Journal of Architecture and Urbanism
ISSN 2029-7955 / eISSN 2029-7947
2018 Volume 42 Issue 1: 52–62
https://doi.org/10.3846/jau.2018.1842

International Conference "Architectural Practice and Education"

ARCHITECTURAL ORGANIZATION OF FACADES ACCORDING TO THE PRINCIPLE OF VARIABILITY: VIDEOECOLOGICAL ASPECT

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Received 29 September 2017; accepted 27 April 2018

Abstract. This original conference topic[1] is devoted to one of the actual problems concerning the current state of facades on apartment buildings – videoecology. Often the terrain dictates its conditions for the creation of banal solutions of facade forms; therefore, this paper focuses on what should be the new facade design that makes a person integrate into the new environment, become interested in this environment. The main purpose of this paper is to determine the method of forming a facade on the principle of variability[2], which involves in the architectural organization of the residential building facade functional and constructive variability with architectural and spatial solutions of this building. Research proposals in the paper are considered on the example of a competition project of a residential building in the historical centre of Subotica city, Serbia.

Keywords: residential building, architectural and spatial solutions, street facade, videoecology, the principle of variability, Subotica, visual perception, morphological analysis of architecture.

Introduction

For a long time people lived surrounded by variable masses and forms. In nature, it is difficult to find the same terrain, trees, leaves, etc., as well as the same spatial systems of buildings, urban layouts, corners. So, a person instinctively feels environmental beauty (such as richness of natural landscapes, color and its variety, suitable to the sensory environment) (Filin, 2009; Day, 2004, p. 9-31; Pallasmaa, 2012; Holl, Pallasmaa, & Alberto, 2006). Also, the architecture of most multistorey residential buildings (MRB) is far from the historically combined idea of the city and home (Zaero-Polo, 2011, p. 121). Especially this problem has an acute effect on the architecture of the facades of MRB of large cities (Binder, 2002; Markevičienė, 2012; Bhatt, 2013; Havik, 2006; Lavrov & Perov, 2016; Kozlova, 2010, 2016; Tohumcu & Cakmakli, 2017). Also, this problem can be clearly seen in the modern MRB of Kyiv city (Figure 1). Architectural organization of facades and the architectural parameters of ecological housing (Tohumcu & Cakmakli, 2017) and cities (Tetior, 2006, 2008) are very important for megapolises and urban areas. An ecologically beneficial visual environment for MRB is important for life (Ristić et al., 2013; Yudelson, 2007; Đorđević and Vujić, 2010), especially for the residents of high-rise buildings (Binder, 2002; Havik, 2006; Bhatt, 2013; Tohumcu & Cakmakli, 2017). In these kinds of buildings people feel that they are further away from nature, not only physically but also spiritually and visually. The façade composition of MRB is based on simple rhythmic forms (Binder, 2002) and "it comprises the paramount task of the rational organization of particular production-byt [mode of life/mode of everyday life] processes, pushing the architect, in most cases, to break with traditional, atavistic systems of production and ossified social-byt forms" (Ginzburg, Leonidov, Leonidov, & Kuzmin, 2017, p. 585). You can see this fenomen on the example of Kyiv city (Figure 1a, 1b, 1c). Identical architectural organization of facades leads to psychological and visual fatigue (Wilkins, 1995, p. 109-115; Filin, 1997, 2007, 2009), especially, when these repetitions are the only pattern which the eye perceives in urban

[1] I International Conference "Architectural Practice and Education" which was organized by Department of Architecture, Faculty of Architecture, Vilnius Gediminas Technical University in Vilnius 19–20 October 2017.

[2] principle of variability – (© by Kozlova Nataliia)

