

PRE-DESIGN ANALYSES OF THE MUTUAL RELATIONSHIP AND LOCATION OF MULTI-FAMILY BUILDINGS USING THE EXAMPLE OF THE ARCHITECTURAL AND SPATIAL CONCEPT AT DŁUGOSZA 22A IN WARSAW

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ABSTRACT

When designing multi-family buildings on plots that have not yet been developed, an important element is their location and its careful preparation. Pre-design analyses allow for the simulation of various solutions in order to select the most advantageous location of individual volumes and accompanying spaces. Appropriate arrangement of architecture and other land development functions helps to meet a number of formal and legal requirements, but also provides an opportunity for effective and comfortable living in a future multi-family development. The aim of the study is to show the possibilities offered by pre-design analyses in terms of sunlight and the organisation of space between buildings. Another goal is to outline the benefits of performing such analyses. Thanks to them, it is possible to use compromise in design solutions when it turns out that individual variants of a building location have better or worse properties, or certain conditions are mutually exclusive. The results were presented in the form of variants, presenting various land development solutions and relating directly to the previously conducted analyses. The analyses presented in the article allow for precise formulation of conclusions, and their selection is justified by the possibility of transparent and graphical interpretation of the algorithms performed during design.

Keywords: architecture, multi-family buildings, urban planning, pre-design analyses

INTRODUCTION

The design of a multi-family residential building at Długosza 22a, in the Wola District of Warsaw, is an example of the creative use of various conditions related to location and legal requirements, as well as a unique sense of place (Rybak-Niedziółka, 2018). The concept assumed the construction of a new building on a plot located in the very centre of the urban interior. The interior was marked on three sides by the existing multi-family buildings, and on one side by the kindergarten building with the adjacent recreation and play area. The architectural concept was commissioned by the developer Magmillon sp. z o.o. and designed by architect Andrzej Majewski from MKM Architekci s.c. in 2017. The main problem of the project was not only

to meet legal and technical requirements, but also to create a proposal for the location of the new building in such a way as to meet the needs of neighbours living in local buildings and minimise interference with the area and intangible space (Toparlar, Blocken, Maiheu & van Heijst, 2017). In this study, a number of analyses were carried out and various land development variants were prepared. These analyses fit into the theory relating to the pluralism of the goals of pro-ecological architecture (Kobylarczyk & Marchwiński, 2020). It was important to locate the building as far away as possible from the existing buildings and to adapt to the planning provisions for access roads issued by the city. The designers wanted not only to optimally shade other objects in the neighbourhood, but also to maximise the potential of sunlight. The use of this potential is understood through the use of active and passive solar systems. The shape of the building and the choice of architectural, spatial, material and construction solutions are of great importance for the energy processes taking place between the building and its surroundings. One of the most important issues in this regard is the penetration of solar energy through external partitions into the interior, and in the Polish climate it is recommended to strive for solutions that will make maximum use of heat and sunlight in cold and transitional periods, and provide protection against their excess in hot periods (Marchwiński & Zielonko-Jung, 2013). In addition, a proposal was made to revalorise the adjacent area, which included, among other things, increasing the biologically active area and introducing elements of recreation and integration between neighbours (Davies, Steadman & Oreszczyn, 2008). The presented concept fits into research on pre-design analyses, including location guidelines and those related to legal, administrative and design conditions (van Hoof, Blocken, Timmermans & Hensen, 2016). Moreover, this work raises issues related to urban zoology in the planning of residential areas. They come down to environmental protection by implementing appropriate solutions resulting from analyses of shading of multi-family buildings and their neighbouring surroundings (Kobylarczyk & Marchwiński, 2019). The aim of this study is to show some of the steps involved in pre-design analyses relating to the distance between buildings, shading, and parking solutions. A number of activities are indicated that are important from the point of view of the proper selection of the building's location in the selected area. It is believed that the work presents the characteristics of the analyses and reflects the theories in practice, based on a real example of a conceptual building.

