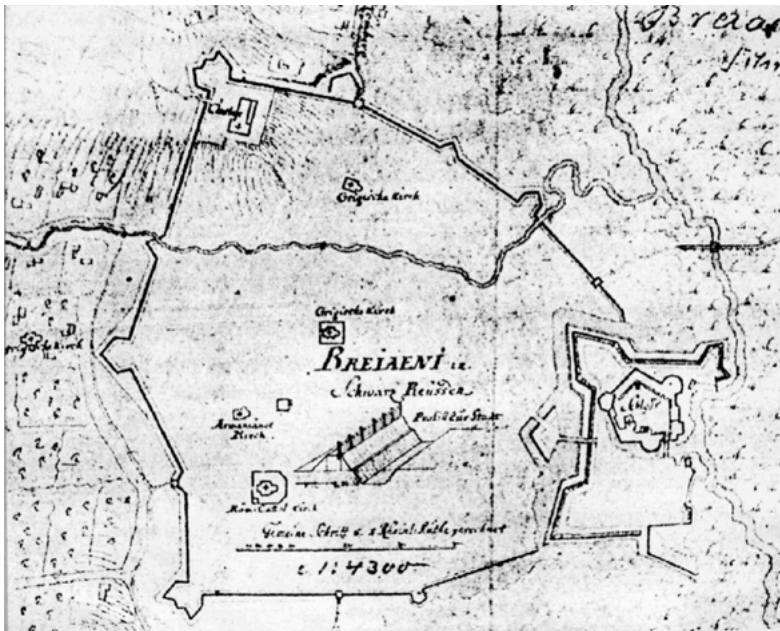


Fig. 17. The fortification of the town of Berezhany on the plan from 1720. In the center a fragment of the fortified line is drawn – a shaft with a wooden fence (according to K. Kuśnierz, 1984). The defensive line included triangular and pentagonal bastions.

In 1663, there were 140 courtyards in the old town, 31 courtyards in the new town, and 6 log cabins on the rampart. According to the register dated 1765, there were 301 households of bourgeois Christians and 125 households of bourgeois Jews in the old and new town [Słownik ... 1888, p. 694]. The register also listed several gypsum mines in the town. According to Jan Zubrzycki, in the 16th–17th centuries, Rohatyn was a wealthy and growing trading town. Such a characteristic may indicate that, first of all, the town was able to build and

modernize the fortified system of the middle town, and, second of all, without good modern fortifications, the town was unlikely to succeed and develop as a mercantile and crafts center.

In August 1914, during the First World War, the suburbs of Rohatyn were almost completely destroyed, burned and ransacked by Russian troops. Photographs taken at that time convey the tragedy of the destruction of a well-built town. Near the wooden Church of the Descent of the Holy Spirit (the church is one of 16 sites that belong to the wooden sacral church architecture of the Carpathian region of Ukraine and Poland included in the UNESCO World Heritage List) there is a cemetery where Austrian soldiers who died in the First World War in battles in Rohatyn and on its suburbs are buried. During the Second World War, the central part of the town was ruined again; the Jewish district was burned almost completely. Nearly nine thousand of the town's Jewish population were killed [38].



Fig. 18. Rohatyn town Plan of 1930 [<http://www.rohatynrg.org/home/geography/city-maps>]. The red circle marks the square in the New Town, which is labeled as "Stara Targovica" (Old Market Square).

Conclusions

In the 16th century, the middle town of Rohatyn was reconstructed after the catastrophe of 1509, and a defensive girdle consisting of bastions was created around it, which also had an earth rampart, a moat, and a number of bastejas. This defensive line consisting of bastejas initially had a wooden fence on the ramparts. Subsequently, after the king's privilege of 1539, the wooden wall was replaced by a masonry wall. The key issue here is whether the system of bastejas was replaced by the system of bastions when the town switched to a masonry system of fortifications. The fact that there was such a change is confirmed by arguments presented in our study. The most important of them include documented remnants of such fortifications on cartographic materials dated 1861–1864. Records dated to the first half of the 20th century about the remnants of the ramparts of the bastion plan and profile also support these conclusions. The photo of the building of a power station from the time of the First World War in which we see remnants of the masonry bastion curtain wall of the former castle is the most convincing argument. The remains of two bastions that were part of this curtain wall can be still identified on that location. You can also identify the bastion plan in the planning structure of the block between Pidvalna and Fortechna streets.



Fig. 19. Photos of the destruction of buildings in the central part of the town of Rohatyn at the time of World War I [polona.pl].

According to our hypothesis, the second fortification girdle consisting of bastions was created in the town later, at the end of the 16th century. In particular, this technique was used for the fortification of the boundaries of the so-called New Town district and for the modernization of fortifications of the Old Town.

We suggest that the fortification history of the town is divided into four main stages:

- Stage 1st – this is the period between 1415 (foundation of the town) and 1509 (complete destruction of the town as a result of the attack of the Wallachian-Turkish army under the leadership of Bogdan III the One-Eyed); at that time, the middle town and the castle, which were fortified with the help of a rampart and a moat, were created. Two gates and corner bastejas were erected on the rampart. A wooden fence was erected at the top of the rampart. The castle was fortified in a similar way as the middle town.
- The 2nd stage – from 1509 until 1539. The town was being restored, and fortifications around the middle town and the castle were being built once again on the basis of new privileges of 1523, 1535, and 1539. The middle town was somewhat expanded, new residential districts were created in place of old leveled ramparts. The fortifications initially had the form of a wooden fence on an earth rampart with triangular or polygonal bastejas (the privilege of 1535).
- The 3rd period – from 1539 until the end of the 16th century. Based on the privilege of 1539, which created financial opportunities for the modernization of the defensive line, works related to the transformation of earth-wooden fortifications into masonry ones were undertaken. At the same time, the defensive girdle of the middle town received a new planning contour with bastions. The privilege of 1539 exempted the town from some taxes and obligated it to use the town's proceeds for the construction of masonry fortifications. There was another transformation which was important for the town: a so-called "New Town" with its girdle of earth bastion fortifications was laid to the west of the old middle town. At the end of this period, fortifications of the middle town and fortifications of the castle were also being modernized by switching from bastejas to bastions. During this period, the bastion line of fortifications of the middle town ("the old town") and the line of ramparts with bastions of the "New Town" existed concurrently and were maintained in proper condition.
- The 4th period – in the 17th century, territorial development of the town in the southern direction led to the emergence of new residential districts and to the expansion of bastion fortifications to the east and

south of the boundaries of the New Town. In the 18th–19th centuries, when fortifications were no longer relevant and had been dismantled, urban and suburban buildings were erected in their place.



Fig. 20. The monument of Roksolana in the central square of the town of Rohatyn. It can also be considered a symbol of the destruction of the town in 1509 [photo: <https://commons.wikimedia.org/w/index.php?curid=4957881>].

References

- [1] M. Baliński, T. Lipiński (1844). *Starożytna Polska pod względem historycznym, geograficznym, i statystycznym opisana*. Warszawa, Nakład S. Orgelbranda, 1844, T. II, s. 702–705; (<http://books.google.com/books?id=PwwKAAAAIAAJ&oe=UTF-8>).
- [2] Bezv M. (1996) Problema zberezheniya riznochasovykh mistobudivnykh istorychnykh kompleksiv u arkhitekturniy tkanyni mista. In: *Urbanistychno-arkhitekturni problemy mist Halychyny*, Zbirnyk naukovykh prats', pid red. B. Cherkesa, M. Bezva. L'viv, DULP, 1996, s. 21–27.
- [3] Bezv M. (1997) Arkhitekturno-prostorovyy ukhad mista Zhovkvy v konteksti yevropeys'koyi urbanistyky. In: *Zhovkva. Halyts'ka brama*. L'viv: Tsentr Yevropy, 1997, №4 (28), s. 6–7.
- [4] Bezv M. (1998) Zhovkva — renesansne „ideal'ne" misto. Ukrayins'ka realizatsiya kontseptual'noyi ideyi z traktatu P'yetro Kataneo. In book: *Istorychna, mystets'ka, arkhitekturna spadshchyna Zhovkvy. Problemy okhorony, restavratsiyi, vykorystannya*. Zhovkva-L'viv, 1998, s. 36–43;
- [5] Bezv M. (2000) Zberezheniya istorychnoho planoval'noho ukhadu v proektakh reheneratsiyi zapovidnykh terytoriy istorychnykh mist. In book: *Visnyk Natsional'noho universytetu "L'vivs'ka politehnika"*. Arkhitektura. L'viv, 2000, №410, s. 62–69.
- [6] Bezv M. (2002) Studiyi arkhitekturno-mistobudivnoho rozvytku mista Belza XI-XX st. In: *Visnyk instytutu "Ukrzakhidproektrestavratsiya"*. L'viv, 2002, Chyso 12, s. 30–67.
- [7] Franciszek Biesiadecki (1936). *Herb królewskiego miasta Rohatyna*. Wydanie II. Lwów, odbitka z „Ziemi Czerweńskiej”, 1936, rocznik II, zeszyt 1, 7 s. (<https://polona.pl/item/herb-krolewskiego-miasta-rohatyna,Njc4NTgxMDQ/11/#item/>);
- [8] Czołowski A. (1930) *Katastrofa Rohatyna 1509 r.: szkiz historyczny*. Lwów, drukarnia Uniwersytecka, 1930. 15 s.
- [9] *Istoryko-arkhitekturnyy oporny plan mista Rohatyna (frahment)*. UDNP «Dipromisto», 2007 r., avtory: Shumyn I., Shubelyak N., Senchak Z.;
- [10] Książek M. (1992) *Zarys budowy miast średniowiecznych w Polsce do końca XV wieku*. Kraków, Politechnika Krakowska, 1992, 147 s.;
- [11] Kuśnierz K. (1984) *Sieniawa. Założenie rezydencjonalne Sieniawskich. Rozwój przestrzenny w XVII oraz XVIII wieku*. Rzeszów, 1984, 258 s.;
- [12] Matsyuk O. (1997) *Zamky i fortetsi Zakhidnoyi Ukrainy*. L'viv, „Tsentr Yevropy”, 1997, s. 105–112;
- [13] Mel'nyk V.I. (1991) *Tserkva Svyatoho Dukha v Rohatyni. Al'bom*. Kyiv, „Mystetstvo”, 1991, s. 5–15;
- [14] Mohytych R. (1995) *Rohatyn u systemi istorychnykh shlyakhiv*. V: *Rohatyns'ka zemlya: istoriya ta suchasnist'*. Materialy pershoi naukovoyi konferentsiyi, 24–25 berezhnya 1995 r. – L'viv-Rohatyn: in-t Ukrayinoznavstva NANU. – 1995. – s. 86–88;
- [15] Mohytych R. (1996) *Rohatyn u systemi istorychnykh shlyakhiv*. V zb.: *Visnyk. Instytut «Ukrzakhidproektrestavratsiya»*. L'viv, 1996, chyso 5, s. 24–26; 12. Okonchenko O. *Evolutsiya ob'yemno-prostorovoyi struktury bastionnykh zamkiv*

- Zakhidnoyi Ukrainy. V: Problemy doslidzhennya, zberezheniya i restavratsiyi ob'ektiv kul'turnoyi spadshchyny. Zbirnyk naukovykh prats' kafedry restavratsiyi i rekonstruktsiyi arkhitekturnykh kompleksiv. L'viv, NULP, 2014, s. 178–182;
- [16] Naronowicz-Naroński Józef. Budownictwo wojenne (1659). Oświęcim, Napoleon-V, 2016. – 272 s.
- [17] Okonchenko O. (2011) Planuval'na struktura rannikh bastionnykh fortyfikatsiy zamkiv Zakhidnoyi Ukrainy. In: Arkhitektura. Landshaft dakhiv istorychnoho tsentru mista: problemy zberezheniya i reheneratsiyi. Visnyk natsional'noho universytetu «L'viv's'ka politekhnika». L'viv, NULP, 2011, №716, s. 198–209;
- [18] Pan'kiv B. (1995) Rohatyn drevniy, ukrayins'kyy. V: Rohatyn's'ka zemlya: istoriya ta suchasnist'. Materialy pershoyi naukovoï konferentsiyi, 24–25 berezhnia 1995 r. – L'viv-Rohatyn: in-t Ukrayinoznavstva NANU, 1995, s. 24–26;
- [19] Słownik (1888) geograficzny Królestwa Polskiego i innych krajów słowiańskich. — Warszawa : Filip Sulimierski i Władysław Walewski, 1888. — T. IX : Pożajście — Ruksze;
- [20] Tsar'ova N. (1995) Pryvileiy Volchka Presluzhycha na nadannya Mahdeburz'koho prava novozasnovanomu mistu Rohatynu. V: Rohatyn's'ka zemlya: istoriya ta suchasnist'. Materialy pershoyi naukovoï konferentsiyi, 24–25 berezhnia 1995 r. – L'viv-Rohatyn: in-t Ukrayinoznavstva NANU, 1995, s. 91–99;
- [21] Yasins'kyy M. (2013) Oboronni elementy v strukturi mista Rohatyna ta yikh vplyv na rozvytok zhytlovoï zabudovy. V: Problemy doslidzhennya, zberezheniya i restavratsiyi istorychnykh fortyfikatsiy. L'viv, NULP, 2013, №4, s. 154–157;
- [22] Wróblewska G. Rozplanowanie miast nowożytnych w Wielkopolsce od XVI do końca XVIII wieku. Warszawa-Poznań, PWN, 1977, 220 s.;
- [23] Mieczysław Dunin Wąsowicz (1869). Rohatyn. Miasto królewskie. Krótki opis tego miejsca. Kraków, w drukarni Uniwersytetu Jagellońskiego, 1869, 14 s. (<https://polona.pl/item/rohatyn-miasto-krolewskie-krotki-opis-tegomiejsca,NzcxMTAy/1/#item/>);
- [24] Zinchenko S. (1995) In: Rohatyn's'ka zemlya: istoriya ta suchasnist'. Materialy pershoyi naukovoï konferentsiyi, 24–25 berezhnia 1995 r., L'viv-Rohatyn: in-t Ukrayinoznavstva NANU, 1995, s. 174–175;
- [25] Jan Sas Zubrzycki (1914). Rohatyn miasto królewskie. W Krakowie, nakładem Akademii Umiejętności, odbito w drukarni uniwersytetu Jagellońskiego, 1914, 14 s. (<https://polona.pl/item/rohatyn-miasto-krolewskie,NTIzNTAw/>);
- [26] <http://www.rohatynrg.org/home/geography/1944-rohatyn-aerial/>;
- [27] <https://get.google.com/albumarchive/104519598602010189193/album/> (1668–1728);
- [28] <http://www.rohatynrg.org/home/geography/city-mapsRohatynResearchGroup/>;
- [29] <https://polona.pl/item/fragment-obrazu-z-cerkwi-sw-mikolaja-przedstawiajacego-oblezenie-rohatyna-przez-tatarow,NjczODcyNTc/0/#item/fragmentobrazuzcerkwisw.Mikolaja/>;
- [30] <https://polona.pl/item/powiat-rohatynski,MTU4MzMwNA/powiatrohatynski/>;
- [31] <http://rohatynjewishheritage.org/en/maps/1846-cadastral/>;
- [32] http://www.rsr.org/rohatyn/map/overlay-1846-cadastral/Rukopysnyy_kadastrovyy_plan,_nakladyeny_na_suchasnu_kartu/;
- [33] <http://rohatynjewishheritage.org/en/maps/1944-aerial-photo/>;
- [34] <https://www.google.com.ua/search?q=Rohatyn&tbm=isch&tbs=rimg;>
- [35] <http://mapire.eu/en/map/secondsurvey/1861-1864>.
- [36] <https://uk.wikipedia.org/wiki/Rohatyn>.
- [37] [https://de.wikipedia.org/wiki/Bastei\(Festung\)](https://de.wikipedia.org/wiki/Bastei(Festung)).

Hipotetyczna rekonstrukcja faz rozwojowych systemu obronnego śródmieścia miasta Rohatyna w XV–XVII w.

Anotacja: Na przykładzie Rohatyna, miasta w Ukrainie Zachodniej, prezentujemy etapy rozwoju architektury obronnej śródmieścia. Argumentacja bazuje się na analizie struktury planistycznej miasta, na analizie materiału kartograficznego historycznego i współczesnego, badaniach terenowych szczatków fortyfikacji, analizie dokumentów historycznych, analizie fortyfikacji budowanej w miastach-sąsiadach. Historia budowy linii obronnych dookoła śródmieścia Rohatyna rekonstruuje się na cztery główne fazy, przentujące ciekawe drogi modernizacji umocnień od typu parkanu drewnianego do murowanych bastionów.

Słowa kluczowe: miasto Rohatyn, śródmieście, fortyfikacja, basteja, bastion, XV–XVII wiek.

The modernization of public spaces in problematic residential areas exemplified on selected projects and realizations in the Bronowice district of Lublin

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Summary: Tatory and Bronowice are considered to be the most dangerous and problematic districts of Lublin. The problems are exacerbated by the changing age structure of the residents – “ageing” and a high percentage of the unemployed, caused by the collapse of industry in Lublin after 1989 (URSUS), which was the main sector of employment for the residents of these districts. Apart from the problems typical for all housing estates from the communist era, e.g. lack of parking spaces, there is vandalism, alcoholism and low material status of the residents.

The development of the Tatory district after World War II was connected with the industrial district (among industrial plants, the biggest employer was the Fabryka Samochodów Ciężarowych (Heavy Goods Vehicle Factory) established in 1951, there was a slaughterhouse, and now – meat processing plants.

Housing estates built within the Tatory district in 1950–1972 (ZOR Tatory and Motor) and Bronowice (ZOR Bronowice I 1954–1956 and Bronowice II and III 1956–1969) were characterised by a large share of green and recreational areas dedicated to various users. After several decades of lack of investment and with changing lifestyles and users’ needs, these spaces are among the most neglected in Lublin. Currently works related to the improvement of infrastructure in these housing estates are being undertaken such as: replacement of street lights, sidewalks, etc. District councils are working intensively to raise funds for the most urgent needs, but they are not always well thought out or designed in an appropriate way. The problem is the lack of models and often duplication of functional and aesthetic schemes, not always appropriate to the area.

The modernization of public spaces is one of the elements of revitalisation processes, in which the involvement of future users at the design stage is a necessary element. Good public spaces increase the sense of security, comfort of living and even contribute to the increase in real estate prices. This paper presents the problems posed by the design process, implementation and functioning of selected public spaces in Tatory and Bronowice districts of Lublin where community participation played a crucial role.

The article presents issues related to the design, implementation and functioning of selected public spaces in the Bronowice district, where social participation was an important factor. Challenges of public space modernization in problematic residential areas are exemplified on selected projects and realizations in the Bronowice district of the city of Lublin.

Keywords: Bronowice district of Lublin, public spaces modernization, housing estates in Lublin

Introduction

The Bronowice district of Lublin is composed of several different kinds of housing developments. This is caused by the historic development of the area. The oldest part of Bronowice – Stare Bronowice is localized along the

banks of the Bystrzyca river and the railway line and spans in north-eastern direction. Second half of the XIX century saw the development of housing related to the strong growth of industrial manufacturing in the area. This period of growth lasted for several decades until first half of the XX century.¹ During the interwar period many industrial plants were localized in the area, biggest of which was the airplane factory. The main public space at the time was the City Garden of Foksal, established in 1869 the Garden is still functioning today. After the war the industrial area had kept its role to some point with Lublin Auto Repair Facility being located there by the authorities². The area of the airstrip had been used for the construction of new housing estates. The post-war estates are separated from the pre-war housing by the industrial area.

The post war housing estates of the Bronowice district (ZOR Bronowice I 1954–1956, Bronowice II and III 1956–1969 and the Maki (Poppy) estates) were characterized by a big share of green recreation areas dedicated for various uses.

The Workers' Housing Development Administration (Zakład Osiedli Robotniczych, ZOR) operated during the 1949–1955 period. The estates being constructed as part of the ZOR effort realized the housing program accompanying the development of new plants and other industrial facilities in the south-eastern part of Lublin. The implementations from that period display exemplary characteristics of the social realism trend in architecture of the city of Lublin.

In the early period of ZOR their developments continued with the traditional city street model with city blocks with services and facility spaces located on the ground floors of new buildings. M. Kurzątkowski remarks on the subject: spatial planning had not immediately broke with the old peripheral estate model.³ ZOR estates had bomb shelters built which are now under the management of Security and crisis management department of the city of Lublin town hall.

When Władysław Gomułka became 1st Secretary of the Polish United Workers' Party (1956) the task of housing estates construction was handed over to cooperative building societies modeled after similar prewar organizations. The Council of Ministers had moved the ZOR housing to local National Councils.⁴ Estates being constructed during that period no longer bear the characteristics of the old pre-war peripheral quarter model. Instead the new implementations are completely fitted urban units. The buildings designed in that era are 5 floor stairwell buildings and 8–10 floor high risers.⁵ Service premises are moved from the ground floors of newly designed building to separate buildings and pavilions. The majority of estate construction technology is industrialized.

The Bronowice district has been gradually growing in the following years absorbing suburban gardens orchards and small farms expanding east (Pogodna and Krańcowa Streets). The paper will describe examples of relicts left behind by former spatial arrangement. ... Works improving the infrastructure are constantly being carried out however some glaring omissions, especially in the "inter-block" space of the ZOR developments are obvious. ZOR estates are sticking out like a sore thumb against the remaining estates of Bronowice.

Social participation in the investment decision making process vs social issues

Social evaluation of Bronowice district's area puts parts of the Stare (old) Bronowice and the ZOR estates among the least friendly and most dangerous districts in the city of Lublin. The introduction of free market economy

1 The residential district, consisting mainly of two or three storey tenement houses, stretched between the railway line and grassland by the Bystrzyca River. Łęczyńska Street leading to the village of Tatory was its main communication axis. Bronowicka Street (originally leading to the municipal slaughterhouse) was designed parallel to Łęczyńska Street. Between them a system of parallel streets was laid out, in time filled with workers' houses. N. Przesmycka, Lublin. Urban transformations 1815–1939, Lublin 2012, p. 109. After several decades of lack of investment, in view of the changing lifestyle and users' needs, these spaces are among the most neglected in Lublin. The condition of the so-called Old Bronowice became so bad in terms of both technical and social degradation that this area is covered at the moment by the City's Revitalisation Programme. The article focuses on initiatives and actions undertaken in the remaining part of the housing estate.

2 Studziński J., Zakłady mechaniczne E. Plage i T. Łaskiewicz, [w:] Czerepińska J., Michalska G., Studziński J., Katalog architektury przemysłowej w Lublinie, t. I, cz. I, s. 68.

3 Kurzątkowski M., Lublin trzech pokoleń, s. 11

4 Kurier Lubelski, 7–8 IV, 1957, R 1, nr 13.

5 Budownictwo i Architektura w Polsce 1945–1966, Praca Zbiorowa pod red. Prof. Dr J. Zachwatowicza, Wyd. Interpress Warszawa 1968, s. 43.

in the beginning of 1990s led to the creation of real estate market however the majority of apartments in Bronowice remained in the ownership of their first tenants. As is the case in the ZOR estates – the majority of tenants are older people in retirement. Until this day the prices of apartments and rents are among the lowest in Lublin. Bronowice district exemplifies a country wide tendency for such estates to become drained of young people. Young aspiring people are seeking out different districts with new modern estate buildings.

Covering the Stare Bronowice with the revitalisation program is a chance to transform this part of the district completely. Unfortunately the part of the Bronowice described in this paper is not under the program since the unfavourable social phenomena gauge is slightly below the required level.⁶ However the overall image of the district as “problematic” is due to the disproportions in the state of social technical and economic space in the district.

Modernising of the public space is essential to the revitalisation process it is of utmost importance to engage the future users already on the level of design. Good well designed public spaces are a part of elevated feeling of security, dwelling comfort and are also contributing to the growing real estate prices. Civic participation, expressed in the recent years by growing interest in the quality of surrounding space is in turn shaping the city spatial policy.⁷ Unfortunately the decisions made by residents are not necessarily thought through. The main issue as presented in this paper is the lack of norms and standards which leads to duplication of previous implementations, rarely adequate for the new application.

2010 District Council’s initiative

The council moved to rectify the attractiveness of the estate to its residents as an important element of improving the feeling of self worth and to strengthen the attachment to their place of residence. Since they were erected the buildings of Bronowice with their surrounding spaces were neglected, underinvested and dilapidated especially in the oldest part (ZOR estates) which led to the growing divide into “better” and “worse” Bronowice.

Back in 2010 the district council have moved forward with the initiative to improve the quality of its public space. The main idea revolved around the development of four new squares named after saints and important figures in the Catholic Church: St. John Paul II, Blessed George Popiełuszko, Cardinal Stefan Wyszyński and Our Lady of Fatima.



Fig. 1. Placement of squares in the space of the Bronowice estate. On the left side of the ZOR estate. Compiled by the author

The residents intended the squares to take the form of organized, fenced places of worship in the form of exhibited sculptures – figural representations. The inhabitants wanted to enliven the space by introducing

6 Uchwała nr 735/XXIX/2017 Rady Miasta Lublin z dnia 27 kwietnia 2017 r.

7 Od 2015 roku funkcjonuje w Lublinie Budżet Obywatelski, a od 2016 Zielony Budżet Obywatelski.

decorative plantings of low shrubs and perennials. Concepts, followed by construction and detailed designs, were realized by KAUiPP employees on behalf of the Lublin Environmental Protection Foundation, and from the very beginning they were subject to social consultations. In order to improve communication, not only visualizations of places, but also mock-ups, which were presented during a series of meetings, were made for the need to present project ideas. Public consultations were a tool for developing a design solution acceptable to the widest possible group of recipients, meeting contemporary aesthetic and functional standards. The lack of budgetary restrictions (caused by the initial lack of an idea for financing the project) gave the designers the opportunity to choose high-quality material and technical solutions, and to design individual elements of small architecture objects. The four locations indicated by the district council included spaces with different levels of investment and use to date (Fig. 1).