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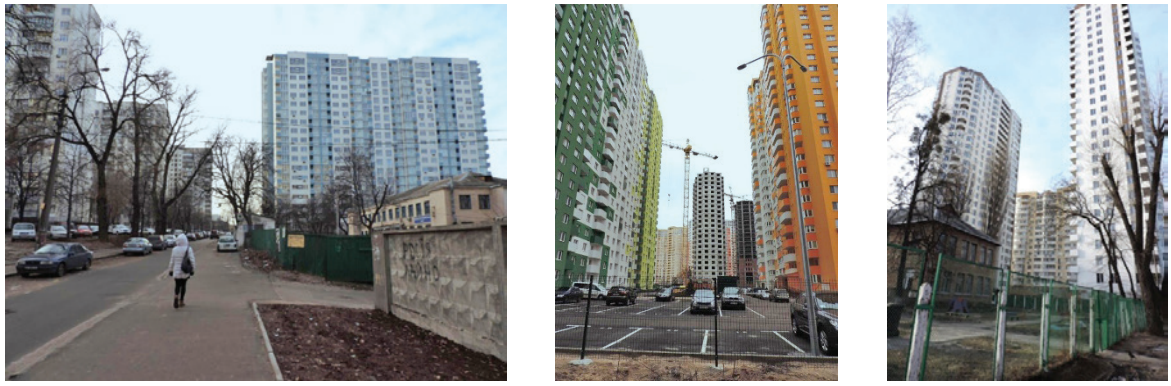


a) b) c)

Figure 1. Multistorey residential buildings in Kyiv based on a simple description of a rhythm (source: author, 2017); a, c) Buildings in the residential district of Solomenskiy. The number of floors is 20–30; b) Buildings in the residential area between Vasylkivska and Teremky districts. The façade consists of monotonous windows and bay windows which are repetitive in form, it creates an aggressive visual environment in the city

developments (Ikonnikov, 1971, p. 30). The problem of the visual environment has become extremely important. The scientific trend based on the role of the visual environment in human life is called "videoecology" (Filin, 1997, 2009). Videoecology is based on the automation of saccades (Filin, 2007, 2009).

"Saccades of both the right and left eyes are absolutely synchronous and of the same amplitude. They are oriented in the same direction. There are many saccades – approximately two or more in a second which means that the direction of the look changes every half second. So the eye is constantly scanning the environment" (Filin, 2009). In terms of videoecology details are the major aesthetic and functional basis for a facade.

1. Methodological approach

Methodology in this paper is based on earlier studies of the architectural organization of facades of MRB in Kyiv, which included: full-scale research and photographic record of the architectural organization of modern and post-Soviet facades of MRB of Kyiv, a sociological survey of the city's population, and a graphical analytical apparatus of the study (Kozlova, 2016); I have identified four architectural organization principles of the facade of MRB, taking into account the requirements of videoecology. One of them is *the principle of variability*. To test a scientifically sound principle, design and experimental design was used on the project of the Novopechersky Lipki in Kyiv, as well as a contest for the best design idea of "The architectural solution of the street facade for the future residential-commercial building GF+2F+A – GF+3F+A in Subotica, Petefi Sandor Street 3 and 5"[3] was conducted (Competition, 2016).

[3] see Competition, 2016

2. The principle of variability

The research was based on the study of architecture of the facades of multistorey residential buildings in Kyiv, but generally also included houses of medium and small stories (9, 4–5- floors). So, the principle of *variability* (Figure 3) in the architecture of the facades of MRB involves the inclusion of *functional* and *constructive variability* in the architectural organization of the MRB. The principle of variability is achieved by using a mixed type of MRB, by combination of different types of vertical and horizontal communications in the structure of the building, by arrangement of different types of planning blocks of apartments in accordance with socio-demographic needs of the urban population.

Functional variability involves variability in the treatment of different planning structures of residential cells, which according to the laws of architectonics are expressed by variability of the facade structure, and application of the house-complex, depending on its location in the urban environment. Variability of the planning structures of residential cells involves using of mixed planning structures of the MRB. The combinations can be varied, with a combination of both the vertical and horizontal. The most characteristic combination of a mixed type is a combination of low houses with multistorey (vertical combination), a combination of vertical types of multistorey housing (sectional and corridor or sectional and gallery), sectional corridor (sectional-gallery) houses are sectional houses (as a rule, with high-comfort two-storey sections), which through several floors are combined with common corridors or galleries (Korol', 2006, p. 146-148).