MATERIAL AND METHODS

The study summarises original analyses aimed at identifying the most optimal location of the building in the existing urban space at the conceptual stage. Determining the best location was also intended to meet the needs and expectations of the local population, with whom a number of consultations and arrangements were made regarding the concept for a given plot. The development project was never finally implemented, but serves as the subject of this study. It concerned the construction of an intimate, six-story apartment building with a basement on Długosza street (Fig. 1). The plot is located 2.5 km from the centre of Warsaw. The architectural solutions refer to the traditional buildings in a given district. The building has 18 apartments with an area of 40, 60 and 70 m², and the area of the designed building is approximately 1,000 m² of usable space. On floors I–III, there are two-room and three-room apartments, and on the top floors, there are multi-room, two-level apartments. As part of this study, all the above-mentioned elements regarding a given architectural concept were used and presented in graphic and tabular form. The research material is, therefore, based on the design value, pre-design analyses performed by the author and on the author's own observations with reference to the literature. On this basis, conclusions are drawn.



Fig. 1. Visualisation of an exemplary form of the building late in the evening (concept stage)

Source: Mikołaj Donderewicz, commissioned by Magmillon sp. z o.o., 2017.

The order in which the analyses are performed is specified (After completing all stages, the main design phase should begin):

1. Reconnaissance of the area included in the analysis of existing technical documentation, geodetic maps, orthophotomaps, aerial photos and other graphic materials. Performing an inventory and valorisation of the area. Performing distance measurements in the field using maps.
2. Conceptual and technical analyses, selection of several comparative variants, preliminary assumptions for the designed communication connections, pedestrian and driving routes and parking solutions. Performing analyses related to the solar ecliptic: (a) shading analysis, (b) obscuration analysis, (c) solar insolation analysis.
3. Analyses of distances between existing and planned buildings in the field. Lists of additional factors, consultations and social discussions. Preliminary selection of the best design variant.
4. Analyses of the possibilities of land development and landscape revalorisation.

RESULTS

Reconnaissance of the area

By using the current orthophotomap and map for design purposes, neighbouring buildings were found in the area, which marked the urban interior in a given location. An important aspect of the analytical stage was the characterisation and reconnaissance of a given area (Mirzaei & Haghighat, 2010). For this purpose, a graphic interpretation of the collected conclusions was developed, including measurement data (Fig. 2).

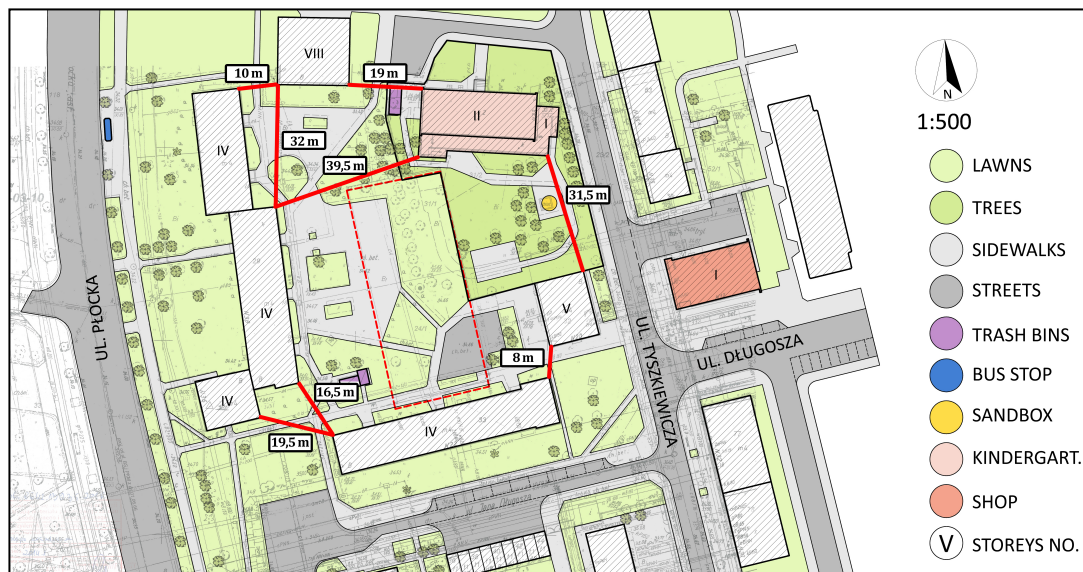


Fig. 2. Inventory and valorisation of the area with building distance analysis

Source: © Mikołaj Donderewicz, 2019.

The distances between the extreme elements of existing buildings were determined and then compared with the distances to the newly designed building in a multi-variant form. Indicating the similarity of given ranges was important from the point of view of the local community (Blocken, 2015). The distances between the buildings were measured, with the smallest distance set at 8 m and the largest at 39.5 m. Performing an inventory of the area is particularly important in identifying local problems. Valorisation of the inventoried area helps estimate the scale of these problems and enables the use of substitute or remedial solutions, which will then translate into a full-fledged proposal for land development.

