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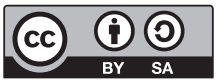

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Wydanie I

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SPIS TREŚCI – CONTENTS

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Barbara LINOWIECKA[1], Anna BOCHENEK[2]

SUSTAINABLE INTERIOR DESIGN OF REGENERATIVE FACILITIES: THE ROLE OF EDUCATION IN SHAPING DESIGN PRACTICES

In the face of escalating environmental challenges, sustainable interior design has become a crucial element of architectural practice. This article examines the possibilities of applying sustainable interior design principles in regenerative facilities such as spas located in natural environments, emphasizing the role of education in preparing future interior architects to implement ecological design practices. The study involved a literature review, analysis of case studies, and two rounds of surveys conducted among second-year master's students of Interior Architecture at Poznan University of Technology, before and after the completion of an educational project. The results indicate a significant increase in students' level of knowledge and ecological awareness following the educational intervention. Analysis of student projects confirmed the participants' ability to practically apply the acquired knowledge, integrating ecological, social, and economic aspects in a holistic approach to sustainable interior design. The article underscores the necessity of integrating sustainable design issues into interior architecture curricula and highlights the need for further research in this area.

Keywords: sustainable interior design, ecology, spa, biophilic design, ecological awareness

1. INTRODUCTION

In the face of escalating environmental challenges such as climate change, ecosystem degradation, and the depletion of natural resources, sustainable interior design has evolved from a trend into a necessity within design practice [Celadyn 2019]. This is particularly significant in the context of recreational facilities like spas, which, situated in natural settings, have the potential to promote harmony between humans and the environment [Rashid, Zimring 2008: 150-190]. Designing interiors of recreational

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facilities in the spirit of sustainable development requires a holistic approach that considers environmental, social, and economic aspects [Piotrowski, Rogers 2010]. A key factor is the use of natural and local finishing materials, which not only reduce negative environmental impacts but also enhance user experience quality [Sun, Luo 2019]. Research indicates that contact with natural materials in interiors can improve well-being, reduce stress, and increase comfort levels [Kellert 2018]. The literature emphasizes the importance of biophilic design – interior design that incorporates elements of nature – which fosters spaces that support health and user well-being [Ryan et al. 2014]. Kellert and Calabrese [Kellert, Calabrese 2015] suggest that integrating natural materials, daylight, and plant elements into interiors can improve quality of life and promote sustainable practices. In the context of spas, which are often places of regeneration and relaxation, applying sustainable interior design principles takes on particular significance [Dilani 2001]. Users increasingly expect spaces that not only fulfill functional requirements but also align with their ecological values [Kwon, Ahn 2020]. Introducing low-carbon footprint materials, efficient energy use, and resource management are becoming key design aspects [Berge 2009]. Despite growing ecological awareness among interior designers, barriers still hinder the implementation of sustainable solutions. These include a lack of sufficient knowledge about ecological materials, higher initial costs, and limited availability of certified products [Hodges 2018]. Therefore, promoting education in sustainable interior design and sharing best practices and experiences is essential [Jones 2014].

To effectively implement sustainable interior design principles, proper preparation of future interior architects is necessary. Education plays a crucial role in this process [Kowalczyk 2015]. Training in sustainable interior design enables future designers to make conscious decisions that directly impact the natural environment [Miłobędzki 2013]. According to research conducted by Celadyn [Celadyn 2019], ecological education in interior architecture studies contributes to increasing students' ecological awareness and shaping their pro-environmental attitudes. Moreover, integrating sustainable design principles in higher education fosters innovation and creativity in design [Nowak 2018]. Students are encouraged to seek new solutions, use ecological materials and technologies, which leads to creating more responsible and conscious projects [Węcławowicz-Bilska 2015]. However, challenges still exist in implementing ecological education in study programs. These include insufficient teaching materials, inadequate preparation of academic staff, and financial constraints [U.S. Green Building Council 2013]. It is therefore essential to undertake actions to strengthen the role of education in promoting sustainable interior design.

The aim of this article is to analyze the possibilities of applying sustainable interior design principles in recreational facilities such as spas located in natural environments, considering the role of education in preparing future interior architects to tackle environmental challenges. The work is based on a literature review, analysis of selected case studies, and survey results conducted among first-semester

second-degree Interior Architecture students at Poznan University of Technology, assessing the state of knowledge before and after the project. We strive to identify key success factors in implementing ecological practices and indicate directions for further development of education in this field.

2. MATERIALS AND METHODS

The aim of this study was a thorough analysis of the possibilities of implementing sustainable interior design principles in recreational facilities such as spas located in natural environments, and assessing the impact of education on preparing future interior architects to adopt ecological design practices. Particular emphasis was placed on examining students' knowledge in the context of sustainable design and the role of the interior architect in this process, both before and after completing the educational project. The study began with a detailed review of the literature, including current scientific publications, standards, and certifications related to ecological interior design, such as LEED, WELL Building Standard, and BREEAM, as well as industry reports and case studies on implementing sustainable practices in spa facilities [Celadyn 2019; Kellert 2018; Gronostajska 2010; Smith 2017]. The literature analysis allowed for identifying key success factors in implementing sustainable design practices and barriers and challenges related to educating interior architects in this area.

Next, empirical research was conducted, including a case study analysis and surveys. As part of the case study, three spa facilities located in Poland were selected, recognized as positive examples in terms of sustainable interior design. A key element of the study was conducting two rounds of surveys among second-year master's students of Interior Architecture at Poznan University of Technology. The first survey was conducted before starting the educational project and aimed to assess the initial level of students' knowledge regarding sustainable interior design and their awareness of the interior architect's role in promoting pro-environmental practices. Questions concerned, among others, knowledge of basic concepts related to ecology in interior design, awareness of the importance of choosing ecological materials, and perception of their own role in the sustainable design process. After completing the three-month educational project, a second survey was conducted to assess the impact of participation in the project on the level of students' knowledge and awareness regarding sustainable interior design. The survey questions concerned acquired skills, changes in perceiving the role of the interior architect, and readiness to apply sustainable practices in future professional work. Comparative analysis of the results of both surveys allowed for evaluating the effectiveness of the applied educational model and identifying areas requiring further improvement.

The educational project, integral to the study, involved students developing a concept for the interior of a spa facility located in a natural environment, considering

sustainable design principles and using ecological finishing materials. Before starting the design work, students participated in a series of lectures and workshops devoted to sustainable interior design, material ecology, and the application of biophilic design in practice. These classes aimed to provide students with the necessary theoretical knowledge and practical skills required to implement the project in accordance with sustainable development principles.

In the design process, students were encouraged to critically analyze the context of the facility's location, user needs, and possibilities of applying ecological materials and technologies. Particular emphasis was placed on integrating elements of nature into interiors, optimizing energy efficiency, and considering aspects of health and user well-being. Projects were evaluated in terms of solution innovativeness, compliance with sustainable design principles, and the quality of integrating natural elements into interiors.

Collected data were subjected to statistical and qualitative analysis. Survey results were processed using descriptive statistics methods, calculating averages for individual questions. Correlation analysis was also conducted to identify relationships between the level of knowledge and students' ecological attitudes. Responses to open-ended questions were analyzed to extract main themes and patterns in respondents' statements.

Additionally, group discussions and individual interviews with students were conducted, allowing for deepening the analysis and better understanding of students' motivations, concerns, and reflections related to the design process and sustainable interior design. Analysis of student projects enabled the assessment of practical application of acquired knowledge and identification of areas requiring further educational support. The study was conducted following the highest ethical standards. Participants were informed about the study's objectives, assured of anonymity, and given the option to withdraw at any stage. Personal data were anonymized.

A limitation of the study is that it involved a limited number of participants – 18 respondents – and focused on a single university, which may affect the ability to generalize the obtained results. Furthermore, the evaluation of student projects, despite established criteria, contains subjective elements. Nevertheless, the applied methodology and triangulation of research methods allow for obtaining reliable and valuable conclusions that can serve as a basis for further research and actions in educating interior architects and promoting sustainable interior design in recreational facilities.

Results and Discussion

The conducted research provided precise data on the level of knowledge and ecological awareness of interior architecture students in the context of sustainable design and the role of the interior architect in this process, as well as their application in the project.

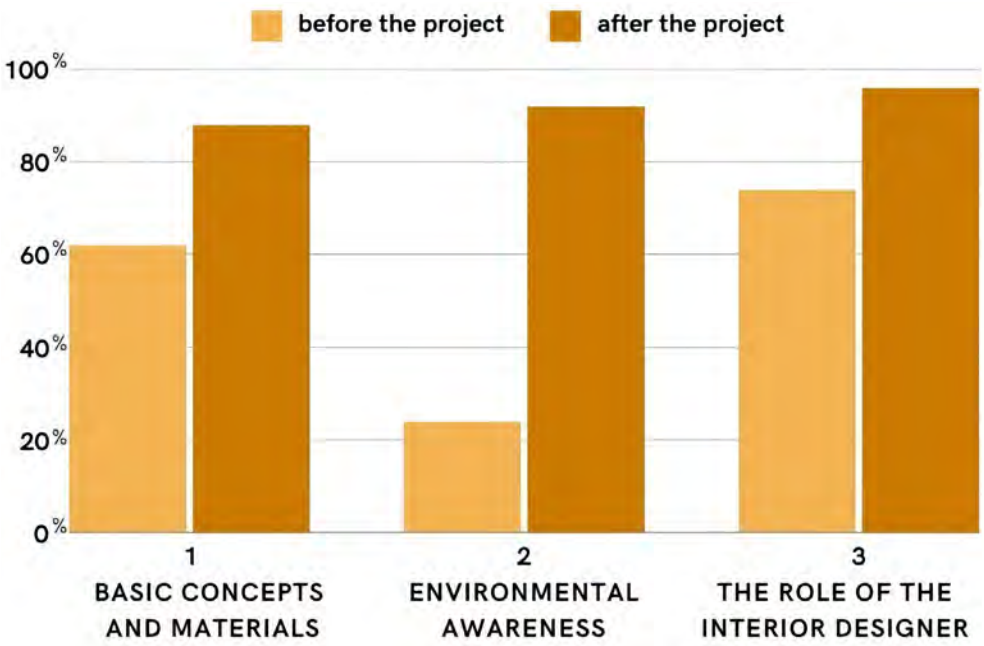

Fig. 1. Results of two surveys conducted before and after the educational project involving Interior Architecture students at Poznan University of Technology (Master's level). Prepared by: Dr Barbara Linowiecka

The survey was divided into three groups of questions, allowing for detailed analysis of individual aspects of students' knowledge and awareness before and after the educational project.

Group I: Knowledge of Basic Concepts and Ecological Materials

The first group of questions concerned basic concepts related to ecology in interior design and knowledge of ecological finishing materials. Before starting the educational project, the average percentage of correct answers in this group was 62%. Students demonstrated a general understanding of basic terms, but their knowledge was fragmented and insufficient for the conscious application of sustainable design principles. After completing the educational project, the result in this group of questions increased to 88%. Students showed a significantly better understanding of key concepts such as product life cycle, carbon footprint, material certification (e.g., FSC, LEED), and could list and characterize various ecological finishing materials, such as natural wood, stone, recycled materials, or organic textiles.

Group II: Ecological Awareness and Influencing Factors

The second group of questions focused on students' ecological awareness, factors influencing this awareness, and understanding what makes a product used in an interior compliant with sustainable development principles. In the first survey, the average percentage of correct answers in this group was only 24%, indicating a low level of ecological awareness and lack of understanding of the impact of individual factors such as production process, transport, recyclability, or material biodegradability. After the educational project, the result in this group of questions increased to 92%. Students demonstrated the ability to critically analyze factors affecting product ecological quality, understanding the importance of material locality, energy efficiency of production, ecological certification, and impact on user health. They could also evaluate products in terms of their compliance with sustainable development principles, considering the entire product life cycle.

Group III: Role of the Interior Architect and Responsibility

The third group of questions concerned the role of the interior architect in the sustainable design process and their responsibility for the ecological character of projects. In the first survey, the average percentage of correct answers was 74%, suggesting that students had a general belief in the importance of their role but lacked a deeper understanding of specific aspects of professional responsibility and the ability to influence pro-environmental practices. After completing the educational project, the result in this group of questions increased to 96%. Students demonstrated a full understanding of the interior architect's role as a key participant in the design process, who, through conscious decisions, can significantly impact the sustainable character of projects. They understood that their responsibility includes not only aesthetic aspects but also material selection, technology, client communication, and public education in ecology.

Statistical analysis of survey results before and after the educational intervention showed the significance of observed differences. Using the t-test for dependent samples confirmed that the increase in results in each of the three groups of questions is statistically significant ($p < 0.01$). This indicates the effectiveness of the applied educational model in raising the level of students' knowledge and ecological awareness. Additionally, analysis of responses to open-ended questions and student comments allowed for identifying changes in attitudes and motivations.

Fig. 2. Eco Spa project, part 1 by Karolina Prodlik, project carried out under the supervision of the author Dr Barbara Linowiecka

Fig. 3. Eco Spa project, part 3 by Karolina Prodlik, project carried out under the supervision of Dr Barbara Linowiecka

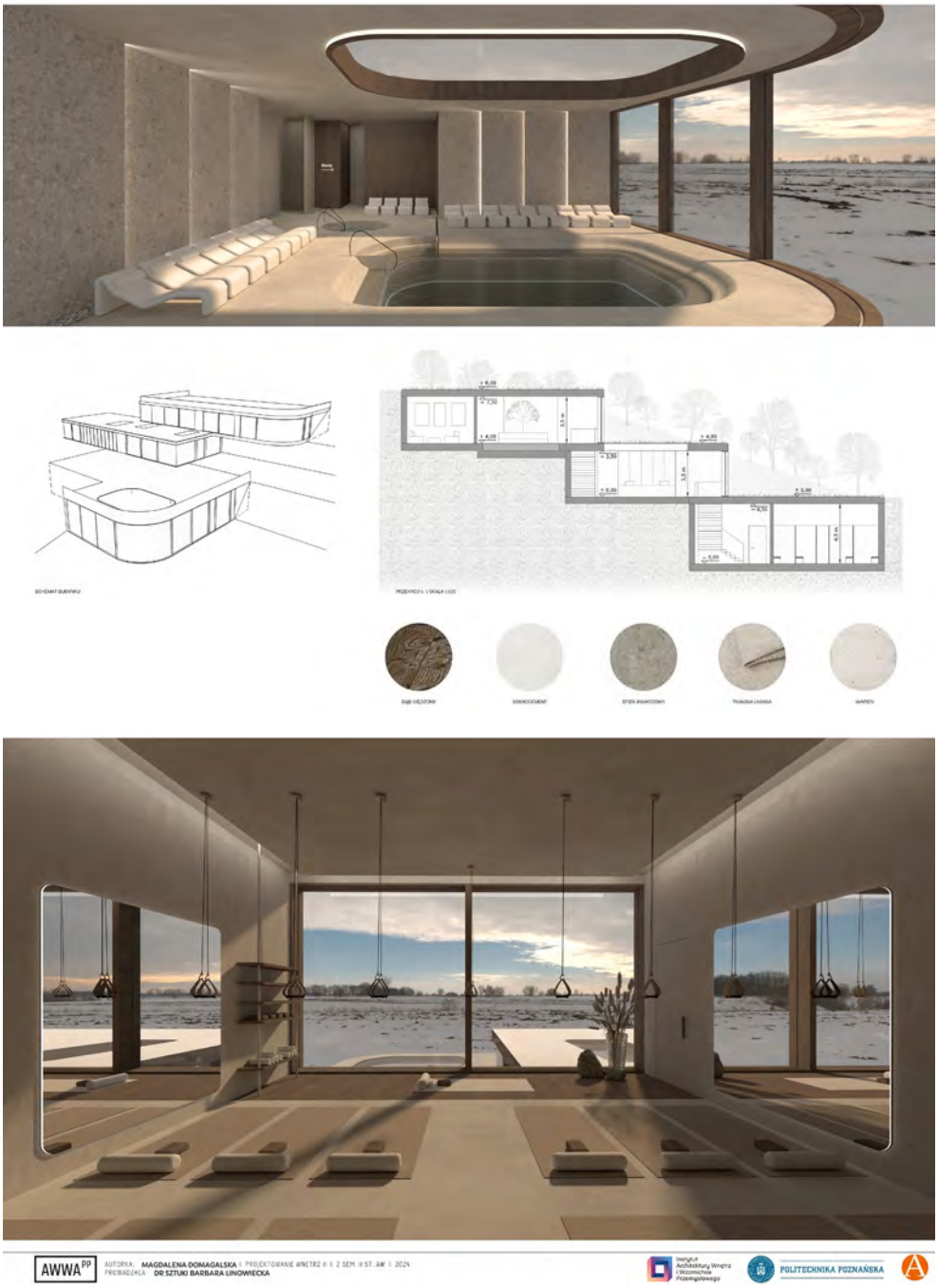

Fig. 4. Eco Spa project, part 1 by Magdalena Domagalska, project carried out under the supervision of Dr Barbara Linowiecka

Fig. 5. Eco Spa project, part 1 by Aleksandra Skolimowska, project carried out under the supervision of the author Dr Barbara Linowiecka

Fig. 6. Eco Spa project, part 2 by Aleksandra Skolimowska, project carried out under the supervision of the author Dr Barbara Linowiecka

Fig. 7. Eco Spa project, part 2, by Aleksandra Skolimowska, project carried out under the supervision of the author Dr Barbara Linowiecka

The analysis of student projects confirmed the practical application of acquired knowledge. Students demonstrated the ability to integrate ecological aspects at various levels of the design process. They used ecological finishing materials such as certified wood, natural stones, or organic textiles, as well as innovative materials from recycling. They also showed the ability to critically analyze and consciously select materials concerning their environmental impact. The application of solutions increasing energy efficiency was visible in most projects. Students optimized the use of daylight through appropriate placement of window openings and glazing. They proposed the installation of energy-saving LED lighting and energy consumption management systems. Integration of renewable energy sources, such as photovoltaic panels or heat pumps, was also reflected in some concepts. The integration of biophilic design elements was common in the projects, indicating an understanding of the importance of contact with nature for user well-being. Students introduced indoor vegetation, used natural materials and colors, and designed spaces conducive to relaxation and regeneration. Many projects also considered aspects of acoustics and indoor air quality, emphasizing a holistic approach to sustainable design.