According to the residents, the figures of saints and fences were supposed to prevent devastation of the space and contribute to increasing the level of safety, especially in part of the ZOR housing estate. The indicated locations differed in terms of relation to the existing buildings, the scale of the interior, the existing elements of development, vegetation, etc. The residents’ initiative to introduce forms of spatial devastation and to contribute to the improvement of safety, especially in part of the ZOR housing estate. The initiative of the inhabitants to introduce sculptural forms with religious content required a wide discussion – there was a threat of appropriation of public space and, above all, the questionable quality of monument construction. The main idea of the developed project resulted from the desire to show the residents that it is possible to approach the issue of worshiping selected patrons differently, without image, basing only on the most important and universal messages carried by them. The idea – a monument of thought – an element common to all squares in the form of a new individual form in the landscape of the housing estate was accepted after public consultations. The common form for various architectural elements, during the participatory process underwent gradual transformations, presented below. The idea of a concrete element with inscriptions in the form of concave reliefs was accepted by the inhabitants. The choice of sentences placed on them was widely consulted. As a result, an element visually identifying the designed spaces was obtained, unique and individual, which, depending on the location, could be a free-standing obelisk, a lantern, a pillar of pergola or a fence (Fig. 2).



Fig. 2. A – the first initial concept presented during social participation, B, C – “image” concepts presented during social participation, D – implementation – the original concept. Compiled by the author

Table 1. Summary of issues related to the discussed public spaces in the Bronowice district.

	Cardinal Stefan Wyszyński Square	Father Jerzy Popieluszko’s Square	St. John Paul II Square	Our Lady of Fatima Square
Duration of the participatory process	06–12. 2010	06–12. 2010	06–12. 2010	06–12. 2010 11–12 2016
Year of project implementation	June 2010	June 2010	June 2010	June 2010

Year of construction (commissioning)	2013	2012	2012	—
Area before starting design works	The communication route between the estate, bus stop and church.	The communication route – trodden path	The zone next to the “Nie Lękajcie się” youth centre – a very technically degraded area	Former orchard area, dog walking area, viewing link to the church
The wishes of the residents	The sculpture of the patron saint of the square or a chapel, „flowery”.			
Designers’ proposal	Lack of images, unaccompanied message in a universal form on the elements of small architecture, Plants symbolism or colour relating to the patron of the square.			
Working solution	A centrally located illuminated obelisk with reliefs and reliefs on pergola and lighting poles. Application of planting in violet, purple (lat. Clematis ‚Kardynał Wyszyński’), and white and red seasonal flowers.	Reliefs on the pergola and lighting poles, free-standing obelisks. Application of plantings with dominant violet colour. Reliefs on fence pillars, pergola included in the fence line.	Reliefs on the fence posts pergola incorporated into the fence. Planting blooming or coloring white and yellow.	Reliefs on the pergola and lighting poles Selection of plants of Marian symbolism (e.g. roses, perennials) and the preservations of orchard.
The wishes of the residents	Fencing of squares, locking gates.			
Designers’ proposal	Lack of fencing			
Working solution	Medium-high hedges (Berberys)	Low hedge, decorative	Locking gates.	—
The wishes of the residents	Square function: a place of adoration, worship, contemplation			
Designers’ proposal	Meeting place for different social groups	A place of recreation for various social groups	Opening of the Centre’s area for residents, integration with the housing estate	Meeting place for different social groups
Working solution	Resting place for various social groups, benches by the communication routes	A resting place for different social groups	Development of the area near the Centre	Place of contemplation, walking

Cardinal Stefan Wyszyński Square

Cardinal Stefan Wyszyński Square was located on the entrance axis of the pedestrian route connecting the oldest part of the ZOR Bronowice estate with the church. The simple geometric form fits into the existing system of communication routes, creating a space equipped with benches and pergolas. The central element of the system is a single post-lighthouse with inscriptions on each wall. Special attention has been paid to the selection of species of the designed plants. Efforts were made to ensure that the species or colours had a reference to Christian symbolism. In the Cardinal Stefan Wyszyński Square, seasonal white and red flowers were also designed, emphasizing the patriotic character of the place.



Fig. 3. A fragment of Cardinal Stefan Wyszyński's Square, photograph by author, 2016.

St. John Paul II Square

St. John Paul II Square is located on the grounds of the “Nie Łękajcie Się” Youth Centre. The design challenge was to bring together the recreational with utilitarian functions i.e. parking spaces for employees, waste disposal site and the requirement of having the area fenced which previously was open to public. The design retained the pre-existing communication infrastructure comprised of sidewalks and paths with gates localized along the walking routes.



Fig. 4. Excerpt from the project documentation and its implementation, photograph by author, 2016.

The poles identifying the space, common to all the discussed spaces, are incorporated into the layout of the fence. The existing clinker brick floor surface has been preserved in this area, which has been reconstructed and reused. The most important space is the eastern part of the installation with seating places and benches located inside the square, and from the outside with a single obelisk with intentions in the form of reliefs.

The choice of plants was based on its symbolism related to the figure of the Pope. The species chosen were yellow or white blooming, planted with grasses turning their colours during autumn and winter and birch trees along the fence.

Father Jerzy Popiełuszko Square

The square was designed inside a housing estate in an open, non-built non-utilised area, which so far has served as a pedestrian communication route. The main axes of this communication determined the course of the designed paths. The character of the square was supposed to be foster passive recreation and contemplation; hence the pergolas with benches were used as main elements of the composition. The square was to remain an open space without tall trees, at the same time creating places to rest in the shade (pergolas). The plants were to refer to the martyrdom of the patron, so the species were chosen with the dominant violet colour: heathers, sage, ornamental garlic, decorative grasses, and burgundy-coloured: barberries and five lobed vines. It was the first project in Lublin with the use of such a large number of perennials in the housing estate public space.



Fig. 5. Father Jerzy Popiełuszko Square pergolas with inscriptions, photograph by author, 2016.

Our Lady of Fatima Square

The square was designed on the area of a former orchard adjacent to a busy street. The main concept involved preserving all existing trees including them in the composition. The designed path with an unsealed surface has a winding, geometric shape, creating garden interiors in six zones. Each of those has a different character thanks to the use of plants of Marian symbolism or referring to Marian holidays. Subsequent zones are: May Corner (lilies, lilies of the valley, and bellflowers), summer Corner (mallows, cereals and poppies), herb garden (mint, sage, lavender, thyme, stock), blooming meadow (flower meadow), white garden and fragrant flower garden. The choice of species guaranteed the year-round attractiveness of the place. The obelisks, located in the centre of each zone, have reliefs of sentences containing universal messages from the Fatima apparitions engraved.



Fig. 6. Excerpts from the project conceptual and construction documentation

Summary

Three of the four squares described above have been completed. The realization of the square of Our Lady of Fatima is the subject of constant efforts on behalf of the district council to secure funding. After several years of operation, one can see varying degrees of upkeep and maintenance. What is interesting, the most neglected is the area near the "Nie Lękajcie Się" Youth Centre, which confirms the designers' reluctance towards public premises dedicated to a single group of end users with additional fencing surrounding the designed area. The Cardinal Stefan Wyszyński Square, located in a prominent location on Męczenników Majdanka Street, is cared for most. Seasonal plants forming a white and red background for the obelisk are replaced twice a year. The implementation of this square was the beginning of further construction and gardening works aimed at improving the aesthetics of this part of the street. On Father Jerzy Popiełuszko Square, due to insufficient plant care, after two years the planting was partially changed to bushes (barberries and meadowsweets) were introduced since they do not require much maintenance. There was no devastation or acts of vandalism in any of the squares. The spaces have merged into the neighbourhood landscape, have increased the attractiveness of public spaces and are an example of successful public participation at the pre-design and design stages of a project.

References

- [1] Budownictwo i Architektura w Polsce 1945–1966, Praca Zbiorowa pod red. Prof. Dr J. Zachwatowicza, Wyd. Interpress Warszawa 1968, s. 43.
- [2] Kot N., Zieleń lubelskich Bronowic – tradycja miejsca w kontekście współczesnych przekształceń, *Architectus* 2017 3 (51), s. 65–77
- [3] *Kurier Lubelski*, 7–8 IV, 1957, R 1, nr 13.
- [4] Kurzątkowski M., *Lublin trzech pokoleń*, s. 11
- [5] N. Przesmycka, *Lublin. Przeobrażania Urbanistyczne 1815–1939*, Lublin 2012,
- [6] Studziński J., Zakłady mechaniczne E. Plage i T. Laśkiewicz, w: Czerepińska J., Michalska G., Studziński J., *Katalog architektury przemysłowej w Lublinie*, t. I, cz. I, s. 68.
- [7] Uchwała nr 735/XXIX/2017 Rady Miasta Lublin z dnia 27 kwietnia 2017 r.
- [8] Studziński J., Zakłady mechaniczne E. Plage i T. Laśkiewicz, [w:] Czerepińska J., Michalska G., Studziński J., *Katalog architektury przemysłowej w Lublinie*, t. I, cz. I, s. 68.
- [9] *Projekty budowlane skwerów ks. Jerzego Popiełuszki, Matki Boskiej Fatimskiej, Kardynała St. Wyszyńskiego, Jana Pawła II*. Zespół autorski: dr hab. inż. arch. Elżbieta Przesmycka, dr inż. arch. Natalia Przesmycka, mgr inż. arch. kraj. Kamila Boguszewska, mgr inż. arch. Edward Koziółek, Lublin 2010

Modernizacja przestrzeni publicznych w problematycznych dzielnicach mieszkaniowych na przykładzie wybranych projektów i realizacji w dzielnicy Bronowice w Lublinie

Streszczenie: Tatary i Bronowice uchodzą za najbardziej niebezpieczne i problematyczne dzielnice Lublina. Problemy pogłębia zmieniająca się struktura wiekowa mieszkańców osiedla – „starzenie się”, oraz duży odsetek osób niepracujących, spowodowany upadkiem przemysłu w Lublinie po 1989 roku (URSUS), który był głównym sektorem zatrudnienia dla mieszkańców tych dzielnic. Oprócz problemów typowych dla wszystkich osiedli z epoki PRL np. braku miejsc parkingowych, dochodzi wandalizm, alkoholizm i niski status materialny mieszkańców.

Rozwój dzielnicy Tatary po II wojnie światowej wiązał się z dzielnicą przemysłową (wśród zakładów przemysłowych największym pracodawcą była powstała w 1951 roku Fabryka Samochodów Ciężarowych, funkcjonowała rzeźnia, obecnie – zakłady mięsne).

Osiedla powstające w ramach dzielnicy Tatary w latach 1950–1972 (ZOR Tatary oraz Motor) i Bronowic (ZOR Bronowice I 1954–1956 i Bronowice II i III 1956–1969), cechował duży udział terenów zielonych i stref rekreacyjnych dedykowanych różnym użytkownikom. Po kilkudziesięciu latach braku inwestowania i przy zmieniającym się stylu życia oraz potrzebach użytkowników, przestrzenie te należą do najbardziej zaniedbanych w Lublinie. Na bieżąco podejmowane są prace związane z poprawą infrastruktury na osiedlach: wymiana oświetlenia, chodników itd. Rady dzielnic intensywnie pracują nad pozyskiwaniem środków na realizację najbardziej palących potrzeb, jednak nie zawsze są one przemyślane i zaprojektowane w odpowiedni sposób. Problemem jest brak wzorców i powielanie schematów funkcjonalnych i estetycznych, nie zawsze adekwatnych do danego miejsca.

Modernizacja przestrzeni publicznych jest jednym z elementów procesów rewitalizacyjnych, w których zaangażowanie przyszłych użytkowników jest elementem koniecznym już na etapie projektu. Dobre przestrzenie publiczne podnoszą poczucie bezpieczeństwa, komfortu zamieszkania, a nawet przyczyniają się do wzrostu cen nieruchomości. Artykuł przedstawia problematykę związaną z projektowaniem, realizacją i funkcjonowaniem wybranych przestrzeni publicznych na Tatarach i Bronowicach, w których ważnym elementem była partycypacja społeczna. Artykuł przedstawia problematykę związaną z projektowaniem, realizacją i funkcjonowaniem wybranych przestrzeni publicznych na Bronowicach, w których ważnym elementem była partycypacja społeczna.

Słowa kluczowe: Bronowice, rewitalizacja przestrzeni publicznych, osiedla Lublina

Project of revitalisation of the area next to the Potocki family Palace in Lublin

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Abstract: The old baroque palace of the Potocki family is located in the heart of Lublin. In 1967 it was entered in the register of Lubelskie voivodeship under the number A/236. Nowadays, this historic building requires a thorough reconstruction and its surroundings – revitalisation. The aim of this study is to suggest a concept of land development around the palace taking into consideration the contemporary needs of its users.

Key words: project of revitalisation, the Potocki family Palace, Lublin

Introduction

The idea of revitalisation refers to all actions which aim at the recovery of devastated areas, which lost their original functions, using specific conditionality and the potential of a given place [Dz. U. 2015 poz. 1777]. It includes planning, conservation, economic and social activities aiming at functional and practical improvement of devastated places [Kołaczkowski i Wielgus 2015]. Revitalisation of urban spaces is connected with preservation, protection of historic and contemporary forms and protection and planning of major elements of nature [Przesmycka 2005]. It is a multifaceted process which according to the vision of the 21 century [Nowa Karta Ateńska 2003] cities leads to the improvement of *'the quality of contemporary urban spaces, their esthetic, functionality, safety and something of the openness to socialisation of city life'* [Fornagiel 2012].

In the revitalisation process social participation plays a major role, which gives a society the feeling of involvement in the issues of the local environment, codecision about the space changes, the protection of cultural heritage and shaping a new space and city and region identity [Hausner 1999, Przesmycka 2008B, Pawłowska 2010].

Since the 90s of the previous century, revitalisation activities in Lublin have been conducted very intensely [Niećko and Boguszewski 2005]. They cover about 60 devastated places such as The Parish Church Square, the former Church of the Most Sacred Heart and the Visitation of the Virgin Mary, the monastic complex of the Nuns of the Visitation in Lublin (present-day the Centre of Culture) or the park on Peowiaków Street. The development and revitalisation programme for Lublin planned between the years 2017–2023 adopted by the Council of Minister as an economic programme within the meaning of point 6 of Article 18(2) of 8 March 1990 is a continuation of activities initiated in previous years [<http://>].

In the years 2016–2017 one of the activities of Lublin centre recovery was revitalisation of Litewski Square and a nearby area at the former Czartoryski family Palace (present-day the head office of Polish Academy of Sciences). The buildings went a thorough reconstruction gaining new social and cultural functions. Reconstruction also included changing the road traffic arrangement (enlarging the area of the place) and giving this place more representative function.

In the neighbourhood of Litewski Square and the Czartoryski family Palace there is another historic building of great architectural values, the former Potocki family Palace. Since 1967 it has been under conservational protection and it is on the list of historic buildings of Lubelskie voivodeship. The building which is situated in

the heart of the city, seriously threatened for many years, requires immediate conservational activities. Frequent changes of the owners who were the users of the palace, resulted in the destruction of Lublin residence of the Potocki family. The building is suffering damage and it requires a thorough reconstruction and its surroundings (entrance courtyard and the northern part – the former garden) putting in order and defining its new function.

The project of land development at the Potocki family Palace, presented in this paper, constitutes a concept which can serve the society while at the same time it focuses on historic and cultural values of one of the historic buildings perceived as a landmark for Lublin inhabitants.

Localisation of the palace and methods

The Potocki family Palace is situated in Lublin at 3 Staszica Street on a rectangular shape plot with the area of 2365 m² (including green areas – 60 m²). The area discussed in the paper covers the main courtyard from the south and the square – the area of the former garden in the north (fig. 1).

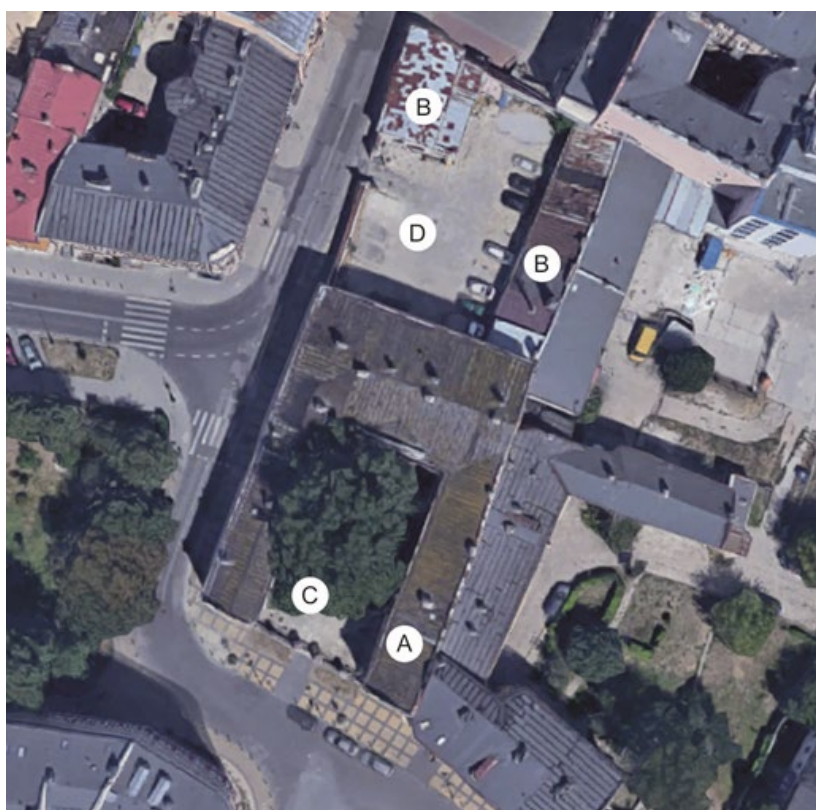


Fig. 1. The satellite view on the area of the Potocki family Palace in Lublin – the state from 2017. A – Palace, B – Front courtyard of the Palace, C – Parking, D – Garage.

Widok satelitarny na teren Pałacu Potockich w Lublinie - stan z 2017 roku (www.google.pl/maps [19.03.2017]). A – Pałac, B – Dziedziniec główny Pałacu, C – Parking, D – Garaże.

The research was initiated by the search of literature sources connected with the history of Lublin and the Potocki family Palace including archive maps, single and dispersed texts from the County State Archive in Lublin. In 2016 there was conducted a detailed inventory of trees and bushes growing in the discussed area. During the research the height of the trees was measured with the use of the altimeter SUUNTO PM-5/1520, the volume of the tree trunk at the height of 130 cm above the ground and the height of the bushes. At the diameter of a tree crown there was used a method of projecting of two the most extreme points of a tree crown on the surface. The names of the taxons were used following Seneta and Dolatowski (2011). The age of the trees was identified using the table of age structure of trees developed by Majdecki (1980/1986). Field studies referred to the localisation of the present buildings on the discussed area. Photographic documentation was added to research works.

The history of the Potocki family Palace in Lublin

The Potocki family Palace in Lublin was built in the years 1719–1730 when it belonged to Jerzy Potocki who was the Capitan of the Polish Army of the Polish Third Republic [Studziński, Michalak and Jodłowska 2006]. Originally, the baroque palace consisted of the storied main body and two ground floor side wings connected with it (from the east and the west). The layout was based on a scheme of a horseshoe with a representative front courtyard in Italian style situated from the south. The courtyard was closed by a semicircular wall with bars and the entrance gate [Michalak and Jodłowska 2006]. The continuation of the axes of the palace and garden complex, was the road leading to Krakowskie Przedmieście ('present-day' the beginning of Staszica Street, former Poczętkowska Street). From the east of the palace there were located garden areas (fig. 2) and from the courtyard side on the storey of the building there was an open porch with five arcades (fig. 3). In 1747 the youngest son of Jerzy, Eustachy Potocki, the Marshal of the Crown Tribunal in Lublin, became the owner of the palace and he decided to enlarge it in the years 1752–1755. Probably the person responsible for the reconstruction could be Jakub Fontana – Polish architect of Italian origin, who worked for Eustachy Potocki [Gawarecki 1957]. Probably the building was enriched with a mansard roof with dormers, covered with tiles and the side outbuildings with shingle [Michalak and Jodłowska 2006]. In the palace there were richly decorated tiled stoves, panelling and golden slates and decorations. The room walls were covered with colourful materials with dominating plant motifs typical for the architecture of the 18th century. The furnishings were Gdansk chairs covered with leather, mirrors in brass and walnut frames [Inventory Palace from 1783 year behind: Michalak and Jodłowska 2006, Studziński 1994].

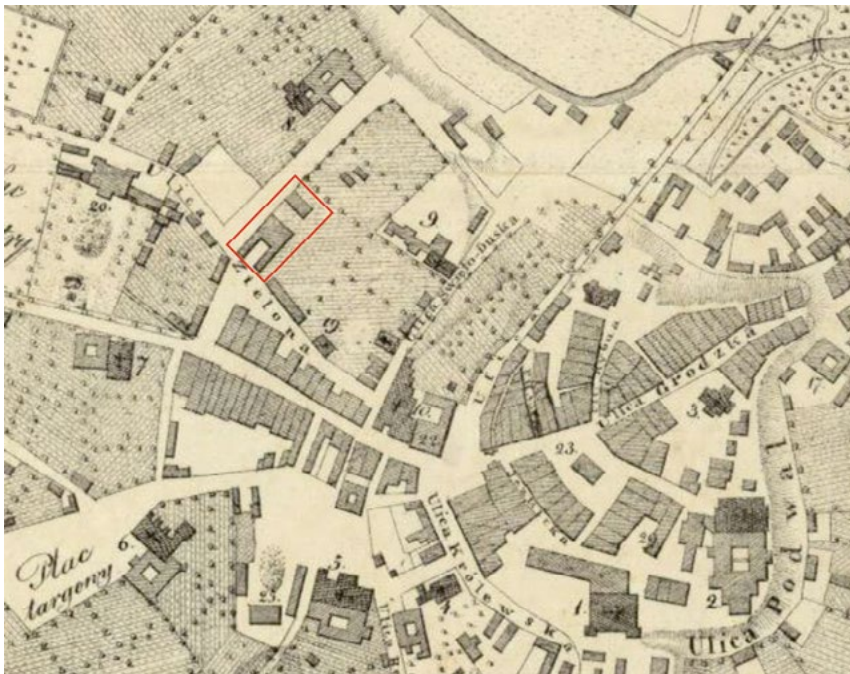


Fig. 2. A part of Lublin map from 1829 (www.stareplanymiast.pl). Former Potocki family Palace.

Fragment mapy Lublina z roku 1829 (www.stareplanymiast.pl). Dawny Pałac Potockich.

In 1789 Jan Nepomucen, the son of Eustachy Potocki handed the Lublin Palace over to State Treasury. Since that time the building has changed its functions and has been redecorated several times. In 1790 it was the quarters of a Polish cavalry and in 1792 during the time of Austrian occupation it was a prison. At this time the layout of the palace rooms was changed, the windows were reduced in size and the side decorations of the windows were removed the same as an open porch on the storey and the 'semicircular fence line closing the courtyard from the south was replaced with the present fence' [Michalak and Jodłowska 2006] (fig. 4 and 5).

After the First World War the building was used as the main Police Headquarters in Lublin. In the next years it was eg. the quarters of the Branch of the Citizens Police or Special Vocational School and since 1994 it has belonged to the Catholic University of Lublin. In 2016 it fell into the hands of a private owner [[http. 2\]](http://).



Fig. 3. Front facade of the palace from the 18th century. Figure author is A. Zwierzchowski (2006).

Elewacja frontowa pałacu z okresu XVIII wieku. Autorem ryciny jest A. Zwierzchowski (2006).



Fig. 4. View to front facade on the Potocki family Palace. Photography presents the reconstruction of the palace facade from the 18th century (dziennikwschodni.pl).

Widok od frontu na Pałac Potockich. Fotografia przedstawia rekonstrukcję elewacji pałacu z XVIII wieku (dziennikwschodni.pl).



Fig. 5. Photography showing the current fence of the yard (P. Krupiński 2017).

Fotografia przedstawiająca obecne ogrodzenie dziedzińca (P. Krupiński 2017).

The present state of the research area

Legal and ownership conditions of the building

At present the discussed research area belongs to a private investment company-Building Investment. After a series of reconstructions and transformations, the palace and its surroundings lost its character of a magnate residence. A current owner is going to adopt a historic building to a hotel [http. 3].

Inventory and dendrological analysis

Dendrological inventory conducted in 2016 shows that in this area there grow 6 plants. These are two trees: Norway Maple (*Acer platanoides* L.) and English Oak (*Quercus robur* L.) and four bushes of Common Lilac (*Syringa vulgaris* L.) (tab. 1, fig. 6). Inventoried species grow on the front courtyard, they are in good condition and they do not need any special care. The age of a Norway Maple is about 120 and English Oak is over 150. It can be estimated that these trees come from the period when the building was a prison. Large tree crown of a Norway Maple and a Common Oak considerably limit the light to the courtyard.

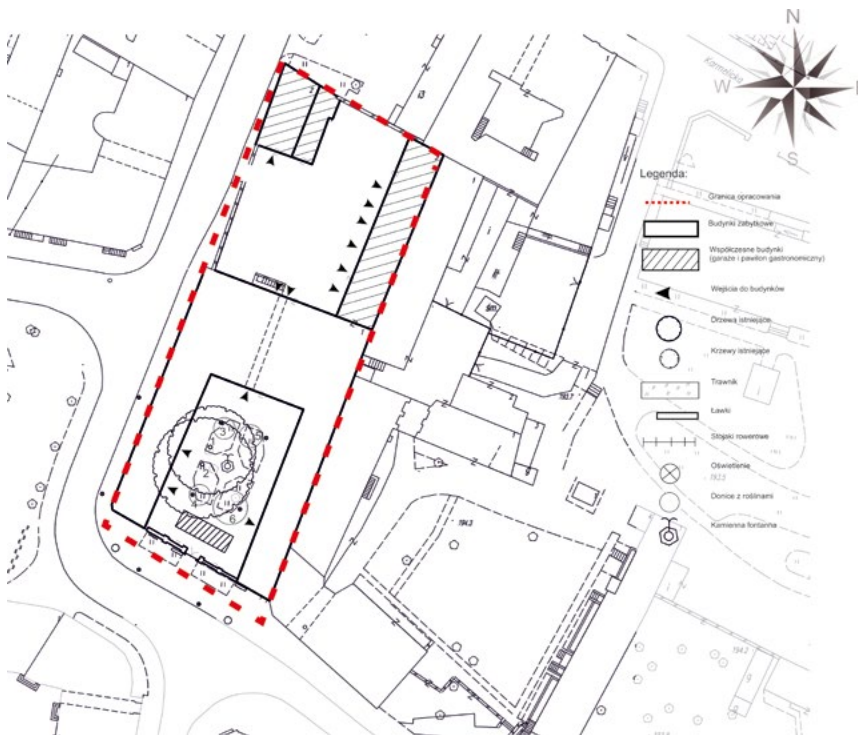


Fig. 6. Inventory of the discussed area by (P. Krupiński 2017).