Conceptual and technical analyses

The distances of buildings to the pedestrian and road transportation systems were measured. The final way of arranging the parking space in the estate and directly on the plot required verification, taking into account the use of appropriate fire protection solutions. It was necessary to check what impact the new access road project would have on the area. It is explained that in some circumstances, e.g. in a given case – in addition to formal, legal, and typically architectural conditions, parking solutions are one of the main factors determining the correct location of the building. This involves the appropriate design of access and fire roads. Depending on whether there is an underground parking lot in the building, the area on the plot will change, which can be allocated to the building development area, access roads or a biologically active area. In addition, the conditions and normatively permitted distances of buildings from parking spaces will change. Underground parking also requires the design of ramps and entrances, for which there is often no space on the plot. It follows from the above that parking solutions are one of the main criteria used when designing the location of buildings and one of the reasons why various parking variants should be analysed. As part of the multi-variant concept, two main, most appropriate variants of the building's location were proposed (Fig. 3).

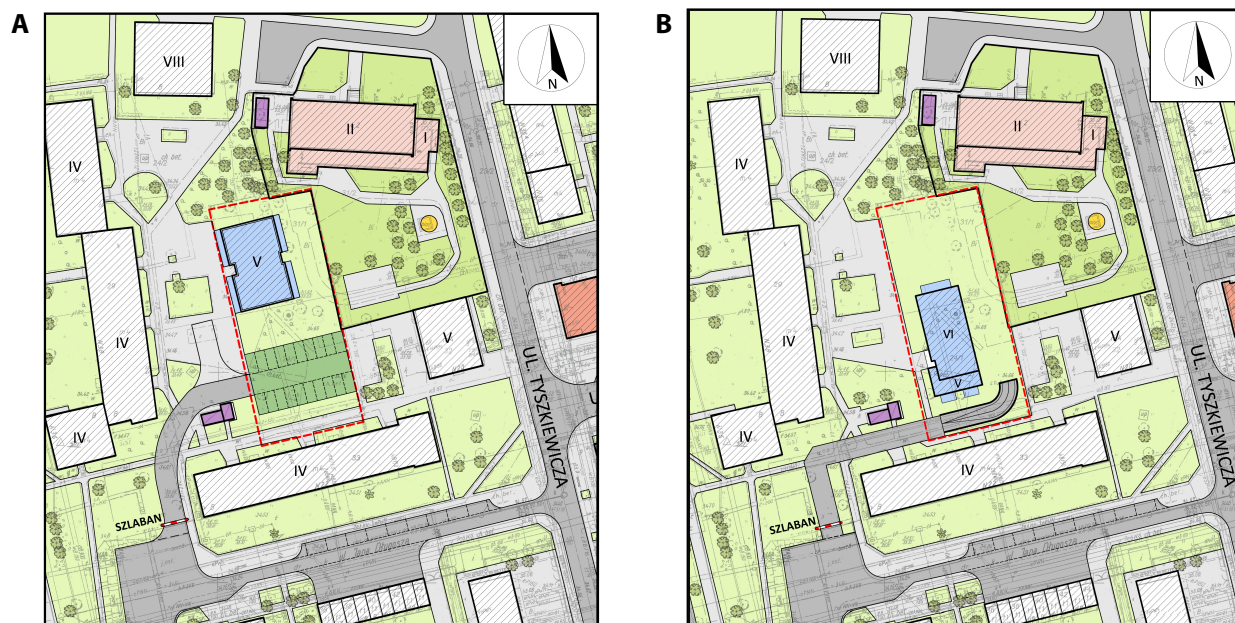


Fig. 3. Variants of the proposed building location, taking into account parking solutions

Source: © Mikołaj Donderewicz, 2019.

The differences related to the method of parking passenger cars and the distance between roads and windows of existing buildings. In the first solution (A), it was an outdoor surface parking lot with a biologically active surface; in the second solution (B), it was an underground parking lot with a direct exit from the road (Fig. 3).