Projects developed by students after completing the educational project confirmed the acquired knowledge and skills. In the qualitative analysis conducted by the author, it was found that:

- 96% of projects included the use of ecological materials, emphasizing locality and certification (plant-based materials, recycled materials, and modern ecological materials such as bio-composites);
- 94% of projects integrated biophilic design elements, demonstrating an understanding of the importance of contact with nature for user well-being (use of indoor vegetation, natural materials and textures, consideration of material life cycles and local availability);
- 69% of projects included technological solutions increasing energy efficiency and resource management (optimization of natural lighting, use of LED lighting, or water-saving fixtures);
- 83% of projects considered aspects of user health and comfort (indoor air quality, use of low-emission materials, use of plants that purify air, improving acoustics and ergonomics).

Students demonstrated the ability to holistically approach sustainable interior design, combining ecological, social, and economic aspects. They showed the ability to critically analyze available materials and technologies and consciously apply them in the design context. The analysis of projects showed that students not only acquired theoretical knowledge but could also apply it in design practice. They demonstrated critical thinking, innovation, and a conscious approach to design, considering both user needs and environmental protection requirements. Projects reflect students' understanding of the importance of a holistic approach, where ecology, aesthetics, functionality, and economy are equivalent elements of the design process.

During discussions after project presentations, students emphasized that participation in the educational project significantly influenced their perception of the interior architect's role and understanding of the importance of sustainable design. Many expressed a desire to continue deepening their knowledge in this area and declared readiness to promote pro-environmental practices in their future professional work. The study results confirm the crucial role of education in shaping the competencies and attitudes of future interior architects in sustainable design. The applied educational model, combining theoretical elements with practical design experience, proved effective in raising the level of students' knowledge and ecological awareness.

3. CONCLUSION

The study confirmed the crucial role of education in shaping the competencies and attitudes of future interior architects in sustainable design. The statistically significant increase in students' knowledge and ecological awareness levels following the educational intervention indicates the effectiveness of the applied educational model. Analysis of student projects demonstrated participants' ability to practically apply the acquired knowledge, integrating ecological, social, and economic aspects in a holistic approach to sustainable interior design. Projects were characterized by innovative use of ecological materials, implementation of biophilic design elements, and solutions increasing energy efficiency and resource management. After completing the educational project, students expressed greater engagement in promoting sustainable design, declared a desire to further deepen their knowledge, and consciously apply ecological principles in future professional work. In summary, education in sustainable interior design is essential in the face of contemporary environmental challenges. Educating interior architects capable of creating innovative and sustainable solutions contributes to environmental protection and meets society's growing expectations regarding ecology and quality of life.

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ZRÓWNOWAŻONE PROJEKTOWANIE WNĘTRZ OBIEKTÓW REGENERACYJNYCH: EFEKTYWNOŚĆ EDUKACJI W KSZTAŁTOWANIU PRAKTYK PROJEKTOWYCH

Streszczenie

W obliczu narastających wyzwań środowiskowych zrównoważone projektowanie wnętrz staje się kluczowym elementem praktyki architektonicznej. W artykule zanalizowano możliwości zastosowania zasad zrównoważonego projektowania wnętrz w obiektach regeneracyjnych typu spa zlokalizowanych w środowisku naturalnym oraz podkreślono rolę edukacji w przygotowaniu przyszłych architektów wnętrz do wdrażania ekologicznych

praktyk projektowych. Badanie obejmowało przegląd literatury, analizę studiów przypadków oraz dwukrotne badania ankietowe przeprowadzone wśród studentów II semestru II stopnia kierunku architektura wnętrz na Politechnice Poznańskiej przed i po realizacji projektu dydaktycznego. Wyniki wskazują na istotny wzrost poziomu wiedzy i świadomości ekologicznej studentów po interwencji edukacyjnej. Średni wynik poprawnych odpowiedzi w ankietach wzrósł z 62% do 88% w zakresie znajomości pojęć i materiałów ekologicznych oraz z 24% do 92% w zakresie świadomości ekologicznej i czynników wpływu. Analiza projektów studenckich potwierdziła zdolność uczestników do praktycznego zastosowania zdobytej wiedzy, integrując aspekty ekologiczne, społeczne i ekonomiczne w holistycznym podejściu do zrównoważonego projektowania wnętrz. W artykule podkreślono konieczność integracji zagadnień zrównoważonego projektowania w programach kształcenia architektów wnętrz oraz wskazano na potrzebę dalszych badań w tym zakresie.

Słowa kluczowe: zrównoważone projektowanie wnętrz, ekologia, spa, biophilic design, świadomość ekologiczna

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COLOR – ANALYSIS OF THE PHENOMENON ON THE EXAMPLE OF SELECTED BUILDINGS

The use of color in architectural design plays a key role in defining the visual identity of cities, creating distinctive landmarks and shaping the appearance of architectural structures. Color not only affects the aesthetics of buildings, but also the perception of urban spaces by residents and visitors. It builds the unique character of a place shaping its dynamic identity created by changing design trends. The aim of the study is to objectively assess contemporary practices and attitudes towards the use of color in Polish architecture. The paper offers insight into how color affects the visual landscape of Polish cities, drawing attention to its importance in the context of architectural design in the 21st century. The main issue the paper addresses is an analysis of current color trends in contemporary Polish architecture and an attempt to create a database that could serve as a reference point for future projects. The results of the study are intended to serve as a valuable resource for architects, urban planners and researchers, enabling them to better understand the dynamic role of color in shaping modern urban spaces and their aesthetics.

Keywords: color, color composition, shaping architectural form

1. INTRODUCTION

Color is an integral component of the context of our daily life. It accompanies us in aspects of physical, biological, and psychological life. It defines the characteristics of objects, combining them synergistically with the names of the elements in question. Additional factors, determining the color condition of the environment of our existence, are individual tastes, habits, trends, and opportunities, allowing us to use specific materials, applied textures, elements of construction, or architectural

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detail. Color serves, not only, to bring out the tectonics of the facade, but is a logical compositional element necessary to shape the massing, as well as to emphasize the function of the building or its parts. It is often a complementary means selected according to the architect's recommendations, and usually results from the materials' characteristics. In this way, color, being the basis of aesthetic and spatial experience, affects the character and quality of the space.

The purpose of this study is to identify trends in the use of color in Polish architecture in the 21st century. For this purpose, the following research questions were undertaken:

1) What is the leading function of color in Polish architecture of the 21st century? And what is the functional diversity of the use of color?
2) Is Polish architecture of the 21st century becoming more chromatic or is it perpetuating itself in achromatic tones?

2. COLOR AND ARCHITECTURE IN LITERATURE

Piotr Setkowicz in the study *Color – a downplayed dimension of the residential environment* states that: "Science is still far from definitive conclusions on the perception and impact of color. Authors of studies in the field of environmental psychology, determining the usefulness of the results obtained so far for urban and architectural practice, are forced to admit that the literature on the use of color is surprisingly limited, and there are few new empirical studies on the effectiveness of various manipulations of environmental color" [Setkowicz 2010: 73].

Mohamed Hosney Radwan, on the other hand, wrote that "color has approved to be important to the level of being a need for humans, not only to achieve some decorative or aesthetic values but also to fulfill some needs of the human being that they cannot live without in architectural and urban contexts" [2015: 533]. He points to color as more than just a component of spatial composition, justifying its presence in architecture by the need to fulfill human needs in terms of space perception. This thought goes deep into both the past and the nature of man, as a being who needs clear and valid visual stimuli to assign a certain identity to places.

Krzysztof Ludwin wrote about optical illusions induced by colors perceived in architecture, and affecting our subconscious, emotions, mental mood, and consequently, human behavior, pointing out that in the current times, "the subject of color in architecture is a most timely topic. After a long period of the *reign* of black, white, and gray, which set the tone for the design of architecture and the materials from which it was built, many architects are turning again to the world of color" [2008: 400]. On the subject of color in the context of architectural compositions using color elements implemented by contemporary architects, Ewa Węcławowicz-Gyurkovich comments in the article *Intense colors in the latest works of architecture* [2019], stressing that the treatment of the facades of buildings with harsh colors is relatively rare. Anna Markowska

in the article *Color in architecture in the interwar period. Color dictatorship or voluntarism?* looks at the issue of color periods in architecture between 1900 and 1933, pointing out that the features of a given style are closely related to color [2000].

Also on the subject of color, Karolina Białobłocka and Andrea Urland comment, focusing on the results of an analysis of the distinctive method of coordinating color in the design process of architecture and urbanism in Poland and Slovakia, designed to support the conscious operation of color in space [2019], as relevant also to contemporary architecture. In her studies, Małgorzata Bąkowska also addresses the issue of the use of color and finishing materials in the context of architectural objects, often constituting only flat facade compositions [2007].

An interesting approach is presented by Artur Zaguła and Anna Jaruga-Rozdowska in their work *The Importance of Color in the Works of MVRDV*, referring admittedly to Dutch architecture, but with a message that can be an accurate guide to areas of other spatial environments. The authors point out that the strong, often contrasting colors give expression to architectural objects while confirming their conceptual character [2021]. Robert Balcerzak also refers to the color in architecture, referring to design ideas of Bauhaus and trying to find analogies in contemporary buildings [2020]. One should not forget the interesting references to color in architecture and the relationship with the external context, light, its reflections, and the play of contrasts, as presented by Steen Eiler Rasmussen [1999].

The cited works are elements of considerations aimed at effective design, in order to optimally fit into the external context and the multi-level expectations of the future recipient-user. This initial phase of design processes, according to Henry Sanoff in his study *Integrating Evaluation and Participatory Programming in Architectural Design* involves the collection of relevant data, review materials, case study analysis, and, by legal conditions, leading to the constitution of a specific design model or the selection of such, is counted as programming in the design process [1999]. To sum up, one can recall the words of Azza Osman Bakr: "The use of color can be in two ways, the first use is symbolic. And second: good shape-building integration" [2019: 1], constituting, as it were, a good message in taking design directions.

The set of parameters facilitating insightful perception, which are also an integral part of it, also includes light and its intensity, surface texture, and the nature of finishing materials (various types of plaster, natural and artificial facade cladding, steel, glass, ceramics), and as much as possible color. This is also emphasized by Bąkowska in her work, where she highlights that architectural and urban perception is strongly shaped by light and color. These elements not only serve as key formal tools in design but also influence the atmosphere of a place, reflecting its purpose, character, and style [2007b]. All of these elements directly affect the final appearance of the designed architectural form, or urban structure, and also interact with each other. The relativity of individual perception is conditioned by the sensitivity and perceptual abilities of the perceiver, often constituting a symptom of a subjective approach. However, it is possible to demonstrate general tendencies and preferences for

the selection and use of specific colors and facade materials, as well as their quality, in shaping the final form of designed objects. An element that significantly stands out in the observed space is color, especially with a high degree of color saturation. It is an important factor influencing the perception of space, leading to a subjective evaluation of its character. "Color is considered as an integral element of our environment, not only represented in the living organisms of the natural environment but also in the man-made various environments. Color always played an important role in the human evolutionary processes from the simple human shelters to the huge mega cities. The environment and its colors are perceived, and the brain processes and judges what it perceives on an objective and subjective basis" [Radwan 2015: 523]. The role of color, especially in urban composition, was also pointed out by Kazimierz Wejchert, indicating that color can bring out the structure and detail of an object [1974].

3. METHODOLOGY

To realize the declared research goal, an analysis of selected objects of Polish architecture of the 21st century concerning the use of colors on the facades of buildings was undertaken. The study was based on the authors' photographic survey and on-site research.

The analysis included the following criteria:

- the number of occurrences of each color;
- the type and simultaneous number of functions that each color performed on each facade;
- the temperature of the predominant hues present on each building – warm colors, cool colors, neutral colors;
- the contrast of the colors used – high, low, moderate;
- the function of the building.

A database was created and used to analyze the collected information. The research methodology is shown in figure 1.

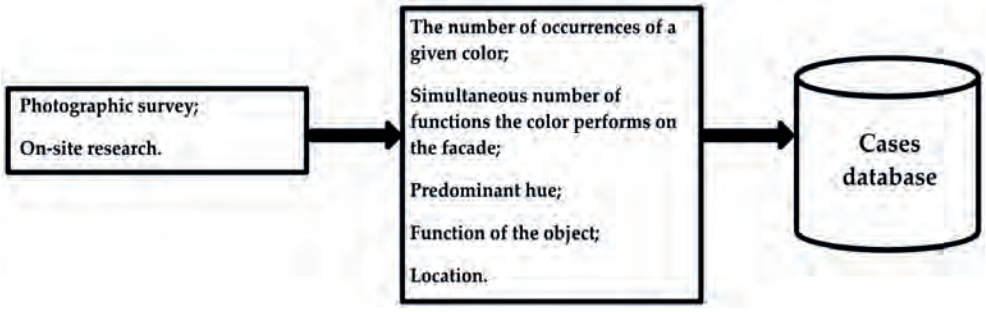

Fig. 1. Methodology for the formation of the database on the studied objects

4. RESULTS

The analysis included 100 buildings located throughout the country with different functions and color palettes. During the study, the following functions of color in an architectural form were specified: accentuation of functional elements, accentuation of component solids, accentuation of load-bearing elements, creation of façade composition, emphasis of façade composition elements, and emphasis on building function. The percentages of occurrence of each function are shown in figure 2.

The most common was the use of color to highlight the functional elements of the building, such as window and door woodwork, balustrades, or loggias. This function was performed by color in 92% of the buildings surveyed. Another significant function, which was used in 60% of the buildings, was to accentuate components of the building's form. Emphasizing the composition of the building's facade appeared with moderate frequency (32%), and less common were creating the composition of the facade (18%), emphasizing structural elements (2%), and emphasizing the function of the building (1%).

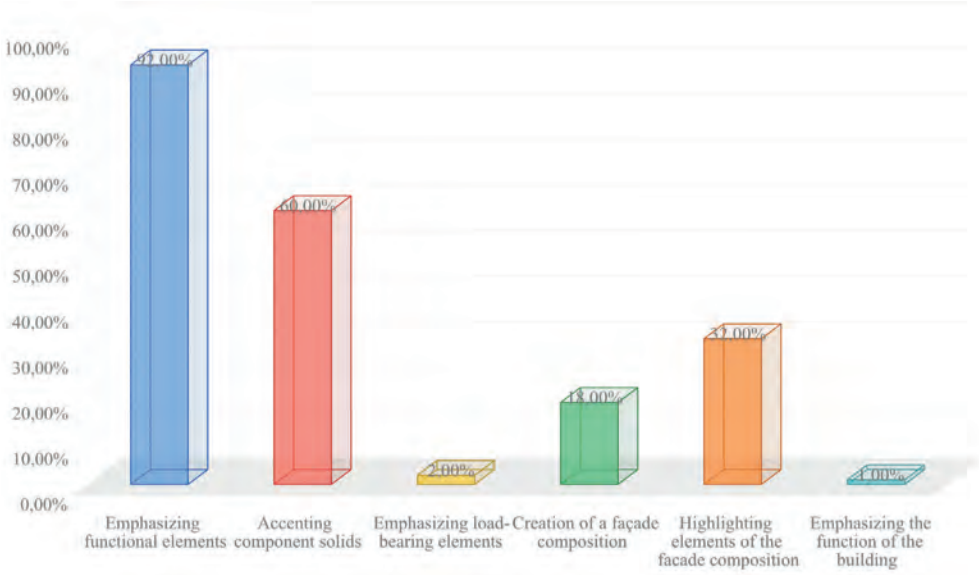

Fig. 2. Percentage of occurrences of the listed functions of color application in the studied objects

In particular objects, color performed a varying number of the functions mentioned above. The vast majority of the surveyed buildings were characterized by the simultaneous occurrence of two functions of color application in the form of the

building. The simultaneous occurrence of three and one function was recorded in a comparable number of cases, 16 and 13 percent, respectively. Only one percent of the cases are characterized by 4 different functions of color (fig. 3).

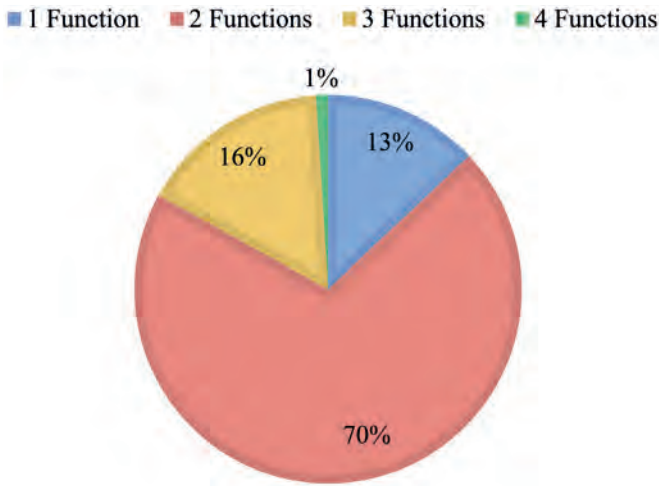

Fig. 3. Percentage of simultaneous occurrences of various functions of color application in the surveyed objects

The perception of the facades of the surveyed buildings was dominated by colors with warm color temperatures (57%), further, neutral shades prevailed in 27% of the objects, and cool colors prevailed to the smallest extent (16%). At the same time, it can also be seen that 27% of the buildings were characterized by full achromaticity.

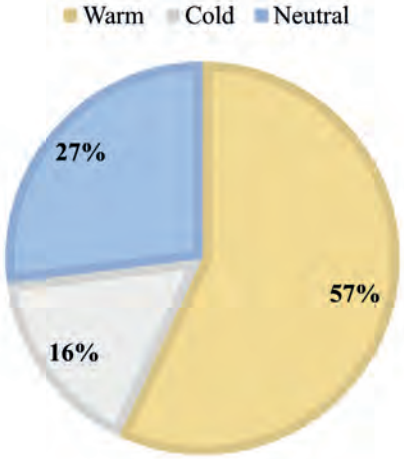

Fig. 4. Percentage of occurrences of prevailing warm, cool, and neutral colors in the surveyed buildings

Among the surveyed buildings, the dominant colors were gray (84 occurrences), anthracite (61 occurrences), glass surfaces (51 occurrences), and white (50 occurrences). Next with scores of 24, 20, and 17 occurrences, respectively, were beige, ceramic cladding, and wood and wood-like cladding. The least frequent appearances were green (8 occurrences), yellow (7 occurrences), orange, red, stone cladding (4 occurrences each), black (2 occurrences), blue and chrome (1 occurrence each).