Inwentaryzacja terenu opracowania oprac. (P. Krupiński 2017).

Table 1. Dendrological inventory of trees and bushes growing on the area under discussion (2016).

Inwentaryzacja dendrologiczna drzew i krzewów rosnących na terenie opracowania (2016).

No. Lp.	Latin and English name species Nazwa łacińska i angielska gatunku	Diameter of the crown Średnica korony [m]	Trunk circumference Obwód pnia [cm]	Plant height Wysokość rośliny [m]	Comments Uwagi
1.	<i>Acer platanoides</i> L. Norway Maple	17	200	11	

2.	<i>Quercus robur</i> L. English Oak	15	280	12	
3.	<i>Syringa vulgaris</i> L. Common Lilac	3.7	60	3	
4.	<i>Syringa vulgaris</i> L. Common Lilac	3.6	60	4	
5.	<i>Syringa vulgaris</i> L. Common Lilac	4	60	3	
6	<i>Syringa vulgaris</i> L. Common Lilac	6	70	3	2 stems 2 pnie

Compositional analysis, cultural values of the building and its surroundings

The area under discussion has a central layout with a palace building and two outbuildings – shaped in U letter- and with the main compositional axis running across the centre of the main body of the palace, the courtyard closed from the front with a fence and a gate and towards the south along Staszica Street to Krakowskie Przedmieście Street. From the south and north side of the Potocki family Palace there are interiors geometrical in shape. From the south, on the courtyard, there are two trees and the focus is on the stone fountain situated in the centre. The negative side of this interior is a neglected elevation of the building, damaged surface and a restaurant (open in summer) situated on the axis of the complex and limiting the view to the south. The north side is a parking and it is the most damaged part of the whole complex. The east side is closed by brick one storey buildings used as garages and utility rooms. The interior courtyard is unattractive and inconsistent with the former magnate residence.

The Potocki family Palace in Lublin is a valuable building with great historic values situated in the heart of the city. On the basis of the decision of 28 February 1967 it was entered in the register of Lubelskie voivodeship under the number A/236. A series of reconstructions, eg. destruction of window decorations as a result of reducing the size of the windows and including the building in the frontage development of Zielona Street resulted in the lost of its residential style. The only decorations left are tympanons on the top walls of the outbuildings and the attics above them [Szymula 2014]. However, the Potocki family Palace called ' The Old Jail ' is still an important and recognisable (by Lublin inhabitants) place in the heart of the city. In its vicinity there are some other buildings of a great cultural value under conservatory protection, eg. the Czartoryski family Palace (in the register of Lubelskie voivodeship under the number A/225), the Lubomirski family Palace (No A/480 and A/509), the Church of the Immaculate Conception of the Blessed Virgin Mary at Staszica Street (No A/240) or the Church of St. Joseph (former Greek Monastery) at Zielona Street (No A/238) and a tenement house of Europa Hotel (No A/502). Besides, the discussed building borders directly with a historic architectural and urban Lublin complex having the status of Historic Monument (since 2007). The area of Historic Monument covers the most important historic buildings in Lublin of special historic, scientific, artistic values and the places worth visiting. That is why the Potocki family Palace after its reconstructions which are the result of different functions of the building, should be available to tourists the inhabitants of Lublin [http. 3].

Revitalisation concept of the area next to the potocki family palace

The main aim of the presented project is to raise the importance of the building by making it visible and introducing two interiors inspired by the styles of Italian gardens. The project is based on geometrical layout of squares, both in representative interior from the south as well as in the north side, designed as a meeting and relaxation place of the building users, tourists and inhabitants (fig. 7). From the south side in the place of a former courtyard, more representative entrance zone which highlights the values of the building seen from Krakowskie Przedmieście Street is proposed. Reconstructed squares are shaped as a boxwood hedge line. Inside

the squares there are flowering plants: rambler roses of large, pink flowers – ‘Bonica 82’ or ‘Diadem’ species, lavender (*Lavendula angustifolia* L.) and hosta (*Hosta*), periwinkle (*Vinca minor*), ivy (*Hedera helix*) under the tree crowns (fig. 7).



Fig. 7. Suggested concept project of land development by (P. Krupiński 2017).

Proponowany projekt koncepcyjny rewitalizacji terenu oprac. (P. Krupiński 2017).

In the north part, at the entrance to the building, a place for a garden cafe is suggested. In this place a decorative element will be plant pots with Corall Bell ‘Green spice’ (*Heuchera ‘Green spice’*), Bridgewort (*Astibile japonica* or *Astibile arendsi*) which will give pastel shades to the garden in summer and autumn. This part can have some additional benches, eg. stone seats, sculptures or the containers with some species which can be formed (eg. laurel noble – *Laurus nobilis* L.). In both courtyards, paving stone which would match with the elevation of the building is suggested.

Conclusion

Revitalisation of the area next to the Potocki family Palace in Lublin is a step towards the recovery of the building „disappearing” from the city map and strongly connected with its history. A new layout and the function of the surroundings next to the historic building and its furnishings is to revive the role of its separate interiors and allow to use them according to the requirements of its future users. The suggested actions will result not only in the economic benefits, but most of all, they will improve the quality of the central urban space making it more attractive. The palace requires immediate revitalisation to become a historic building shaping the identity of the city.



Fig. 8. Visualisation of a front courtyard of the palace edited by (P. Krupiński 2017).

Wizualizacja dziedzińca frontowego Pałacu oprac. (P. Krupiński 2017).



Fig. 9. View on ground floor gardens in the north part of the complex edited by (P. Krupiński 2017).

Widok na partery ogrodowe w północnej części założenia oprac. (P. Krupiński 2017).

References

- [1] Dz. U. 2015 poz. 1777, Ustawa o rewitalizacji z dnia 9 października 2015.
- [2] Fornagiel K. 2012. Rewitalizacja miast a potrzeby społeczne. Czasopismo Techniczne Z.12: 182–190.
- [3] Gawarecki H. 1957. Pałac Potockich w Lublinie. Kalendarz Lubelski na rok 1958.
- [4] Hausner J. 1999. Komunikacja i partycypacja społeczna. Małopolska szkoła administracji publicznej akademii ekonomii w Krakowie, Kraków: 40–42.
- [5] Inwentarz z Pałacu z 1783 roku za: Michalak T., Jodłowska E., Zwierzchowski 2006. Pałac Potockich Lublin ul. Staszica 3 Badania architektoniczne na obecność polichromii.
- [6] Kołacz P., Wielgus P. 2015. Przepis na rewitalizację. Fundacja dla Uniwersytetu Kazimierza Wielkiego, 6–17.

- [7] Majdecki L. 1980/1986. Tabela wiekowa drzew. Rkpś, Oddział Architektury Krajobrazu SGGW, Warszawa
- [8] Michalak T., Jodłowska E., Zwierzchowski 2006: Pałac Potockich Lublin ul. Staszica 3 Badania architektoniczne na obecność polichromii. Maszynopis. LWKZ Lublin.
- [9] Niecko E., Boguszewski R. 2005. Programy przyrodniczej rewitalizacji miast w strategiach rozwoju regionalnego. Teka Kom. Arch. Urb. Stud. Krajobr.-OL PAN, 68–75
- [10] Nowa Karta Ateńska Wizja miast XXI wieku. 2003.
- [11] Pawłowska K. 2010. Idea i metody partycypacji społecznej w ochronie krajobrazu i kształtowaniu przestrzeni. Fundacja Partnerstwo dla Środowiska Kraków.
- [12] Przesmycka E. 2005. Rewitalizacja przyrodnicza miast-kontynuacja czy dyskontynuacja. Teka Kom. Arch. Urb. Stud. Krajobr.-OL PAN: 53–59.
- [13] Przesmycka E. 2008B. Wschodnie innowacyjne centrum architektury w Lublinie. Teka Kom. Arch. Urb. Stud. Krajobr.-OL PA: 300–310.
- [14] Seneta W., Dolatowski J. 2001. Dendrologia. Wydawnictwo Naukowe PWM Warszawa.
- [15] Studziński J. 1994. Kamienica Staszica 3, d. Pałac Potockich d. Stary Kryminal: rozpoznanie historyczne i wnioski konserwatorskie, Opracowane na zlecenie zarządu miasta Lublin, Lublin 1994.
- [16] Szymula A. 2014. Pałac Potockich tzw. „Stary Kryminal”, witryna internetowa encyklopedia Lublina (dostęp 12.02.2017); dostępny w Internecie: <http://encykpedialublina.pl/architektura-i-urbanistyka/palace/127-palac-potockich.html>.
- [17] Zwierzchowski A. (2006). Decyzja LWKZ w Lublinie. IN/4001/LU-20/365/06 z dn.27.01.2006. Wydanie zezwolenia na prowadzenie prac badawczych w budynku dawnego pałacu Potockich przy ul Staszica 3 w Lublinie.

Internet source

- [1] [http1: Biuletyn informacji publicznej Lublin](http1:Biuletyn%20informacji%20publicznej%20Lublin) (dostęp 20.02.2018); dostępny w Internecie: <https://bip.lublin.eu/bip/um/index.php?t=210&id=282440>
- [2] [http2: Dziennik wschodni witryna internetowa](http2:Dziennik%20wschodni%20witryna%20internetowa) (dostęp 10.11.2017) dostępny w Internecie: <http://www.dziennik-wschodni.pl/lublin/kul-sprzedal-palac-potockich-polsko-wloskiej-spolce-wiadomo-co-bedzie-w-srodku,n,1000179282.html> [http:Strona internetowa Miasta Lublin](http:Strona%20internetowa%20Miasta%20Lublin) (dostęp 20.12.2017); dostępny w Internecie:
- [3] <https://lublin.eu/lublin/przestrzen-miejska/zabytki/zabytki-lublina/zabytki-wpisane-do-rejestru/>

Projekt rewitalizacji terenu przy pałacu Potockich w Lublinie

Abstract: Dawny barokowy pałac rodu Potockich usytuowany jest w samym centrum Lublina. W roku 1967 został wpisany do rejestru zabytków województwa lubelskiego pod numerem A/236. Obecnie zabytkowa budowla wymaga gruntownej restauracji a jej otoczenie rewitalizacji. Celem pracy jest propozycja zagospodarowania przestrzeni wokół pałacu przy uwzględnieniu współczesnych potrzeb użytkowników.

Key words: projekt rewitalizacji, pałac Potockich, Lublin

Classroom training strategies to strengthen the hotbed of research in architecture

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Abstract: The Architecture program at the Catholic University of Colombia needs to strengthen the research processes within its classrooms and consequently, it is important to make a direct link with the hotbeds of research. In this context, it is worth asking what the best classroom training strategy to link and strengthen the architectural hotbed of research would be. The objective of this article is to explain said strategy. The results of this exercise were: first, the identification and formulation of a research training strategy applied to the eighth, ninth and tenth semesters of the Architecture programme. This applied exercise changed the didactic means of teaching research competencies to the students in order to better organise their innovative ideas through systematised processes. This enabled the development of collaborative work experience oriented towards scientific research within the classroom, in a very short time.

Keywords: Hotbed of Research, Research skills, Training Strategies, Computer Application.

Introduction

The Architecture program at the Catholic University of Colombia needs to strengthen research processes within its classrooms. To do this, it was proposed that the leaders of the Hotbeds of Research should formulate classroom training strategies, aimed at developing research skills among students of the program. Therefore, in response to this need, in the seedbed Computer Applications in Architecture (CAA) the investigative abilities a student requires to develop their training process were identified, so that they can analyse the characteristics of the impacts of climate change on the urban habitat, proposing solutions for mitigation and adaptation.

The CAA hotbed of Research was oriented towards two fundamental study problems. The first being climate change and the second habitability. Sustainable technologies, sustainable environments and technological environments were defined as the three areas of study. The intersection of these three areas are the three following lines of research (Figure 1):

- The first is the relationship between sustainable and environmental technologies, resulting in modelling processes. In this line the following question is asked: What I am going to do? This is answered through sustainable design.
- The second is the relationship between sustainable technologies and technological environments, resulting in the use of simulation processes. In this line the following question arises: How am I going to do it? This is solved through sustainable management.
- Third, the relationship between the sustainable environment and technological environments results in experimentation. In this line, the question is proposed: When and under what conditions am I going to do it? This is met through technological development.

For these reasons, the study was of an experimental and exploratory nature. It focused on the development of four techniques: reverse engineering, quality matrix QDF, Business Model Canvas (Osterwalder, 2011; Clark, 2012) and business plan tools from Information and Communication Technologies (ICT). For this study, the open WikiHouse (Parvin, 2013) was selected as an object of study, as it is an innovative development product.

With this system the study sought to develop three types of innovation: incremental, fundamental or radical. Therefore, the design of the proposed methodology focused on the development of investigative skills needed to train students in the area of integrated design (Trebilcock, 2009).

To achieve this, some of the investigatory abilities proposed by the Catholic University of Colombia (2007) were used:

- First, personal skills focused on adapting to change.
- Second, intellectual skills focused on decision making and problem solving.
- Third, interpersonal skills that were based on teamwork and leadership.
- Fourth, organizational skills based on information management and resource management.
- Fifth, technological skills concentrated on identifying innovation processes.
- Finally, labour skills were based on the design of processes and products.

One might ask what would be the best strategy to develop research training in the classroom. The aim of this article is to explain said strategy, which was developed in the field of the research hotbed "Computer Applications in Architecture" (CAA). The results of this exercise were: first, the identification and formulation of a research training strategy applied to the classroom.

Second, the development of research skills in students of semesters eight, nine and ten of the Architecture program. Finally, the methodology developed, the partial results of the implementation of the training strategy, and the discussion and conclusions of this study will now be presented.

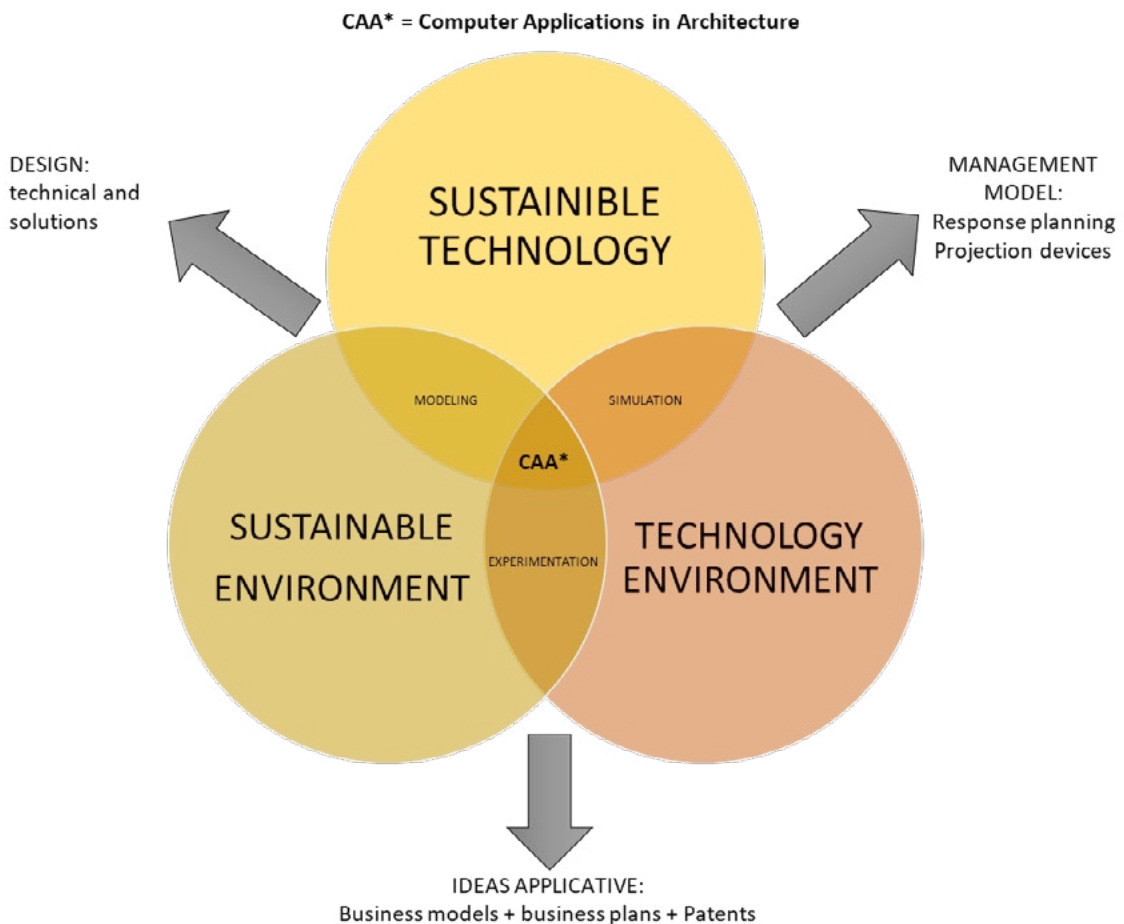


Fig. 1. Computer Applications in Architecture hotbed of Research framework. Prepared by the author.

Methodology

The process of training in investigative skills is composed of four stages (Figure 2):

- Reverse engineering: is a process of analysis that seeks the cutting of a product, to produce a process of technological innovation from existing elements. To achieve this it uses computer systems and technological tools (Cubillos-Gonzalez, 2011).
- Matrix product planning QFD (Quality Function Deployment): is a concurrent engineering (CE) technique and consists of a planning process for new products driven by customer needs to be carried out by the CE team (Beard, 2001; Riba, 2010; 2006).
- Model Canvas: is a method that builds a language to describe and easily manage a business model in order to develop new strategic alternatives (Osterwalder et al, 2011, 18).
- Proposal for entrepreneurship using IT tools: is the management of a business model through the implementation of computing platforms that enable the processing of information in real time (Tooze et al, 2014).

METHODOLOGY FOR THE DEVELOPMENT PROCESS OF SOFTWARE APPLICATIONS AIMED AT TECHNOLOGICAL INNOVATION

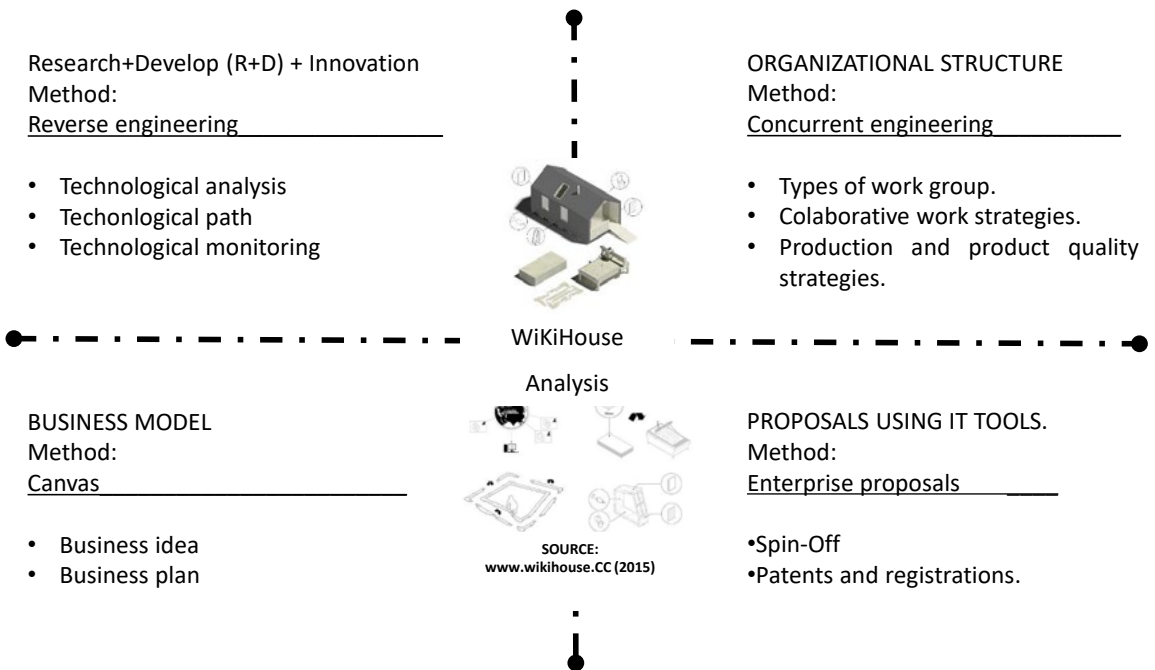


Fig. 2. Study Methodology. Prepared by the author.

To develop the exercise, it was applied in four courses of the architecture program, one during the day and another in the evening (From figure 3 to figure 6), for two elective semesters (one year). The exercise was applied in the elective Information and Communication Technologies. Each course consisted of 20 students and four groups of five students were formed per course. The procedure that was followed was composed of five steps organized below:

- Technological analysis: it is intended that students identify the various innovation possibilities that can be made from the study of an existing object through reverse engineering.
- The establishment of teams: consisted of selecting the type of collaborative team that will develop the process of technological innovation (Cubillos-Gonzalez, 2012; Nieto, 2010). Whether this be functional, matrix or self-contained.
- Production techniques and product quality: the organization, production and quality management from the study of the QFD matrix were analysed.

- Business model and business plan: once the innovation process was developed, the business model was designed, thus enabling the transfer of technology to the market.
- Spin-off: to propose a technological development project derived from scientific research process in order to optimally place the innovation product in the market.



Fig. 3. Day course student work. Prepared by the author.



Fig. 4. Day course student work. Prepared by the author.



Fig. 5. Evening course student work. Prepared by the author.



Fig. 6. Evening course student work. Prepared by the author.

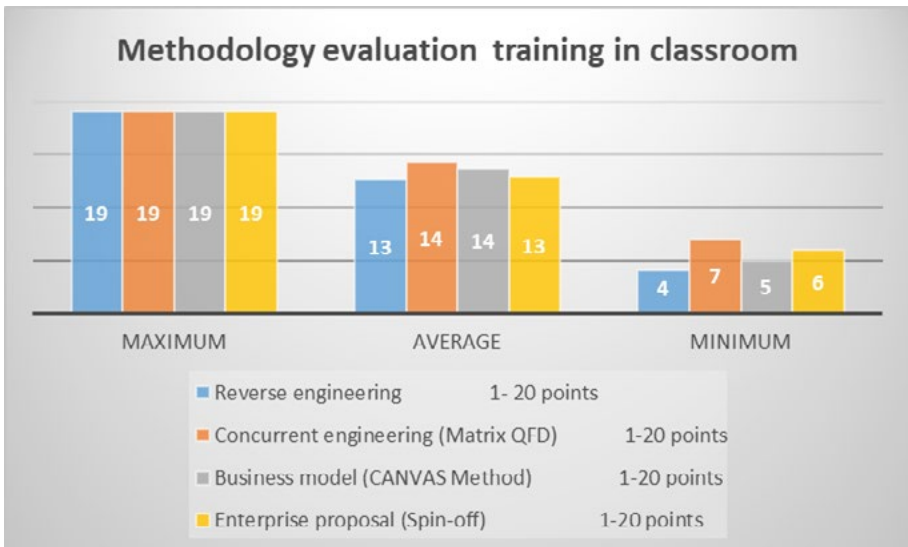


Chart 1. Student work results first semester. Prepared by the author.

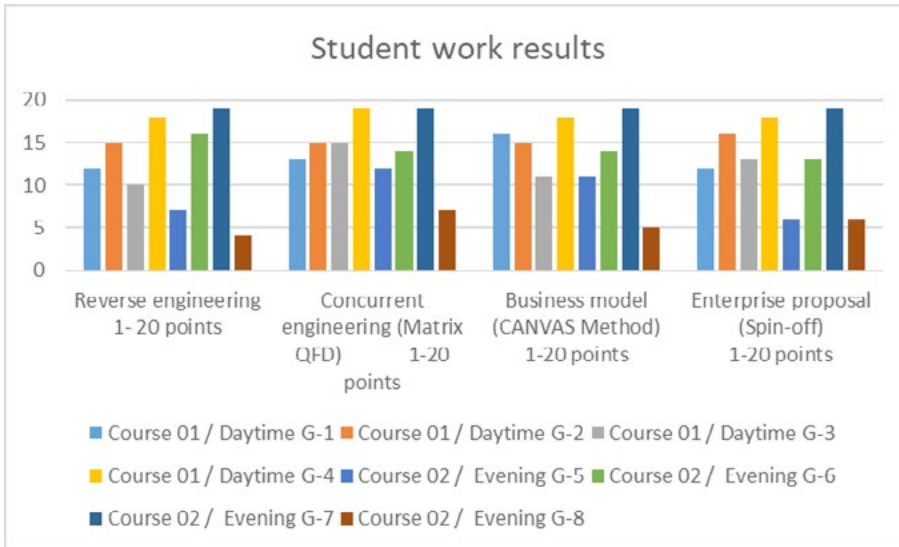


Chart 2. Student work results first semester. Prepared by the author.

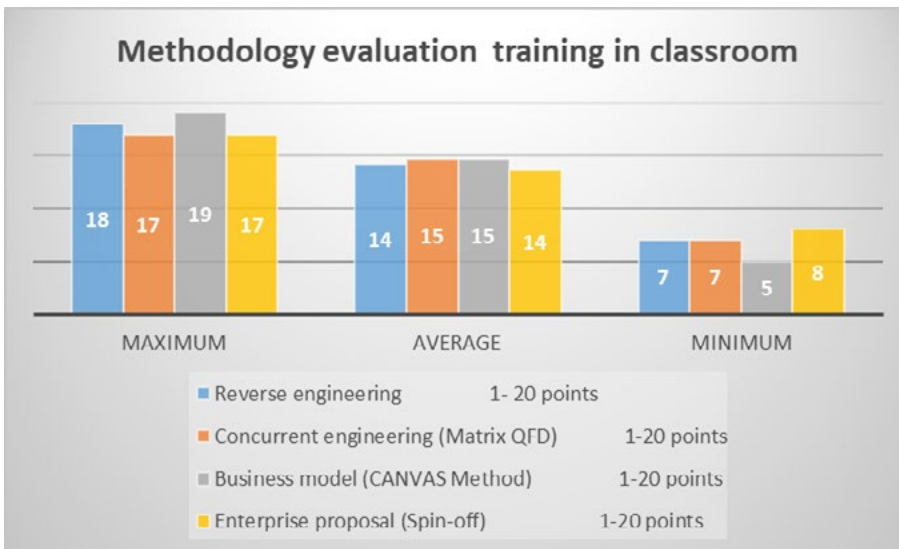


Chart 3. Student work results second semester. Prepared by the author.