Performing analyses related to the solar ecliptic

Analyses of shading (Fig. 4), obscuration and sunlight (insolation) were carried out, as well as a detailed analysis of the area of impact of the facility on the surroundings – reflecting the requirements contained in the Polish Construction Law (Dz.U. 2023 poz. 682). The research adopted requirements related to the insolation of rooms, where rooms intended for the collective stay of children in kindergartens should have a period of sunlight (insolation time) of at least 3 h on equinox days from 8:00 a.m. to 4:00 p.m., while residential rooms should have a period of sunlight (insolation time) from 7:00 a.m. to 5:00 p.m. In multi-room apartments, sunlight requirements may only be met for one room. In the case of buildings located in the city centre, the required sunlight time can be limited to 1.5 h, and in the case of a one-room apartment in such a development, the required sunlight time is not specified. “Period of sunlight” in law refers to the time during which solar rays are able to penetrate the room and be measured (physically, using tools such as the Sun Ruler, or precise computer software that is based on a 3D model of the terrain and buildings). An additional term for this phenomenon may be the solar insolation time, as required in accordance with the Polish Regulation of the Minister of Infrastructure in the technical specifications that are intended for use and their location (Dz.U. 2022 poz. 1225) and in accordance with the Polish Construction Law (Dz.U. 2023 poz. 682). Precise determination of the scope of shading of buildings in the field was used at a later stage to understand which existing facilities should be examined in terms of requirements related to obscuring and sunlight duration.

As the analysis shows (Fig. 4), the shadow cast by the designed building on the surroundings varies slightly depending on its location on the plot. Between 11 a.m. and 3 p.m., the newly designed building in Variant A partially shades the existing kindergarten, while in Variant B it does not shade it, therefore (B) is more advantageous in this respect.