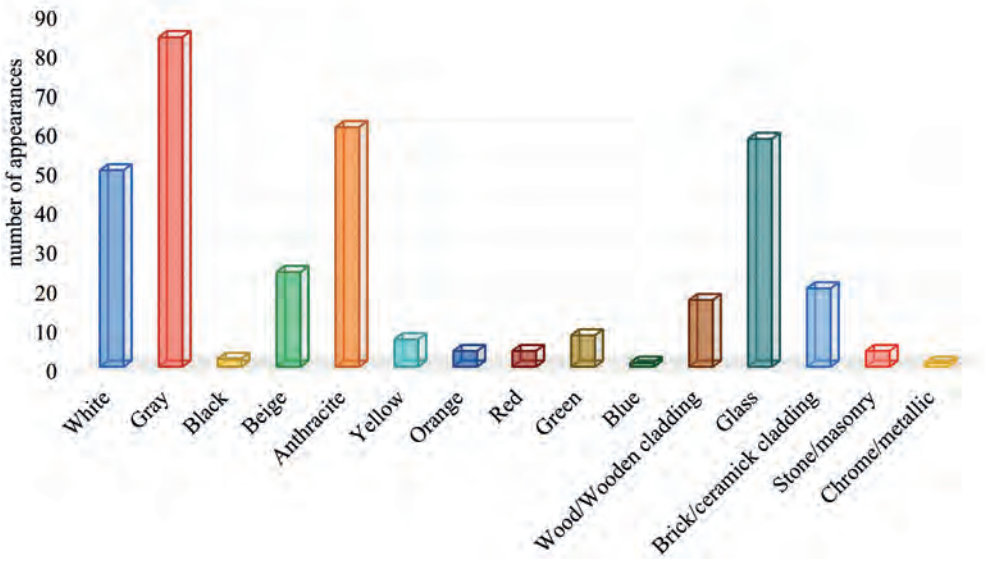

Fig. 5. The number of occurrences of the listed colors and materials

Notable in the assessment is the repeated use of color in the compositions of objects with residential (27), commercial-service (7), and educational (7) functions oscillating around a palette with warm tones. The bold use of color elements is also noticeable in the case of residential and service (5) and public utility buildings (5). Analyzing the use of high color contrasts also refers to residential facilities, where the use of contrasts of high (14) and medium saturation (16) was noticeable. The least frequently used color can be seen on administrative, office-administrative, purely commercial, purely service, and technical buildings. This group also includes an animal shelter, but the final aggregate assessment may be different when considering more buildings with a similar function.

It seems interesting to juxtapose buildings with a similar function, namely apartment buildings, intended for the rental or sale of apartments, and residential buildings, where the second group comes first in the evaluation of the use of color, and the group of apartment buildings is almost entirely achromatic. In this group, cool or neutral colors were noted, with very high contrast or, conversely, low saturation.

Tab. 1. Summary of occurrences of dominant shades and contrast levels by listed function

Function	Dominant shades			Contrast		
	warm	cool	neutral	high	middle	low
Administration	0	0	1	1	0	0
Apartment	0	1	1	1	0	1
Office	2	2	3	3	4	0
Office + Service	0	5	0	1	3	1
Office + Administration	0	0	1	1	0	0
Education	7	1	1	3	4	2
Retail	0	0	1	0	1	0
Retail + Service	7	3	4	6	7	1
Hotel	3	0	1	2	1	1
Residential	27	1	10	14	16	8
Residential + Service	5	0	0	1	3	1
Animal shelter	0	0	0	1	0	0
Service	1	1	0	0	1	1
Public	5	2	1	2	5	1
Technical	1	0	0	0	1	0

5. DISCUSSION AND CONCLUSIONS

The research results indicate new trends in design techniques and color selection. The most common turns out to be the use of colors for:

- accentuating functional elements with color;
- accentuating component solids in the object with color;
- accentuating architectural details (compositional elements) with color;
- also, a tendency to use color less frequently in public buildings is observed.

In terms of the use of color, the vast majority of the surveyed buildings (92%) were characterized by the simultaneous occurrence of two functions of the use of specific colors in the body of the building, of which the most common color was used to emphasize the functional elements of the building (window and door frames, balustrades, loggias). In only 1% of cases color was used to highlight one feature. The use of color to emphasise building's function will become more frequent as the research area expands and the number of objects examined increases.

The study shows that despite the more frequent appearance of achromatic colors, the majority of buildings were characterized by the predominance of warm or cool colors, which allows us to question the thesis of the predominance of the achromatic approach in the creation of building facades in the 21st century Poland. However, this does not mean the absence of such a trend as Sibel Ertez Ural mentions in her paper *Multiple Choice of Colors in Architecture* [2016]. Also, the correlation between the use of chromatic or achromatic colors and the quality of the space in which they are located has not been demonstrated, which seems to be an interesting direction for further studies.

During the on-site searches, it was also noted that 21st-century architecture seems to exhibit a perceived material insincerity. One observes a shift away from the use of specific materials intended to perform specific functions and representative in their display to substitute materials that mimic an original material (ceramics with a wood pattern instead of wooden elements, plastic that imitates concrete, etc.). Polish architecture seems to be striving for a certain color uniformity, involving moderate or negligible use of chromatic colors. This may be due to the conservative approach to the use of chromatic colors, as it is commonly believed that achromatic colors add elegance.

By relating the results of the analysis to color compositions, an attempt can be made to make inquiries aimed at finding an answer to the question of the need to change the observed trends in design and to find premises for moving away from the flat treatment of the facades of buildings, as painting decoration, to three-dimensional thinking in the processes of shaping architecture.

Architecture as a spatial form, as a composition of solids in proprietary arrangements, guaranteeing specific functions to a specific user or group of users, is perceived in spatial form, where its structure, individual components and relationships between them, relations with the external context can be observed, each time about environmental conditions, independent of the observer. Facilitating perception was and is color, emphasizing functions, highlighting solids or details, in the 21st century predominantly in shades of grey, anthracite, and white.

In light of the results of the survey, Krzysztof Ludwin's statement indicating that Polish architecture is moving away from achromaticity [2008] needs to be revised. On the contrary, this tendency seems to be perpetuated, and chromatic colors turn out to be in most of the elements only an addition in the achromatic composition.

In the pursuit of material truth, it is important to consider the austerity that arises from the logical nature of the action and the underlying structural truth. It raises the question if the thesis of Jose Luis Caivano is true, who is saying that architects such as Walter Gropius who write about color and study its relationship with architecture usually do not use it much in their buildings. In opposition, we can find designers such as Bruno Taut, who, although they use a wide range of colors in their buildings, do not devote much research attention to them [Caivano 2006].

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KOLOR – ANALIZA ZJAWISKA NA PRZYKŁADZIE WYBRANYCH REALIZACJI ARCHITEKTONICZNYCH

Streszczenie

Zastosowanie koloru w projektowaniu architektonicznym odgrywa kluczową rolę w definiowaniu wizualnej tożsamości miast, tworzeniu charakterystycznych punktów orientacyjnych oraz kształtowaniu wyglądu struktur architektonicznych. Kolor nie tylko wpływa na estetykę budynków, ale również na odbiór przestrzeni miejskich przez mieszkańców i odwiedzających. Buduje on unikalny charakter miejsca kształtujący jego dynamiczną tożsamość kreowaną przez zmieniające się trendy projektowe. Celem przeprowadzonego badania jest obiektywna ocena współczesnych praktyk i postaw wobec zastosowania koloru w polskiej architekturze. Praca oferuje wgląd w to, jak kolor oddziałuje na wizualny krajobraz polskich miast, zwracając uwagę na jego znaczenie w kontekście projektowania architektonicznego w XXI w. Główne zagadnienie, które poruszono w artykule, to analiza aktualnych trendów kolorystycznych we współczesnej architekturze polskiej oraz próba stworzenia bazy danych, która mogłaby stanowić punkt odniesienia dla przyszłych projektów. Wyniki badania mają służyć jako wartościowe źródło wiedzy dla architektów, urbanistów i badaczy, umożliwiając im lepsze zrozumienie dynamicznej roli koloru w kształtowaniu nowoczesnych przestrzeni miejskich i ich estetyki.

Słowa kluczowe: kolor, kompozycja kolorystyczna, kształtowanie formy architektonicznej

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THE RELATIONALITY OF ART AND SPACE ON THE EXAMPLE OF SCULPTURAL OBJECTS LOCATED ON ALEJE MARCINKOWSKIEGO IN POZNAŃ

The purpose of the article is to analyze the relationship between art and space in the context of sculptural objects located on Aleje Marcinkowskiego in Poznań. Art in urban space implies many problems. The context of the place, as well as the needs of the recipients – users of the space are associated with the necessity to take into account many factors, such as the history of the place, its specificity, land development, or trans-subjectivity of perception. Aleje Marcinkowskiego is located in the area of the Old Town – in close proximity to the Old Market Square and constitutes an axis connecting such streets as: Plac Wolności, 23 Lutego and Paderewskiego. Among the sculptures placed there are both objects of historic character and works by contemporary artists. The dialogue between history and the present is an interesting field of research, as are the interactions between the sculptures and architectural components located in their surroundings.

Keywords: art, space, urban space, sculptures, public space, public art, Aleje Marcinkowskiego

1. PUBLIC SPACE AND ART

Public space is a research area for various disciplines. Its social aspect is of primary importance. One of the definitions of public space emphasizes egalitarianism in the context of access and trans-subjectivity of perception. All activities in public space are characterized by the need to take into account both the context of the place and the different needs of the users of the space. Art, as a place-making, transformative tool, allows for the individualization of the environment, but also serves

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a commemorative function. However, the location of art objects outside the walls of institutions is associated with many problems that require a holistic approach. The origin of the term "public" dates back to the end of the 17th century and refers to sharing/accessibility[4]. Its antonym is the adjective "private", which is related to limited access, and therefore openness to a selected, hermetic group – most often friends and family. As Richard Sennett wrote: "The concept of *public* thus began to refer to life outside the circle of family and close friends. In the public sphere, various, complex social groups were to enter into inevitable contacts with each other" [Sennett 2009: 35]. This meant consent to interactions without any limitations, keyless access, expectations and acceptance of unpredictability in the reception.

The expanded public sphere is a specificity of modernity. It shapes society and is one of the most important aspects of life, as it allows for both the manifestation of one's own views, beliefs, reflections, and the perception of stimuli provided by the environment. Coexistence means participation in the process. The dynamic nature of the public sphere is reflected in art. All activities in public places must include the cultural, social, geographical and architectural-urban context. Placing artworks outside the walls of institutions is related to the intention to cross the boundary between the interior and the exterior, as well as between what is private and what is available to everyone – for a random recipient, perhaps. It is also an invitation to interaction – a gesture towards those who do not participate in artistic life. Josie Appleton stated that "Art in public life is used by British elites to plug holes in public life" [Appleton 2013]. These bitter words refer to the way art in public space is treated by elites – governments, city councils, i.e. bodies deciding on the financing of the implementation of artworks that become part of the image of a given city. The number of monuments, especially those of a historical-patriotic or sacral nature, says a lot about the significance of the interaction between the artwork (art) and the community. Ignoring the needs of recipients, dialogue, leads to the emotional and intellectual impoverishment of the impact of art and the creation of a gap in interpersonal relations.

Art in public space has been present since the beginning of human artistic activity. Exhibiting artworks outside the gallery, the sterile white cube, allows for increasing the accessibility of art to recipients who are not regular visitors to exhibitions. Works presented in the space of museum or art gallery usually have a narrowed group of recipients. The niche nature of art is associated not only with the subject of the artwork, its nature, but also with the place of exhibition. Going beyond elite exhibition spaces increases accessibility by eliminating the boundary between the recipient/viewer and the place of exhibition. Entering

[4] According to the PWN Dictionary of the Polish Language: 1. "concerning the entire society or some community", 2. "available or intended for everyone", 3. "related to some office or some non-private institution", 4. "taking place in front of witnesses, in an open manner" [Sjp.pwn.pl 2023].

a gallery means entering a place that is governed by different rules than those functioning in other public spaces. Galleries and museums separate artworks and recipients from external factors. Minimizing visual stimuli that could disrupt the perception of the work means creating an artificial situation. The primacy of art objects in relation to their surroundings means subordinating the exhibition space to exhibition procedures, and therefore eliminating all competing components. Exhibiting an artwork in a gallery or museum forces the recipient to cross the threshold between the interior and the exterior.

Art is an alternative reality. According to Baudrillard, the greatness of art is determined by its fame, which means that the greater the number of recipients, the greater the significance of the work. Postmodern art has become independent from non-artistic reality. Schoneberg, radicalizing the slogan "art for art's sake", postulated that utility excludes the object as a potential work of art freed from social reality. The exhibition space is a visual frame for works. Art as a "spiritual matter" requires appropriate presentation. Classic exhibition assumptions assume the primacy of the work in relation to the exhibition space.

Art in urban space undoubtedly has an aesthetic effect. However, one should not forget about the intellectual and emotional impact on the recipient. As Bauman wrote, works of art allow to create identity and character of the place by emphasizing the relational specificity of the place-recipient configuration.

The architectural space can be a visual continuum of the artwork's narrative, or its frame-closure. A work placed outside the building gains a broader context. The relations between it and its surroundings are intensified, and the boundaries between the art object and the exhibition background become illegible. An additional factor that changes the reception of art objects is light. The variability of natural light introduces a dynamic aspect to reception of the work. In an art gallery, the artwork is exposed to a large extent through the action of light. A concentrated stream of light helps to focus attention on a given object, which marginalizes the egalitarianism of the art-place relationship. Daylight that evenly illuminates the works and their surroundings creates a situation in which both the artwork and its surroundings exist on equal terms.

A piece of art placed in space becomes its component. Balance and harmony between the work and its surroundings affect the reception of both, the artwork and the space in which it has been placed. The boundaries between art objects and the surroundings can be radical, ephemeral, or conventional. The relationality of art and architecture determines the perception of the whole space, in a philosophical approach, is one of the basic components of material reality. It is connected with the extension of entities, their dimension, form, location, relations. Going beyond the space of the building means expanding the boundaries of perception by reducing the division into interior and exterior. The work, becoming a component of the place, gains a wider spatial context, and triggers new associations – going beyond conventional reception associated with the artistic narrative.

The surroundings of the work can enhance the aesthetic experiences of the recipient, stimulating their sensitivity. For this to happen, it is necessary to create harmony between the work and the space in which it was placed. Public space is an egalitarian zone – open to everyone. Its main aspect is accessibility. Interactions between the components of the space and its users, and among users, affect the specificity of the place. Art is one of the most important manifestations of human activity in public space. In contrast to activities in art galleries, each implementation transferred outside the walls of the institution increases the range of impact on the recipient, because it is associated with going beyond the hermetic area – both in the architectural and social context.

Josie Appelton in her text *The return of statuemania* distinguishes contemporary public art into: megalomaniac public art, suicidal public art, and public art focuses on building relationships. In the first case, the creator is at the center of the action, in the second the artist represents the collectivity and in the third the most important thing is building relationships. The last situation emphasizes happening, processuality. Appelton emphasizes the importance of relationality. Dialogue between elites, artists, and the audience allows for crossing social boundaries, because every voice, every reaction is based on egalitarianism. As Appelton writes: "But today the artist is invested with almost magical powers to solve social problems, and is given free rein to go where he/she likes. The artist is asked to conjure up the public, to create points of public identification and allegiance. He/she is a paid-up missionary without a mission […]. Artistic creativity is seen as a balm for all ills, a magic power that can get people to relate to one another again and to create new forms of legitimacy for a democratic society" [Spiked-online.com 2022]. Appelton draws attention to the problem of the excess and inadequacy of some public space projects to their surroundings. Statuemania led to the construction of as many as 659 permanent monuments in the years 1990-99 in Great Britain. For comparison, between 1870 and 1879 there were built only 85. However, a change in their character is visible – a transition from political, historical narratives to abstract forms, increasingly expressing social ideas. Art has been present in public space since time immemorial – examples include triumphal arches and all monuments commemorating heroes, important events, etc. Erected in honor, they played an important role in the education of subsequent generations, but also fulfilled an aesthetic function. They were the ones who individualized particular zones of the city, becoming important points of reference. However, there is a visible difference in the perception of the function of these objects and contemporary assumptions. The boundary between works placed in museums or art galleries and those intended for viewing outside the walls of institutions became blurred in the 1960s. It was then that sculptures, previously presented only in museum or gallery halls, began to be moved outside. The most outstanding sculptors, not specializing in monumental sculpture, such as Isamu Noguchi, Henry Moore, or Alexander Calder, started to receive

commissions for works intended for exhibition in the city space. Authorial projects did not always refer to the context of the place. Works were created in the studio and artists often did not take into account the site-specific aspect. The projects were financed by the city authorities or private investors – owners of a given area. Miwon Kwom suggests distinguishing between two types of public art: "art as public space" and "art in the public interest". As Kwon writes about the latter: "Many critics, artists and patrons agreed that it was at best a pleasant visual contrast to the rationalized regularity of the surroundings, a nice decorative effect. At worst, it was an empty trophy. A monument to the power and wealth of the dominant class – a corporate or architectural trinket" [Spiked-online.com 2022]. There is a pejorative term for the activities that Kwon writes about – plop art. According to the current understanding of public art, one cannot ignore social and locational issues. A place, with its history, architectural and urban solutions, has a significant impact on artistic realization. The aspect of meaning cannot be omitted either. Art is supposed to initiate reflection, dialogue, and therefore participation in action/realization. Interpersonal interactions are as important in contemporary art as the medium used by the artist. Participation in an exhibition is a significant meeting from the perspective of both the artist and the recipient. A meeting means an exchange of reflections and observations, but it also sometimes means co-creating a form that is part of an artistic realization or a situation, especially in the case of typical happening activities.

2. HISTORY OF ALEJE MARCINKOWSKIEGO

Aleje Marcinkowskiego was created in 1794 after Wielkopolska was annexed to the Prussian partition (Hohenzollern state) and was given the name Wilhelmstrasse. Together with Plac Wolności, then Wilhelmplatz, it formed the centre of Nowe Miasto the plan of which was developed by Berlin councillor and architect David Gilly. The new district was to fulfil residential and representative as well as cultural and recreational functions. Wilhelmowska Street was designed based on the Berlin avenue Unter den Linden, and the author of the promenade constituting the main axis was Lindhorst. A special feature of Wilhelmstrasse was the introduction of greenery as an element creating the new urban planning of the city. Four rows of trees were planted along the avenue, and the walking part was separated from horse-drawn traffic. The street had the character of a promenade and encouraged residents to take part in recreation. In 1806, the avenue changed its name to Rue Napoleon (Napoleon Street) and became a place for exercising and horse riding (manege), which contributed greatly to the devastation of the greenery and had a negative impact on the street's pedestrian character. Shortly after the city was reincorporated into the Prussian partition, the street was restored to its previous name and appearance – trees were replenished and horse

riding was banned. In the 1820s and 1830s, the avenue, together with the adjacent Wilhelmplatz, were an important meeting place for the city's residents. In the second half of the 1850s, the construction of several representative buildings was completed, and on the ground floors of the tenement houses, shops appeared, the windows of which were made of crystal glass. The streets began to be lit with gas lanterns, the promenade was covered with granite paving slabs, and the previous wooden barriers that had surrounded it were replaced with a fence made of iron railings and granite posts. In 1884, near the Rzymski hotel, at the request of Gustaw Kronthal, a cast iron, openwork weather booth was built, which had not only a utilitarian but also an aesthetic function.