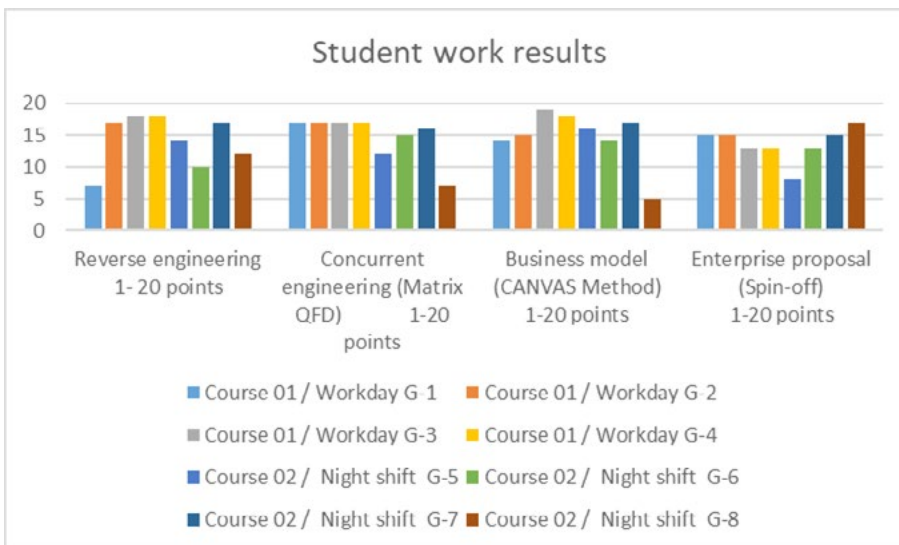


Chart 4. Student work results second semester. Prepared by the author.

Table 1. Datasheet fieldwork results. Prepared by the author.

Item	First semester		Second semester		Partial results	
	No	%	No	%	Total groups (No)	Total average (%)
Optimal results	1	12.50	0	0.00	1.00	6.25
Good results	4	50.00	0	0.00	4.00	25.00
Regular results	2	25.00	4	50.00	6.00	37.50
Poor results	1	12.50	4	50.00	5.00	31.25
Total	8	100.00	8	100.00	16.00	100.00

Table 2. Datasheet fieldwork results. Prepared by the author.

Item	Reverse engineering	Concurrent engineering (Matrix QFD)	Business model (CANVAS Method)	Enterprise proposal (Spin-Off)
First semester	24%	27%	26%	24%
Second semester	25%	26%	26%	24%
Average	24%	26%	26%	24%

Results

The results of the application of the exercise in first semester classes were as follows:

Of the eight working groups, one evening group achieved optimal results representing 12.5% additionally, a different evening group performed poorly, and representing 12.5% of the total sample. Furthermore, four groups achieved satisfactory results representing 50%. Two of these were daytime groups and two were evening groups. Finally, two groups achieved consistent results, representing 25%.

It is noted that in the 4 daytime groups the results are even; 75% of them are in a range of good results, while only 25% yielded regular results. Also for the evening groups the results are different, dividing evenly between bad, regular, good and excellent with 25% representation for each endpoint.

It is noted that the learning stages for the eight groups are similar, where 24% of the groups assimilated the stage of reverse engineering, while 27% of the groups assimilated the stage of Concurrent Engineering (Matrix QFD). 26% of the groups assimilated the application of the model Canvas.

Finally, 24% of the groups assimilated the Spin-Off stage. Two graphs that show the maximum, average and minimum achieved by the working groups are presented below. The scores obtained by groups at each stage of the proposed methodology (Chart 1 and 2) are also shown.

On the other hand, the results of the application of the exercise in the second semester classes were: Of the eight working groups, four groups achieved consistent results representing 50%, of these only one group was during the evening. Finally, four groups achieved poor results with a representation of 50% of the total sample. It is noted that in the daytime classes the results of the four groups are uniform, with 75% of them in a range of regular results, while only 25% yield poor results. For evening classes the results are poor with 75% representation for each endpoint and only 25% yielding good results.

It is noted that the learning stages for the eight groups are homogeneous, where 25% of the groups assimilated the stage of reverse engineering, while 26% of the groups assimilated the stage of Concurrent Engineering (Matrix QFD). 26% of the groups assimilated the application of the model Canvas. Finally, 24% of the groups assimilated the Spin-Off stage.

Below are two graphs that show the maximum, average and minimum achieved by the working groups in the second half. Additionally, in these graphs the scores obtained by groups at each stage of the proposed methodology are shown (Chart 3 and 4).

Finally, when comparing the two exercises applied to each semester, it is clear that the first half achieves better and more diverse results, compared with the second half which obtained between regular and poor results that are balanced.

With regards to the development of the process, a considerable difference in learning occurs in the first two stages, ranging from 24% to 27%. As for the last two stages, homogeneity is presented with a learning percentage of 26% in the penultimate stage and 24% in the last stage. This indicates that in the first stages students find it more difficult to analyse work references, but once they have overcome these stages an improved development of the exercise is noted (Table 1 and 2).

Discussion

As mentioned earlier in this article, the aim of this paper was to explain the implementation of a strategy to link classroom training and strengthen seed research within the Architecture program at the Catholic University of Colombia. As a result of this it was possible to identify how to apply the six investigative abilities a student needs in order to develop his training process within the context of analyzing the impact produced by climate change in the urban habitat.

The use of innovation and research processes made it possible to equate difficulties in order to build sustainable technologies and environments in the early stages of the process. It should be noted that in these stages skills such as adaptation to change, problem solving and teamwork are essential. As established in the results, this learning process is not homogeneous in the last three semesters.

For this reason it is necessary to emphasize the teaching proposal to fill conceptual gaps that students may have acquired during their training process. It is therefore necessary to identify future relations between different subjects in the first semester of the program, so that students can appropriately develop the investigative process in their last semesters.

On the other hand, it is clear that by overcoming the early stages of the process it is much easier for students to propose sustainable technologies and rapidly create technological environments. At this point, the use of techniques such as reverse engineering and concurrent engineering are essential.

They reinforce skills such as information and resource management with which students are appropriately oriented towards identifying innovation processes in order to do this, the resource business model from the Canvas technique allows them to systematize processes and connect research results with business plans.

Here it is important to note that the term business model refers to a broader concept than just a financial model. Finally the last stages of the strategy allow for the effective linking of the sustainable environment and technological environments. According to the results discussed above (Figures 1 and 3), these two stages allow one to perceive that students can develop processes of innovation and entrepreneurship once they have assimilated the skills of the early stages.

However, the results have found that in the evening classes it is much harder to develop the research training strategy. One reason is that students of the evening classes do not have sufficient time and they also form part of the labour force, which does not allow them to devote enough time to the research process. It is recommended that the training processes of the evening classes are evaluated, in order to propose a teaching method that suits the time schedules of these students.

Conclusions

As a summary, it is noted that it is necessary to introduce research training processes in the courses of the Architecture program in the School of Design. This involves giving a systemized vision of the process of sustainable design, which today is more oriented to innovation and industrialization with the aim of reducing environmental impact.

However, these processes require that the investigative training process is more applications, so that students can understand and incorporate these concepts into their daily work. Innovation processes are rigorous

and are closely linked to research processes. That is why the incorporation of research training methodologies from the hotbeds of research can be a contribution to the architecture program and its different electives.

In conclusion, this first applicative exercise changed the didactic teaching method of investigative abilities in students of eighth, ninth and tenth semesters of the Architecture program. Students learned to organize their ideas through systematic innovation processes that allowed them to develop IT tools that can then be transferred to the productive sector through business ideas that are oriented to respond to climate change.

To do this, the proposed methodology was applied in the classroom, enabling the simulation of an appropriate environment for research and innovation. It allowed the development of collaborative research orientated work in a short period of time. In the future it is hoped that this strategy will be strengthened and incorporated into the formative processes of the Architecture program at the Catholic University of Colombia.

Acknowledgements

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References

- [1] Barba, E. (2001). *Concurrent Engineering: A Guide for implementation in the company, diagnosis and evaluation* [Ingeniería concurrente: guía para su implantación en la empresa, diagnóstico y evaluación]. Gestión 2000.
- [2] Clark, T., Osterwalder, A., & Pigneur, Y. (2012). *Business model you: a one-page method for reinventing your career*. John Wiley & Sons.
- [3] Cubillos-González, R. (2011). *Technological development impact in the architecture field*. [El impacto del desarrollo tecnológico en arquitectura]. ARKA Revista de Arquitectura, 3, 54–61.
- [4] Cubillos-González, R. (2012). *Collaborative environments design through IT tools*. [Diseño de Entornos Colaborativos a Través de Herramientas TIC]. ARKA Revista de Arquitectura, 2, 78–91.
- [5] Nieto, J. (2010). *And you...innovate or abdicate? [Y tú... ¿Innovas o abdicas?]*. Valencia. Editorial Universitat Politècnica de València.
- [6] Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.
- [7] Parvin, A. 2013. *Architecture (and the other 99%): Open-Source Architecture and Design Commons*. Architectural Design, 83(6), 90–95.
- [8] Riba, C. (2010). *Concurrent design* [Diseño concurrente]. Universidad Politèc. de Catalunya. Ediciones UPC.
- [9] Riba, C., & Molina, A. (2006). *Concurrent design: an integrated methodology* [Ingeniería concurrente – una metodología integradora]. Universidad Politèc. de Catalunya. Ediciones UPC, 314.
- [10] Trebilcock, M. (2009). *Integrated Design Process: New paradigms in sustainable architecture* [Proceso de Diseño Integrado: nuevos paradigmas en arquitectura sustentable]. Arqitectura Revista, 5(2), 65–75.
- [11] Tooze, J., Baurley, S., Phillips, R., Smith, P., Foote, E., & Silve, S. (2014). *Open Design: Contributions, Solutions, Processes and Projects*. The Design Journal, 17(4), 538–559.
- [12] Universidad Católica de Colombia (2007). *Investigative skills to research training* [Competencias investigativas para la formación en investigación]. Editorial Universidad Católica de Colombia.

Effect of accessibility in housing complexes on shaping of beauty in the urban environment. Selected examples from Cracow

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Abstract: Attractiveness of the urban environment, most of all as a place of residence, but also as a place of recreation, work, and everyday activities is moulded by numerous factors, only some of which are purely aesthetic in nature. An important role can be also played by the functional aspect – that of accessibility as a possibility of moving around the urban structure freely. A tendency which is still commonly observed in contemporary housing investments is their complete or partial fencing. It is applied in suburban projects, as well as in broadly understood city centres. In the latter case it results in a private space with limited access, which often constitutes an actual barrier for pedestrian traffic and local traffic within the territory of the city district. This paper presents and analyses selected examples of several housing projects implemented in recent years in Cracow, as well as it examines the role which can be played by specific urban-planning and architectural aspects in moulding of the beauty of the city.

Keywords: accessibility, fenced housing estates, form of the city

Introduction

Beauty is a notion which is particularly difficult to define with reference to the city of parts thereof. It contains a considerable dose of subjectivity, although at the same time there are places the beauty of which is unquestionable and commonly recognised. Cities shaped during centuries-long processes of development and transformations, characterised by historical continuity, usually inscribe in this category, becoming important landmarks on the tourist map of the world¹. Amongst many other roles the city plays and needs it is to satisfy, it is still most of all the environment of man's residence. Creating conditions enabling to satisfy also the more complex needs should constitute the actual objective of actions undertaken within the scope of designing and managing of such a complex structure. Today, the tendency which seems to be getting more and more important is the conscious creation of the image of the city, 'branding' of some sort, which most often is based on highlighting selected features of the image, such a skyline containing characteristic structures. Sometimes the urban layout comes to the fore, a good example of which seems to be e.g. Barcelona, which succeeds in building its recognisability and uniqueness based on a regular grid of the *Eixample* project².

As early as in the 1960s, K. Lynch was one of the first to write about the appearance of the city and the possibility of conscious creation of its 'image', at the same time proposing effective tools allowing to link a flat drawn

1 Although the term 'urban tourism' is much more capacious and comprises a vast array of behaviours and activities, it can be generalised that it is a type of tourism, where the city and the attractions offered by it become the goal of the trip. Obviously, this is not a new phenomenon. It suffices to mention the tradition of 'Grand Tours', developing since the 14th century, although today this tendency becomes more and more common [2].

2 www.bcd.es – access on 17.09.2016.

map with the actual visual perception of space. Referring to the quality of the urban space, he emphasised the role of conscious arrangement, of composition of individual elements, which by operating within the scheme of a greater whole have their effect on the way the city is perceived [23, 25]. In Poland, K. Wejchert, working, as it were, on the foundation of the theory coined by Lynch, emphasises the decisive role of spatial composition 'in creating living condition in urban organisms' [36, p. 150]. Entering the realm of feelings and emotions, he claims that 'man's happiness will depend to a great extent on the architecture of space' [36, p. 272]. Today the condition of an individual towards the urban environment, their sense of well-being, is a value brought down to measurable indicators and subjected to diversified analyses [35]. According to a survey carried out recently, a place which offers the highest living standard among cities in Vienna, which outran other capital cities of Europe and all over the world. The survey took into account many economic, social and other aspects; none of them, however, referred even indirectly to aesthetics³. Hence a question arises whether beauty truly has such a minor effect on the measurable quality of life. Or perhaps we just reach for tools enabling to measure this beauty way too rarely⁴. J. Rykwert observes that 'deliberations on the physical form of the city are believed to be too old-fashioned or *aesthetic*, and therefore not serious enough to be taken into consideration' [33, p. 30]. However, as R. Florida et al. [8] demonstrate, there is a direct relation between the beauty of the urban environment and the level of satisfaction among the community that inhabits it.

The beauty of the city as a residential environment can be approached by means of the classification proposed by W. Kosiński [14], who proposes the following components: the beauty resulting from the landscape form, from the urban layout, and the beauty of architecture. Co-existence of these three values, therefore, decides about the attractiveness of the city of a part thereof. As W. Kosiński further observes, the beauty of the city should become the subject matter of research not only in the field of aesthetics, but also of empirical and analytical research, which will lead to conscious designing creation. What seems to be particularly interesting from the perspective of this article is the mutual relation of the two latter factors and their participation in the evaluation process. Whereas, by means of simplification, architecture can be approached as an arrangement of individual forms, the aesthetics of which remain combined with the current tendencies in art, the urban layout escapes simple assessments. Due to its complexity, extent, and transformations it is subjected to, it opens up the way to different kinds of perception [13]. Observation of sequences of empty spaces and buildings, panoramas and views, is a natural experience of each city 'user', communing – often unconsciously – with the factor of composition. Despite the existing theories, it is difficult to recognise that cities develop spontaneously according to mathematical rules of self-organisation, or that space in its physical form is a social construct [19]. Specific decisions are made by persons or groups, which due to the current balance of forces have the biggest effect on the physical form of the urban layout.⁵ Contemporary cities, as M. Dymnicka writes, 'constitute experimental laboratories of innovation and backwardness, affluence and poverty, 'cancer' and foundation of the world at the same time' [6].

Good form of the city

From the perspective of empirical research it is much easier to talk of a 'good' instead of 'beautiful' urban form, although in the philosophical approach these terms sometimes intermingle⁶. In several last decades many attempts have been made to define it in light of dynamically changing social, economic, and political conditions. Concepts which are worth attention among the arising and developing ideas are e.g. the concept

3 www.imercer.com – access on 21.09.2016. Similar results are provided by a study of the European Commission, assessing the quality of life in cities in 2015. Among many questions that were answered by respondents, the ones devoted to the level of satisfaction with the condition of streets and buildings and of public spaces (such as e.g. pavements and squares) were the closest to the field of aesthetics. In Vienna, which in this study, too, took the lead, the result was 88%; interestingly enough, the same indicator e.g. in Lisbon was only 40% [30].

4 This factor appears as one of the most important ones in the assessment of the quality of the city in an approach other than the morphological one, e.g. in the economic approach, although researchers emphasise that 'there are not enough studies determining the role of beauty of architecture'. [9].

5 In literature they are dubbed 'the agents of change' [5].

6 Sometimes beauty is approached as a synthesis of other values of the Platonic triad, although it is only one of many ways this notion can be interpreted [16], [38], as well as [7].

of 'the compact city'⁷, 'smart city'⁸, 'eco-city'⁹, 'creative city'¹⁰, determining also the mode of functioning and relations of the city versus the region, or pertaining to the organisation of the very form of the system, e.g. of 'New Urbanism'¹¹. It is assumed that by implementing the programmes referred to above it will be possible to shape the built environment in the spirit of sustainable development¹². Studies devoted to urban morphology introduce the notion of tissue as the basic material of the form of the city [17], [18]. The quality of the tissue will, therefore, have a decisive effect on the perception and evaluation of the entire layout, which comprises also such elements as functioning, social relations, and development potential. Adopting the criteria constructed by K. Lynch, we can assume that a good urban space should be characterised by:

- Vitality, understood as a biological ability to support life functions,
- Sense, which can be translated as identity, uniqueness, recognisability,
- Fitness, simply meaning the ability to satisfy the needs of the community and to adapt to changing behaviour,
- Access to other places and people, but also to different resources, information, and activities,
- Control performed by users and residents, who have their effect on the shape and functions of the place.

Additional meta-criteria mentioned by Lynch: effectiveness and equity, do not have a direct connection with the physical form of space, and their task is to determine an appropriate convenient manner of distribution of the costs incurred, as well as of the potential benefits [24].

The indicators referred to above, eventually formulated in the 1980s, due to their universality and a big potential of interpretation, seem to be applicable also today, when many challenges of the contemporary urban planning have remained in the theoretical phase.

Access as a form evaluation criterion

In the context of the emerging new housing projects, the factor of access comes to the fore as it is particularly important in case of locations inside the existing urban tissue. Lack of access, creating barriers, especially for the pedestrian traffic, contributes to the reduction of the quality of life, most of all in regions surrounding selected enclaves. In case of fenced housing estates or buildings, with controlled access, negative phenomena connected with separating parts of the space may comprise e.g. closing streets, no entry streets, hampered access for emergency services, fragmentation and disintegration of the urban tissue, creation of areas which do not foster social contacts [34]. Possible consequences include the need to use car transport instead of walking and cycling [22], although this phenomenon is encountered predominantly in vast, peripheral projects.

For the sake of an analysis of selected examples, one might venture to clarify and restrict this term. It is assumed that broadly understood access stands for the possibility of free movement and choosing convenient, also the shortest, routes, the easiness of reaching the destination and benefitting from all sorts of services, including recreation and rest, the possibility of satisfying basic needs in the closest neighbourhood. It is worth pointing out that such relations are usually characteristic for historical, compact urban systems [15], [17], [28]. Access defined this way may depend on the following interrelated parameters, which will be analysed in the selected cases:

- Size of the city block or an area separated by public roads
- Orientation of buildings towards roads, which also determines the character of the street interior
- Conditions for pedestrian and cycling traffic

7 Cf. e.g. [1],[12], [27], [29], [37].

8 Cf. e.g. [4].

9 Cf. e.g. [32].

10 Most of all works by R. Florida and Ch. Landry, cf. also [4].

11 Present most of all in the United States of North America. Cf. e.g. [3].

12 It is the broadest term, comprising all activities aiming to improve the well-being of present generations without any reduction of the chances of our successors to reach this state. It consists in two main concepts: satisfaction of needs – most of all of the poorest, and limitations – imposed by the state of the environment and the opportunities offered by technology, <http://www.un-documents.net/wced-ocf.htm> – access on 11.10.2016. Cf. also [35]

- Relations between a closed space and a space open to the public¹³, demarcation methods
- Diversity of the offered functions as the generator of pedestrian and local traffic.

Case of the district Krowdrza in Cracow

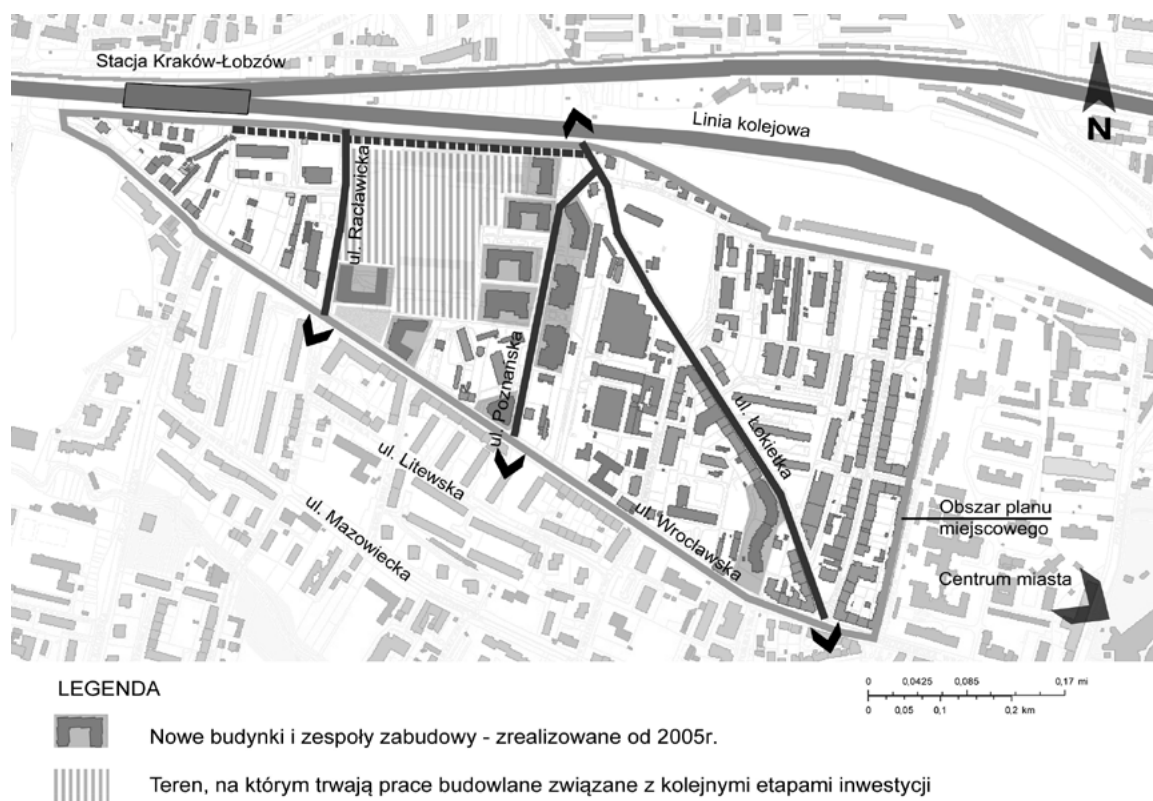


Fig. 1. Scheme of the new development.

Author's scheme on the basis of materials available at: <http://msip.um.krakow.pl/msip/>

The western part of Cracow is seemingly the most densely invested zone, where big production plants were built rather occasionally, there are also no typical housing estates with large-panel prefabricated blocks of flats there. There are, however, many areas which still can be used for new investments. One of the location when a specific development pressure can be observed, is the area along the railway line leading towards the west. The vicinity of the Royal Palace in Łobzów¹⁴, the park sequence of the former watercourse of the Młynówka Królewska river¹⁵, or the vicinity of the historical city centre make this location unique in the scale of the city. Until recently, this area was occupied by industrial plants and halls belonging to the Krowdrza Technology Park, Anczyca printing house, etc.; today most of them have been demolished and construction works on several projects are in progress now. The historical urban tissue of the nearby centre of Cracow creates a regular, relatively dense grid of streets and blocks. Compact, frontage architecture, characteristic for city centres, which

¹³ A more obvious differentiation may seem to be the division into the public and private space; nevertheless, according to the Author this division is not precise enough as the private space may be fully accessible, or – which is much more common – completely closed. In the categories of building and functioning of the urban tissue, access or lack thereof seems crucial. Cf. e.g. [21],[22].

¹⁴ Today the building belongs to the Cracow University of Technology and houses – without limitations – the Faculty of Architecture and the Faculty of Physics.

¹⁵ Providing water for e.g. the moat at the defence walls, the system of mills, and being the source of potable water for Cracow [26].

towards the west becomes more relaxed, intermingles with the territory of a villa housing estate from the early 20th century, which today is one of the most attractive parts of the city¹⁶.



Fig. 2. 1. First of the buildings planned as the '5th district' development. 2. New buildings along Poznańska street, seen from the construction site. 3. Second row of buildings among Poznańska street. 4. Poznańska street – view towards the north. 5. Fenced housing along Poznańska street. 6. Buildings' orientation along the new fragment of internal road.

Author's photo

¹⁶ Built on the grounds of the former fortress as a garden housing estate [39].

One of the first new investments implemented in this area is a relatively small housing estate called 'Fabryka Czekolady' (Chocolate Factory)¹⁷, erected in the place of one of the branches of the 'Wawel' chocolate factory, transferred in 2006 to Dobczyce near Cracow¹⁸ and covering the area of nearly 88a¹⁹. The complex, located at the junction of Wrocławska and Łokietka streets, at the edge of the historical block urban structure, will consist of four buildings²⁰, with the total of 72 apartments. The building which is the closest to Łokietka street forms a frontage along its section, whereas the rest of the building bends in gentle arches towards the centre of the plot, beyond the frontage. This complex of calm, modernising architecture, is completely fenced and provided with access control, creating a typical closed enclave. Another part of the project along Poznańska street²¹ consists of detached buildings, erected within the scheme of different investments²². Some of them have the character of extended urban villas with service outlets on ground floors, some of them are fully residential buildings. They shape the space of the city in different ways, only partially forming a frontage, which is continued by means of fences demarcating private spaces in the vicinity of individual buildings. This large-scale investment, in the media referred to as 'the 5th district', which is suggested by a fully functional fragment of the city, so far consists of two buildings at Wrocławska street, the remaining vast area reaching as far as to the railway line being prepared for development, but its final form is not known so far²³. Development of such a big area of the city, one may conclude, is left as a field of activities of several developers holding individual parts of the area. A detailed analysis can refer only to the existing buildings or structures the construction of which is in progress, which most probably constitute only a small fraction of larger projects, and the final form of this crucial part of the city²⁴ is still unknown. The local development plan for the area 'Łobzów – area of Łokietka and Wrocławska streets'²⁵ is rather general in the determination of the intended use and traffic connections, leaving great freedom in the design of the built environment and spatial relations on the demarcated areas. Location along the railway line constituting a serious spatial barrier, influencing the functioning of this part of the city, seems to be an additional factor which may hamper the integration of this new area with the surrounding structure.