Functional variability is possible by using the application of differentiation of the building, its saturation by various functions. There are two main ways to use compositional quality of the public function volumes: "volume-background", on which the living parts are played, "volume-synthesis", in which two masses share the same

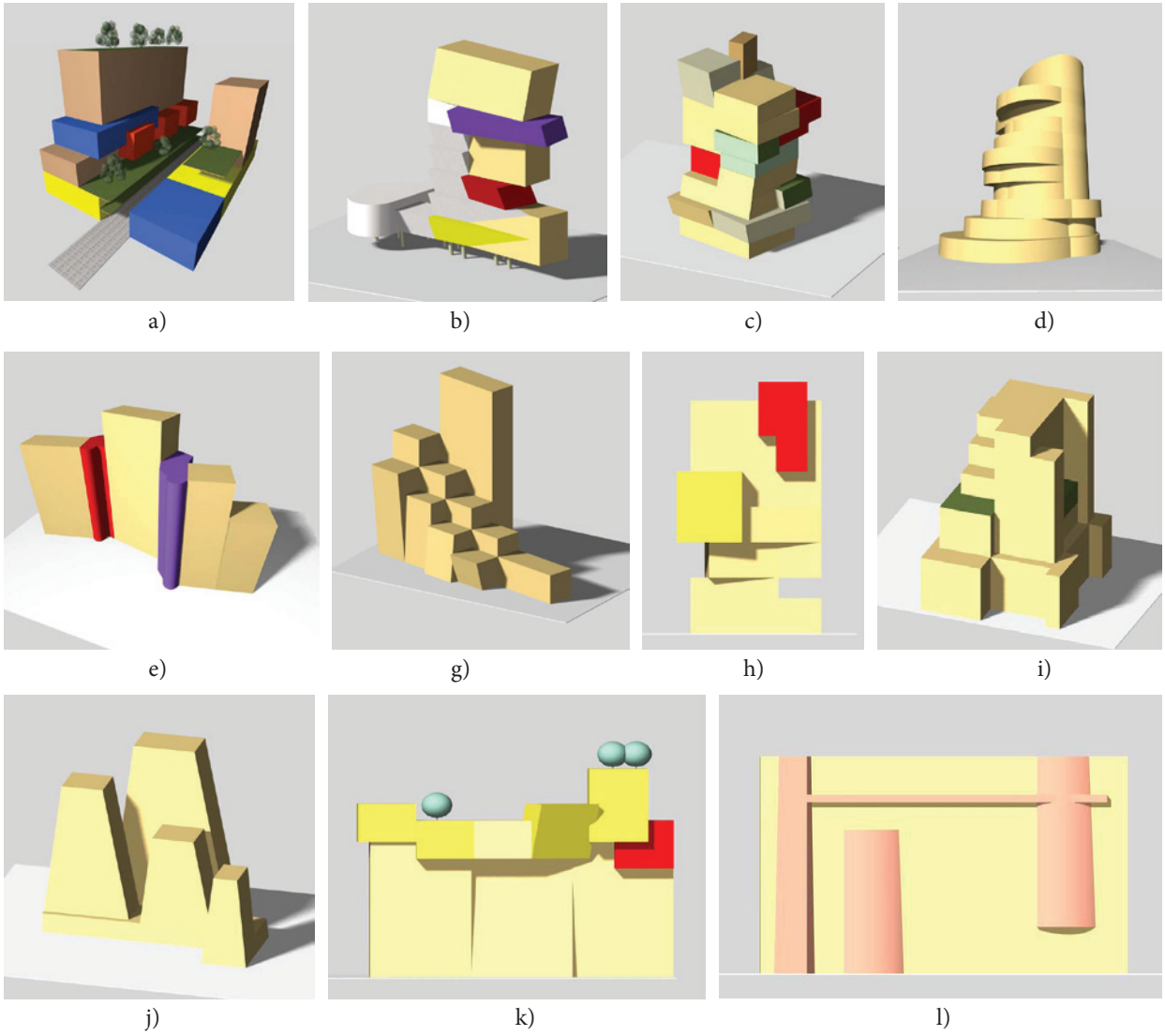


Figure 2. The principle of variability in schemas (source: author, 2013); a) mixed type of MRB; b) combination of different types of vertical and horizontal communications in the structure of the building; c) mixed planning structures of the MRB; d) terracing of the building volume; e) use of block inserts; g) volume breakdown on separate tiers; h) large vertical divisions; i) change of the number of apartments in high-rise levels; j) separate tiers with free floors or free ruptures between volume parts; k) selection of the last floors of the house; l) differentiated approach to use of summer premises by types and principles their rhythmic placement on the façade field