Wilhelmstrasse evoked connotations of a seaside promenade. The transformations implemented at the beginning of the 20th century, such as new development of greenery, changes in the tree stand, and in the location of the promenade axis were to meet the metropolitan aspirations and make Poznań more attractive. The visit of the Emperor of Prussia himself was also significant.

The most representative buildings located on Wilhelmska Street were undoubtedly: the Raczyński Library built in 1822-28, the Bazar hotel from 1842, the Museum of the Emperor Frederick III (Keiser Friedrich-Museum)[5], the Main Post Office (Kaiserliches Postamt) built in 1873-81, Hotel de Berlin, the Credit Land building[6] from 1838 and Vogelsang's Hotel. Unfortunately, the fighting that took place on the streets of the city during World War II completely destroyed both the representative buildings, sculptural objects and greenery. The city authorities decided to transform the promenade – a through artery was introduced connecting the southern and northern parts of the city. The reconstruction plan also assumed the creation of a multi-level intersection, or a roundabout aspiring to be the main communication hub of Poznań. This meant the need to demolish all tenement houses located in the southern part of Aleje Marcinkowskiego. The demolition, as well as the idea of the intersection, were abandoned due to the financial crisis, but the introduction of vehicular traffic was considered necessary.

3. ART OBJECTS LOCATED ON ALEJE MARCINKOWSKIEGO

Art in public space is a shared cultural heritage. Taking care of it involves administrative, inventory, legal, and scientific challenges. The primary goal of the *Miasto Sztuki* [Sztukapoznania.com 2024] project, launched in 2019, was to place as many sculptures and installations by prominent contemporary artists in public space as possible. The project was initiated by the unveiling of

[5] Later called Muzeum Wielkopolskie – currently the National Museum in Poznań.

[6] Currently, the building of Magdalena Abakanowicz University of the Arts Poznań is located here.

Magdalena Abakanowicz's installation entitled *Nierozpoznani* (*Unrecognized*). Two years later, 16 more objects located in the city were included. In 2020, the National Museum in Poznań hosted an exhibition entitled *Formy w przestrzeni* (*Forms in Space*). The exhibition recalled the creators and history of outdoor sculptures that were created in Poznań in the 1960s and 1970s during numerous open-air events, symposia, meetings, and sculpture competitions held at that time. One of the assumptions of the exhibition was to draw residents' attention to sculptural objects located in public space. The projects created on the initiative of the Greater Poland Society for the Encouragement of Fine Arts as part of the Poznań City of Art project are: *Nierozpoznani* (*Unrecognized*) by Magdalena Abakanowicz, *Stela* by Heinz Mack, *Golem* by David Černý, *Obszar obrazów efemerycznych* (*Area of ephemeral images*) also known as *Lustra* (*Mirrors*) by Jan Berdyszak, *Transmutatio* by Sławomir Brzoska.

Heinz Mack's kinetic installation entitled *Stela* was placed at Al. Marcinkowskiego, at the height of the National Museum and The Raczyński Library in 2006. The author has created many objects in the space of cities all over the world – all of them are connected by the aspect of movement, light and the relationship between sculpture and place (architectural and urban space). The 18m high steel column is finished with a rotating head driven by a rotary engine. At the top, there are diagonal sheet metal forms reflecting light. The movement of the head and the shine of the structure cause constant changes in the reception of this object. On sunny days, you can observe the reflections of light cast by the sculpture on the facades of nearby buildings and the pavement. The object forces viewers to look up, which can be treated as an invitation to change perception – to contemplate what is happening above the line of sight, to stop, which is not easy in the center of a large city, especially in such a noisy place.

Fig. 1, 2. Heinz Mack, *Stela*, 2006, Al. Marcinkowskiego, Poznań – view from the National Museum in Poznań, 2023, photo by Paulina Kowalczyk

On the axis with the Mack's object, also on Al. Marcinkowskiego, between Magdalena Abakanowicz University of the Arts and the post office building, there is a sculpture *Golem* created by the controversial Czech artist David Černý. According to legend the title character was created by the Prague rabbi Jehuda Low ben Becalel, who lived in the 16th century. The Golem was to protect the inhabitants of the Prague ghetto from anti-Semitic attacks. According to legend, it was made of clay, and brought to life by the rabbi with the words – a holy inscription written on the giant's forehead, which had to be wiped off every morning to maintain control over him. One day, the rabbi forgot to wash off the inscription and the Golem walked away from the ghetto, destroying everything around. The rabbi managed to find it and wipe the words off his forehead, but then the giant turned to dust. It is worth adding that Becalel regularly visited Poznań because he served as the chief rabbi in Wielkopolska, and Poznań was an important center of Jewish philosophical thought and mysticism. According to the first concept, the sculpture was to be made of concrete and placed in a different place – at the intersection of 23 Lutego and Nowowiejskiego Streets. The project assumed that the Golem would have red glowing eyes and steam would come out of his mouth. Ultimately, however, Černý's proposal was chosen. Unlike the original, the 2.5-meter sculpture was

made of metal. The openwork object has been deprived of a plinth, which encourages interaction. Unfortunately, since its unveiling, it has already been the target of vandals' attacks three times, as a result of which repairs were necessary. Opinions on the sculpture in the Poznań artistic community are divided, but in the case of Černý's implementation, this is not surprising. The artist has as many supporters as opponents, and his sculpture *Entropa* is one of the most popular art objects in public space.

Fig. 3. *Golem* by David Černý, Al. Marcinkowskiego, *Stela* visible in the background, winter view, Poznań, 2023, photo by Paulina Kowalczyk

Fig. 4. *Golem* by David Černý, Al. Marcinkowskiego, spring view, Poznań, 2023, photo by Paulina Kowalczyk

In the immediate vicinity of *Golem,* near the intersection with 23 Lutego Street, there is a *Fountain with Dolphins* from 1909, also called *the Lederer Fountain* – after the sculptor, Hugo Lederer, or *the Kronthal Well* – after its founder, the merchant Gustaw Kronthal. The sculpture commemorates the water supply well that functioned at the site in the years 1841-1906, built on the initiative of Edward Raczyński. The fountain project was approved by Emperor Wilhelm II. The object was made of shell rock, and the balustrade is decorated with copper figures depicting boys sitting on dolphins. The author of the sculptures is unknown, although some point to Berliner August Gaul, the author of one of the sculptures located in the Old Zoo in Poznań.

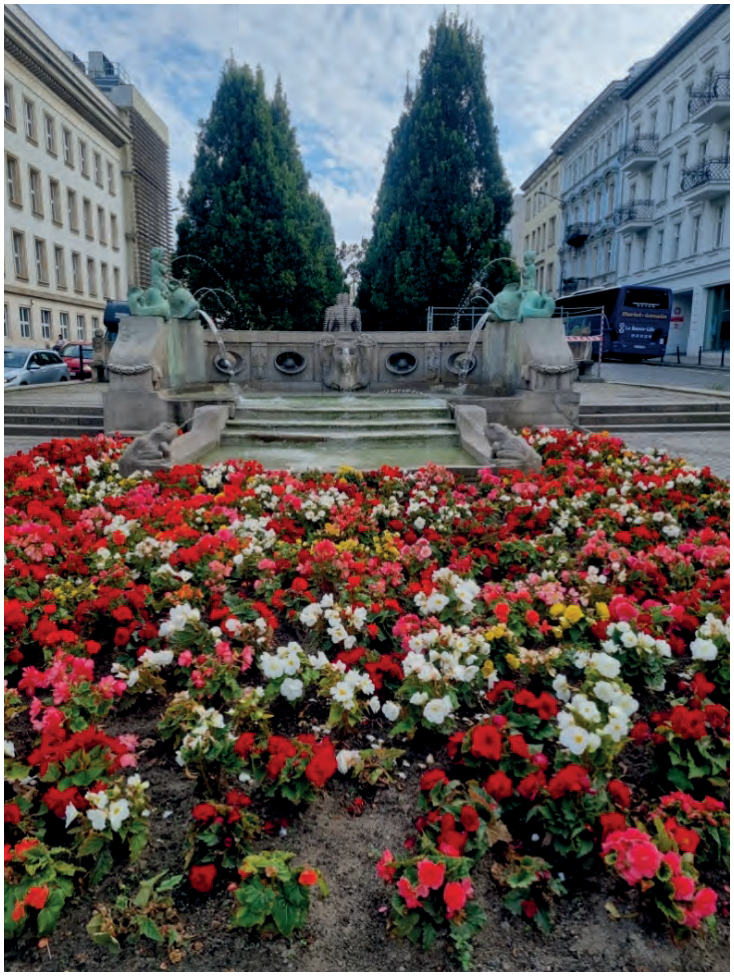

Fig. 5. *Fountain with Dolphins/Lederer Fountain/Kronthal Well*, 1906, restored in 2006, author unknown (presumably August Gaul), Al. Marcinkowskiego, 2023, photo by Paulina Kowalczyk

Fig. 6. Fountain with Dolphins/Lederer Fountain/Kronthal Well, 1906, restored in 2006, author unknown (presumably August Gaul), Al. Marcinkowskiego, 2023, photo by Paulina Kowalczyk

The axis created by the sculptures is closed by a monument from 2005 – a statue of Karol Marcinkowski – a famous Poznań doctor, social activist and philanthropist who initiated the construction of the Poznań Bazaar. The creator of the object was the Gdańsk artist Stanisław Radwański, and the founders were Kampania Piwowarska, Enea, Agrobex, Fundacja 750-lecia Lokacji Poznania (Foundation of the 750th Anniversary of the City of Poznań) and PKO Bank Polski.

Fig. 7. The statue of Karol Marcinkowski, author: Stanisław Radwański, 2005, photo by Paulina Kowalczyk, 2023

When writing about the sculptures located on Aleje Marcinkowskiego, it is also worth mentioning two objects that constitute an important part of the history of this place: Hygieia's Fountain statue and the statue of Emperor Wilhelm I. The first object was placed at the intersection of Wilhelmstrasse and Friedrichstrasse. The author of the artwork was Albert Wolff, and the plinth was created by the Berlin architect Christian Gottlieb Cantian. The sculpture was commissioned by Edward Raczyński. The mythological Hygieia (Hygieia, Hygea, Hygia) was the patron of health. The term "hygiene" was created from her name. In art, she was usually depicted as a young woman with a snake, symbolizing renewal/rebirth, and a bowl or a cup. The goddess was given the facial features of Konstancja Raczyńska. The ceremonial unveiling of the well took place in 1908. It is currently located in front of the Raczyński Library, on Plac Wolności. The statue of Kaiser Wilhelm I, also known as the Provincial War Memorial, was erected on the occasion of the imperial visit and stood in front of the no longer existing building of the Dowództwo

V Korpusu Armijnego (V Army Corps Command). It was designed by Robert Baerwald. The emperor's figure was cast in bronze, while the pedestal elements were made of Carrara marble, the pedestal of red granite, and the cornice of grey marble. The monument was unveiled in 1889. The building was destroyed in 1919, just after Poland regained independence as part of the Polonization of the city.

Fig. 8. *Hygieia Fountain*, plac Wolności, Poznań, photo by Paulina Kowalczyk, 2024

4. RESEARCH AND CONCLUSIONS

As part of this article, the authors conducted research on the relationship between sculptural objects located on Aleje Marcinkowskiego. It was a survey sent to 30 respondents who have been living in Poznań for years. The intention of the article's authors was to check whether, according to the respondents the sculptures located on Aleje Marcinkowskiego are adequate to the place, whether they constitute elements

that aestheticize the space, whether their narrative is legible, whether the interactions between the objects are satisfactory, whether the scale of the sculptures is adequate to the place, whether the reception and access to the objects are satisfactory and whether the alleys encourage recreation. The survey used a five-point Likert scale [Surveylab.com], according to which 1 means not at all, and 5 – very much. The survey results showed that according to 90.5% of the respondents, the sculptural objects located on Aleje Marcinkowskiego make this place more attractive, with 61.9% of the answers taking into account the highest level of the scale. 9.5% of the respondents selected the answer "average". 85.7% of people considered the sculptural objects to be appropriate for the place, however 54.2% of people indicated that the objects do not create a coherent narrative. For most respondents, the narrative of the objects is clear and the scale is appropriate. The answers regarding the reception of the objects and the appropriate access to them are varied, but the overall assessment is negative. The recreational aspect of Aleje Marcinkowskiego was also assessed negatively. Only 19% of people indicated a positive response. The research results show that both the sculptural objects located on Aleje Marcinkowskiego and their adequacy to the place are assessed positively. However, the problem is the difficult access and therefore the uncomfortable reception. It is also worth noting that according to the respondents, Aleje Marcinkowskiego does not encourage recreation.

Tab. 1. Results of the survey on the topic: Relationality of art and space on the example of sculptural objects located on Aleje Marcinkowskiego in Poznań

Relationality of art and space on the example of sculptural objects located on Aleje Marcinkowskiego in Poznań – survey results					
Number of question	Rating scale (1 – not at all, 5 – very)				
	1	2	3	4	5
1	0%	0%	9,5%	28,6%	**61,9**%
2	0%	4,8%	9,5%	33,3%	**52,4**%
3	4,8%	9,5%	**52,4**%	28,6%	4,8%
4	0%	9,5%	9,5%	**42,9**%	38,1%
5	9,5%	26,6%	**42,9**%	19%	0%
6	0%	4,8%	14,3%	52,4%	14,3%
7	4,8%	14,3%	**47,6**%	28,6%	0%
8	**23,8**%	14,3%	**23,8**%	19%	19%

Source: Kowalczyk 2024.

Questions:

1) Do the sculptures placed on Aleje Marcinkowskiego in Poznań make the place more attractive?
2) Are the sculptures on Aleje Marcinkowskiego compatible with the place?

3) Do the sculptures placed on Aleje Marcinkowskiego create a coherent narrative?
4) Is the narrative of the individual objects clear to you?
5) Does Aleje Marcinkowskiego encourage recreation?
6) Is the scale of the sculptures adequate to the place?
7) Is the reception of the objects comfortable?
8) Is access to the sculptures sufficient?

5. SUMMARY

The sculptures located on Aleje Marcinkowskiego in Poznań are an example of successful synergy between art and place. The interactions between them and the surroundings are characterized by harmony and dynamics related to the changeability of the seasons, and therefore light, colors, etc. as well as street traffic. The sculptures without plinths encourage direct contact with recipients – users of public space and naturally become part of the surroundings. An additional aspect worth paying attention to is the consideration of the context of the place, which creates a dialogue between historical and contemporary objects. The axis marked by the sculptures emphasizes the character of the street and determines the direction of movement. Therefore, the processuality concerns not only the reception of the artworks, but also refers to the multi-threaded narrative created by them, spread over time related to the reception of individual objects. The location of the artworks is unique not only because of its historical value, but also because of the proximity of such institutions as: the National Museum in Poznań, the Raczyński Library, Magdalena Abakanowicz University of the Arts in Poznań and the Wielka Scena art gallery. Art objects placed outside the space of art institutions constitute a certain *continuum* of the idea related to making art available to a wide audience. The primary assumptions regarding the function of Aleje Marcinkowskiego, then Wilhelmstrasse, took into account the culture-forming and recreational aspect of this place. The transformations it underwent over the years became an integral part of its history and a record of the changing needs of its residents. The decision to place contemporary sculptural objects can be treated as an attempt to restore the original function of the avenue, as well as to commemorate the past.

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RELACYJNOŚĆ SZTUKI ORAZ PRZESTRZENI NA PRZYKŁADZIE OBIEKTÓW RZEŹBIARSKICH ZLOKALIZOWANYCH NA ALEJACH MARCINKOWSKIEGO W POZNANIU

Streszczenie

Celem artykułu jest dokonanie analizy relacji między sztuką a przestrzenią w kontekście obiektów rzeźbiarskich znajdujących się na Alejach Marcinkowskiego w Poznaniu. Sztuka w przestrzeni miejskiej implikuje wiele problemów. Kontekst miejsca, jak i potrzeby odbiorców – użytkowników przestrzeni wiążą się z koniecznością uwzględnienia wielu czynników, takich jak historia miejsca, jego specyfika, zagospodarowanie terenu czy transsubiektywizm percepcji. Aleje Marcinkowskiego mieszczą się w obszarze Starego Miasta – w bliskim sąsiedztwie poznańskiej starówki – i stanowią oś łączącą plac Wolności, ul. 23 Lutego oraz ul. Paderewskiego. Wśród umieszczonych tam rzeźb są zarówno obiekty o zabytkowym charakterze, jak i dzieła współczesnych artystów. Dialog historii z teraźniejszością stanowi interesujące pole badawcze, podobnie jak interakcje zachodzące między rzeźbami a komponentami architektonicznymi znajdującymi się w ich otoczeniu.

Słowa kluczowe: sztuka, przestrzeń, przestrzeń miejska, rzeźba, przestrzeń publiczna, sztuka publiczna, Aleje Marcinkowskiego

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HISTORIC CRYPTS OF THE CHURCH OF THE EXALTATION OF THE HOLY CROSS IN ŁUKÓW – CHALLENGES PRECEDING ADAPTATION

The article discusses the technical and conservation challenges of adapting the historic crypts of the Church of the Exaltation of the Holy Cross in Łuków. This church is an important example of Baroque architecture with great historical and cultural value. Over the years, the crypts suffered damage from external factors and long-term dampness, which made thorough restoration work necessary. The adaptation process, carried out in recent years, used advanced technologies such as laser scanning and required an interdisciplinary approach combining engineering, conservation, and architecture. The first step was a detailed survey of the crypts' condition, which helped define the scope of work. The next steps included repairing walls, strengthening foundations, and protecting the structure from further damage. A key focus was preserving the authenticity of materials and the historical aesthetics of the site, which meant using methods that followed the principles of heritage protection. The project was inspired by similar successful adaptations in Poland and Europe that combined heritage preservation with modern functional needs. The planned goal of the project is to transform the crypts into an exhibition space while keeping their historic character. The article highlights the importance of a holistic approach, combining traditional conservation methods with modern technology, as a good example of protecting cultural heritage.