Analysis based on the set criteria

At this stage, the size of the city block is a value difficult to be determined in case of a new project the majority of which is still not implemented. Nevertheless, as it can be concluded from the provisions of the local spatial development plan, the only public roads in the area in question will be the existing Poznańska, Wrocławska, and Łokietka streets, as well as an access road planned to be built along the tracks, which will demarcate a sort of a 'super-block' with the side length of 350m. It should not be assumed that contrary to the provisions of the plan this area will be additionally perforated with a traffic route accessible to the public. Nevertheless, nuisances caused by excessive car traffic are quite considerable and must not be disregarded; a public road also fulfils a citygenic [11], or 'tissue-genic', role [20], [28]. In the surrounding structure, in places where the logic of the existing road system allows to separate a form of the city block, most often its size does not exceed

17 Built according to a design by a Cracow-based studio 'Studio S', www.studios.krakow.pl – access on 09.09.2016.

18 www.wawel.com.pl – access on 08.09.2016.

19 According to the Author's measurements on the basis of the materials available on the website <http://miip.geomalopolska.pl/imap/> – access on 28.09.2016.

20 Two of them have been completed to date. Others, including the building which is to form the frontage of Wrocławska street, are in progress.

21 Until recently a dead end, today quite awkwardly linked to the nearby Łokietka street.

22 It is the location of buildings designed e.g. by Cracow-based studios 'Skoczek-Wojdacki' and 'B2 Studio' – <http://investmap.pl/> – access on 01.10.2016.

23 Developers' websites contain only photographs and visualisations of buildings which are on offer at the moment; considering the construction works in progress, the absence of the overall concept is quite puzzling, cf.: <http://www.murapol.pl/>, <http://poznanska10.pl/>, <http://terracasa.pl/>, <http://www.muratorplus.pl/>, as well as <http://msip.um.krakow.pl/msip/>, where one can only learn that the areas in question are subject to many sometimes overlapping decisions on the development conditions.

24 Covering over 25ha according to the Author's measurements on the basis of the materials available on the website <http://miip.geomalopolska.pl/imap/> – access on 28.09.2016.

25 The procedure of drawing up the plan currently in force is available on the website www.bip.krakow.pl.

200 m²⁶, which enables to move around and change directions freely. In case of architecture from the 1970s and 1980s, partially embedded in the surrounding tissue, a completely free flow of the pedestrian traffic is possible between individual buildings²⁷, and so is reaching service outlets or public transport routes located along the main streets.

The location of buildings in the space and their relation to the roads, along with the first criterion discussed above, influence the physical shape and perception of the space in the most distinct way. The frontage, its continuity or lack thereof, orientation of the building, location of the entrance – all this is crucial for building urban interiors of a specific character. The structure of Poznańska street, which constitutes one of the edges of the new 'block', although it came into being over the last decade or so²⁸, is definitely heterogenous. Detached buildings face the street with their fronts or sides, along the frontage line, or are shifted, preceded with a sort of square. One may have an impression that the opportunity to create a street with urban features, or even features of the city centre, considering the location, has not been properly taken. It seems legitimate to refer to the structure of the historical centre of Cracow as a comparative value. The block development is connected with the need to legibly define the front of the building – it usually faces the road, is easily accessible, which fosters arranging service outlets on ground floors. Natural separation of public and private spaces takes place not by means of fences and barriers, but by the way the edges are formed and the buildings are positioned. In this context the development of the western side, near the junction with Raclawicka street, seems to be more consistent in forming the space of the street. The buildings, simple and compact in their form, constitute – as it were – the beginnings of blocks, which perhaps will be continued. Their location respects the significance of the existing streets, as well as of the planned green square²⁹. The access to the buildings, as we can conclude on the basis of visualisations³⁰, is planned to be straight from the public space, and the ground floors will be occupied by service outlets.

The possibility of pedestrian and cycling traffic depends predominantly on the two values discussed above. Pedestrian routes can run long pavements of public roads, but also inside the planned spacious block³¹. The diversity of choice of the pedestrian route constitutes an encouragement to use this type of transport, which – as J. Gehl writes – 'strengthens the life of the city' [10 p.19]. The possibility of reaching one's destination conveniently in case of the pedestrian traffic is only one of the aspects, 'walking is a form of communication among people, who use the public space as a platform and setting for their activities' [10 p. 19]. In the area in question the rule of pedestrian accessibility is not legible yet. The previous utilisation was characterised by fragmentation and dispersion, access routes and roads to industrial and office buildings operated as extensions of the main street, whereas a vast majority of the area remained inaccessible. The railway tracks running along the northern edge constituted a strong barrier separating the tissue, and they still do, despite the pressure of the new buildings coming closer and closer, observed in recent years. In this context it may seem that the complete replacement of the development we witness today will automatically result in the improvement of the spatial order. This statement is not completely true. In the vicinity of Poznańska street we can observe projects which make use of the pedestrian routes located nearby, but which do not contribute to this system at all³², as well as structures which clearly demonstrate the effort to provide a higher quality social space³³. The continuity of pavements along the street is disturbed with driveways to underground garages and private parking spaces assigned to individual buildings. Along adjacent fences there are still narrow passageways leading to the buildings located in the second line, which have been there for years. Creating alternative pedestrian

26 Due to the heterogeneity of this part of Cracow, obviously this value is considerably simplified; for the sake of comparison, along a part of Królewska street a relatively regular grid of streets demarcates ca. 159m blocks.

27 Block of flats at Mazowiecka, Litewska, and Wrocławska streets.

28 The so-called 'Kamienice Herbowe' buildings were completed in 2009, the apartment building at 10 Poznańska street – in 2016, the buildings in the northern part of the street are under construction.

29 Design by 'B2 Studio' for the company LC Corp. <http://www.lcc.pl/pl/5-dzielnica> – access on 03.10.2016.

30 <http://www.lcc.pl/pl/5-dzielnica> – access on 03.10.2016.

31 As it is the case e.g. in the residential complex 'Wiślane Tarasy' in Cracow, where the pedestrian, having passed the gates of the security services, can move around the buildings freely, use the attractions of the pedestrian route in the seemingly public, but controlled space. The roads intended for car traffic dividing blocks of buildings are not public roads and are accessible only to residents and users. <http://www.wislanetarasy.pl/> - access on 03.10.2016.

32 Like the 'Chocolate Factory' referred to above.

33 Like in the building 'Poznańska 10', in front of which there is a small square designed with great care and attention to details.

routes, interconnected sequences of interiors, thanks to which it is possible to move around the city not only along the main roads, is a commonly observed global tendency, legible especially in historical cities³⁴, and the accessibility for pedestrians and important connections are determined at the stage of drawing up the local development plan.

In the relation between the open and closed space, the lack of any rule is perceivable again. In the area in question one can find fenced, controlled enclaves, where access to buildings located deeper is possible only from a private, closed space, as well as intermediate solutions, where most of the plot assigned to the building, except for the front elevation, is surrounded with a fence. Against this background, unfenced buildings clearly stand out – these are structures the surroundings of which have been designed as a public space³⁵, although it, too, is restricted, ending with a fence on the side of the neighbouring plot. Another phenomenon that can be observed is the secondary fencing of the existing buildings, which results in a maze-like form of access roads and pavements. Investments launched on the western side, located at Wrocławska and Raclawicka streets, seem to follow a more urban layout, where the building elevation is a border of the public space. The architecture that is planned for the interior of this area is still unknown. Instead of the two structures referred to above, it might finally correspond to the layout commenced at Poznańska street, where by and large it is the fencing, and not the spatial structure, that decides about privacy or public accessibility.

The diversity of the functions offered with reference to the development which is planned to be a housing estate for several thousand people³⁶ constitutes a disputable issue. In some buildings along streets service outlets are planned in the ground floors, which perhaps will become elements enhancing the functioning of the public space. Simultaneously, however, fully residential buildings come into being, which do not make full use of the potential offered by the location inside the urban structure. Moving away from the street, putting a fence around the ground floor, makes it impossible to create an active, living front of the building. Minor commercial services, possibility of satisfying basic needs within a convenient distance – this is only one side of the problem. It can be solved without the need to go beyond the ground floors of the designed buildings. Their diversity, however, depends on the will of the tenants, which may lead to certain monotony, and eventually to the lack of the planned diversity. The second issue concerns the services of education, culture, recreation, catering, healthcare, etc., which most probably are not taken into account in the plans in force. Announcements encouraging to purchase apartments mostly emphasise the vicinity of the existing infrastructure, such as schools, pre-schools and day-cares, attractive green areas and sports facilities. Therefore, the use of the existing values will not be balanced with the construction of any new infrastructure which could serve the entire district. It is a common tendency, partly resulting from the imperfection of the planning model in force, further conditioned by economic factors. Whether we like it or not, access to the services referred to above will be limited in two ways: by the distance and barrier to be overcome, and by the receptivity of the existing structures³⁷. Lack of diversity may result in the creation of a bedroom suburb, which – deprived of appropriate facilities – will become an enclave excluded from the urban use, in the same way that industrial areas used to be inaccessible not so long ago.

34 Like in case of many other successful projects from the field of urban planning, one can have a look at the example of Barcelona, where for more than ten years now attempts have been made to reclaim the city for pedestrians, e.g. by opening and developing interiors of city blocks, or by limiting the car traffic [31].

35 It is the building 'Poznańska 10', referred to above, and – paradoxically – one of the first buildings to be erected here, the house called 'Dom pod klonami', located at the corner of Wrocławska and Poznańska streets, designed by 'Skoczek-Wojdacki'.

36 Almost 1200 apartments have been built in the buildings already completed or still under construction to this day. Despite the fact that most of them are rather small (1 or 2 rooms), it increases the population of this district by ca. 3 thousand people. Assuming similar intensity of the next stages of development, it will offer another 1600 apartments for 4 thousand people. Source: the Author's calculations on the basis of the data provided on the websites of the investments: <http://investmap.pl>, <http://poznanska10.pl/>, <http://terraccasa.pl/>, <http://www.lcc.pl/pl/5-dzielnica>, <http://www.murapol.pl>, <http://www.urbanity.pl/> and on the portal of the city information <http://msip.um.krakow.pl> – access on 07.10.2016.

37 According to the statistical data, in 2014 Krowodrza was inhabited by over 39 thousand people. Increasing this number by the assessed 7 thousand may change the functioning of this part of the city considerably.

Summary

It seems that the most obvious component of the image of the city is the architectural expression of buildings. Nevertheless, studies in the field of urban morphology devoted to the urban tissue demonstrate that in contrast to the urban disposition, most often legitimised with the ownership division, it is a parameter which can be subjected to relatively frequent changes³⁸; hence, in the long run its role in shaping the complete image of the city may be weakened. Even different articulation of elevations and the selection of finishing materials usually have a considerable effect on the architectural expression of the entire building. S. Gzell claims that 'when analysing the importance of architecture in the creation of the image of the city we must not forget that it depends even more on the quality of urban spaces (...), that is on what for years now we have called urban composition, creating the spatial order. It is no secret that this spatial order comes into being most certainly as a result of building large urban complexes, as they contain a code (...) of a high degree of spatial and functional coordination between individual elements of the whole. Consequently, large-scale systems decide about the image of the city' [12, p. 71].

The analysed case can definitely be dubbed a large-scale one, and its significance in the scale of the city seems considerable. Individual stages, implemented independently from one another by separate entities, are characterised by a certain degree of accidentality. Despite the fact that the projects in question mostly do not inscribe in the most classic system of closed housing estates, they do not satisfy the set criteria determining the quality of the tissue by means of the accessibility, either. Only to a certain extent can attractive architecture of individual buildings compensate for the observable weakness of the spatial layout, where the public space has been reduced and deprived of continuity. Beauty in the city occurs as a result of harmonious cooperation of a good urban form and high-quality architecture.

Literature

- [1] Burton E., Jenks M., Williams K., *The Compact City: A Sustainable Urban Form?*, Routledge, London, 2003
- [2] Chaney, E., *The Evolution of the Grand Tour: Anglo-Italian Cultural Relations since the Renaissance*, Frank Cass Publishers, London – Portland, OR 1998
- [3] Congress of the New Urbanism, Talen E., *Charter of the Urbanism 2nd Edition*, McGraw Hill Professional, 2013
- [4] Deakin M., (ed), *Cerating Smart-er Cities*, Routledge, Oxon, 2013
- [5] Deptuła M., *Idea podmiotowego sprawstwa w morfologii miast*, [in:] *Acta Universitatis Lodzianis Folia Geographica Socio-Oeconomica* 21, Łódź 2015 pp. 85–99
- [6] Dymnicka M. *Przestrzeń publiczna a przemiany miasta*, Wydawnictwo Naukowe Scholar, Warsaw 2013
- [7] Eco, U. Red, *Historia Piękna*, Rebis, Poznań, 2006
- [8] Florida R., Mellander C., Stolarick K., *Beautiful Places: The Role of Perceived Aesthetic Beauty in Community Satisfaction*, [in:] *Regional Studies* 45 No1, 2011 pp. 33–48
- [9] Glaeser E.L., Kolko J., Saiz A., *Consumer City* [in:] *Journal of Geographic Economy Volume 1 Issue 1, Oxford University Press, Oxford, 2001*
- [10] Gehl J. *Miasta dla ludzi*, Wydawnictwo RAM, Cracow 2014
- [11] Gzell S., *Miastotwórcza rola transportu w teorii urbanistyki* [in:] *Czasopismo Techniczne, 1-A/2010, zeszyt 3 rok 107, Publishing House of the Cracow University of Technology, Cracow 2010, pp. 5–19*
- [12] Gzell S., Wośko-Czeranowska A., Majewska A., Świeżewska K., *Miasto zwarte. Problem terenów granicznych*, Urbanistyka, Międzyuczelniane zeszyty naukowe- 2011, Akapit-DTP, Warsaw 2011
- [13] Kantarek A., *O orientacji w przestrzeni miasta*, Publishing House of the Cracow University of Technology, Series: Architecture, Monograph 368, Cracow 2008.
- [14] Kosiński, W., *Preliminaria badań nad problematyką : piękno miasta*, [in:] *Przestrzeń i Forma* 2008 No. 10 pp. 13–42
- [15] Kostoff, S., *The City Assembled: The Elements of Urban Form Through History* Thames and Hudson, London, 1992

38 As P. Larkham writes, 'Carried further, morphological studies have also tended to show that there is a hierarchy of change within urban features. Buildings can change fastest, from alterations to complete demolition and replacement, in reaction to changing use requirements including an owner's desire to personalise a house (...). Most resistant to change is the street network (...). Nowadays, the investment in underground infrastructure beneath our streets helps to fossilise this pattern still further' [18].

- [16] Krąpiec M.A., Kamiński S., Zdybicka Z.J., Maryniarczyk A., Jaroszyński P., (ed.): *Wprowadzenie do filozofii*. Publishing House of the Catholic University of Lublin, Lublin 2003
- [17] Krier L., *Urban Components* [in:] Papadakis, A., Watson, H. (eds), *New Classicism: Omnibus Edition*, Academy Editions, London 1990, pp. 96–211.
- [18] Larkham, P., *Understanding Urban Form*, [in:] Evans, R. (ed.), *Urban Design*, Winter, Issue 93, Urban Design Group, London 2005. Online access: <http://www.rudi.net/books/6053> on 08/06/2006.
- [19] Lefebvre H., *The Production of Space*, Blackwell, Oxford, Cambridge MA 1991
- [20] Levy A., *Urban morphology and the problem of modern urban fabric: some questions for research*, [in:] *Urban Morphology Volume 3.2*, 1999, pp. 79–85
- [21] Lorens P., *Główne typy i rodzaje współczesnych przestrzeni publicznych*, [in:] Lorens P., Martyniuk-Pęczek J., (ed.) *Problemy kształtowania przestrzeni publicznych*, Wydawnictwo Urbanista, Gdańsk, 2010
- [22] Low S., *Behind the Gates*. Routledge, New York 2003
- [23] Lynch K., *Obraz Miasta*, Wydawnictwo Archivolta, Cracow 2011
- [24] Lynch K., *Good City Form*, MIT Press, Cambridge, MA 1981
- [25] Lynch K., Rodwin L., *A Theory of urban Form*, *Journal of The American Planning Association*, 24 : 4, 1958, pp. 201–214
- [26] Małocha M., Hebda-Małocha A., *Gospodarcza rola Młynówki Królewskiej w Krakowie i jej wpływ na obecne zagospodarowanie miasta* [in:] *Czasopismo Techniczne z.15 Środowisko z. 2-Ś*, Publishing House of the Cracow University of Technology, Cracow 2007
- [27] OECD *Compact City Policies: Comparative Assessment*, OECD, Paris 2011
- [28] Panerai P., Castex Jean., Depaule J-C., Samuels I., *Urban Forms: The Death and Life of Urban Block*, Architectural Press, Oxford 2004.
- [29] Paszkowski Z., *Miasto idealne w perspektywie Europejskiej i jego związki z urbanistyką współczesną*, Tow. Autorów i Wydawców Prac Naukowych "Universitas", Cracow, 2011.
- [30] *Quality of Life in European Cities 2015*, Publications Office of the European Union, Luxembourg, 2016
- [31] Roca E., Aquilué I., Gomes R., *Walking the City. Barcelona as an urban experience*, Edicions Universitat Barcelona, Barcelona 2015
- [32] Roseland M., *Dimension of the eco-city*, *Cities*, Vol. 14, No. 4., Elsevier Science Ltd, Amsterdam 1997, pp. 197–202
- [33] Rykwert J., *Pokusa miejsca. Przeszłość i przyszłość miast*, International Cultural Centre, Cracow 2013
- [34] Roitman S., *Gated communities: definitions, causes and consequences* [in:] *Proceedings of the Institution of Civil Engineers: Urban Design and Planning* 163 March 2010 (DP1) pp. 31–38
- [35] Schneider-Skalska G., *Kształtowanie zdrowego środowiska mieszkaniowego. Wybrane zagadnienia*, Publishing House of the Cracow University of Technology, Series: Architecture, Monograph 307, Cracow 2004.
- [36] Wejchert K., *Elementy kompozycji urbanistycznej*, Warsaw 1974
- [37] Williams K., *Can Urban Intensification Contribute to Sustainable Cities? An International Perspective*,
- [38] Zając W., *Piękno jako wartość : konteksty pedagogiczne*, [in:] *Chowanna 1–2008*, Publishing House of the University of Silesia, Katowice 2008, pp. 57–70
- [39] Żychowska M.J., *O potrzebie zachowania architektury modernistycznej w Polsce* [in:] Sołtysik M.J., Hirsch R., *Modernizm w Europie. Modernizm w Gdyni. Architektura lat międzywojennych i jej ochrona* City Hall Gdynia, Gdynia 2009. pp. 179–185

Architecture in transition: the case study of the dormition cathedral in Volodymyr Volynskyi

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Abstract: There are considered the key architectural transformations of the famous architectural monument, the Dormition Cathedral in Volodymyr (now Volodymyr Volynskyi, northwestern region of contemporary territory of Ukraine) during the XII – XIX centuries. The circumstances and motivations that have resulted in radical constructive and stylistic changes of this temple at certain stages of its existence have been retraced. The dependence of architectural changes of the temple on social, political, religious and subjective factors is revealed.

Key words: Volodymyr Volynskyi, Dormition cathedral, Greek-Catholic architecture, Orthodox architecture, architectural trans-morphism, Pavel Giżycki, Adrian Prakhov, Grigorii Kotov.

Introduction

Dormition of the Mother of God Cathedral in Volodymyr Volynskyi belongs to the relatively small group of architectural monuments in Ukraine, dated back to the Old East Slavic (Old Rus') times. During its long life, the shrine was subjected to multiple changes in its original appearance. There can be separated several important stages in its history: the construction of a temple in the 1150s, a large-scale reconstruction in the middle of the 18th century, and a massive restoration of a possible original appearance at the end of the 19th century. The result of the last one is visible now. Although the last restoration was based on the subjective vision of the architect and restorer, in general, it is an attempt to reproduce the general nature of the original.

The first five centuries

The first chronicle mention of this ancient Old Rus' temple dates to 1160. It is extremely concise and does not contain any details on architectural peculiarities. It is noted that Prince Mstislav Izyaslavovich built in the city of Volodymyr-Volynskyi holy church in the city and decorated it perfectly¹. He subsequently was buried here in 1170². In the future, this shrine is often referred to as the Mstislav Temple in honor of the builder.

During the 12th – 13th centuries the temple remained the center of the Orthodox Volodymyr diocese, performing the functions of the cathedral. It is known that during the Tatar invasion in 1491 the Cathedral of the

1 Полное собрание русских летописей. Спб., 1862. Т. IX (Никоновская летопись). С. 229.

2 Літопис руський. Київ, 1989. С. 302–303.

Dormition was greatly injured in the large city fire. However, Bishop Vassian managed to restore the temple in 1494 already, as mentioned in the chronicles³.

The only thing can be judged about the original appearance of the newly built cathedral is planning system. It was a rather large temple with six columns and threeapses with a length of 34.7 m, a width of 20.6 m⁴ (Fig. 1). Unfortunately, the original tops of the ancient temple have been lost long time ago and today only hypothetical attempts of its graphic reconstruction are available.

The church was significantly damaged in 1565 during the battle for the episcopal post between the Orthodox bishop of Chełm Teodozy Lazowski and the nobleman Iwan Borzobohaty-Krasieński. It came to the gunfire of the cathedral with devastating consequences. Only in 1588, "negligent" bishop F. Lazovsky had to repair the temple at the insistence of the Kyiv governor, Prince Vasyl Kostiantyn Ostrozky⁵.

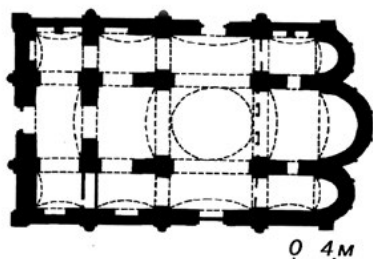


Fig. 1. Volodymyr-Volynskyi. Cathedral of Dormition of the Mother of God. C. 1260. Ground plan. After P. Rappoport (1982, p. 105–106).

Conversion into the grec-catholic church

A new stage in the history of the cathedral relates to its transition under Greek Catholic Church after the Union of Brest in 1596. Due to the active work of the first Greek Catholic bishop, the "apostle of union" Hipacy Pocij, the temple became the center of a new confession in Volhynia and achieved the highest glory.

Bishop Joahim Morochoowski, successor of H. Pocij, strengthened the episcopal mansion with a new stone fence with towers and weaponry. In the 1640s, Bishop Jozef Bakowiecki-Mokosiej built a masonry bishop's house instead of the old wooden one, near the southern wall of cathedral.

In 1683, the cathedral suffered from a citywide fire, which resulted in damage of pediments and masonry towers, and after some time and the vaults collapsed⁶. Former Volodymyr Bishop Lew Szlubic Zalenskyj began restoration works, which lasted several years. In this context, there is a Piotr Krasny's assumption that L. Zalen-sky did not confine to a simple repair of the burnt temple but made its complete rebuilding⁷. However, in our opinion, it is unlikely that it was subjected to radical changes. Such a restructuring would require a holistic design concept and was impossible without involving experienced architect.

Substantial changes in the appearance of the Dormition Cathedral took place already in the 18 c. under the rule of the Greek Catholic bishop and metropolitan of Volodymyr Leon Kiszka (1711–1728), who had to eliminate the consequences of another great fire. Not for nothing contemporaries characterized him as a "glorious restaurator". However, as Orest Lewicki stated, he did not complete the reconstruction, as in his death will there was signed twenty thousand złoty over its continuation⁸.

Another "reparation" of the Cathedral began in 1753 and became a milestone in its history. Bishop Teofil Godebski, who initiated that, testified that he was able to "build the Volodymyr Cathedral as different from

3 Левицкий О. И. Историческое еписание Владимиро-Волынского Успенского храма, построенного в половине XII века князем Мстиславом Изяславичем. Киев, 1892. С. 49.

4 Раппопорт П.А. Русская архитектура X-XIII вв. Каталог памятников. Ленинград, 1982. С. 106.

5 Левицкий О.И. Историческое описание... С. 53.

6 Op.cit. С. 68.

7 Krasny P. *Katedra unicka w Chelmie. O problemach badan nad architekturą sakralną Kościoła grekokatolickiego w XVIII w. // Sztuka kresów wschodnich*, 1998. T. 3. S. 211.

8 Левицкий О.И. Историческое описание... С. 71.

other churches"⁹. It is evident from this statement that in fact a new shrine with late-baroque features was built. The professional level of rebuilding reveals the involving gifted architect, who managed to carry out a full-scale "conversion" of the Byzantine archetype into baroque stylistics. The stylistic handwriting of this transformation gave Jerzy Kowalczyk the idea to attribute it to famous architect of the middle of the 18th century, the Jesuit Paweł Giżycki¹⁰. A. Betlej, the author of the monograph on P. Giżycki's artwork, confirm this version, noting the involvement of this architect in the construction of the entrance gate¹¹. It should also be mentioned the distinct similarity of the triangular pedaments in the old drawings of the Cathedral and the existing St. Joahim's and St. Anna's Parish Church, also designed by P. Giżycki¹².

Consequently, T. Godebski's rebuilding campaign had put the final point in the long-term process of convergence of the Greek-Catholic architectural paradigm with the Baroque European experience. It was a large-scale reconstructive project, the main essence of which was the "reformatting" of the old architectural structure, including the creation of a unique exonarthex. With appearance of this structure, the process of transition from the Old Ruś original with its expressive centrisism to the composition of the basilica's type with a characteristic accent of the longitudinal axis and with the dominance of the western forehead facade was completed. We can only offer our own graphic version of this reconstruction (Fig. 2).