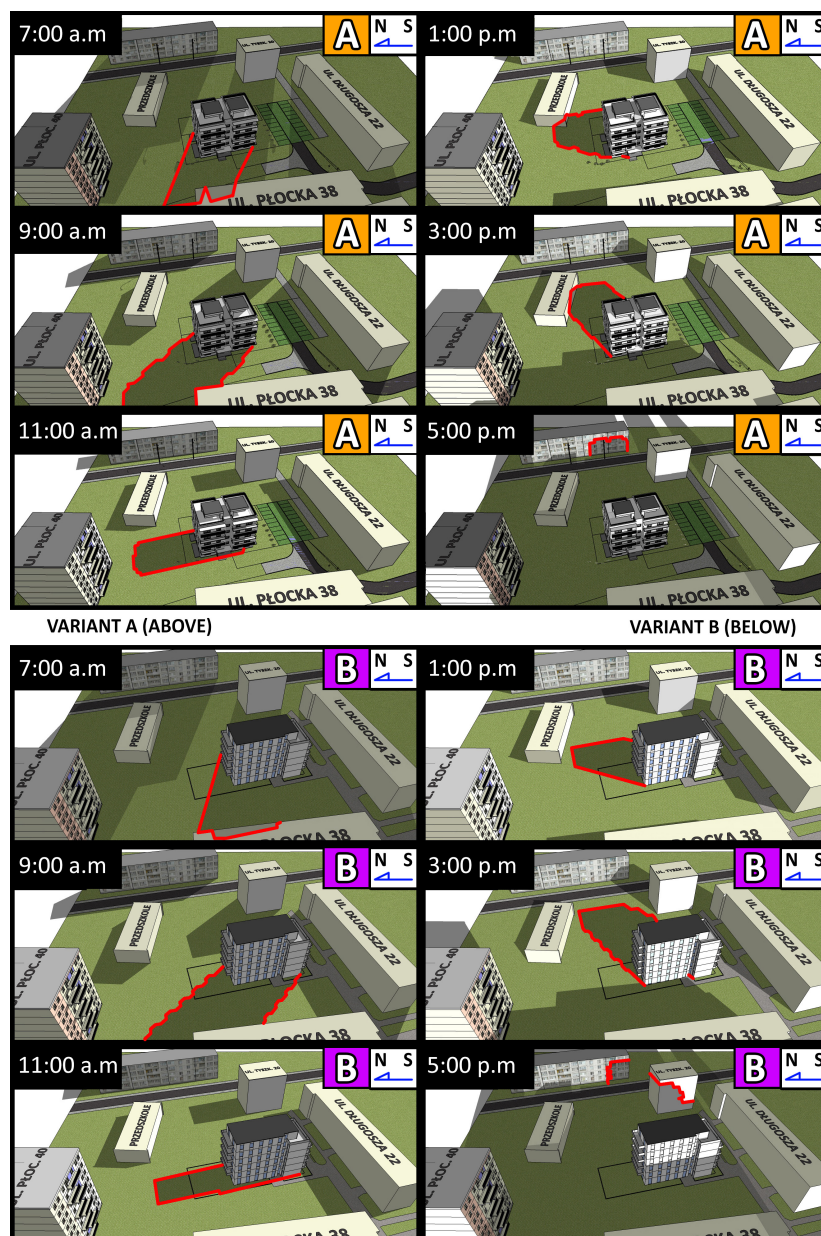


Fig. 4. Graphical interpretation of selected shading analyses results from 7:00 a.m. to 5:00 p.m. on 21 September (one of the two normative test days in the Polish Construction Law)

Source: © Mikołaj Donderewicz, 2019.

Analyses of distances and social consultations

The following variants of the building's location were presented and consulted with local residential communities. It was important to obtain compromise and satisfaction related to the microclimate, problems and conditions of solar management that would satisfy all parties (Moonen, Defraeye, Dorer, Blocken & Carmeliet, 2012). Variant A assumed the amplitude of the distance between buildings between 11–35 m, and Variant B – between 14–50 m (Fig. 5).



Fig. 5. Distance analyses of the designed building to the surroundings, Variants A and B

Source: © Mikołaj Donderewicz, 2019.

The variant of building location that seemed to be the most appropriate for all interested parties due to the above-mentioned factors (Kanda, 2007; Memon & Leung, 2010; Ai & Mak, 2015) was later expanded to include a wide-ranging proposal for the revalorisation of the common area (Grochulska-Salak, 2021). Initially, Variant B was chosen, which was justified, in addition to all the above-mentioned factors, by the fact that it caused the least and normative shading (Fig. 4) of the kindergarten building (building 33).

Analyses of the possibilities of land development and landscape revalorisation

The developer decided to additionally present the recreational and natural potential of the area. An original proposal for land development was prepared (Fig. 6), which took into account the needs of the residents and focused on increasing the planting of trees and shrubs.



Fig. 6. Proposal for land revalorisation and development for the selected Variant B

Source: © Mikołaj Donderewicz, 2019.

In addition, the intensification of the biologically active area was designed, replacing the previously concreted passages and walking paths, as well as a new aesthetic form of waste storage, a common playground, new lighting points, and car passage limiters were introduced as a protective form of greenery. This example indicates that in some circumstances, it is worth considering additional analytical and design processes to increase environmental and social values (Table 1). This makes it possible to obtain a broader architectural context.

Table 1. Summary of proposals and solutions identified for two different design variants

Specification	Variant A	Variant B
Project type	conceptual design	
Standard of solutions	average	
Type of architecture	vernacular	
Basic characteristics of the building	A proposition for a less demanding group of users, economically available to a much wider range of social groups.	A proposal for a more demanding group of users, economically available to a narrower range of social groups.
Receiving social group	large families, student and employee groups, foreigners	small families, managerial or managerial professional groups
Development intention	rental	permanent residence
Residential premises	dependent, flexible	dependent, comfortable
Characteristics of housing premises	The area of rooms intends to meet traditional/basic needs depending on external factors.	
	Susceptible to changes in arrangement and space, use of lightweight walls, multi-room apartments.	Reproducing the livability of single-family houses, presence of apartments, multi-levels, apartments with fewer rooms.
Spatial solutions	The organisation of common space in the context of culture, recreation, sports, learning, integration and relaxation, tailored to specific social groups.	
Parking solutions	parking spaces, and bays	underground garage

Source: own work.

Detailed differences and elements characteristic of both variants are presented in tabular form. The diversity of the proposals oscillated around social, architectural, functional, and spatial and parking categories (Table 1).