Keywords: historic crypts, church, adaptation, monument conservation, heritage protection, laser scanning, inventory, foundation reinforcement

1. INTRODUCTION

The Church of the Exaltation of the Holy Cross in Łuków, originally part of the Bernardine monastery complex, is an outstanding example of late Baroque sacral architecture in Poland. Built in stages between 1655 and 1766, it has withstood

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numerous historical and functional transformations while preserving its unique architectural character. Initially serving as a place of prayer for the monks, the church was handed over to the secular clergy following the dissolution of the order in the 19th century and became a parish church in the 1920s. The church is distinguished by its monumental façade and original interior composition, which harmoniously integrates sculptural and painted details, barrel vaults with lunettes, and iconography reflecting the spirituality of the Bernardines.

Fig. 1. Interior of the Church of the Exaltation of the Holy Cross in Łuków, photo by B. Szostak

As a monument of sacral architecture, this building has served not only a religious purpose over the centuries but also a social one, becoming a lasting symbol of Łuków's cultural heritage.

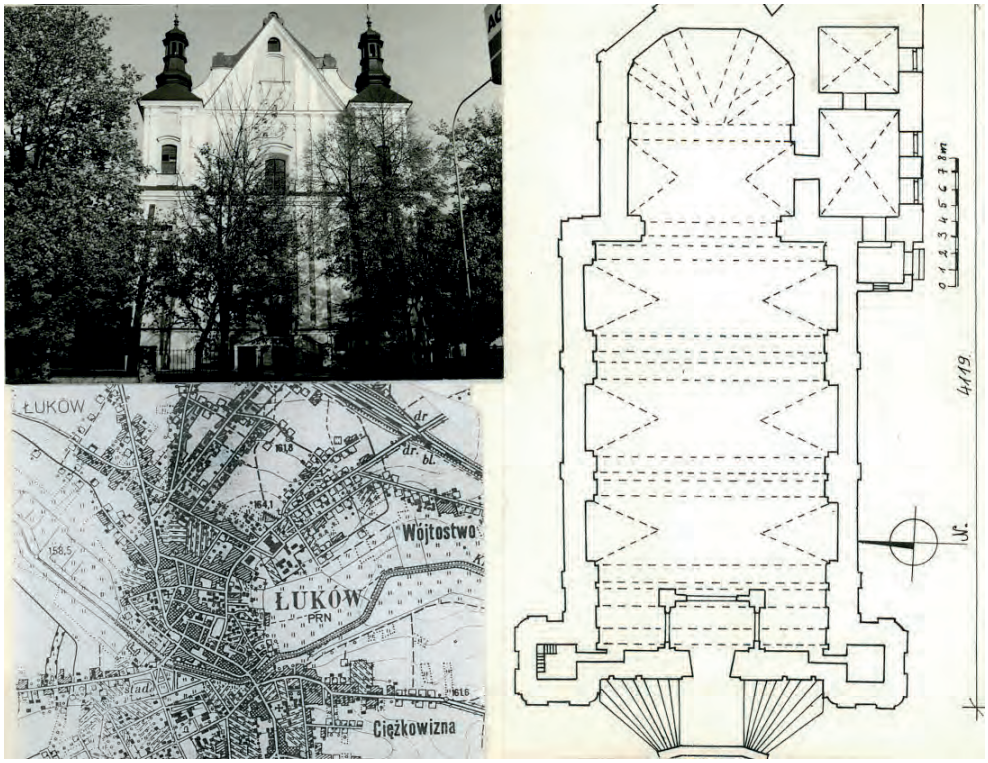

Fig. 2. View from the Monuments Record Card of the historic object listed in the Register of Monuments of the Lublin Voivodeship number A/385

One of the most intriguing features of the church is its underground structures, comprising three crypts – main, northern, and southern – as well as additional rooms. The main crypt, divided into nine cross-vaulted chambers supported by brick pillars, is a testament to the advanced construction techniques employed during the Baroque era. Archaeological studies conducted in 2019, as described in [Michalik, Kolaska, Zmorowska 2019], revealed unique structures such as ventilation channels (now sealed), a "drainage well" for managing groundwater, and secondary elements reinforcing the foundations.

Despite its historical significance, the crypts have suffered severe degradation caused by moisture, salt corrosion, and biological factors, necessitating the implementation of appropriate structural and conservation solutions.

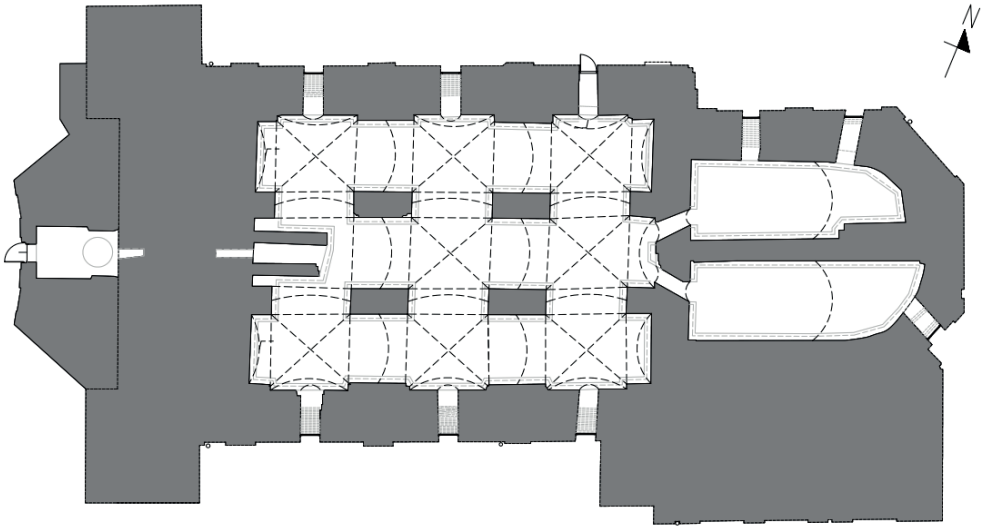

Fig. 3. Layout of the Crypts of the Church of the Exaltation of the Holy Cross in Łuków

A B

Fig. 4. Interior of the crypts – entrance to the northern and southern crypts (A) and interior of the northern crypt (B), photo by K. Drobek

A B

Fig. 5. Church structure from the west (A) and the current view of the front façade (B), 2022, photo by B. Szostak

Similar initiatives carried out in Poland and Europe provide valuable insights into the protection and adaptation of historic crypts. Research conducted in Krakow by the team [Łyczak et al. 2018], for instance, demonstrated the effectiveness of Ground Penetrating Radar (GPR) technology in locating hidden structures, a finding also corroborated in Monopoli, where an interdisciplinary approach combining geophysical, archaeological, engineering, and conservation techniques was applied [Leucci et al. 2012].

Explorations in Płock, presented by [Dobek 2023], highlighted how integrating archaeology with modern conservation techniques enables the uncovering of multi-layered cultural contexts. Simultaneously, the adaptation of crypts for new functional purposes, as seen in the case of St. Martin-in-the-Fields in England, underscores the need to balance the preservation of historical authenticity with the adaptation of spaces to meet contemporary usability requirements [Morrison 2008].

The adaptation process of the crypts in the Church of the Exaltation of the Holy Cross in Łuków, carried out over recent years, necessitated the use of advanced technologies and an interdisciplinary approach. The work included wall repairs, foundation stabilization, and the application of modern methods such as laser scanning. Similar techniques, utilized by [Drążowska 2020] in studies of the crypts of St. Francis Church in Krakow and by [Zajc 2023] during analyses of underground structures in Slovenia, demonstrate the effectiveness of contemporary technologies in documenting and preserving underground heritage sites.

This publication addresses the technical, structural, and conservation challenges involved in adapting the crypts of the Church of the Exaltation of the Holy Cross in Łuków. Drawing on a comparison of Polish and international experiences,

it discusses the challenges posed by the historical complexity of the site and the methods employed to harmoniously integrate heritage preservation with adaptation to new functional requirements.

2. EXAMPLES OF CRYPT ADAPTATIONS IN POLAND

Similar projects have already been undertaken in Poland. The adaptation of crypts in historic churches is a significant aspect of cultural heritage preservation, enabling their accessibility to visitors while ensuring the protection and retention of their historical value. This process requires appropriate conservation and technical measures to secure the structures and maintain their historical significance.

Below are examples of church crypt adaptations in Poland:

– The Cathedral in Drohiczyn: The cathedral's underground spaces have been made accessible to visitors, showcasing the history of the church and the region. The crypts feature archaeological exhibits, including relics of earlier sacral buildings. The adaptation of the crypts allowed the creation of a museum space that brings the rich history of the site closer to visitors.

Fig. 6. Underground of the Cathedral in Drohiczyn [Chelm.naszemiasto.pl 2024]

– The Archcathedral in Przemyśl: The underground of the Archcathedral of St. John the Baptist houses unique burial crypts of the bishops of Przemyśl and laypersons. During the adaptation works, remains of the Romanesque Rotunda of St. Nicholas were discovered. Currently, the underground serves as a museum, displaying exhibits of liturgical vestments, episcopal insignia, and reliquaries.

Fig. 7. Underground of the Rotunda and Crypts of the Archcathedral in Przemyśl [Klubpodroznikow.com 2024]

– The Basilica of the Nativity of the Blessed Virgin Mary in Chełm: The crypts beneath the basilica have been opened to visitors, offering an insight into the history of the church and the city. The underground includes the graves of bishops and archaeological exhibits. The adaptation of the crypts has created a tourist attraction that draws both residents and visitors.

Fig. 8. Crypts under the Basilica in the Sanctuary of Our Lady of Chełm [Chelm.naszemiasto.pl 2024]

3. CHALLENGES RELATED TO CRYPT ADAPTATION

The adaptation of such structures is an exceptionally complex process. It involves not only adjusting the building to comply with current legal regulations but also designing and implementing measures that ensure the safety of both users and bystanders. Equally crucial is that all work adheres to conservation theory principles, showing the utmost respect for the historical and heritage value of the structure.

The adaptation of the crypts in the Church of the Exaltation of the Holy Cross in Łuków presented numerous architectural and technical challenges. The absence of detailed architectural surveys, the poor condition of the walls, and

the need to align the structure with contemporary regulations were the primary issues that required resolution.

Below, the aspects of the adaptation process are discussed, highlighting the necessity of comprehensive preparatory actions and analysing the difficulties associated with repurposing the historic space for new functional uses.

3.1. Preliminary work preceding architectural adaptation

The adaptation of the historic crypts in the Church of the Exaltation of the Holy Cross in Łuków, planned as an exhibition area, posed a significant architectural challenge. The process required addressing numerous technical, conservation, and formal issues to adapt the crypts for new functional uses while preserving their authentic character.

One of the fundamental problems was the lack of a detailed architectural inventory, which made it impossible to develop an adaptation project or plan the functional use of the crypts. Irregular shapes, numerous curves, and structural deviations required precise mapping, which was only made possible through the use of laser scanning. The data obtained enabled the determination of the actual adaptive potential of the spaces and the adjustment of their heights to meet contemporary usability standards. Detailed analysis revealed the necessity of removing internal backfill and adjusting the foundation underpinning levels, which was crucial for the functionality and safety of the adapted crypts.

The technical condition of the crypts was another major challenge. The walls, reinforced over 100 years ago, had been exposed to prolonged moisture, leading to significant damage caused by frost, salt, and biological corrosion. The degradation processes affecting bricks and mortar required comprehensive repair measures, including wall desalination, reinforcing injections, and the replacement of damaged bricks. Only after stabilizing the crypts' structure could further adaptation work be carried out.

Another key challenge was ensuring compliance with current legal regulations, including those regarding safety, fire protection, and accessibility. Adapting historic spaces often requires numerous deviations from standard requirements, necessitating detailed analysis to assess the feasibility of obtaining such exceptions. However, examples of crypt adaptations in other Polish sacral buildings demonstrated that, even in challenging conditions, such adaptations are possible with precise planning and interdisciplinary collaboration among specialists.

Before commencing adaptation work, preparatory actions were essential, including a detailed inventory and securing measures. Proper preparation, such as developing the scope of renovation and conservation work as well as structural reinforcements, laid a solid foundation for the creation and implementation of a comprehensive adaptation project.

Without the necessary preparatory work, it would have been impossible to determine whether the adaptation of the existing structure, in line with the functional and technical requirements, was feasible. Actions such as assessing the technical condition, analysing the feasibility of deepening the crypts, strengthening the foundations, and considering economic aspects related to the repair of significant portions of the masonry provided critical insights into the project's viability and justification. Without these initial steps, the planning of the adaptation would have been fraught with significant risks.

Even the most detailed analyses of adapting underground spaces for new functional uses could prove insufficient if the technical condition or economic constraints rendered the project unfeasible.

Preliminary steps taken for the adaptation of the crypts in Łuków:

- Technical Expertise [Szostak, Trochonowicz 2022],
- Architectural Inventory [Szostak et al. 2022],
- Construction Project for Renovation and Securing the Crypts [Kendzierawski et al. 2023].

3.2. Architectural inventory

The purpose of inventorying in the process of adapting historic crypts is to thoroughly assess their current technical, spatial, and material condition, serving as a foundation for planning conservation and adaptation measures. The inventory enables the creation of detailed documentation that considers both historical structural elements and contemporary damage caused by environmental factors such as moisture, salt corrosion, or biological degradation. By employing modern technologies, such as laser scanning and geophysical studies, it is possible to accurately map the structure of the crypts and identify hidden elements, helping to avoid potential risks during adaptation work. A key aspect of the inventory is also determining the functional potential of the space, such as its adaptation to contemporary usage needs while maintaining the integrity of the historical fabric and unique architectural features.

Detailed inventorying in the form of a point cloud serves a crucial role in the documentation and adaptation of historic structures, providing exceptional precision in capturing spatial and architectural details. This method, based on laser scanning, allows for the creation of a three-dimensional model of the object, capturing even the smallest surface irregularities and structural details often invisible using traditional measurement methods. For church crypts, characterized by complex spatial layouts, irregular shapes, and often limited accessibility, point cloud technology facilitates accurate mapping of hard-to-reach areas such as vaults or foundations. This technology enables not only precise planning of conservation and adaptation activities but also archiving the state of the structure at a specific moment in time, which is important for monitoring future changes. Additionally, the data obtained

from the point cloud can be directly used in design processes, simulations, and structural analyses, significantly accelerating and streamlining the entire revitalization process for historic structures.

The existing archival inventory of the crypts in the Church of the Exaltation of the Holy Cross in Łuków includes a collection of historical plans and descriptions documenting structural and adaptive changes made over different periods. These materials provide a valuable source of information about the original spatial layout and construction techniques, though their limited detail required supplementation with modern documentation methods.

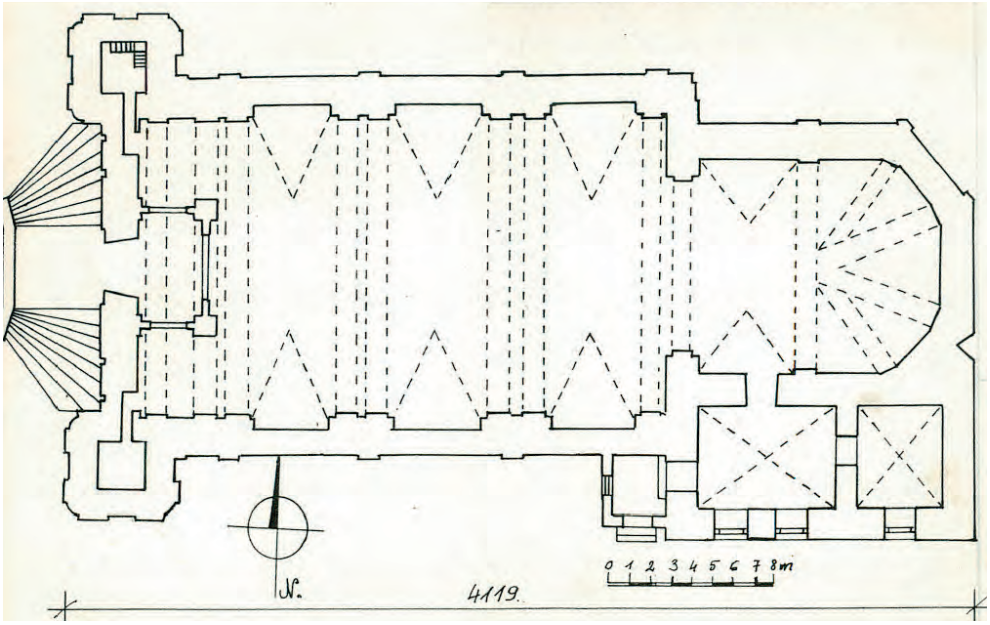

Fig. 9. Ground floor plan of the building from the Monuments Record Card of the historic object listed in the Register of Monuments of the Lublin Voivodeship number A/385

In the process of inventorying historic crypts, advanced techniques such as laser scanning and photogrammetry can be employed, and these methods can also be combined to achieve maximum precision in documentation. Laser scanning provides accurate spatial data in the form of a point cloud, while photogrammetry captures the texture and colour of the object. Combined, they create a comprehensive and realistic 3D model useful for conservation and design analyses.

For the inventorying of the crypts in the Church of the Exaltation of the Holy Cross in Łuków, laser scanning was chosen due to its exceptional precision in mapping complex spatial structures and its ability to record even the smallest irregularities and damages. This method allows for the rapid acquisition of detailed 3D data,

which is crucial for accurately planning adaptive and conservation measures in a historic space characterized by an irregular layout, limited accessibility, and very low lighting conditions.

The scanning procedure for the crypts involves several key steps: conducting an on-site inspection to assess spatial conditions, planning the scanner positions, and selecting scanning parameters such as resolution and device range. Once measurements are completed, data from various positions are merged into a single point cloud, which is then homogenized to eliminate measurement errors and ensure consistency and high precision in representing the object in a 3D format.

Fig. 10. Laser scanning process of the Crypts, photo by B. Szostak

The raw results of laser scanning, presented as a point cloud, depict a three-dimensional model of the crypts with all spatial details, such as wall irregularities, vaults, and structural damage. This creates a detailed foundation for further analyses and project work.