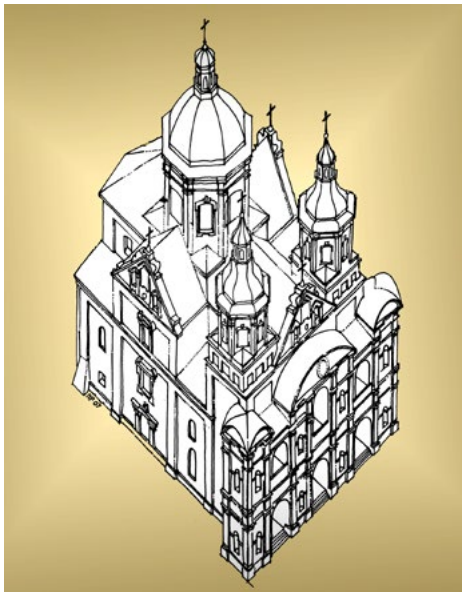


Fig. 2. The Dormition cathedral in the mid of 18th c. Hypothetical reconstruction by P. Rychkov.

As a result of architectural innovations by T. Godebski, temple became about three meters longer, and its western part – by six meters wider. He also had a plan to construct a monumental brick bell tower instead of the old wooden one. He casted a huge copper bell for it 500 pounds in weight, but because of his death in 1756 these plans have not been implemented.

The characteristic planning of the Old Ruś temple and its cross-in-square structural system had much in common with the models of temple construction of those times. However, the final spatial transformations in 1753 were extremely significant, therefore it was very difficult to imagine how the temple looked like 600 years ago.

The existing iconography of the Cathedral, which reproduces the results of late baroque reconstruction, clearly illustrates this circumstance. There can be identified main components, on which this transformation was based: the fundamental changes in the spatial composition with transept separation, the extension to the

9 Op. cit.

10 Kowalczyk J. *Znaczenie wzorów Giówanniego Battisty Montano dla architektury barokowej w Polsce i na Litwie* // *Biuletyn Historii Sztuki*. 2000. N 1–2. S. 35, 42.

11 Betlej A. *Paweł Giżycki SJ architekt polski XVIII wieku*. Kraków, 2003. S. 80–81.

12 Ричков П.А., Луц В.Д. *Сакральне мистецтво Володимира-Волинського*. Київ, 2004. С. 90–91.

western facade of two-level arched loggias (exonarthex), the active application of baroque forms – both in the exterior and in the interior. Based on these changes, P. Krasny did not accidentally attribute this building to the group of basilicas with double-towered façades. However, it should be noted that this characteristic refers to the rebuilt temple and is not attributed to the original ancient building.



Fig. 3. West elevation of the Cathedral of Dormition. Postcard. End of 19th cent.

The most important innovation was the extension to the western facade of exonarthex in the form of two levels of the loggia: first one at the ground level, and the second one at the level of the choirs (Fig. 3). Both levels had three open loggias with half-circle vaults. At the same time, the central loggia of the second level was higher than the others, accentuating the main compositional axis. Screw stairs to the second level were arranged in one of the pylons. The loggias were separated by massive pylons, attached to the old western wall. Winding staircase to second level was arranged in one of the pylons. The facade and exterior side surfaces of the pylons were decorated with paired pilasters, between which half-circle niches (loggettias) were arranged at both levels for the sculptural figures of the saints.

The creation of the exonarthex, obviously, was intended not only to make the architectural image of the Greek Catholic shrine closer to the formative traditions of European architecture. The monumental facade composition with six loggias, open to the pre-cathedralsquare, gave additional opportunities for conducting special liturgies in the open air. According to O. Levytsky, it should remind believers the portico of the St. Peter's Basilica in Rome, from which the Pope gives traditional address "The Urbi et Orbi"¹³.

Thus, in the middle of the 18th century the Cathedral of Dormition received a new architectural image based on of late-baroque style. The logic of these changes generally correlates to the general principles of the late Baroque. However, it cannot but mentioned the role of denomination preferences in the Greek Catholic Church. That was the decision of the Union of Zamość in 1720, in which it was not the last position to maintain properly the existing and build new temples. Therefore, significant rise of the new construction of the Greek Catholic denomination was observed in the second and third quarter of the 18th century. New initiatives were often accompanied by the destruction or radical rebuilding of the old temples (Chełm, Lviv, Pochaiv, etc.). In fact, late baroque transformations of the Cathedral, which apparently in their "old-fashioned" architecture no longer corresponded to the new image needs, should be considered in the context of occidentalization ("westernization").

Unfortunately, further repairs were devastating. Symeon Młocki, the last Greek-Catholic bishop, in 1782 planned to cut stairs in the north-western inner supporting element to the preaching pulpit. The consequences were catastrophic. The weakened support fell, pulling a part of the vaults and roof. The cathedral was open to devastating atmospheric influences, and repair work were conducted slowly. It was placed at the disposal of the Russian state treasury department, and in 1806 he was transferred to the Orthodox department in such a dilapidated state, after Third Partition of Poland.

Under patronate of Russian ortodox church

The first half of the 19th century was associated with unsuccessful attempts to rebuild the cathedral. However, the destruction of the temple continued and in 1878 in the official report it was noted that now there are "only the walls"¹⁴ (Fig. 4).



Fig. 4. Ruins of the Cathedral of Dormition. Litograph 1860s. After: Памятникирусскойстарины в западныхгуберниях. Вып.1. СПб. 1868.



Fig. 5. Ruins of the Cathedral of Dormition. Photo by A. Prakhov. 1886. After: Памятники Вольни. Альбом фотографий к археологической поездке проф. А.В. Прахова на Вольнь. Collection of National Bibliotheca of Ukraine in Kyiv.

Finally, in 1886, extensive studies of the temple ruins began. In the conditions of active support of the royal power and the Orthodox Synod, the rebuilding of the Assumption Cathedral as one of the most ancient shrines of the Old Ruś era became real. At the same time, the main issue that troubled the researchers and the public was how exactly the architectural forms should be reproduced at the same time. However, the answer to this question was to study the actual state of a semi-destroyed temple.

The well-known Kyiv art expert Professor Adrian Prakhov was to be the first to examine thoroughly the structures and make architectural measurements of the temple ruin. Finally, in 1886, he performed a series of documentary photos that recorded the actual state of the building, in particular its appearance from the north-east (Fig. 5).

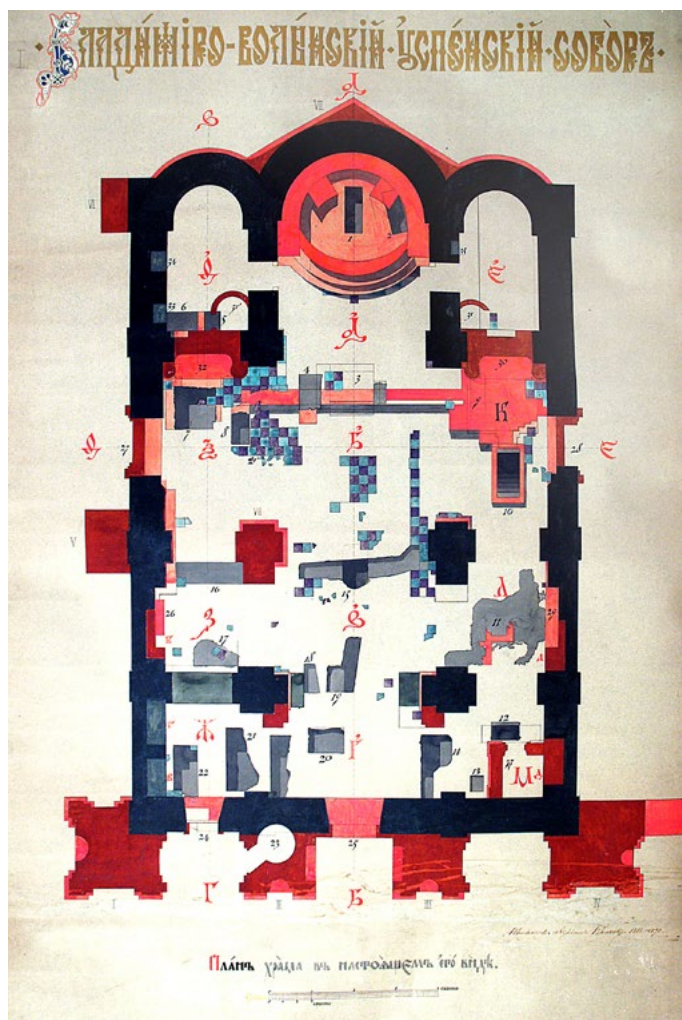


Fig. 6. Plan of the Cathedral of Dormition with structural additions (in red) made in 18th cent. The analytical drawing by A. Prakhov. 1886. Source: A. Prakhov Collection of the Volynian Museum of Regional Studies (VMRS).



Fig. 7. Western elevation of the Cathedral of Dormition. Drawing by A. Prakhov. 1886. Source: VMRS.



Fig. 8. Northern elevation of the Cathedral of Dormition. Drawing by A. Prakhov. 1886. Source: VMRS.

A. Prakhov also made a series of detailed dimensional drawings as of 1886. Initially, he recorded a plan of the temple, on which he painted in red all the structural elements not attributed to the original building of the 12th century (Fig. 6). At the same time, he performed detailed measurements of the exterior facades and

drawings of internal sections. These drawings not only gave a detailed idea on the actual state of the Cathedral at that time but could serve as the source material for the reconstruction project (Figures 7–10). At the same time, they characterize A. Prakhov as a virtuosic master of architectural graphics. His drawings consist of eight large-scale sheets with the reproduction of plans, facades and sections of the Cathedral are now kept in the funds of the Volynian Museum of Regional Studies.



Fig. 9. Longitude section of the Cathedral of Dormition. Drawing by A. Prakhov. 1886. Source: VMRS.

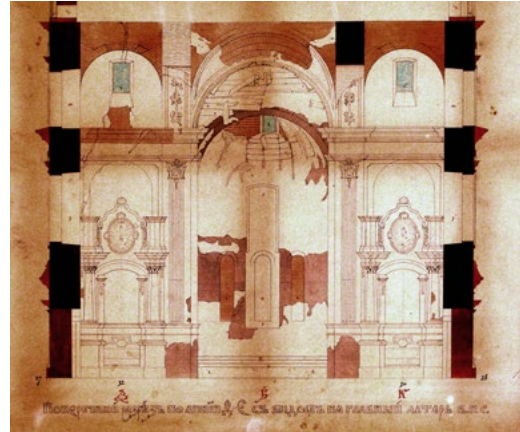


Fig. 10. Cross-section of the Cathedral of Dormition. Drawing by A. Prakhov. 1886. Source: VMRS.

The reconstruction project by Adrian Prakhov

After performing a large amount of research works, Professor A. Prakhov's attempt to offer his own version of the rebuilding of the Cathedral seems to be quite logical.



Fig. 11. Project of the Cathedral of Dormition reconstruction. Western elevation. Architect A. Prakhov. 1886. Source: VMRS.

His design proposal was based on the use of ancient "Greek-Russian forms of the twelfth century"¹⁵. The restored temple was supposed to have five-domes. At the same time, the central dome was seen by the author in the form of mitra, and smaller domes – in the form of a skufia. He considered appropriate to preserve partially those architectural forms that appeared in the 18th century, the monumental exonarthex on the western facade. The sculptural and picturesque images of the saints, symbolically associated with the sacred history of Russia (fig. 11), should appear in the niches and on the main pediment. However, such an original project idea did not find support among the public and clergy.

It was decided to continue studying the remains of the temple and make a more acceptable version of the reconstruction based on it, more relevant stylistically to the traditional forms of Russian temples constructed in the Pre-Mongolian age. It was styled as a work of the Old-Russian Chernigiv Architecture School.

The reconstruction project by Grigorii Kotov

After lengthy professional discussions, the development of a new project was entrusted to St. Petersburg architect Georgii Kotov (1859–1942). His project envisaged the complete destruction of all architectural changes and additions related to the Greek Catholic period. In contrast to the previously proposed A. Prakhov's "five-headed" variant with one helmet-shaped dome on a cylindrical tholobate(drum) was chosen with twelve window openings (Fig. 12).



Fig. 12. Project of the Cathedral of Dormition reconstruction. Western elevation. Architect G. Kotov. 1895. Source: Scientific and research museum of the Russian Academy of Arts (St. Petersburg).

Project by G. Kotov was considered by The Imperial Archaeological Commission, with the participation of representatives of the Russian Academy of Arts, the Ministry of Internal Affairs, the leading Russian architects. It was approved in 1896. Reconstruction started immediately and in 1900 there were already official celebrations dedicated to the restoration of the temple. Since then, and to this day, it exists unchanged, and does not remind its Baroque "predecessor" even remotely (Fig. 13).

15 Паннопорт П.А. Мстиславов храм... С. 18.



Fig. 13. Volodymyr-Volynskyi. Dormition of the Mother of God Cathedral. The present state. Photo by P. Rychkov. 2011.

The decision of the Russian authorities to eliminate Baroque architectural stylistics of the Cathedral was in the socio-political plane, considering peculiarities of the historical development of this territory. The return to the 12th century model was evident ideological motivation for the Orthodox Church. This should have happened by destroying all the architectural innovations that appeared as if from the desire of the Greek Catholic bishops “to give this Orthodox church a form of Catholic church”¹⁶.

In our opinion, Professor A. Prakhov was right in discussion about the ideological bases of reconstruction, proposing to preserve the western façade (exonatherx) and, at the same time, return to the temple the features of Orthodox architecture. In other words, the actual ruin could eventually become the original historical symbiosis of two different architectural and artistic paradigms – eastern and western (respectively, Orthodox and Catholic).

However, the his project was not approved by the Orthodox Synod because of supposedly excessive “Byzantineism”. Although the idea of a compromise between time-varying architectural forms within a single building looked rather interesting. However, in the socio-political context of that time, such a decision was unacceptable. Architect G. Kotov in this situation, with all his professionalism, had to unconditionally support the orthodox version of the reconstruction.

Conclusions

From the historical and cultural point of view, the project had disputable assesment of researchers who emphasized the value of Baroque architecture of the totally deformed the interesting, impressive volume of the Cathedral, which appears today as an inadequate, largely fantastic new concept. “The history of this reconstruction, with the scale of its destruction, comparable to disputable restorations of the ancient churches in Ostrog and Ovruch”¹⁷.

At the same time, it was, probably, thebrightest attempt to find its own style for the new Greek-Catholic denomination. This process became widespread in the West Ukrainian and Belarusian lands in the eighteenth century, resulting in several original architectural objects (Chełm, Pochaiv, Buchach, Lviv, Pidubtsi, Polotsk, Mohyliv, etc.). And when the firstPolish–Lithuanian Commonwealth collapsed, the adaptation of liquidated Greek Catholic and Roman Catholic churches to Orthodox stylistic canons became common. Consequently, we can speak of contemporary architectural transmorphism as a rather widespread phenomenon on the Orthodox–Union-Catholic boundary. In this sense, the Cathedral of Dormition in Volodymyr-Volynskyi is an exemplary example.

16 Д[верницький] Е. Владимиро-ВолинськийМстиславовський собор XII в. и предстоящее его обновление // Киевская старина. 1886, апрель. С. 83–84.

17 Walicki M. Średniowieczne cerkwie Włodzimierza // Rocznik Wołyński. 1931. T. 2, S. 375–376.

References

- [1] Батюшков П. Памятники старины в западных губерниях империи. СПб.: Б.и., 1868. Вып.1. Б.п.
- [2] **Дверницький Е.Н.** Владимиро-Волынский Мстиславский собор 12 в. и предстоящее его обновление // Киевская старина. 1886. № 2. С. 837–839.
- [3] Каргер М.К. Вновь открытые памятники зодчества XII-XIII вв. во Владимире Волынском // Ученые записки Ленинградского госуниверситета. 1958. №252. Серия исторических аук. Вып.29. С.3–33.
- [4] Левицкий О.И. Историческое описание Владимиро-Волынского Успенского храма, построенного в половине XII века князем Мстиславом Изяславичем. Киев, 1892. 132с.
- [5] Памятники Волыни. Альбом фотографий к археологической поездке проф. А.В. Прахова на Волынь в 1886 г. [Владимир-Волынский], б.г.
- [6] *Прахов А. В.* Об исследовании Мстиславова Владимиро-Волынского собора 12 в.: реферат на Московском археологическом съезде. // Волынские епархиальные ведомости. 1890. № 5. С.162–164.
- [7] *Раппопорт П.А.* Мстиславов храм во Владимире-Волынском // Зограф (Београд).1977, № 7. С. 17–22.
- [8] Ричков П. Пізньобарокова трансформація Успенського собору у Володимирі-Волинському // Архітектурна географія бароко в Україні: регіональні особливості та спільні риси: Збірник наукових праць. Ніжин, 2012. С.79–101.
- [9] *Betlej A. Pawel Giżycki SJ architekt polski XVIII wieku.* Kraków, 2003. 399 s.
- [10] *Galicki B. Włodzimierz na Wołyniu.* Łuck, 1939. 57 s.
- [11] *Giżycki J.M. Bazylianie we Włodzimierzu i Trzygórach.* Kraków, 1912. VIII, 170 s.
- [12] *Kowalczyk J. Kierunki w późnobarokowej architekturze sakralnej na Wołyniu // Sztuka kresów wschodnich.* Kraków: 1994. T.1. S. 7–38.
- [13] *Raczynski J., Walicki M. Z wycieczki naukowej Zakładu architektury polskiej na Wołyń (Włodzimierz Wołyński i Zimno) // Przegląd Historji Sztuki.* 1929. Z. 1–2. S. 24–28.
- [14] *Walicki M. Średniowieczne cerkwie Włodzimierza // Rocznik Wołyński.* 1931. T.2.S. 371–383.
- [15] *Źródła dziejowe. T.VI: Rewizya zamków ziemi Wołyńskiej w połowie XVI wieku (1545).* Warszawa, 1877. C1X, 153, VIII s.

The earliest public green areas connected with Jelenia Góra, part. 1.

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Summary: In the third part of the 18th century the earliest public landscape gardens began to appear in the area of suburban Jelenia Góra. They were the first public parks in Silesia. When establishing them, the natural landscape features of the area were used (Karkonosze). Such an early creation of these parks was influenced by the growing fashion for mountain hiking and the increased (thanks to the nearby health resorts) awareness of the benefits of contact with nature, while remaining in harmony with contemporary views on garden art.

Keywords: landscape gardens, public gardens, Silesia

Preface

This article is the first of three parts¹ of a study which describes public greenery foundations that were created in the last quarter of the 18th century on the outskirts of Jelenia Góra. Three surrounding hills were chosen for their location: Hausberg, Sättler and Galgenberg. The last two, in whole or in part, took on the names of these complexes: Helikon and Kavalierberg. For the inhabitants of Jelenia Góra, a densely built-up city, devoid of greenery and surrounded by medieval walls until the 1860s, they constituted places of rest, allowed contact with nature and provided extraordinary views of almost the entire Jelenia Góra Valley and the Karkonosze range with its highest hill – Śnieżka.

The formation of those complexes coincided with a revolutionary change in the way of shaping green areas, including gardens and parks. However, they have preceded many other public greenery layouts created in European cities or in their surroundings, including the oldest park in Wrocław called Szczytnicki. This park was founded in 1783, but as a private area; it became available to the public only in 1789. This fact makes Jelenia Góra an exceptional place, at the same time raising the question of what made the residents turn so early to nature and what made them create some of the projects carried out on those hills.

Introduction

In the last quarter of the 18th century radical changes in the perception of gardens began to take place in Silesia. Consequently, those changes started to be visible also in the way gardens were shaped. Those vital changes were initiated by a modified attitude to nature. This attitude began changing in a large part of Europe in the eighteenth century (especially in the second part of the eighteenth century). Nature started to be seen as *a feeling organism organically connected with a human being*². A new approach to nature was originally represented only by private gardens. Public complexes began to appear on a wider scale only in the 19th century.

1 The two following articles will be published in the next issues of "The Folders of the Architecture, Urban Planning and Landscape Studies Commission" and will include the presentations of separate gardens.

2 [Oosthoek, b.r.]

It was also the time of the appearance of numerous publications devoted to the foundation of landscape gardens, starting with the work of T. Whateley from 1770³, through the work of H. Walpole and W. Mason⁴, H. Repton⁵ and many others. For the German language zone, the most important, especially in the early stage, was the five-volume work by C. C. L. Hirschfeld⁶, summarizing the state of knowledge on shaping the gardens and constituting the basic textbook for their creation in this area.

The gardens that were created at the time initially represented a sentimental trend, saturated with literary programs and rich symbolism based on philosophical and poetic ideas. They were included in numerous monuments and buildings (often of exotic forms), including greenhouses used for growing and displaying plants imported from all parts of the world. Around 1780, neoclassical tendencies became more popular in the landscape gardens. They were characterized by a greater restraint in the use of the architectural relic and by an increased interest in more spatial designs related to the surrounding landscape. Acting in accordance with the recommendations of the main theoretician of this trend, H. Repton (who introduced the term “landscaped garden”⁷), the natural properties of the area were first thoroughly explored, and then the gardens were shaped according to the character of the place. The natural valleys of rivers, hills, caves and springs were used to create beautiful views. They were diversified with single buildings, e.g. temples.

Another variation in the nature of landscape complexes was introduced by the Romanticism in the beginning of the 19th century (although its elements were already present earlier, revealed in the cult of the Middle Ages, which was visible in England throughout the eighteenth century). At the same time, new aesthetic categories were applied to the gardens, including the picturesqueness defined as sudden variability, rawness and uniqueness.

It should be added here that in practice, especially outside the British Isles, these trends (sentimental and romantic) have often been combined within a single project, as exemplified by Seifersdorfer Tal park, created in 1781–1791 from the initiative and according to the concept of Christina von Brühl⁸. It was shaped using the Große Röder river, which was meandering northeast of Dresden and near the Seifersdorf castle. On both sides of the river a composition was created, stretching over a distance of one and a half kilometres. Numerous paths, connected by a lot of bridges, were laid along it. Among the trees artificial ruins and “temples” were erected, obelisks were set, and, above all, numerous monuments (some of them with subtitles and quotes) were placed⁹.

In the area of Seifersdorfer Tal, a wooden and bark-covered temple dedicated to Apollo and the Muses was erected, as the inscriptions on two sides of the preceding avenue informed¹⁰. This is an important thread because we will also find it in the area of Jelenia Góra in Helicon, which is discussed in more detail later in the study. Moreover, it is the closest to Silesia (though more modern) example of recalling the mythological scenery connected with Parnassus in a landscaped complex¹¹.

Let us recall here that the earliest modern examples of such realizations associated with topos covering the mountain of Parnassus, Apollo and Muses were organized in the gardens of the 16th century Italy, among others in the Florentine Giardino di Boboli, Villa Aldobrandini in Frascati, Giardino del Bufalo, at Pius IV Casino, on two grounds belonging to the d’Este family: in Tivoli and near Rome, in Villa Lante in Bagnaia, in Medicean gardens (Pratolino and near Rome) and also in Villa Barbaro near Maser¹². Particular attention is drawn to Pratolino, where this group is almost the *clou* of the entire composition, *pointing to its literary origin and theatrical*

3 [Whately, 1770].

4 [Walpole, 1771]; [Mason, 1772].

5 [Repton, 1803].

6 [Hirschfeld, 1779–1785].

7 [Majdecki, 2008, vol. II, p. 115].

8 Her father-in-law was Heinrich von Brühl, minister at the service of August II the Strong.

9 In this way, the concept of the so-called educational landscape (German: pädagogische Landschaft) was realised; it should be understood as a place where Nature itself “teaches” order, diligence, loyalty, honesty, humbleness, sincerity, as well as religiousness. [Schatz, n.d.]

10 [Braeß, 1915, p. 402–415]

11 On the potential impact of Saifersdorfer Tal on the nature of a garden created at the end of the 18th century around the Książ castle. [Brzezowski, Jagiełło, 2017].

12 [Cellauro, 2003]; [Ważbiński, 1992].

character and at the same time being *an allusion to the virtues and genius of the Medici*, reminding people of their *sublime culture*¹³.

This idea was taken outside of Italy by two German builders, engineers and garden designers at the same time, namely by Heinrich Schickhardt and Salomon de Caus. The latter, after returning from a trip to Italy, published in 1615 some drawings¹⁴ related to the topic. There is no proof, however, that any of these concepts have ever been implemented.

It was not until the second half of the seventeenth century that the hill of Parnassus was placed in the gardens of other European countries, first in the Netherlands, including Enghien and Catshuis (The Hague), and later in German complexes (Kleve, 1647; Salzdahlum, 1706–1709; Lützenberger Garten; Charlottenburg, 1702)¹⁵. In many places, the symbolic function of the Parnassus was combined with musical elements¹⁶ (this relationship is already known from Pratolino), which became part of the show played in the gardens.

Elevations, often artificially formed, called Parnassus, were given in the gardens of that time very diverse forms, character and context. It is shown by numerous engravings from the period. In each case, however, they were a visible influence of the Manneristic Italian art on the shape and iconographic program of Baroque gardens.

Let us add, at the end of these considerations, that the only Parnassus known to us, which was placed in the baroque garden in Silesia, was located in Piotrowice (Środa County). It was located on a small island and was given the shape of a conical mound crowned with a figure, probably of Apollo¹⁷.

In the Sefersdorfer Tal complex one should also pay attention to the monument dedicated to the author of a fundamental work for shaping gardens in the German territories from the third part of the eighteenth century – the “father of garden landscape art”, Christian Cay Lorenz Hirschfeld¹⁸. His work also summarizes the achievements of landscape theoreticians and practitioners, mainly English, and describes the state of knowledge at the time.

In the fourth volume of Hirschfeld’s work a chapter can be found in which the properties of landscape gardens are described, depending on the topography of the place, namely the “garden in the valley” (Talgarten) and the “mountain garden” (Berggarten)¹⁹. The author drew the reader’s attention to various types of valleys. He describes those in which “calmness”, “seclusion”, “gentleness”, “gentle charm” and “harmony” dominate, but also others that are characterized by “severity”, “boldness”, “strength”, “depth” and “violence.” This corresponded to the concept of “sublime” introduced in the 18th century to the garden aesthetics, which arose from the experience of the first walks in the Alps. Hirschfeld mentioned in his work also other non-natural elements that are part of such complexes, namely “Greek temples” and “Gothic castles” (preferably in picturesque remains), adding to them hermits, caves and other ruins (negatively referring to all exotic forms)²⁰.