DISCUSSION AND CONCLUSIONS

The assumption made at the beginning was to collect various aspects present in the process of creating multi-family residential buildings. A clear bond was the development context, i.e. additional conditions determining the contemporary approach to design solutions. Taking into account the key factors presented in the study, the basic ones that concern the possibility of meeting the needs of residents and the legal norm have been specified (Tofiluk, 2020). The problem of pre-design analyses largely coincides with the understanding of developers and designers, but it could be said that clear goals to be achieved are often set at the beginning, and then it is verified how they will affect specific target groups or further solutions. Then, appropriate decision-making provisions are adapted, and finally, design provisions are adapted (Okeil, 2010). The tendency to search for a set of solutions whose implementation will be most appropriate for particular social groups for financial or location reasons can be specified, and then a full-fledged architectural and construction project can be created on this basis (Starzyk et al., 2023). Distinguishing these factors by location, leading theme, target groups and the type of finishing standard offered leads to naming the criteria on the basis of which the architectural compromise is created (Kanda, 2007; Hong & Lin 2014; Goodfellow, 2019). These criteria, depending on the intentions, will be divided into solid, spatial, material, parking or technological solutions. Depending on the lower or higher standard, other characteristic elements will be present (Turunen, Paanala, Villman, Nevalainen & Haverinen-Shaughnessy, 2010; Chohan et al., 2015). The number of apartments and their livability will require the best possible use of available space for development, and relatively simple construction systems will appear. It will be necessary to arrange parking spaces by designing a larger number of parking bays, ground parking lots or shelters as an alternative to the underground parking floors of the building – which are sometimes problematic in their implementation. Less restrictions will be accompanied by a maximum number

of apartments in the building and savings in the use of residential, common or service areas. The increase in demand for more potential parking spaces forces the organisation of more complex access and garage variants, especially underground ones. The aspects listed in the study may constitute a procedural blueprint and key pre-project issues. The analyses aim to determine the target's desired effect. The aim of such analyses may be to result in multi-variant architectural concepts that can better express the understanding of a given space and the problems associated with it.

Performing pre-design analyses offers:

- a more personalised architectural proposal that better suits the terrain,
- reducing the number of irregularities at later stages of the development, and thus reducing costs and implementation time,
- meet the expectations of the local community,
- the possibility of increasing the volume of buildings to their maximum permissible levels, and thus increasing the number of apartments,
- the possibility to apply greater attention to pro-environmental solutions.

Authors' contributions

Conceptualisation: M.D. and K.R.N.; methodology: M.D.; validation: K.R.N.; formal analysis: M.D. and K.R.N.; investigation: K.R.N.; resources: M.D.; data curation: K.R.N.; writing – original draft preparation: K.R.N.; writing – review and editing: M.D.; visualisation: M.D.; supervision: M.D. and K.R.N.; project administration: M.D.; funding acquisition: M.D. and K.R.N.

All authors have read and agreed to the published version of the manuscript.

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ANALIZY PRZEDPROJEKTOWE WZAJEMNEJ RELACJI ORAZ USYTUOWANIA BUDYNKÓW WIELORODZINNYCH NA PRZYKŁADZIE KONCEPCJI ARCHITEKTONICZNO-PRZESTRZENNEJ PRZY ULICY DŁUGOSZA 22A W WARSZAWIE

STRESZCZENIE

W trakcie projektowania budynków wielorodzinnych na działkach jeszcze niezagospodarowanych istotnym elementem jest ich lokalizacja i jej staranne przygotowanie. Analizy przedprojektowe pozwalają na symulację różnych rozwiązań, tak aby wybrać najkorzystniejsze usytuowanie poszczególnych kubatur oraz przestrzeni towarzyszących. Odpowiednie rozmieszczenie architektury oraz pozostałych funkcji zagospodarowania terenu pozwala nie tylko spełnić wiele wymagań formalnoprawnych, ale daje też szansę efektywnego i komfortowego zamieszkiwania w przyszłej zabudowie wielorodzinnej. Celem

opracowania jest pokazanie możliwości, które oferują analizy przedprojektowe w aspekcie nasłonecznienia oraz organizacji przestrzeni pomiędzy budynkami. Kolejnym celem jest nakreślenie benefitów, jakie niesie wykonywanie analiz przedprojektowych. Dzięki nim stosowanie kompromisu w rozwiązaniach projektowych jest możliwe, kiedy okazuje się, że poszczególne warianty usytuowania budynków mają lepsze lub gorsze właściwości bądź pewne uwarunkowania wzajemnie się wykluczają. Wyniki zostały zaprezentowane w postaci wariantów rozwiązań zagospodarowania terenu i odnoszących się bezpośrednio do przeprowadzonych wcześniej analiz. Prezentowane w artykule analizy pozwalają na precyzyjne sformułowanie wniosków, a ich wybór uzasadniony jest możliwością przejrzystej i graficznej interpretacji algorytmów wykonywanych podczas projektowania.

Słowa kluczowe: architektura, budynki wielorodzinne, planowanie urbanistyczne, analizy przedprojektowe