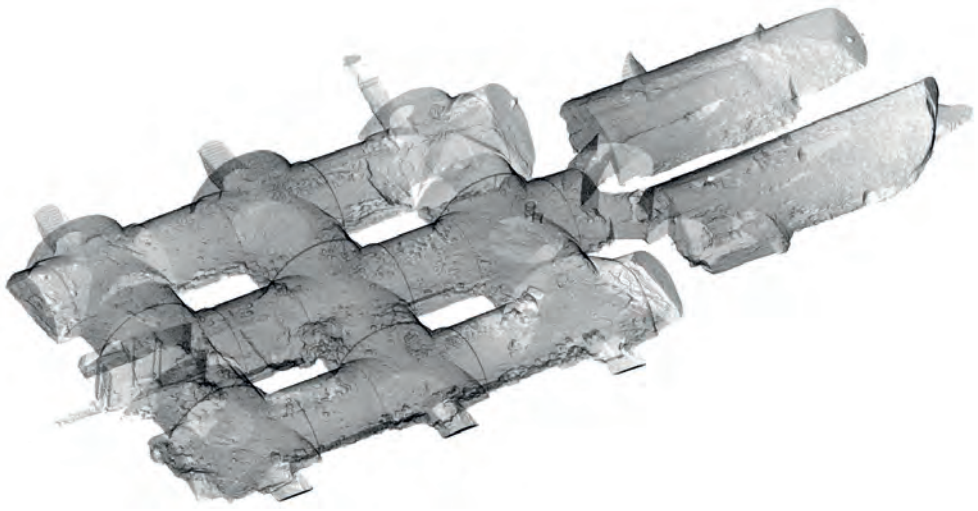

Fig. 11. View of the point cloud generated

From the point cloud, precise elevations of walls, vaults, and floors can be generated, representing the layout of the crypts in the form of highly detailed plans and sections. Additionally, surface analysis based on these data allows for the identification of deformations, losses, and irregularities, providing essential support for planning conservation and adaptation activities.

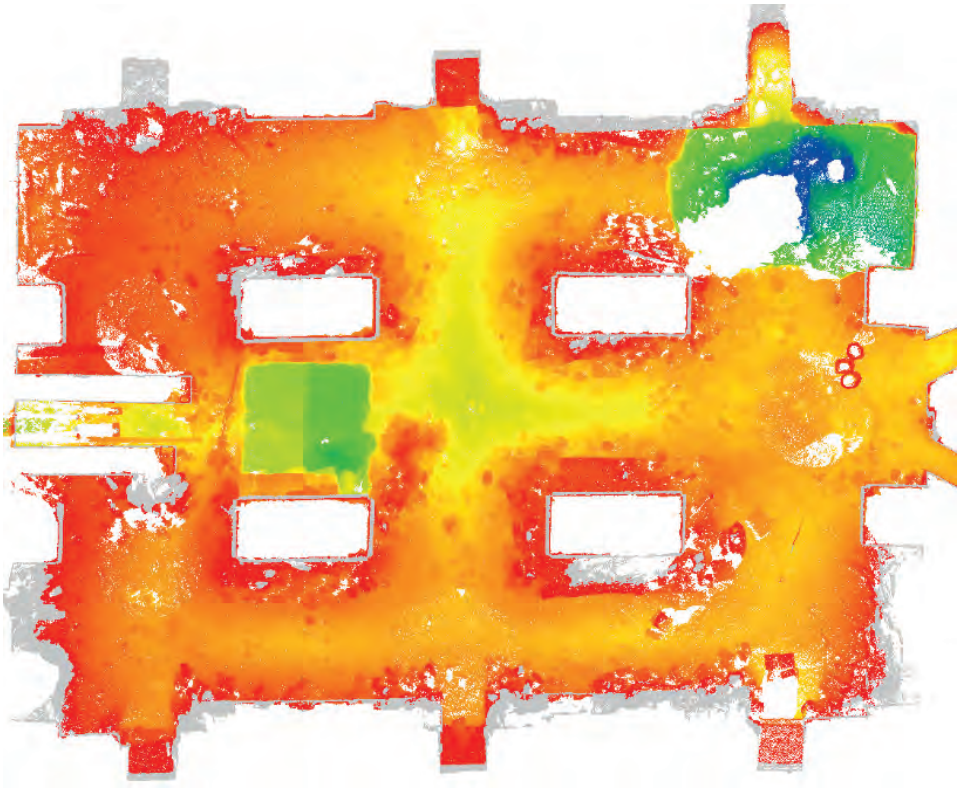

Fig. 12. Hypsometric projection of the crypt floor surface

Fig. 13. Section through the point cloud of the crypts

Based on the elevations generated from the point cloud, detailed technical drawings were prepared, including plans and sections, accounting for all irregularities and preserved architectural details. Such documentation serves not only as a foundation for project and conservation work but also as an archival record, enabling the accurate reconstruction of the object's condition in the future.

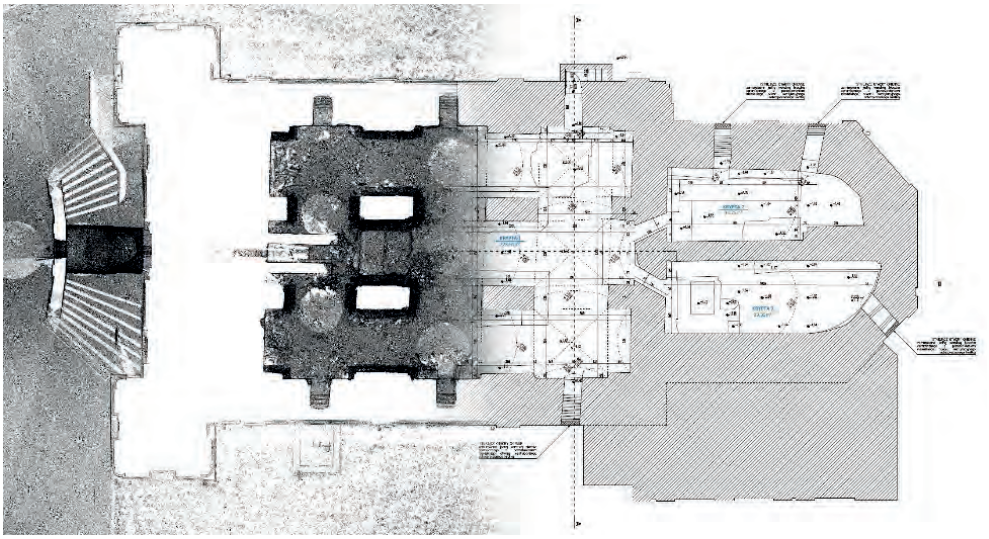

Fig. 14. Combination of the crypt point cloud projection with technical drawings [Kendzierawski et al. 2023]

The inventory of the crypts in the Church of the Exaltation of the Holy Cross in Łuków, carried out using laser scanning, provided exceptionally precise data, enabling a comprehensive understanding of the spatial layout and technical condition of the object. The resulting documentation serves as a solid foundation for planning adaptive and conservation measures, combining modern technologies with a commitment to preserving the authenticity of the historic structure.

3.3. Structural and conservation reinforcements

Research conducted in the technical expertise report [Szostak, Trochonowicz 2022] revealed a significant issue with high groundwater levels in the crypts, particularly in the area of the northern entrance. This led to periodic wall dampness and damage caused by salt and frost corrosion. The external walls and pillars were secondarily reinforced with brickwork, likely due to significant degradation of the lower sections of walls constructed with fieldstone and lime mortar. The technical condition of the historic walls and later reinforcements was deemed sufficient, with localized areas in poor condition. The best condition was noted in the southwest corner. The vault and pillar structures remained in good condition without visible damage, but the well chamber exhibited issues related to high moisture levels.

A B

Fig. 15. Technical condition of the foundations (A) and crypt height before adaptation (B), 2022, photo by B. Szostak

To achieve a usable height for the church crypts, deepening was necessary, requiring the underpinning and reinforcement of the foundations. Previous issues with groundwater levels were evidenced by an old drainage well (beneath the main stairs leading to the church) and the recent installation of a perimeter drainage system in 2022. Due to the drainage system and changes in soil moisture conditions near the foundation walls, there was a risk of soil stabilization and uneven settling of the structure. Therefore, foundation reinforcement work was necessary.

Fig. 16. Condition of foundation walls after removing reinforcing walls and exposing soil layers, photo by A. Kieliszek

Reinforcement of the foundations was achieved by installing a reinforced concrete ring beam and a relieving slab. The reinforcement level was lowered below the foundation level to ensure a minimum height of 2.20 m in the crypts, allowing for their use. The designed element serves as a relieving slab to absorb soil pressure resulting from the crypt deepening and acts as a stiffening shield. At the foundation level, it counters lateral loads caused by wall pressure.

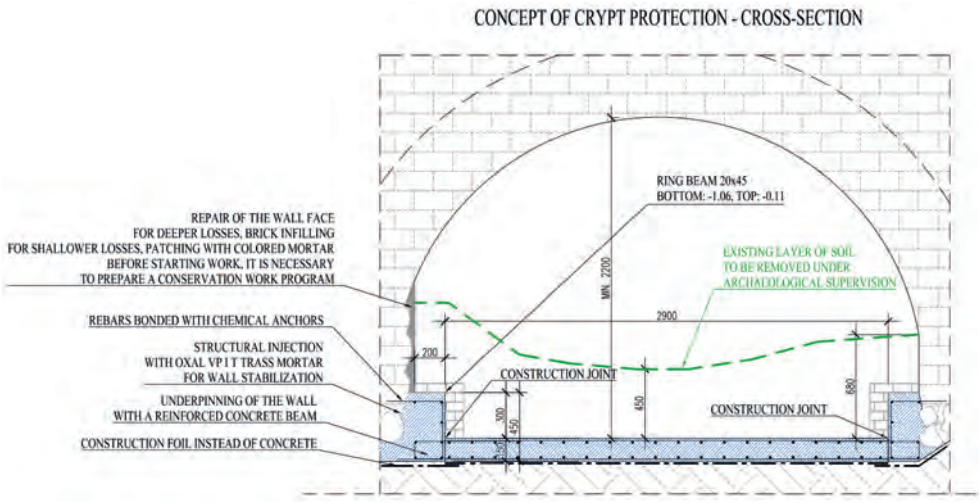

Fig. 17. Cross-section of the crypts – reinforcement scheme

The relieving slab was placed about 15-20 cm below the existing foundation level. Given the substantial wall thickness (ranging from 1.2 m to over 2.5 m), the foundations were underpinned with the slab, enabling integration of the walls with the new element and deepening the crypt floor. Additionally, a perimeter ring beam was installed to further stiffen the structural system and integrate the stone and brick foundations.

Technical work for the crypt adaptation began with underpinning the walls in the entrance area to facilitate communication and material transport. The underpinning was executed traditionally using C30/37 class concrete. The foundations were cut down by approximately 30 cm and then gradually deepened to the required level. The process was carried out in stages, starting from one side of the passage. Once the concrete reached half of its guaranteed strength or after seven days, work continued on the opposite side.

Initially, the corner foundation near the entrance was deepened and underpinned, where much of the excavation had been previously completed. The work was divided into sections, and the underpinning was executed according to the technical documentation. The base was adjusted to the planned level of the relieving slab.

Reinforcing walls that previously supported the structure were carefully dismantled, with bricks salvaged for use in constructing the perimeter ring beam. Loose fragments of stone and brick from the wall faces were removed during excavation. For deeper wall damage, trass structural injections were applied, and walls were reinforced with steel rods in areas previously drilled for injection.

A perimeter ring beam was installed during the section work, with reinforcement laid as per the technical design. The perimeter ring encircled both the external and internal crypt walls.

Fig. 18. Crypts after installing the perimeter ring beam and underpinning the foundations – northern corner, photo by B. Szostak

Fig. 19. Crypts after installing the perimeter ring beam and underpinning the foundations, photo by B. Szostak

Upon completing the ring beam, the soil inside the crypts was removed under constant archaeological supervision. The ground was then leveled and stabilized to prepare for the relieving slab installation, with a construction film laid over the base. After the concrete achieved the required strength, wall face damage was repaired, and the ring beams were clad with salvaged bricks.

Fig. 20. Crypts after reinforcing the slab, photo by A. Kieliszek

Fig. 21. Crypts after completing the reinforced concrete slab, photo by A. Kieliszek

Fig. 22. Crypts during finishing work – covering the reinforced concrete perimeter beams with reclaimed bricks, photo by A. Kieliszek

Conservation work in the crypts included removing faulty masonry, degraded bricks, and corroded mortar. The walls were dry-cleaned to preserve their patina, using gentle electrocorundum blasting at low pressure (0.5-2.0 MPa). Biological corrosion was treated with biocides, which were then rinsed with steam. Wall desalination was conducted using lignin or cellulose pulp poultices, supported by manual tools and micro-sandblasting.

In areas with missing bricks, salvaged bricks and specialized renovation mortars were used. Mortar joints were filled in two layers: a base plaster and a historical lime mortar with ground brick or charcoal additives. All work preserved the original architectural layout. After completion, the site was cleaned, enabling further adaptation work in the crypts.

A B

Fig. 23. Brickwork before (A) and after (B) conservation work, 2022, photo by B. Szostak

4. SUMMARY

The adaptation of the crypts in the Church of the Exaltation of the Holy Cross in Łuków is a project requiring precise planning, the use of advanced technologies, and consideration of the historical specificity of the site. This process demonstrated how complex technical, structural, and conservation challenges can be addressed through an interdisciplinary approach that integrates knowledge from engineering, heritage conservation, archaeology, and modern measurement technologies.

A key aspect of the project was the permanent resolution of the moisture problem in the crypts through the installation of a perimeter drainage system and the reinforcement of structural elements. This ensured the protection of the crypts from further degradation and their preparation for adaptation.

Challenges related to inventorying and analyzing the technical condition allowed for the creation of precise documentation and the development of a detailed plan for conservation activities.

The conservation work carried out, including surface cleaning of the walls, desalination, reinforcement of weakened structural elements, and filling in gaps, preserved the authenticity of the historical substance.

The application of methods consistent with the principles of cultural heritage protection made it possible to maintain the aesthetic and historical character of the crypts while adapting them to their new exhibition functions.

5. CONCLUSIONS

The conclusions drawn from the project indicate that the successful adaptation of historical structures requires:

- A holistic approach: considering technical, cultural, and functional aspects.
- Advanced technologies: such as laser scanning, enabling precise and non-invasive inventory work.
- Interdisciplinary collaboration: involving specialists from various fields, such as architecture, conservation, and structural engineering, to optimize actions and minimize risks.
- Balancing modernity and tradition: allowing adaptation to contemporary needs without losing the historical identity of the object.

The example of the crypts in Łuków serves as an inspiration for future conservation efforts, demonstrating that even the most complex adaptation projects can be successfully executed with proper planning and commitment.

The crypts have not only regained their original character but also hold the potential to gain a new life as functional spaces in the future.

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ZABYTKOWE KRYPTY KOŚCIOŁA PW. PODWYŻSZENIA KRZYŻA ŚWIĘTEGO W ŁUKOWIE – WYZWANIA POPRZEDZAJĄCE ADAPTACJĘ

Streszczenie

W artykule szczegółowo omówiono wyzwania techniczne i konserwatorskie związane z adaptacją zabytkowych krypt kościoła pw. Podwyższenia Krzyża Świętego w Łukowie, który jest istotnym przykładem architektury barokowej o znaczącej wartości historycznej i kulturowej. Krypty te, przez lata narażone na szkodliwe działanie czynników zewnętrznych oraz długotrwałe zawilgocenie, wymagały kompleksowych działań naprawczych. Proces adaptacji prowadzony w ostatnich latach opierał się na zastosowaniu zaawansowanych technologii, takich jak skaning laserowy, oraz na interdyscyplinarnym podejściu łączącym wiedzę z zakresu inżynierii, konserwacji i architektury.

Pierwszym etapem było wykonanie szczegółowej inwentaryzacji stanu technicznego, która umożliwiła precyzyjne określenie zakresu prac. Kolejne działania obejmowały naprawę murów, wzmocnienie fundamentów oraz zabezpieczenie konstrukcji przed dalszą degradacją. Szczególną uwagę poświęcono zachowaniu autentyczności materiałów i estetyki zabytku, co wymagało zastosowania metod zgodnych z zasadami ochrony dziedzictwa kulturowego. W realizacji projektu inspirowano się podobnymi adaptacjami przeprowadzonymi w Polsce i Europie, które skutecznie łączą ochronę dziedzictwa z nowoczesnymi wymaganiami użytkowymi.

Planowanym celem adaptacji jest przekształcenie krypt w przestrzeń wystawienniczą, która zachowa ich historyczny charakter. W artykule podkreślono znaczenie holistycznego podejścia, które integruje tradycyjne metody konserwatorskie z nowoczesnymi technologiami, stanowiąc przykład efektywnej ochrony dziedzictwa kulturowego.

Słowa kluczowe: zabytkowe krypty, kościół, adaptacja, konserwacja zabytków, ochrona dziedzictwa, skaning laserowy, inwentaryzacja, wzmocnienia fundamentów

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ANALYSIS OF THE QUALITY OF HYBRID RESIDENTIAL ENVIRONMENTS USING THE EXAMPLE OF RZESZÓW CITY

Rzeszów is a provincial capital where a sudden increase in multi-family residential investments can be observed after the year 2014. Since then, over 60 residential complexes have been built, with more planned or already under construction. Such intensive development may carry certain negative effects, and that is why, the aim of this study is to analyze the quality of selected investments and their impact on the existing architecture. The information-gathering phase using data provided by the Rzeszów University of Technology. Based on this data and using the observation method, a division into 7 categories was made, which were used to evaluate the residential complexes. Within each category, semantic scales have been created with the help of professional literature, allowing for a detailed qualitative evaluation of the investments. Based on the results of the individual scales, general conclusions were drawn and included in the summary. This study, along with its results, may contribute to improving the process of designing new residential complexes within the existing architecture, both in Rzeszów and other Polish cities.

Keywords: Rzeszów, urban planning, expletive development, residential complexes, city design, contemporary residential environment

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1. INTRODUCTION

The founding of Rzeszów city is estimated for period before 1340. Until World War I, Rzeszów developed slowly and did not represent any important point on the map of Poland. After the war, due to the construction of the Central Industrial District, the city's development accelerated, as it involved the construction of worker housing and urban infrastructure. In March 1939, an ambitious urban development plan was created by K. Dziewoński and W. Śmigielski, but it was not implemented due to the outbreak of World War II [Budzyński 2004]. Another plan (devised by the communist authorities), authored by Z. Wzorek, which also incorporated Dziewoński and Śmigielski's suggestions, focused more on the importance of the city center, the placement of new administrative buildings, and the value of green spaces [Gosztyła, Mikrut 2017: 79-90].