In the case of Jelenia Góra, though far away from the Alps, we deal with a deep valley of the meandering Bóbr River and with the accompanying Sättler range. On those hills Helicon was designed as one of the destinations for suburban walks. Helicon was a place inhabited by Muses and Apollo (next, on Parnassus). It was preceded from the city by the Hausberg hill. With time, more elements were added to this walking route, ending with a view of the high promontory on the Bóbr River valley, where the ruins of the medieval castle (Raubschloss) were located²¹.

It should be noted here that all the above-mentioned gardens, to which the theme of Parnassus, Helicon, Apollo and Muses was introduced, were private properties and accompanied private residences. In the Jelenia Góra Garden of Muses, on the other hand, we deal with a complex available to everyone. It is worth emphasizing, because – as already mentioned – the history of public complexes of greenery goes back to the beginning of the 19th century (except for small squares in English cities, which were created as early as the 17th century).

13 [Cellauro, 2003, p. 45].

14 [Schickhardt, n.d.]. In the case of Salomona de Caus, it is the representation of Parnassus with bosco in the garden of Pratolino, signed by the author as “Musenberg.Orgelberg”. [de Caus, 1615, vol. 2, table 13].

15 [Hannebo, Hoffmann, 1963, Bd. 2, s. 76–77].

16 Apollo was also a god of music.

17 More on this topic [Brzezowski, Jagiełło, 2016, s. 245–250].

18 [Hirschfeld, 1779–1785]; [Parshall, 1993].

19 [Hirschfeld, vol. 4, s. 33–37].

20 [Parshall, 1993, s. 142].

21 Its medieval origin has been confirmed by the research of Legut-Pintal [Legut-Pintal, n.d.].

The most famous was the London Hyde Park. It was originally the royal property, but it was occasionally made available to the public from the 17th century. It was permanently opened in the 19th century, when urban parks were founded in London (the first one being Regent's Park, 1812). Much later, only after the regulation of Paris was carried out by Baron Haussmann in the years 1852–1891, such activities were undertaken in the French capital. Then, suburban forest areas were developed and the Bois de Boulogne and Vincennes forest were created. Together with other parks, among others Monceau and Montsouris, as well as newly built boulevards and squares, they have been connected by a combined urban greenery system²².

We, because of our country's location, will be most interested in Germany (or more precisely the Kingdom of Prussia). The first park intended for general use and equipped with various attractions was created (designed) the F.L. von Sckell, in 1789 in Munich (*Englischer Garten*). However, the oldest complex, considered to be the original of the so-called folk park, was created according to the design of P.J. Lenné only in 1823 in Magdeburg (*Klosterberge-Garten*).

In a later period, in the 1830s and 1840s, the first public greenery was established in the capital of Prussia Berlin (the transformation of the former Tiergarten, 1833–1839, the folk park – Friedrichshain, 1840–1846). The creation of the famous Flora Park in Cologne (1862) is also worth noting. It was established (like the extension of Tiergarten) according to the design of P.J. Lenné, active at that time also in the Jelenia Góra Valley²³.

The end of the eighteenth century and the entire next century is also the time of transforming the areas previously connected with fortifications into a series of greenery called promenades or plants. Some of the oldest projects of this type are found in Mannheim and in Würzburg (1804). Soon afterwards, in the years 1813–1816, a promenade in Wrocław was established.

To sum up all that has been written above, activities aimed at creating places for recreation and entertainment in European cities, places which were generally accessible for the public, in the form of parks or developed suburban forest areas, generally started only in the 19th century.

What, then, contributed to such an early, going back to the 70s of the eighteenth century, effort to undertake the arrangement of suburban areas for the needs of the general population in the case of Jelenia Góra? Before we answer this question, let's look at this city, located in the centre of the Jelenia Góra Valley, connected with two rivers (the Bóbr and the Kamienna rivers) and surrounded by mountain ranges (Izerskie Mountains from the west, Kaczawskie Mountains from the north, Rudawy Janowickie from the east and from the south – by the highest range of the Sudetes – Karkonosze) closer.

In the 17th century, thanks to the economic situation on world markets, Jelenia Góra became one of the richest cities in Silesia. Linen fabrics produced here were exported to all European countries, to Russia and to the Americas. At that time, the city had a population of 6,000 residents living in 800 houses (including many suburban ones). The area of the proper city was surrounded by medieval walls and a dry moat. On the south and west side of the city, numerous summer houses of newly enriched and sometimes also newly ennobled merchants were built, surrounded by exquisite gardens. They were presented on the old plans and views of the city, among others on plans by F.B. Werner; they were also included in descriptions (sometimes even poetic)²⁴. It can be said that while the possession of a magnificent tenement house in the city was a sign of prestige, a house outside the city with an impressive and exquisitely decorated garden symbolized luxury.

The prosperous development of the city was interrupted in 1742 when it became a part of the Prussian state. This led to the isolation of the city from the existing outlets. The problem was deepened by the change in the way the fabric was made due to the introduction of machines in its production. It made handicrafts, and this dominated in Jelenia Góra, unprofitable. The situation improved at the beginning of the 19th century, when factories were built in suburban areas. Along with new jobs, there were also more residents, whose number increased from 6 thousand in 1800 to 15,6 thousand in 1885.

The gardens in Jelenia Góra were also subject to significant changes. At the end of the 18th century the Baroque complex of Daniel von Busch²⁵ was mentioned among the most prominent ones. Yet, there was a

22 [Majdecki, 2008, s. 314–331].

23 [Hoffmann-Marszałek, 2011].

24 [Lindner, 1742, s. 226].

25 On this subject, and also about other baroque gardens of Jelenia Góra extensively [Brzezowski, Jagiełło, 2017, s. 167–171].

commentary added: *The layout of the whole garden is old French but in more recent times, a lot of stiffness was subtracted from it*²⁶, which shows that some “modernization” measures were taken there.

In this “stiffness subtraction”, but on a much larger scale, Johann Christoph Schönau (1727–1802), the mayor of Jelenia Góra in the years 1780–1802, played an important role. He was the initiator of the founding and the founder of the most important park complexes in and around the city intended for its residents. The first complex used the advantage of the hill called Hausberg located on the north-eastern side of the city, in the bend of the Bóbr river. The second one was located on the Sättler hill behind Hausberg and was called Helicon. The third one was located south-east of the city and carried several names, the most popular being Cavalierberg. They served as places (visited by the inhabitants of Jelenia Góra even earlier) for walks, picnics and wandering. It is all the more important that until the 1860s the city was stuck inside double defence walls. Outside the walls, in the northern section, in 1756–1763, a facility, unique in the Silesian area, was created in the place of a dry moat. It was ‘an animal habitat’, in which deer and roe deer were kept. Thus, the place was called Hirschgraben (now Jelenia Street). The remaining parts of the fortifications were dismantled only in the 1860s. In its place, after 1865, the city park was created in the form of a promenade.

The growing awareness of the beneficial effects resulting from direct contact with nature was also important. Due to those new tendencies spa complexes began to arise. They were created also in Silesia, including spa complexes near Jelenia Góra²⁷. Local forest areas and attractive scenic spots were often included in their areas. Undoubtedly, impressive park layouts had a significant influence on changing the nature of gardens associated with Jelenia Góra and on arranging new greenery complexes in places that were considered attractive in their landscape and nature. Those parks were created, together with numerous residences, in the Jelenia Góra Valley in a way that opened them to the surroundings, including views of the Karkonosze range. The oldest of them (Ciszycza and Bukowiec) are dated to the last quarter of the eighteenth century. From the 1830s, an important role in shaping many of those parks played Peter Joseph Lenné, the general director of Prussian gardens²⁸.

It is also impossible not to notice the influence of the growing popularity (from the middle of the 18th century) of hiking in the Karkonosze Mountains. The geographical and natural values of the Jelenia Góra Valley influenced the birth and development of local tourism. Expeditions to Śnieżka, the highest peak of the Karkonosze Mountains, were organized as early as the middle of the 16th century, and one of the first local tourists was Christoph Schilling, the rector of the Latin school in Jelenia Góra²⁹. From the end of the 18th century, the Jelenia Góra Valley became increasingly popular among wandering poets, painters and travellers looking for beautiful landscapes, inspiration and ideal destinations. There were among them, apart from many others, an eminent German poet of romanticism – Johann Wolfgang von Goethe³⁰ and the famous naturalist and traveller – Alexander von Humboldt³¹. Also, the mayor Schönau, who was considered one of the precursors of Riesengebirgs-Verein³² in Jelenia Góra, was also involved in the promotion of tourism in the Karkonosze Mountains.

All this opened the inhabitants of Jelenia Góra very early to their closer and more distant surroundings, which were sometimes designed with surprising sophistication. These places encouraged people to go for walks and to take further trips, which were made for health, but also for intellectual and aesthetic experiences. Many of the inhabitants of Jelenia Góra at that time would probably sign under the following thought of Horace: *Not everyone admires the same; for what one considers to be an uninhabited wilderness, the other, who feels like me, is going to call beauty*³³.

26 [Hensel, 1797, s. 655].

27 In the Jelenia Góra Valley it was Cieplice (known since the 12th century, gaining popularity since the 17th century), and closer to the Karkonosze – Swieradów Zdrój (from 1763)

28 On this topic [Hoffmann-Marszałek, 2011].

29 [Steć, Walczak, 1962].

30 J. W. von Goethe was in Cieplice in August 1790 [Scholz, 1887]

31 A. von Humboldt was in the Jelenia Góra Valley in June 1830 in connection with the visit of the Russian and Prussian court. He visited, among others, Karpniki and Mysłakowice.[Hoffmann-Marszałek, 2011, s. 45].

32 [Donat, 2015]

33 *Non eadem miramur; eo disconuenit inter/ meque et te; nam quae deserta et inhospita tesqua/ credis, amoena uocat mecum qui sentit.* Horace, *Letters*, Book I, Letter XIV, verses 18–20.

The state of research

Until now, the gardens of Jelenia Góra were not fully dealt with, although there is no shortage of source descriptions and studies based on them. They cover selected periods of the formation of those gardens³⁴ or individual complexes, presented in the historical context. The transformation of Helikon Hill into a park layout, carried out at the end of the 18th century, was presented in the "topographic-historical" description of Jelenia Góra from 1797 by Johann Daniel Hensel³⁵. The same process was described in separate publications by anonymous authors, which appeared in 1790 and about 1796³⁶, as well as (also by an unknown author) in an article published in 1790 in the "Schlesische Provinzial Blätter"³⁷.

The Sättler hill was also very popular among researchers. The first one was Daniel Stoppe³⁸, who in 1735 drew attention to the recreational qualities of this place. He also suggested a new name for this hill – Parnassus. It added some poetic values and symbolic references to the place. In Stoppe's book, we will also find the oldest graphic representation of the Sättler hill.

The earliest arrangement of Helicon on the Sättler hills was presented in an article that was a guide to the Jelenia Góra Valley published in 1785³⁹. A year later, the publication of I. Krahn, discussing Helicon as well as the Elysian Fields, was published⁴⁰. Helicon was also described by an anonymous author in a booklet published in 1796⁴¹. An almost identical description was written one year later by J.D. Hensel⁴². In both publications, there was also an area adjacent to Helicon, described as the Elysian Fields, with references to the 4th Book of Aeneid by Virgil. Of special interest was the temple constructed on Helicon and dedicated to Frederick II. A separate article, published in the "Schlesische Provinzial Blätter"⁴³, was devoted to this temple.

Historical research on presented complexes was made only in the 90s of the twentieth century. Based on the above-mentioned sources, the history of the Hausberg hill is presented in the articles of R. Rzeszowski and I. Łaborewicz published in the "Rocznik Jeleniogórski"⁴⁴. For our considerations the publication of the second of these authors, which contains a lot of information about the arrangement of this place, is particularly useful. The texts by Łaborewicz were also placed on information boards set a few years ago on the Kavalierberg hill. The complexes of Kavalierberg and Helicon have also been synthetically presented in the article by W. Brzezowski, describing the eighteenth-century gardens of Jelenia Góra⁴⁵. A monographic publication was also devoted to the monument of the mayor Schönau, the founder of the Kavalierberg and Helicon hills⁴⁶.

An important contribution to the restoration of the importance of the former Helicon is also done by a Jelenia Góra researcher Eugeniusz Gronostaj, who provides information on Helicon on various internet forums, where he places richly illustrated studies⁴⁷. He has also published an article about Helicon in "Rocznik Jeleniogórski"⁴⁸. His actions have vastly contributed to the continual restoration of the readability of the composition of this complex. It has been achieved through corrections in the trees planting, the improvement in the trails system and the placement of information boards.

In the study of ancient landscape gardens of Jelenia Góra a large number of iconographic materials play a very important role. These include drawings, maps, postcards and photographs. They will be presented in more detail in the subsequent parts of this study.

34 On the theme of the Baroque gardens of Jelenia Góra [Brzezowski, Jagiełło, 2016]

35 [Hensel, 1797]

36 [Anon. *Nachricht von der merkwürdigen ...*, 1790]; [Anon. *Beschreibung...*, 1796].

37 [Anon. *Nachricht von dem Ehemaligen...*, 1790]

38 [Stoppe, 1735]

39 [b.a., *Wegweiser...*, 1795].

40 [Krahn, 1796].

41 [b.a., *Beschreibung...*, 1796].

42 [Hensel, 1797].

43 [b.a., *Friedrichs*, 1800].

44 [Rzeszowski, 1998, p. 17–28]; [Łaborewicz, 1998, s. 29–39].

45 [Brzezowski, 2011].

46 [Ptaszyński, 1995].

47 [Gronostaj, Łętkowska, n.d.]

48 [Gronostaj, 2012].

Despite the apparent abundance of sources and studies devoted to the complexes of Hausberg, Helicon and Kavalierberg, it should be emphasized that they focus almost exclusively on the historical-topographic description of “things”. The authors of this article (and its other two parts) believe that this does not cover the whole topic, and thus share the opinion expressed by a renowned expert of gardens J.D. Hunt: *Gardens generally deserve to be studied at the intersection between physical place and metaphysical idea. This is only in part a reworking of the old formula about form and function; a garden's function may not only involve the growing of food, social uses, political prestige and power; we must study how the physical facts of a garden intersect with a whole gamut of less tangible but no less instrumental concerns*⁴⁹.



Fig. 1. Jelenia Góra, in the background the Giant Mountains, in the foreground the Hausberg hill. Postcard from the beginning of the XX century, (<https://polska-org.pl/632930,foto.html> [access date: 12.10.2018]).

Bibliography

- [1] [no autor], 1790. *Nachricht von der merkwürdigen Umschaffung des ehemaligen Galgenberges bei Hirschberg in einen schönen Volksgarten*. Schmiedeberg.
- [2] [no autor], 1790. *Nachricht von dem Ehemaligen Galgenberge bey Hirschberg*: Schlesische Provinzial Blätter, 11, 346–357.
- [3] [no autor], 1795. *Wegweiser durch das Riesengebirge*, w: *Berliner Almanach zum Vergnügung und zur Verbreitung nützlicher Kenntniße für 1796*. Berlin, 1–63.
- [4] [no autor], 1796. *Beschreibung des Pflanzberges, Helikons und denen Elisäischen Feldern bei Hirschberg*, (no place of issue)
- [5] [no autor] 1800. *Friedrichs des Einzigen Denkmal auf dem Hirschberger Helikon*, "Schlesische Provinzial Blätter", 31, 311–325.
- [6] Braeß M., 1915. *Das Seifersdorfer Tal mit seinen Denkmälern*: Mitteilungen des Landesvereins
- [7] Caus S. de, 1615. *Les Raisons des forces mouvantes*, Francfort, vol. 2.
- [8] Brzezowski W., 2011. *Ordnung, Fleiß, Natur und Kunst... The Gardens of Jelenia Góra in the 18th century: Stadtfluchten/ Ucieczki z miasta (Escapes from the city)*, edited by M. Omilanowska, B. Störtkuhl, Warszawa, 67–76.
- [9] Brzezowski W., Jagiełło M., 2016. *Ogrody na Śląsku. T. 2. Barok* (Gardens in Silesia. Vol. II. The Baroque), Wrocław.
- [10] Brzezowski W., Jagiełło M., *Założenie ogrodowo-krajobrazowe w Książu: Książ. Pamiętajmy o ogrodach* (Landscape garden in Książ: Książ. Let's remember the gardens), edited by B. Lejman, Wrocław 2017, s. 37–64.

49 [Hunt, 1996].

- [11] Cellauro L., 2003. *Iconographical aspects of the Renaissance villa and garden: Mount Parnassus, Pegasus and the Muses: Studies in the History of Gardens & Designed Landscape*, vol. 21, 42–56.
- [12] Donat T., *Stadtdirector Schönau, ein Vorläufer des Riesengebirgs-Vereins*, (transcription Ulrich Junker, Bodnegg 2015). http://jbc.jelenia-gora.pl/Content/18463/JEL_19122_2015_Stadtdirector-Schona_19122_Sch%C4%82%C2%B6nau_Wanderer_1882.pdf [access date: 27.10.2018];
- [13] Gronostaj E., Łętkowska A., b.r. *Bogactwo przyrodniczo-historyczne Borowego Jaru w rozwoju turystyki i aktywnego wypoczynku*. (The richness of nature and history of Borowy Ravine in the development of tourism and active recreation) http://wpt.kpswjg.pl/public/ckfinder/userfiles/files/borowy_jar_valory_15_09_17 [access date: 24.10.2018]
- [14] Gronostaj E., 2012. *Parnas na Siodle. Helikon – siedziba muz* (Parnas on the Saddle. Helikon – the seat of Muses): *Rocznik Jeleniogórski*, 261–270.
- [15] Hannebo D., Hoffmann A., 1963. *Geschichte der deutschen Gartenkunst in drei Bänden*. Hamburg, vol. 2.
- [16] Hensel J. D., 1797. *Historisch-topographische Beschreibung der Stadt Hirschberg in Schlesien*. Hirschberg.
- [17] Hirschfeld Ch. C. L. 1779–1785, *Theorie der Gartenkunst*, vol. 1–5, Leipzig.
- [18] Hoffmann-Marszałek A., 2011. *Działalność Petera Josepha Lenného oraz innych projektantów ogrodów na terenie Kotliny Jeleniogórskiej w XIX w.* (Activities of Peter Joseph Lenné and other garden designers in the Jelenia Góra Valley in the 19th century) (*Mystakowice, Wojanów, Łomnica i Karpniki*). *pr dr. wykonana na WA PWr.* (Activity of Peter Joseph Lenné and other garden designers in the Jelenia Góra Valley in the 19th century) PhD thesis executed on Faculty of Architecture, Wrocław University of Science and Technology
- [19] Horacy, *Listy*, Księga I, List XIV, wersy 18–20. Horace, Letters, Book I, Letter XIV, verses 18–20
- [20] Hunt J. D., 1996. *The Italian Garden: Art, Design and Culture*, Cambridge.
- [21] Krahn I., 1796, *Vom Helikon und den Eisäischen Feldern bei Hirschberg*, Hirschberg.
- [22] Legut-Pintal M., *A study of the defensiv system of Jelenia Góra*: <http://wratislavia.archoe.uni.wroc.pl/18-tom/16.pdf> [data dostępu: 2.10.2018]
- [23] Lindner K.G., 1742. *Historische und poetische Beschreibung des Landberühmten Hausberges oder Burglehns bey Hirschberg aus alten und sichren schriftlichen Urkunden gesammelt*. Hirschberg.
- [24] Łaborewicz I., 1998. *Historia Wzgórza Bolesława Krzywoustego (Hausberg) w Jeleniej Górze od połowy XV w. do dnia dzisiejszego* (History of the Bolesław Krzywousty Hill (Hausberg) in Jelenia Góra from the mid-15th century to the present day): *Rocznik Jeleniogórski*, p. 29–39.
- [25] Majdecki L., 2008. *Historia ogrodów* (Garden history). Warszawa, t. II.
- [26] Mason M., 1772. *The English Garden*. London.
- [27] Oosthoek J., *Romantism and nature*: <https://www.eh-resources.org/romanticism-and-nature/> [data dostępu access date: 25.10.2018]
- [28] Parshall L., 1993. C. C. L. *Hirschfeld's concept of the garden in the German Enlightenment*: *The Journal of Garden History*, vol. 13, p. 127–171.
- [29] Ptaszyński J., 1995. *Johann Christoph Schönau i jego pomnik* (Johann Christoph Schönau and his monument): *Karkonosze*, 1, p. 8–9.
- [30] Repton H., 1803. *Observations on the Theory and Practice of Landscape Gardening*. London.
- [31] Rzeszowski R., 1998. *Legendarne dzieje i historia Wzgórza Krzywoustego i okolic do połowy XV wieku* (Legendary past and history of Krzywousty Hill and the surrounding area until the middle of the 15th century): *Rocznik Jeleniogórski*, p. 17–28.
- [32] *Sächsischer Heimatschutz*, 4 (1915) 10, Dresden, p. 402–415.
- [33] Schatz Ch., *Brühl, Johanne Margarethe Christina (Jeanne Marguerite Christine, gen. Tina) Gräfin von*: *Sächsische Biografie*, Institut für Sächsische Geschichte und Volkskunde e.V., (red.) Martina Schattkowsky. [http://saebi.isgv.de/biografie/Christina_von_Br%C3%BChl_\(1756-1816\)](http://saebi.isgv.de/biografie/Christina_von_Br%C3%BChl_(1756-1816)) [access date: 18.12.2017]
- [34] Schickhardt H., *Beschreibung einer Reiss...*, Württembergische Landesbibliothek Stuttgart, Inv. No Cod. hist. fol. 562, p. 193v.
- [35] Scholz [P.], 1887. *Goethes Riesengebirgsreise im Jahre 1790: Wanderer im Riesengebirge*, Hirschberg, nr 7, 84–89.
- [36] Steć T., Walczak W., 1962. *Karkonosze. Monografia krajoznawcza* (Karkonosze. Tourist monography), Warszawa.
- [37] Stoppe D., 1735, *Der Parnaß im Sättler oder Scherz- und Ernsthafte Gedichte Herrn Daniel Stoppens*. Frankfurt/Leipzig.
- [38] Walpole H., 1771. *Essay on modern Gardening*. Strawberry Hill.
- [39] Ważbiński Z., 1992. *Willa Medycejska w Pratolino uratowana...* (Villa Medici in Pratolino rescued): *„Ochrona zabytków”*, vol. 45, nr 1–2, 65–70.
- [40] Whately T., 1770. *Observations on Modern Gardening, illustrated by descriptions*. London.

Najwcześniejsze publiczne założenia zieleni związane z Jelenią Górą, cz. 1.

Streszczenie: W trzeciej tercji XVIII w. zaczęły powstawać na ówczesnych terenach podmiejskich Jeleniej Góry, najwcześniejsze na terenie Śląska publiczne ogrody krajobrazowe przeznaczone dla wszystkich mieszkańców. Przy ich zakładaniu wykorzystano naturalne walory krajobrazowe okolicy (Karkonosze). Na wczesne powstanie tych założeń wpływ miała budząca się moda na górskie wędrowki oraz rosnąca (dzięki pobliskim uzdrowiskom) świadomość pożytków płynących z kontaktu z naturą, pozostająca w zgodzie z ówczesnymi poglądami na sztukę ogrodową.

Słowa kluczowe: ogrody krajobrazowe, ogrody publiczne, Śląsk

Overview and classification of housing forms intended for older and disable people occurring in high-developed countries in context to deficit of similar forms in Poland

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Abstract: In most highly developed countries, in addition to services and home care system, there are various forms of housing with care and services for the elderly and the disabled. In this work, the author presents the effect of searching for various housing solutions in a brief description of residential forms. A classification of recognized housing models was prepared in the form of a summarizing table, in which groups of housing forms with similar characteristics were selected, and assigned to groups of residents with different level of disability and independence. In addition, the author systematizes the terminology in English-language publications and presents general conclusions from the conducted research in the context of a deficit of similar to the presented solutions in Poland.

Key words: architecture, housing, care, elderly, disabled people, intermediate housing forms;

Introduction

Analyzes and demographic projections for Poland show a very intensive process of population aging, which progresses much faster than in Western Europe, where this process began much earlier and is at an even more advanced stage. Along with demographic changes in Poland, there are social changes in the model of the traditional family, which will result in a drastic decline in the family welfare potential in the coming years, on which the social welfare system in Poland is currently based. In the perspective of ongoing transformations, the greatest and most urgent challenge is to provide help and care to dependent elderly and disabled people, and to provide living conditions and services that will extend the period of their psycho-physical fitness and functional independence. Not only the increase in the number of older people in society, but above all the lack of family care is becoming the main factor influencing the growth of demand for special housing forms for the elderly and disabled, which require support or daily care. Faced with this situation, new challenges for social and housing policy in Poland arise. They concern the extension of the offer of caring and housing forms for the elderly and the disabled, both in quantitative and qualitative terms. Considering that other highly developed countries have encountered this problem earlier and have already implemented housing models and support systems for dependent people, it is important to get to know and analyze these solutions that can be the basis for developing standards adequate to the scale of needs and preferences of older and disabled people in Poland.

Research goals, tasks and methods

Considering the fact that Polish seniors, in terms of their needs and preferences, are becoming more and more similar to seniors in other highly developed countries, and demographic projections indicate that in the coming decades the proportions of age groups in the European Union countries will be very similar – the main scientific goal has become the search for various patterns and solutions accepted in other countries that could be helpful in predicting the directions of changes in housing for the elderly and the disabled in Poland. The indirect goal was to systematize the various terminologies appearing in English-language publications. The paper contains an overview of housing forms for the elderly and the disabled appearing in the framework of the Polish social welfare system. The author also presents general conclusions from the conducted research on housing solutions occurring in highly developed countries, in the context of the deficit of such solutions existing in Poland.

Results of research

The paper presents the current results of the conducted research in the form of a concise characterization of the identified groups of special housing forms for elderly and the disabled people. A classification was also developed in which groups of special housing forms with similar characteristics were selected, and assigned to groups of residents with different health and independence levels.

Discussion

System of stationary long-term care in Poland

In Poland, care for the elderly and the disabled is included in the social welfare system. The most common form of residential care are **Social Care Homes** (in polish – domy pomocy społecznej – DPS) run by local self-government bodies, associations and religious gatherings. Persons who are in need of intensive care because of age, illness or disability and who are unable to function independently can apply for residence in these special housing forms. The current law distinguishes several types of homes to which adults are addressed: for the elderly, for the chronically ill people, for the chronically mentally ill, for people with physical disabilities, and for people with intellectual disabilities. The regulations allow to combine certain types of houses.¹

The stationary care sector also includes facilities providing 24-hour care on a commercial basis as part of business or statutory activities. They are colloquially called “**private**” **care homes** and are very similar in terms of organization and scope of services offered to social welfare homes². Only the standards that these institutions must meet are different. The guidelines are quite general³, so the level and range of care services is strictly dependent on the amount of fees paid in full by residents.

Another form of care for people in need of round-the-clock care due to advanced age are **Family Care Homes** (in polish – rodzinne domy pomocy – RDP), providing services for 3–8 residents, in the carer’s place of residence.⁴ The first facilities of this type started operating in 2003, so it is still a relatively new form of housing for older people. Maintaining a resident in a family home is much cheaper than in Social Care Homes (DPS), mainly due to the smaller range of services provided. For the same reason, people who do not require constant nursing care are directed here. Persons running such a house do not need to have education in this direction. Unfortunately, only a few Family Care Homes have been operating in Poland over the last years. The research

1 *Social Welfare Act of 12 March 2004*, Dz. U. No. 64, item 539 (in polish).

2 Z. Szweða-Lewandowska, The forecast of the demand for places in social welfare homes for people aged 75 and over, [in:] *Aging of the Polish population. Between demography and social gerontology*, edited by J.T. Kowalewska, P. Szukalski, Lodz 2008, p. 138; (in polish).

3 According to the regulations, the manner and scope of service provision should include: “health, physical and intellectual fitness as well as individual needs and abilities of residents”, *Social Welfare Act of 12 March 2004* (Chapter 3, Article 68); (in polish).

4 *Regulation of the Minister of Labor and Social Policy of October 17, 2001 on family care houses*, Dz.U. No. 127 item 1399; (in polish).

of Supreme Audit Office (in polish – Najwyższa Izba Kontroli – NIK) shows that most local governments are not interested in developing this form of 24-hour care for elderly and disabled people.⁵

The Act of 12 March 2004 on social assistance also introduced the possibility of organizing **Sheltered Apartments** (in polish – mieszkania chronione) for the elderly and the disabled, which require support in functioning in everyday life, but do not need 24-hour care.⁶ Sheltered Apartments are designed to replace a stay in a facility providing 24-hour care. According to the current regulations, they are designed for a minimum of 3 people, and the maximum number of residents is not specified.⁷ These are more like collective, group and not individual apartments. This solution allows to significantly reduce housing costs, and increase the independence of residents based on mutual assistance between them. Also for the local government this form of social assistance is financially more beneficial than creating and maintaining 24-hour care homes. Sheltered apartments can be organized as part of a social care home program. Unfortunately, in polish practice, this form of housing was almost not available to the elderly and the disabled.

Forms of housing for the elderly and the disabled appearing in other highly developed countries

In the majority of highly developed countries, affected by the problem of population aging, apart from services and the home care system, there are various forms of housing with care or services for elderly and disabled people. These are both collective buildings (such as a polish social care home), but also multi-apartment buildings, housing communities, as well as entire housing estates and villages for the elderly and disabled. Knowledge about them is, however, disordered. In the subject literature and Internet sources there are different names and classifications. For the purpose of this study, a division of housing forms for older people was proposed, depending on the level of independence of residents. Housing forms for the elderly and the disabled were divided into the following forms: with service, with care, with long-term care, housing for people with dementia, and housing complexes with continuity of care, combining several of the above forms (Fig.1.)

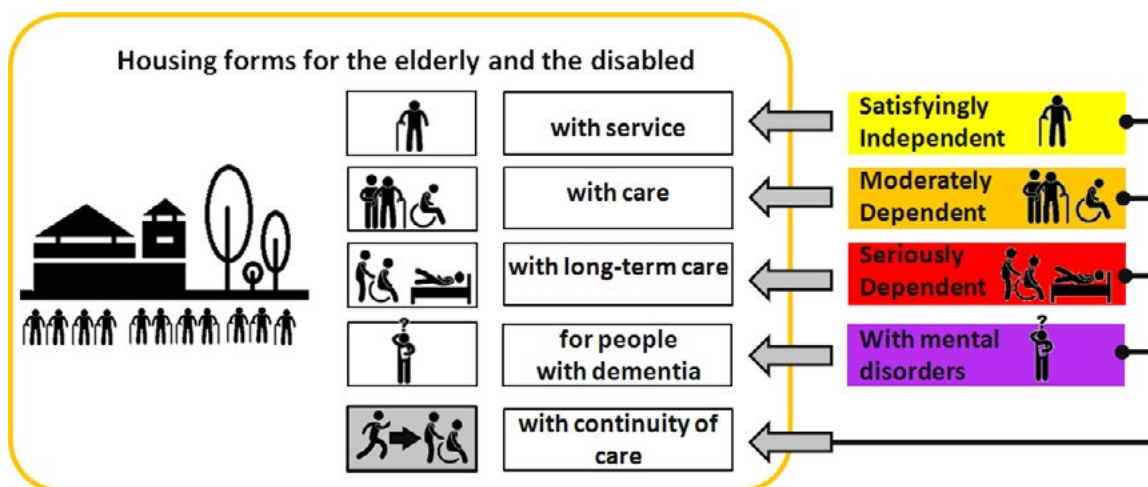


Fig. 1. Division of housing forms for older and disabled people, depending on the level of independence of residents, author's work.

Podział form mieszkaniowych dla osób starszych i niepełnosprawnych w zależności od poziomu samodzielności, opracowanie autorskie.

5 E. Wesołowska, *Running social assistance homes is unprofitable*, Dziennik Gazeta Prawna, http://praca.gazetaprawna.pl/artykuly/595837,rowadzenie_domow_pomocy_spolecznej_jest_nieoplacalne.html (21.02.2012); (in polish).

6 Dz. U. No. 64, item 593 with changes art.53; (in polish).

7 Dz. U. of 22 March 2012, item 305; (in polish).



Fig. 2. An example of a flat with service – with one bedroom. The bedroom is connected, with the living room through mobile walls. Bathroom connected to the bedroom by additional sliding doors. De Plussenburgh, Rotterdam, the Netherlands. *Graphic and photo – author.*

Przykładowe mieszkanie z serwisem – z jedną sypialnią. Sypialnia łączona jest w zależności od potrzeb z salonem poprzez mobilne ścianki. Łazienka połączona z sypialnią za pomocą dodatkowych przesuwanych drzwi. De Plussenburgh, Rotterdam, Holandia. Opracowanie graficzne i fot. Autorki.

Housing forms with service – this is a grouping of individual flats (Fig. 2.). Elderly and disabled people live completely independently and can, depending on the needs, use the cleaning service, meals delivered to the apartments or served in the common dining room, organized educational, recreational or rehabilitation activities and other services that are designed to enable the longest independent functioning. They are intended for people who are independent, in a period of full or satisfactory state of health, do not require constant care, but only relieve from daily duties, or need to improve the level of social contacts and a sense of security. Housing forms with the service create independent groups or are more often integrated with a care facility within a single building or a housing complex.

■ **Independent groups of apartments with service** can be in the form of a multi-apartment building with a separate common area or they can form a group of houses (mostly terraced houses) with a common part located in a separate facility located mostly in the central part of the complex. As part of such a group of apartments, there may also be commercial services such as a shop, a café, a hairdresser or a dentist. The offer does not include long-term care and medical care, although it happens that the complex has a medical clinic also available for people living in the local environment. In English-language publications, independent groups of apartments with service appear under the name of: *Congregate/Sheltered housing* – small social, one and two-room apartments, rented by older people over 55 or 60 years old⁸; *Residential/Independent Living Apartments* – flats and condominiums with a variety of standards and number of rooms⁹.

8 D. Robson, A. Nicholson, N. Barker, *Homes for the Third Age: A Design Guide for Extra Care Sheltered Housing*, Taylor & Francis, 1997, s. X.

9 E. Perkins, *Building Type Basics for Senior Living*, John Wiley & Sons, 2013, p. 5.

- **Apartments with a service integrated with a care facility** – this is a form of social housing and rental apartments, located in a separate part of the building or in a separate building on a shared plot next to a care facility. The apartments are completely independent, but integrated with Care Call and Alert Systems. Residents can use the site, commercial services, and sometimes also rehabilitation, and various types of activities in the care facility. In the English-language publication it is known as *Close Care Housing*¹⁰.

Housing forms with care – these forms of housing are intended for people in a period of limited health, when there are difficulties in performing everyday activities, such as bathing, dressing, washing, eating, cleaning, taking medicine – for people in need of daily help, but not requiring 24-hour medical care. Housing forms with care occur in the form of a multi-dwelling building or in the form of a collective residence building. In both cases, the residential area is expanded to include common rooms, social services, care and rehabilitation programs, administration rooms and commercial functions.



Fig. 3. Housing form with care – groups of flats with additional common spaces and staff points (marked with dotted line). The division is also reflected in the body of the building. Common areas include terraces. Rosenlund, Mørkhøjvej, Denmark. Graphic and photo – author.

Forma mieszkaniowa z opieką – grupy mieszkań uzupełnione o wspólne przestrzenie i stanowiska personelu (oznaczone linią przerywaną). Podział jest również odzwierciedlony w bryle budynku. Przy pomieszczeniach wspólnych znajdują się tarasy. Rosenlund, Mørkhøjvej, Dania. Opracowanie graficzne i fot.autorki.

- **In a multi-apartment building**, older people live in individual small, one and two-room flats, equipped with a kitchenette and a bathroom. Choosing this form of housing allows older people to maintain full privacy

¹⁰ *Design for Aging: International Case Studies of Building and Program*, red. J.W. Anderzhon, John Wiley & Sons, 2012, p. 276.

and a sense of independence. It is a form of housing offering smaller apartments, but a higher level of care than in housing forms with service. Flats are divided into groups with dedicated day zone in which residents consume meals and spend time (Fig. 3). In English-language publications, they appear under the name – Assisted Living Apartments (Am.), Extra Care Housing, Very Sheltered Housing (Eng.)¹¹.

- **In collective buildings**, residents occupy individual rooms with bathrooms, which are part of the housing groups (8–12 rooms with a shared common day zone) or composition of collective apartments, where 6–10 inhabitants share the day zone of the flat – living room, kitchen, dining room (Fig. 4.). Residents have smaller private space. This model is the closest in terms of the scope of care and services, organizational solutions and characteristics of residents, to Polish **Social Care Homes for the elderly (DPS)**¹². In contrast to these solutions, in Poland, residents usually live in two, three and even four-person rooms, less often individually. The rooms are arranged along long corridors, without division into groups. In English-language publications, they appear under the name – *Assisted Living Facility, Assisted Living Residences, Personal Care Homes, Residential Care Facility, Adult Homes, Retirement Residences, Adult Congregate Living (Am.), Care Homes, Residential Homes, Homes for the aged, Rest Homes (Eng.)*¹³.



Fig. 4. Housing form with care – A group apartment for eight older people. De Maarteshof, Groningen, Netherlands. Graphic and photo – author.

Forma mieszkaniowa z opieką – Mieszkanie grupowe dla ośmiu osób starszych. De Maarteshof, Groningen, Holandia. Opracowanie graficzne i fot. autorki.

Housing forms with long-term care – this is a form of residence based on the model of 24-hour nursing care, on seriously ill, dependent and disabled people. Usually, they are people lying or moving in wheelchairs with the help of caregivers. Residents usually stay in single and double rooms with bathrooms. Due to the fact that most of residents spend the most part of the day in their own room, the residential area is expanded only by a small program of common and rehabilitation rooms. It is the model most similar in terms of care to the Polish Care and Treatment Facilities (in Polish – zakłady opiekuńczo-lecznicze – ZOL) or Nursing and Care Facilities (in Polish – zakładów pielęgnacyjno-opiekuńczych – ZPO), whose tasks and competences are subject to

11 D. Hughes, S. Judd, *Design for Aging: International Case Studies of Building and Program*, John Wiley & Sons, 2012, p. 275–276.

12 DPS – Dom Pomocy Społecznej – registered name, obligatory in Poland since 2004, Dz. U. 2004 No. 64, item 593.

13 K. Christensen, *Encyclopedia of Community: From the Village to the Virtual World*, Sage Publications, 2003, pp. 427–430; D. Hughes, S. Judd, op. cit., pp. 275–276.

medical care and go beyond the scope of social care. In Poland, due to the lack of places in the above-mentioned facilities, in many Social Care Homes for somatically ill persons, nurses are employed as caregivers. Among the residents, we meet people who do not leave the bed and use specialist medical equipment. Therefore, it can be said that the real, Polish equivalent of this form of housing are **Social Care Homes for somatically ill people**. In English-language publications, they appear under the name – *Care Homes with nursing, Nursing Homes (Eng.), Skilled Nursing Facilities, Long-Term Care Facilities (Am.)*¹⁴.

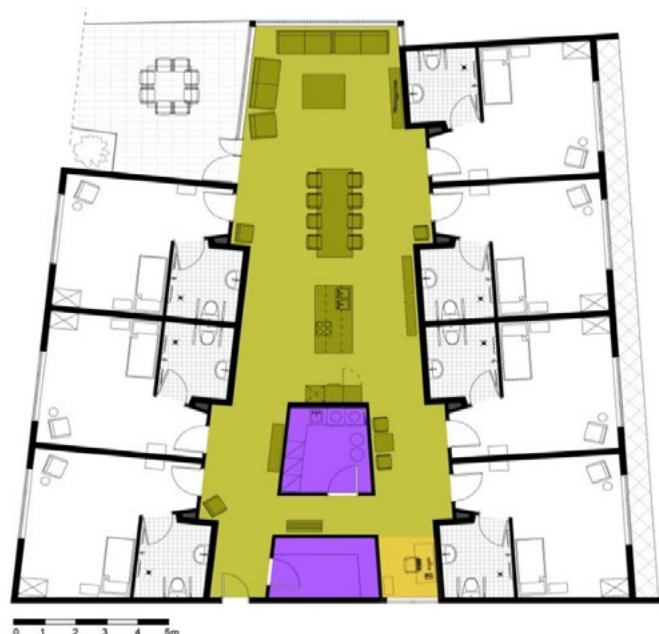


Fig. 5. Group apartment for people with Alzheimer's disease. From the common day zone there is an exit to a fenced, secure garden. Rosenlund, Mørkhøjvej, Denmark. Graphic design and photo by the author.

Mieszkania grupowe dla osób z chorobą Alzheimera, Ze wspólnej strefy dziennej prowadzi wyjście do ogrodzonego, bezpiecznego ogrodu. Rosenlund, Mørkhøjvej, Dania. Opracowanie graficzne i fot. autorki.

Housing for people with dementia – it is a special form of housing for diverse group of older people with disorders of cognitive processes, personality, memory and intellect. The most common form of dementia is Alzheimer's disease. Most people with dementia are people with a satisfactory degree of physical fitness, but due to mental disorders, requiring supervision and assistance in many daily activities. The facilities existing in other highly developed countries are either closed facilities or isolated safe parts of residential complexes with care. They have very diverse functional and spatial programs, which results from insufficient knowledge about proven solutions suitable for people with dementia. Designers are constantly looking for new space models that will provide a safe and intellectually stimulating housing environment¹⁵. The in-situ study shows that the

14 D. Hughes, op. cit. , pp. 280–281; C.E. Yesalis, *U.S. Health Care: Principles and Perspectives*, Cengage Learning, 2012, pp. 148–147.

15 E.C. Brawley, , op. cit p. 165–168.

most favourable form of housing development for people with dementia is the creation of small objects (25–30 people) located in the natural environment, and in larger buildings, a division into housing groups for a maximum of 8–10 inhabitants, where each person has an individual room with a bathroom and shares the day zone with other co-residents (Fig. 5.). This solution allows keeping small scale of rooms and reducing space, which eliminates the feeling of being lost. The indicated extensions of the residential area are rooms to occupational therapy and a secure, fenced garden. Apart from the isolated housing zone, other functions are located, including rooms for rehabilitation¹⁶. In Poland, due to the lack of dedicated examples of Social Care Homes for people with Alzheimer's disease, such people are usually directed to care facilities for mentally ill people. In addition, in all Social Care Homes for the elderly and somatically ill, we meet people with Alzheimer's disease, which has already appeared during the stay in the facility. In English-language publications, they appear under the name – *Dementia Care Homes, Nursing Homes for Alzheimer's (Eng.), Alzheimer's Nursing Home, Dementia Care Facilities, Alzheimer Special Care Units (Am.)*¹⁷.

Housing forms with continuity of care – they consist of several previously discussed forms of housing for the elderly and disabled, corresponding to the subsequent stages of care. As the health condition deteriorates, residents within the same housing community move to housing forms offering a higher level of care. By placing different housing models in one place, it is possible to ensure continuity of care and preserve the idea of aging in the same place where you live for years, regardless of the deteriorating health condition of residents, until the end of their days. The combination of various forms of housing into a larger one offers the opportunity to propose more diverse spaces, a richer offer of services, and to integrate seniors at various stages of old age. Individual housing forms can be located in one building or located on the same building plot next to each other. In the United States of America, housing forms with continuity of care are classified into: small – up to 200 inhabitants, medium – from 200 to 400 inhabitants, and large – over 400 inhabitants.¹⁸ In English-language publications, they appear under the name – *Continuing Care Retirement Communities (Am.), Retirement Care Villages (Eng.)*¹⁹.

Summary

As a summary of the conducted research, a classification of recognized and characterized forms of housing for the elderly and the disabled in other countries was developed (Table 1). Groups of special housing forms with similar features were selected, and assigned to the recipient groups of varying degrees of health and level of independence in life. The assignment of users to residential forms is aimed to point out an appropriate housing environment that will provide services and care at a level adapted to the level of functional level of dependence of residents. The disadvantage is to live in a place that is not sufficiently adapted to the needs of the resident, but also if the level of care and services exceeds its capabilities, which may accelerate the process of functional dependence.

Conclusions

In Poland, the most common form of residential care for the elderly and the disabled are currently Social Care Homes and "private" care homes. The availability of places and the housing standard offered in them is insufficient and inadequate to the needs. Other forms of housing operating within the framework of social assistance are Sheltered Apartments and Family Care Homes. Seniors have difficult access to them, and number of places designed for them is marginal. It is necessary to develop new patterns of formal care that will reduce the need for places in care facilities. This is possible by introducing new forms of housing, similar to the forms available in other countries previously affected by the phenomenon of an aging population. Introduction of

16 B. Schwarz, R. Brent, *Aging, Autonomy, and Architecture: Advances in Assisted Living*, JHU Press, 1999, p.17–18.

17 E.C. Brawley, *op. cit.*, p. 41–47.

18 B. Perkins, *op. cit.*, p. 87.

19 S.Evans, *Community and Aging, Maintaining quality of life In housing with care settings*, The Policy Pres, 2009, p. 34.

Table 1. Classification of housing forms for the elderly and the disabled. Symbols: In column 4. – the destination group of inhabitants was distinguished with color, (+ –) transition periods were determined between successive stages of old age, * Polish housing forms – intended for users with a similar degree of functional independence, but which may differ in terms of architectural solutions and operating principles.

Zestawienie zbiorcze form zamieszkiwania osób starszych. Oznaczenia: W kolumnie 4. – kolorem wyróżniono docelową grupę mieszkańców, (+ –) oznaczono okresy przejściowe między kolejnymi etapami starości, * polskie formy mieszkaniowe, przeznaczone dla użytkowników o podobnym stopniu sprawności i samodzielności funkcjonalnej, jednak mogące różnić się pod względem rozwiązań architektonicznych i zasad działania.

		<div style="display: flex; justify-content: space-around; font-weight: normal;"> Satisfyingly independent Moderately dependent Seriously dependent With mental disorders </div>					
1. Housing forms	2. Names	3. Polish housing forms*	4. Profiles of residents				
with service	Independent groups of apartments	<i>Congregate housing, Sheltered housing, Residential Living Apartments, Independent Living Apartments</i>	–	+	+	–	–
	Apartments integrated with a care facility	<i>Close Care Housing</i>	–	+	+	–	–
with care	In a multi-apartment building	<i>Assisted Living Apartments, Extra Care Housing, Very Sheltered Housing</i>	–	+	+	+	–
	In collective building	<i>Assisted Living Facility, Assisted Living Residences, Personal Care Homes, Residential Care Facility, Retirement Residences, Adult Congregate Living, Adult Homes, Care Homes, Residential Homes, Rest Homes, Homes for the aged,</i>		+	+	+	+
with long-term care	<i>Care Homes with Nursing, Nursing Homes, Skilled Nursing Facilities, Long-Term Care Facilities</i>	Care and Treatment Facilities (ZOL), Nursing and Care Facilities (ZPO), Social Care Homes for somatically ill (DPS)	–	+	–	+	+
for people with dementia	<i>Dementia Care Homes, Nursing Homes for Alzheimer's, Alzheimer's Nursing Home, Dementia Care Facilities, Alzheimer Special Care Units</i>	Social Care Homes for mentally ill people (DPS)	–	+	+	+	+
With continuity of care	<i>Continuing Care Retirement Communities, Retirement Care Villages</i>		–	+	+	+	+

Source: own study²⁰

20 Based on, M. Magdziak, *Housing forms of elderly people*, PhD thesis, Lodz, 2014, p. 111

intermediate forms, i.e. flats with service and apartments with care, contributes to extending the period of independence of residents. This leads to lowering the demand for places in 24-hour care facilities. Polish law regulations regarding care facilities are so general that they enable the creation of various alternative forms of housing for the elderly and the disabled, which could fill the gap between home care and stay in a Social Care Home, offering seniors the conditions more homogeneous and close to independent living. However, it is necessary to provide organizational support and develop standards for various housing forms in Poland.

Based on experiences from other countries, general recommendations for existing social care homes in Poland can be indicated. They include:

- Improvement of housing conditions in terms of ensuring privacy and decision-making of residents,
- Improvement of the image of care facilities through integration with the local community,
- Improving the safety and freedom of life of residents with Alzheimer's disease,
- Extending the current form of Polish Social Care Homes with intermediate housing forms located in the surrounding,
- The division of larger forms of housing into clearly identifiable groups of a few residents, where scale and general character of space is closer to home conditions.

Literature

- [1] Anderzhon J.W., *Design for Aging: International Case Studies of Building and Program*, John Wiley & Sons, 2012.
- [2] Brawley E.C., *Design Innovations for Aging and Alzheimer's, Creating Caring Environment*, Wiley & Sons, 2006.
- [3] Christensen K., *Encyclopedia of Community: From the Village to the Virtual World*, Sage Publications, 2003.
- [4] Evans S., *Community and Aging, Maintaining quality of life In housing with care settings*, The Policy Pres, 2009.
- [5] Hughes D., Judd S., *Design for Aging: International Case Studies of Building and Program*, John Wiley & Sons, 2012.
- [6] Magdziak M., *Housing forms of elderly people*, PhD thesis, Lodz, 2014. (in Polish)
- [7] Perkins E., *Building Type Basics for Senior Living*, John Wiley & Sons, 2013.
- [8] *Regulation of the Minister of Labor and Social Policy of 14 March 2012 in the matter of sheltered housing*, Dz. U. of 22 March 2012. (in Polish)
- [9] *Regulation of the Minister of Labor and Social Policy of October 17, 2001 on Family Care houses*, Dz.U. No. 127 item 1399. (in Polish)
- [10] Robson D., Nicholson A., N. Barker, *Homes for the Third Age: A Design Guide for Extra Care Sheltered Housing*, Taylor & Francis, 1997.
- [11] Schwarz B., Brent R., *Aging, Autonomy, and Architecture: Advances in Assisted Living*, JHU Press, 1999.
- [12] *Social Welfare Act of 12 March 2004*, Dz. U. No. 64, item 539. (in Polish)
- [13] Szweda-Lewandowska Z., Predictions of demand for places in social welfare homes for people aged 75 and over, [in:] *Aging of the Polish population. Between demography and social gerontology*, red. J.T. Kowalewska, P. Szukalski, Lodz 2008, p.138. (in Polish)
- [14] Wesółowska E., *Running social care homes is unprofitable*, Dziennik Gazeta Prawna, <http://praca.gazetaprawna.pl> (21.02.2012). (in Polish)
- [15] Yesalis C.E., *U.S. Health Care: Principles and Perspectives*, Cengage Learning, 2012.

Przegląd oraz klasyfikacja zespołów mieszkaniowych przeznaczonych dla osób starszych i niepełnosprawnych występujących w krajach wysokorozwiniętych w kontekście deficytu podobnych rozwiązań w Polsce

Streszczenie: W większości krajów wysoko rozwiniętych, dotkniętych problemem starzenia się społeczeństwa, oprócz usług i systemu opieki środowiskowej (domowej), funkcjonują różnorodne formy mieszkaniowo-opiekuńcze i mieszkaniowo-usługowe dla osób starszych i niepełnosprawnych. W niniejszej pracy autorka prezentuje efekt poszukiwań różnorodnych rozwiązań mieszkaniowych w postaci zwięzłej charakterystyki i tabelarycznej klasyfikacji zbiorczej, w której wyłoniono grupy o podobnych cechach, oraz przyporządkowano je do grup odbiorców o różnym stopniu sprawności i samodzielności życiowej. Ponadto autorka systematyzuje nazewnictwo występujące w publikacjach anglojęzycznych obejmujące kilkadziesiąt nazw oraz proponuje nazwy polskie dla wyłonionych grup specjalnych form mieszkaniowych oferujących pomoc lub opiekę stacjonarną dla osób starszych i niepełnosprawnych. W pracy zawarto także wnioski ogólne z prowadzonych badań w kontekście deficytu podobnych do prezentowanych rozwiązań na terenie Polski.

Słowa kluczowe: architektura mieszkaniowa, osoby starsze, niepełnosprawni, starzenie się społeczeństwa, pośrednie formy mieszkaniowe

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