From August 1944, when the city became the capital of one of the 17 voivodeships, the development opportunities for Rzeszów increased even further. Another milestone in the city's progress was its designation in 1988 as the center of one of the 16 regional governments [Sepioł et al. 2023].

Before 1939, the population of Rzeszów estimated 41 000, but it dropped to 29 000 during World War II. When the communists took over the country, they resumed the city's development process. Under their rule, Rzeszów grew to 150 000 residents by 1989 [Gosztyła, Mazur 2016: 21]. This was followed by stagnation until 2004, when Rzeszów reached a population of 160 000. Since then, Rzeszów has continued its development and currently has around 200 000 permanent residents.

The largest periods of growth occurred in the 70s, necessitating the construction of additional housing estates such as Mieszko I (1968), Nowe Miasto (1973), and Kmity (1974). These estates were developed based on the requirements of the Athens Charter [Gosztyła, Mazur 2016: 9]. According to the documents postulates urbanism should have four principal functions. First, to assure mankind of sound and healthy lodging, that is to say, places in which space, fresh air, and sunshine – those three essential conditions of nature – are abundantly available. Second, to organize places of work in such a way that instead of being a painful subjugation, work will once more regain its character as a natural human activity. Third, to set up the facilities necessary for the sound use of leisure time, making it productive and beneficial. And fourth, to establish links between these different organizations by means of a traffic network that provides the necessary connections while respecting the prerogatives of each element. Once the city is defined as a functional unit, it should grow harmoniously in each of its parts, having at hand the spaces and intercommunications within which the stages of its development may be inscribed with equilibrium [Le Corbusier et al. 1973: 96-99].

After privatization and the stabilization of the national situation, Rzeszów began to develop at a rapid pace. Thanks to favorable development conditions and the lack of comprehensive spatial development plans for most of the city, new businesses and investments flocked to the city. This is evidenced by the second place in ranking of

"The Most Attractive Cities for Business in the category of 150 000 – 300 000 inhabitants" in May 2011 [Rzeszów Municipal Office 2012: 4]. More and more residential investments are appearing, and due to the lack of space, blocks are being built within earlier (modernist) development – this phenomenon is defined as a hybrid living environment. Since the overall housing environment in Poland is homogeneous [Stachura 2013: 25], similar situations can be observed throughout the entire country in major city. According to the Cambridge Dictionary, a hybrid is "something that is a combination of two different things, so it has qualities relating to both of them" [Cambridge Dictionary n.d.]. In our case, these different elements are the existing pre-2014 development of Rzeszów and the post-2014 development. Different, because they serve different urban functions in a given area, and their relationships are clearly illustrated by the suburbs of Rzeszów. The discussed estates were still being developed when the city was expanding according to a larger, central planning strategy. Among them were gaps – places for future investments, land reserves, or difficult areas that are now being used for new investments, often residential [Gosztyła, Mazur 2016: 28].

As mentioned earlier, large Polish cities are developing in a homogeneous manner. However, Rzeszów is an interesting case, as over 60 residential estates have been built on its territory since 2014 and more similar investments are planned or already under construction.

Due to the drench of space in the largest Polish cities (Warsaw, Kraków, Poznań, or Wrocław), the eyes of developers and consumers are increasingly turning to smaller (but still major) provincial cities like Rzeszów, with the expectation of filling the housing market gap.

The aim of the article is therefore to examine the impact of expletive development built after 2014 on the functioning of existing residential areas. To achieve this goal, it is necessary to answer the following questions:

- How does expletive development correlate with existing development?
- What are the benefits and losses for one or both sides resulting from the emergence of expletive development?
- What should developers do to improve the functioning of the estates when building between existing developments?

The benefit of such study is not only to analyze the functionality of Rzeszów's hybrid development but also to translate its results into the realities of other Polish cities, thus creating universal conclusions and assumptions.

2. METHODOLOGY

62 housing estates built after the year 2014 were examined using the data provided by students from Rzeszów University of Technology (table of all 62 housing estates is available at the end of an article). The study was based on the observational method, resulting in the identification of eight categories. This detailed division

allowed for a more accurate judgement of the estates and their quality elements. All the mentioned categories have a key impact on the overall urban quality of a housing estate. The classification looks as follows:
- access to commercial services,
- access to social and administrative services,
- building density,
- provision of an adequate number of parking spaces,
- access to green areas,
- access to recreational areas,
- visual value of the estates.

The evaluation results were concluded in semantic scales which range from [–2] to [+2]. The analysis of individual scales were based on the method of reviewing professional literature which gave results in individual descriptions.

For more detailed analysis 14 estates were selected from the entire research sample, which are located in suburbs closest to the city center, where the case of hybrid residential development is most visible. The overall distribution of the entire research sample and the selected estates is illustrated on the map below.

Tab. 1. Selected research sample – list of 14 selected housing estates in Rzeszów

Designation of the housing estates on the schematic map of Rzeszów /no./	Addresses
1	Lubelska 15a
2	Krajobrazowa 25
3	Jana Wywrockiego 11
4	Jana Wywrockiego 2
5	Strzelinica 3
6	Plenerowa 13
7	Ignacego Paderewskiego 51
8	Ignacego Paderewskiego 51f
9	Witolda 8 c/d/e
10	Hetmańska 75
11	Kwiatkowskiego 4
12	Graniczna 4a
13	Paderewskiego 30
14	Lewakowskiego 1A

Source: based on the research from the Rzeszów University of Technology.

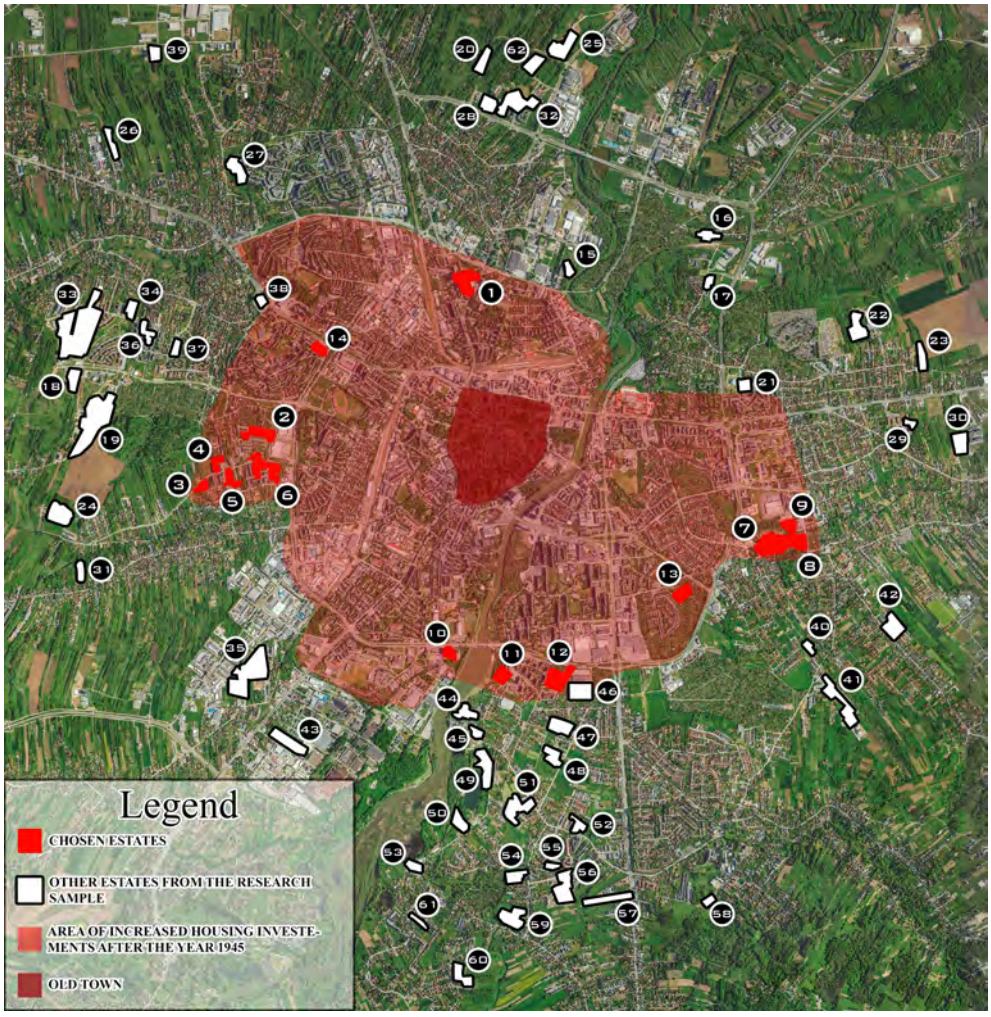

Fig. 1. Map of selected house estates
[based on research from the Rzeszów University of Technology]

2.1. Provision of an adequate number of parking spaces

Parking is an integral part of cities, including residential areas. Parking policy significantly impacts the quality of private transportation in cities, as almost every car journey begins and ends on a parking slot. Peter Christiansen, referring to research by Professor Hermann Koflacher, notes that the distance from residential buildings to the nearest parking spot is often shorter than to the nearest public transport stop, which consequently encourages the use of cars over public transportation [Christiansen et al. 2017].

With the continuous population growth and the overall improvement in quality of life, the demand for cars, and consequently for parking spaces, increases. A shortage of parking spaces can lead to some issues such as illegal parking, while an excess can promote car use, resulting in congested cities. Therefore, an appropriate parking policy is crucial [Parmar et al. 2020]. Considering the factors mentioned above, the semantic scale was divided as follows.

Tab. 2. Semantic scale of parking spaces

Grade	Description
–2	No access to own parking, requiring the use of paid or free parking away from the estate, which cannot accommodate all the cars from the area.
–1	No access to own parking, requiring the use of paid or free parking away from the estate, but the size and number of spaces can accommodate all the cars from the area.
0	No access to own parking, with other paid or free parking nearby, but the size is insufficient to accommodate all the cars from the area.
1	Own parking, including reserved spaces, but insufficient to accommodate all the residents' cars, forcing some to use nearby paid or free parking.
2	Own parking with a sufficient number of spaces, including reserved ones.

2.2. Building density intensity

The density intensity index for residential estates is a crucial tool in spatial and urban planning, as it allows for the determination of how densely specific areas can be developed. According to Article 15 par. 2 subsec. 6 of the Act on Spatial Planning and Development, local spatial development plans must obligatorily specify, among other things, the maximum and minimum building density intensity as a ratio of the total building area to the plot area. A well-defined building density intensity contributes to the creation of more livable spaces by offering a suitable amount of recreational space, access to services, and adequate daylight.

The city average from all housing estates built in its territory was considered based on the Municipal Spatial Development Plan. For investigating residential building density intensity in Rzeszów, the following approach was adopted.

Rzeszów Spatial Development Standards:

- for detached or semi-detached housing: 0.2 to 0.65,
- for terraced housing: 0.45 to 1.0,
- for multi-family housing:
  - building density intensity: 0.6 to 3.2 (average: 1.6),
  - above-ground building density intensity: 0.6 to 2.0,
  - biologically active area: not less than 25% of the plot area,
  - building height: not more than 30 meters.

The building density intensity index is calculated as the ratio of the total building area to the plot area in a given location.

$$I = \frac{Pc}{Pt}$$

- I = building density intensity index
- Pc = total building area (sum of the areas of all floors)
- Pt = plot area (land area)

Fig. 2. The building density formula [Act on Spatial Planning and Development]

Tab. 3. Semantic scale of building density

Grade	Description
–2	Very densely built-up area For detached or semi-detached housing: 0.55 < 0.65 For terraced housing: 0.9 < 1 For multi-family housing: >2.5
–1	Heavily built-up area For detached or semi-detached housing: 0.45 < 0.55 For terraced housing: 0.8 < 0.9 For multi-family housing: 1.7 < 2.5
0	Moderately built-up area For detached or semi-detached housing: 0.45 < 0.55 For terraced housing: 0.7 < 0.8 For multi-family housing: 1.3 < 1.7
1	Lightly built-up area For detached or semi-detached housing: 0.35 < 0.45 For terraced housing: 0.6 < 0.7 For multi-family housing: 0.9 < 1.3
2	Sparsely built-up area For detached or semi-detached housing: 0.2 < 0.35 For terraced housing: 0.45 < 0.6 For multi-family housing: 0.1 < 0.9

Source: based on Act on Spatial Planning and Development.

2.3. Visual value

The person, as the central figure in this process, plays a crucial role in forming and assessing urban areas as environments for living and growth. Visual value is a key aspect that enables an individual to access the objective characteristics of the space and its surrounding elements visually. Visual values and sensation are determined by the aesthetic, functional, historical, or symbolic values of a given area or individual object. Here are some examples:

– distinctive expression of a building or public space,

- architectural quality of the structures,
- form and development of public spaces composition, mutual relationships, proportions and notable objects,
- mutual relationships and contrasts in the built environment or landscape,
- diversity of urban forms and places,
- dynamics activities, flows,
- legibility and accessibility [Lorens, Martyniuk-Pęczek et al. 2014].

According to Kazimierz Wejchert, it is crucial to assess the places where people spend their time, as this has an impact on their health, productivity, and development. The influence of the environment on a person's psyche, perception of aesthetics, and habits is most clearly revealed in the fields of urban planning and architecture. In other words, architectural and urban spaces significantly affect our well-being and the way we perceive the world around us [Wejchert 2010].

Tab. 4. Semantic scale of visual value

Grade	Description
–2	Underdeveloped elements highlighting the landscape or their complete absence. Absence of objectivity and distinct dominant architectural elements or notable features.
–1	Visually appealing but not necessarily playing an important role in the social context or community life, mainly obstructing the view. Shortage of dynamism and diversity.
0	Fragments are clearly distinguished in the space, emphasizing their integration into the composition and highlighting aesthetic and functional goals.
1	The local areas and the surrounding landscape shape society's aesthetic preferences and contribute to its satisfaction.
2	High-quality planning, the presence of significant, distinctly defined elements highlighting the location, developed visual integration of streets and spaces for residents, harmoniously planned estates without substantial differences within a specific zone, and developed elements highlighting the landscape features.

2.4. Recreational areas

Recreational and leisure areas are often introduced in conjunction with the construction of residential complexes. The introduction of such spaces enhances and diversifies the lives of residents. These areas positively affect social interactions and the well-being of individuals who utilize them. Those spaces have a positive impact on the mental health of the residents, the community involvement and also determine the quality of life [Jenkins, Young 2008]. The semantic scale was evaluated based on the walking distance from the residential complex to recreational spaces,

as well as the presence of smaller and larger recreational areas within the complexes. The criteria include playgrounds, sports fields, courts, outdoor gyms, and other recreational spaces such as boulevards.

Tab. 5. Semantic scale of recreational areas

Grade	Description
–2	No recreational areas near the residential complexes, with no significant leisure and recreational spaces within a 30-minute walk from the residential complex.
–1	Small recreational areas appear within a 20-30 minute walk from the residential complex, but the complex itself lacks any designated leisure and recreational spaces.
0	Various recreational and leisure areas are within a 10-20 minute walk from the residential complex, with the complex itself having either no recreational spaces or only small ones.
1	Various leisure and recreational spaces are within a 5-10 minute walk from the residential complex, with small recreational areas located near the complex.
2	Larger recreational and leisure spaces are located adjacent to the residential complexes.

2.5. Access to commercial services

Commercial services are services that strictly focus on getting profits. They can be run by private local or foreign entrepreneurs, less often by state-owned companies. This category consists of all stores, salons, cafeterias, restaurants etc. [Chmielewski 2010: 191-202]. When there is no spatial development plan, then the free market determines their location or standard.

Tab. 6. Semantic scale of commercial services

Grade	Description
–2	Complete lack or great scarcity of commercial type services within an adequate radius of pedestrian or vehicular access.
–1	Scarcity of commercial type services within an adequate radius of pedestrian or vehicular access.
0	Moderate amount of commercial type services within an adequate radius of pedestrian or vehicular access.
1	Sufficient amount of commercial type services within an adequate radius of pedestrian or vehicular access.
2	Great amount of commercial type services within an adequate radius of pedestrian or vehicular access.

2.6. Access to social and administrative services

According to Jan Chmielewski division, services can be divided into commercial and, social and administrative services [Chmielewski 2010: 180-184]. Both of these types are crucial for humans proper functioning in the city, whereas the deficiency or complete shortage of them can cause dysfunctional problems or even can be unhabitable whatsoever. Based on the definition of constant proceeding level of quality of life in residential estates, they should be located near workplaces, schools, clinics etc. [Ciborowski, Jędraszko 1980].

Social and administrative services are state or municipal services that focus on helping their citizens. This includes for instance: education, culture, health and social care as well as administration [Chmielewski 2010: 182]. That is why it is important for municipalities to focus on locating them according to spatial development plan.

Tab. 7. Semantic scale of social and administrative services

Grade	Description
–2	Complete lack or great scarcity of social and administrative type services within an adequate radius of pedestrian or vehicular access.
–1	Scarcity of social and administrative type services within an adequate radius of pedestrian or vehicular access.
0	Moderate amount of social and administrative type services within an adequate radius of pedestrian or vehicular access.
1	Sufficient amount of social and administrative type services within an adequate radius of pedestrian or vehicular access.
2	Great amount of social and administrative type services within an adequate radius of pedestrian or vehicular access.

2.7. Green areas

Green spaces, including parks, forests, and other green areas, are crucial elements not only of urban fabric but also of residential complexes. They significantly impact the quality of life for residents and create better living conditions by positively influencing air quality. In an era of constant rush, green recreational spaces provide a respite for residents, improving their perception of the residential complex. Research indicates that the presence of greenery

significantly enhances mental well-being and reduces stress and depression [Callaghan et al. 2021].

Green areas were evaluated based on a semantic scale, which considered the walking distance (in minutes) from the residential complex to green spaces, as well as the presence of low and tall greenery within the complex. This method was based on findings from the article "The 15-minute city: interpreting the model to bring out urban resiliencies", which suggest that the shorter the walking distance to services and green or recreational spaces, the more comfortable the residents' lives are [Abdelfattah et al. 2022]. The criteria included spaces such as forests, parks, grass-covered areas and areas with tall greenery.

Tab. 8. Semantic scale of green areas

Grade	Description
–2	No green spaces within a 15-minute walk from the complex, the buildings are surrounded by parking lots and concrete spaces, with little to no tall or low greenery.
–1	Green areas are 10-15 minutes' walk from the residential complexes, with concrete spaces dominating near the complexes, and little to no low or tall greenery.
0	Green spaces are 5-10 minutes' walk from the residential complexes, with some low greenery and minimal tall greenery near the complexes, alongside large concrete spaces.
1	Green areas are within a 5-minute walk from the complexes, with both tall and low greenery near the buildings.
2	Parks, forests, and other green spaces are adjacent to the complexes, with the buildings surrounded by tall and low greenery and minimal concrete spaces around the complexes.

3. RESULTS

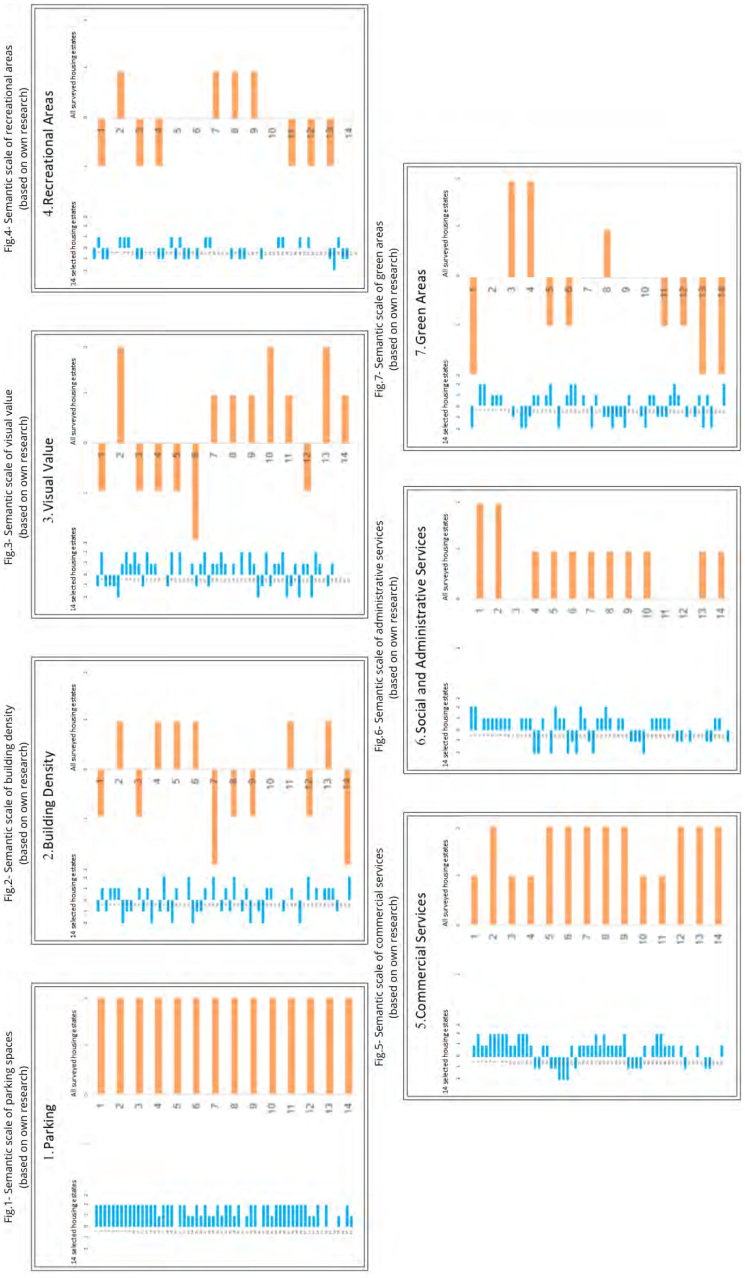

Fig. 3. Semantic scale of the full research sample compared with semantic scale of 14 selected housing estates in Rzeszów in 7 different categories [data presented in the graphs based on own research]

The analysis of housing estates built after 2014 presents a varied assessment of their urban quality. Certain aspects show satisfactory performance, while others reveal shortcomings that affect the overall functionality and integration of these estates within the existing urban fabric. The results reflect the diverse development strategies employed and highlight both strengths and weaknesses of recent residential growth in Rzeszów. These findings identify key areas where improvements are needed to enhance the quality and sustainability of new residential areas.

3.1. Parking

The results of the semantic scale for the selected housing estates clearly indicate that the average score for the provision of parking spaces is 2.0. This score is higher than the arithmetic average of the entire sample – 1.55, which is also a high score. This means that the number of parking spaces near the estates is at least sufficient.

3.2. Building density

After analysing the semantic scale of density intensity index a wide spread of results can be seen across the whole research sample (arithmetic average of 0.00). This stands in contrast to the residential estates located between the modernist settlements (arithmetic average of –0,21). The data indicates that despite a denser neighbourhood, the results do not significantly differ from the overall findings. The entire study on building density demonstrates the diverse and extreme approaches that developers take regarding the construction of residential complexes. Lower scores are directly proportional to the lack of or smaller communal areas for residents (excluding parking lots).

3.3. Visual value

The semantic scale rating of the visual value criterion for the selected 14 housing estates averages 0.28, which is significantly lower compared to the semantic scale rating of the general plan for estates in Rzeszów, where the average score is 0.38. The evaluation of visual value mainly considers integration with the urban composition and surroundings, contributing to visual attractiveness, aesthetic preferences, and functional design. These results primarily refer to newly built housing estates constructed after 2014, which unfortunately suffer from deficiencies in the visual appeal of their structure. Despite implementing a balanced land-use plan, there is a lack of refined elements that could enhance the landscape and high-quality design. Consequently, designated areas remain undeveloped, with no plans for further adaptation. Developers invest substantial funds in new initiatives, allocating large spaces in hopes of achieving a sustainable and delicate design that harmoniously blends into the environment. The aim is to integrate into the composition or

highlight aesthetic and functional goals; however, this often results in minimal effects, leading to negative perceptions of the area.

3.4. Recreational areas

Research findings on recreational areas in new residential complexes built in Rzeszów after 2015 suggest that while the recreational areas and facilities near the complexes, as well as those directly within the complexes, are not entirely neglected, there is a significant monotony and repetitiveness. These facilities typically include a small playground or a few benches for adults, with other types of recreational facilities being absent. There are instances of individual complexes with access to a variety of recreational facilities and spaces, such as boulevards, tennis courts, beach volleyball courts, or sports fields. However, in most complexes, a repetitive pattern is clearly visible. The arithmetic mean derived from the semantic scale of selected complexes is –0.14, while for all complexes, it is –0.11.

3.5. Commercial services

After analysing the semantic scale of commercial type services, a similar contrast between the scales can be seen, similarly to the scale of social and administrative type services (the arithmetic average from the overall research sample is: 0.6 and from the selected 14 estates: 1.64). Both results are higher than the average scores from the previous semantic scale and it can be attributed to more efficient private sector.

3.6. Social and administrative services

After analysing the semantic scale of social and administrative type services a wide spread of results can be seen across the whole research sample (arithmetic average of 0,18). This can be attributed to the inclusion of all new settlements – including those in the suburbs where the necessary infrastructure has not yet been built. This stands in contrast to the residential estates located between the modernist settlements (arithmetic average of 0.92), which are located in close proximity to already existing infrastructure.

3.7. Green areas

Research findings on green areas in new residential complexes built in Rzeszów after 2015 indicate that green spaces in these new complexes are largely neglected. Most residential areas exhibit a complete lack or minimal presence of trees and other tall greenery. Small patches of grass are usually present, but unused and empty. Additionally, there is a widespread issue regarding access to parks or forests in most complexes. However, there are also positive examples where attention has been paid to and care

taken of green spaces. Nevertheless, the majority consist of concrete expanses used as parking areas or left without any specific use. The arithmetic mean derived from the semantic scale of selected complexes is –0.35, while for all complexes, it is –0.03.

4. DISCUSSION

The analysed housing estates significantly differ ideologically from the earlier developments around which they were built. Established after 2014, instead of following the footsteps of the "Athens Charter", their principles should theoretically be aligned with the "New Athens Charter" or the "17 Goals of Sustainable Development". They should follow the established industry standards for multi-family developments and aspire to be a good place to live in. However, deviations from these principles can be observed in the analysed investments. It is important to highlight the role of the developer in this process, making decisions such benefit solely to the monetary value of the estate. Further research should be concluded including a more detailed examination of the relationships between new and old buildings, and the direct connections of new buildings to the "New Athens Charter" and "17 Goals of Sustainable Development". The discussion is divided into the same categories previously established so to better understand how the singular elements work into the bigger picture – also analysed at the end of the section.

4.1. Parking

Most of the analysed estates offer both ground and underground parking. However, the increasing number of new residential investments, with new parking spaces included, brings also negative consequences. According to data from the Central Statistical Office, the number of private cars in Rzeszów in 2022 increased by almost 50%, compared to 2014.

Tab. 9. Results of a study on the number of all private cars in the city Rzeszów

Overall number of private cars in Rzeszów								
2014	2015	2016	2017	2018	2019	2020	2021	2022
86 437	90 973	96 672	103 057	108 750	115 084	119 188	122 830	125 195

Source: based on Central Statistical Office.

4.2. Building density intensity

A well-defined building density intensity contributes to the creation of more livable spaces by offering a suitable amount of recreational space, access to services,

and adequate daylight. The results have shown that the maxima and minima of the building density index are subject to interpretation and often manipulated by developers to maximize their revenues by utilizing the land to the greatest extent possible. This leads to reduced communal areas for residents.

Frequently, despite a low building density index and good mutual relationships between the buildings within a complex, resulting in ample daylight for the residents, the remaining space between the buildings is converted into parking lots rather than communal areas. It should be considered whether, in addition to the spatial development plan, other guidelines should be established for designing residential complexes, such as requirements for communal spaces?

4.3. Visual value

Since new housing estates began to be built in Rzeszów after 2014, the city has made significant strides in its urban development plan. Substantial investments were directed towards the construction of new modern estates to promote the city's new development. The quality of construction and the final result have significantly impacted the new modern visual perception as well as certain visual values. Conducting a general assessment of visual aesthetics and research analyses allows for the identification of key points important for new housing estates in the city of Rzeszów.

In many housing estates, a common issue is the complete disregard for the surrounding environment, which could otherwise complement visual appeal and emphasize the aesthetics and functionality of the area. Often, specific zones for particular uses by residents are not designated. In such cases, designated areas could be designed with visual attractiveness and design structure in mind, thereby adding visual accents to the area. However, in some instances, these designated zones remain empty and undergo no further development or changes.

Another example is the unprofessional execution of landscape design that negatively integrates with the residential complex and its surrounding environment which also deteriorates the quality of perception and highlights the weakness in design execution. This is most pronounced in the estates Strzelnica 3 (no. 6) and 28 Krajobrazowa 13 (no. 7). In certain cases (estates no. 12 no. 9) an excessive area is allocated for parking spaces, while other factors, including visual appeal, are completely disregarded in the most prominent areas.

4.4. Commercial srevices

In contrast to the former type of services, the new housing estates have a direct impact on this category. It is typical for new housing estates to include, for example, service premises on the ground floor or even a separate building. However out of the 13 discussed estates, only 3 (23%) have taken such steps. Therefore, it should

be noted that the remaining 10 estates completely rely on the already existing infrastructure, also adding only additional consumers.

Analysing both types of services, we see a significant lack of cooperation between the private and public sectors, which results in not ideal living conditions for the people.

4.5. Social and administrative services

None of the evaluated housing estates had a direct impact on their access to such services. As newly built investments, they connected to the existing, already present infrastructure. This way, the new estates additionally burden often already full hospitals, schools, or clinics. Due to the current lack of a spatial development plan in the city of Rzeszów (14,3% of the total city area), cooperation between the private sector (new housing estates) and the public sector (municipal developments) is very limited. By densifying the old buildings, the housing estates only add more people who need to be served by municipal service points.

The period after 2014 marked a rapid densification of residential development in Rzeszów [Gosztyła, Mazur 2016]. From the swift pace of new residential complex construction, certain conclusions can be drawn regarding green and recreational areas. The primary focus was placed on the structure and design of the residential complex itself, neglecting other components that could enhance its attractiveness. This densification led to a significant reduction in the quantity and quality of green spaces. Green areas were neglected, and the complexes were typically surrounded by concrete parking lots. We observe large, undeveloped spaces, with tall greenery appearing very sporadically. Recreational areas are limited to a playground and a few benches in each complex. Some complexes were built on areas previously occupied by garden allotments, such as the Krajobrazowa 25 (residential complex number 2) and Graniczna 4a (residential complex number 12) complexes. The space, once a recreational area filled with greenery, has been replaced by residential complexes surrounded by concrete spaces.

The introduction of new recreational facilities that residents could use has been overlooked. The monotony of these residential complexes must also be considered. Developers focused primarily on the investment in the specific residential complex itself, ignoring the broader consequences for the surrounding environment, which rapidly transformed from green spaces into concrete surroundings of residential complexes. New residential complexes replicate these same problems, which are prevalent in most complexes and stem from the rapid pace of construction and the focus on profit.

Residential complexes built after 2014 significantly differ from those built between 1945 and 2014 in terms of attention to green and recreational areas. Older complexes, although often less visually appealing, placed much greater emphasis on the presence of tall and low greenery. Typically, diverse recreational and leisure areas were seen either within or near these complexes. An example is the Kmity

complex, built in 1976. Despite being constructed in a period that prioritized rapid execution over the quality of the complex, it placed great emphasis on the presence of tall and low greenery within the complex, as well as the presence of a park and various recreational facilities. This complex fosters resident integration and creates a friendly space for spending time [Gosztyła, Mazur 2016].

Residential complexes built after 2014 are designed in a very similar way to each other, leaving large undeveloped concrete or grass spaces.

However, the hybrid approach positively impacts newer complexes. They are built near older complexes, which are better planned, with more facilities and recreational spaces, as well as green areas, allowing residents of newer complexes to use the facilities and areas of the older complexes.

4.6. Overall

The new developments are creating space that is a bare minimum for living in a place. They mainly rely on the already existing infrastructure. They are frequently being built in places where the urban designers originally didn't want to have building estates – due to this they block the neighbourhoods from expanding their infrastructure by taking its supposed place. The major conclusions are as follows:

1) The new development itself does not introduce anything besides a residential function, it uses existing urban functions, often straining their effectiveness.
2) Cessation of designing cities based on experts' conclusions and instead opting for designing it based on maximizing the profit of entrepreneurs.
3) There is a gap needed to be filled concerning starting a private-public partnership in urban space.

New developments, as well as the municipal government have to take responsibility for the quality of urban design and living standards in the city. Each side is pushing the responsibility away from themselves, towards the other, preserving the status quo during which both sides gain something – the investor earns money from buildings and the city earns money from the taxes. The one losing are ordinary citizens who have to live in more and more dense cities where infrastructure is overused by the ever-growing number of people.

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Tab. 10. The entire research sample – list of 62 housing estates in the city of Rzeszów

Designation of the housing estates on the schematic map of Rzeszów /no./	Addresses
1	Lubelska 15a
2	Krajobrazowa 25
3	Jana Wywrockiego 11
4	Jana Wywrockiego 2
5	Strzelnica 3
6	Plenerowa 13
7	Ignacego Paderewskiego 51
8	Ignacego Paderewskiego 51f
9	Witolda 8 c,d,e
10	Hetmańska 75, Bulwary Park
11	Kwiatkowskiego 4
12	Graniczna 4a
13	Paderewskiego 30
14	Technologiczna 26
15	Lucjana Siemieńskiego 17A
16	Załęska 9B
17	Załęska 8F
18	Błogosławionej Karoliny 25/81
19	Czudecka 8
20	Jana Welca 7
21	Małopolska 1
22	Bałtycka 31f
23	Marcina Filipa 68
24	Potokowa 120 d
25	Lubelska 94
26	Dworskie Ogrody 60
27	Prymasa Tysiąclecia 4a
28	Teofila Niecia 5
29	Krasne 1112-1116 / ul. Jana Olbrachta
30	Świętej Kingi 20

Designation of the housing estates on the schematic map of Rzeszów /no./	Addresses
31	Staroniwska 11
32	Antoniego Gromskiego 10c
33	Iwonicka 3/6
34	Słoneczny Stok 57
35	osiedle Zawiszy Czarnego, ul. Architektów
36	Nowosądecka 1/1A
37	Sanocka 31 a-j
38	Krakowska 31
39	Lewakowskiego 1A
40	Karola Karpa 55
41	Wieniawskiego 55
42	Świętego Rocha 45
43	Rymanowska 38
44	Kwiatkowskiego 38
45	Kwiatkowskiego 44
46	Powstańców Warszawy 48
47	Zaciszna 5
48	Zaciszna 13
49	Panorama Kwiatkowskiego
50	ul. Eugeniusza Kwiatkowskiego 46
51	Szklane Tarasy 18C
52	Aleja Dębowa, Strażacka 21
53	Kwiatkowskiego 50 E
54	osiedle Srebrne Klony, ul. Miła 14E
55	Miła 9
56	Strażacka 54D/M
57	Sikorskiego 134
58	Zelwerowicza 20C-E
59	Miła 52C (Miła Park)
60	Makuszyńskiego 45
61	Apartamenty Jana Pawła II
62	Lubelska 77

Source: based on the research from the Rzeszów University of Technology.

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ANALIZA JAKOŚCI HYBRYDOWYCH ŚRODOWISK MIESZKANIOWYCH NA PRZYKŁADZIE RZESZOWA

Streszczenie

Rzeszów jest miastem wojewódzkim, w którym po 2014 r. zauważyć można nagły wzrost wielorodzinnych inwestycji mieszkalnych. Od tamtej pory wybudowano tam ponad 60 osiedli mieszkalnych, a następne są planowane lub już w budowie. Tak intensywna rozbudowa może nieść ze sobą pewne negatywne skutki, tak więc celem niniejszego badania jest analiza jakości wybranych inwestycji oraz ich wpływu na istniejącą już zabudowę. Na etapie zbierania informacji posłużono się danymi udostępnionymi przez Politechnikę Rzeszowską, na podstawie których wybrano 14 osiedli zlokalizowanych najbliżej centrum, między istniejącą już zabudową. Wszyskie osiedla oceniono w siedmiu kategoriach, wykorzystując metodę obserwacji. Na podstawie fachowej literatury dla każdej kategorii stworzono skalę semantyczną, dzięki której możliwa była szczegółowa ocena jakościowa inwestycji. Opierając się na wynikach poszczególnych skal, sformułowano ogólne wnioski, które zostały zawarte w podsumowaniu. Tak przeprowadzone badanie może ulepszyć proces projektowania nowych osiedli mieszkaniowych zarówno w Rzeszowie, jak i pozostałych polskich miastach.

Słowa kluczowe: Rzeszów, urbanistyka, zabudowa uzupełniająca, osiedla mieszkaniowe, projektowanie miast, współczesne środowisko mieszkaniowe