or similar elements. Depending on advantages of the public or residential part, the building complexes are divided into: business (with a developed business group – 50–80%, residential – 10–20%, trade and household 10% from Vtotal), residential (with housing up to 90% and trade and household function 10–20%); mixed structure (housing part is equal to public part) (Grigor'yev, 2003, p. 37). Development of each function indicates the development of corresponding components. Thus, residential and business function determines vertical development, and trading – horizontal development (Grigor'yev, 2003, p. 38). Functional variability in the architectural organization of facades involves using methods of heterogeneous solution of MRB: variable number of stories, varied volumes, mixed planning structures with specific solution of individual floors (first, last, middle), with differentiated approach to use of summer premises by types and principles of their rhythmic placement on the façade field and in height, with change in the dimensions of the floors, with change of the number of apartments in high-rise levels, with volume breakdown on separate tiers with free floors or free ruptures between volume parts (Petrova, 1994, p. 15), with terracing of the building volume, using of block inserts, with large vertical divisions and selection of the last floors of the house.

Constructive variability is aimed at achieving maximum balance and rationality of MRB general constructive treatment. Constructive system of residential building should correspond to volumetric-spatial design and be economically justified. Also, it may include installation

Figure 3. Polystylistics in Subotica (source: Internet, 2016)

of energy-efficient energy sources on the surface structure of MRB façades (in the middle/outside on the facade surface). The architectural principle of variability of MRB facades can be achieved using (flexible) construction systems: a frame system with vertical supports in the form of columns or pylons, pylons of a complex contour; structural systems of shells; combined constructive systems; constructive system with suspended floors; structures of the hinged facade in combination with solid glass and a lightweight masonry of external fencing structures.

Testing the principle of variability[4]

"The construction of the building that is subject of this Competition shall be realized in the protected city core, in Petefi Šandor street 3 and 5, between the Gymnasium – built in 1895 in baroque style according to projects by the famous Raichle Ferenc which represents an immovable cultural heritage of the city on one side and the Policlinic – also a protected building, one of the most beautiful buildings from the period between two World wars, on the other side."[5] Approbation practice of various principles and approaches to designing and reconstructing of the appearance of the city facade (Sanders & Baker, 2016, p. 218-223, 225, 227; Basso, Mililli, Herrero, Sanz, & Casaldiga, 2017) taking into account the peculiarities of perception has long been widely spread (Bachyns'ka & Kozlova, 2008; Kozlova, 2009, 2010, 2012; Đorđević & Vujić, 2010; Piroozfar & Farr, 2015; Djordjevic & Djukanovic, 2017; Kiruthiga & Thirumaran, 2017; Havik & Van Haeren, 2017). In the spring of 2016, the company DG (Competition, 2016) announced a contest for the best design idea of the building street facade in the Serbian city of Subotica, which served as one of the options for approving the principle of variability. The project of the housing and commercial building was completed within a month, and presented in the exhibition at the Raichel palace[6].

Subotica (Szabadka)

Subotica by Filep's[7] investigation is a "provincial town of 100,000 inhabitants" and "is known for its multicultural spirit… the town has been a meeting point of different cultures and religions, home to Hungarians, Serbs, Croats (and Bunjevci), Montenegrins, Germans, Slovaks, Ruthenians and Roma as well as to Catholics, Protestants, Serbian-Orthodox, Jews and Muslims." "Owing to industrialization, Subotica has developed and grown into a modern mid-European city in the period from the end of the 19th and beginning of the 20th century. Wealthy citizens at that time-landowners, industrialists, craftsmen and merchants build modern buildings following examples from Budapest and Vienna. In the following period, architecture typical for other European cities such as Munich, Paris and London also made its way through in Subotica. Today, buildings in Secession, Neo-renaissance, Neo-gothic, Neo-baroque Neo-classicism and Modern style (Figure 3) are dominant in the protected city core" (Competition, 2016). In the historical heart of the city (Aladžić, 2010) many architectural monuments are concentrated. And the main highlights of the city are the buildings – representatives of the Art Nouveau style and multistorey buildings, which deserve the special attention of specialists in preserving historical heritage (Aladžić, 2009).

[4] on the example of a competition project "The future business-residential building in Subotica, Petefi Sandor street 3 and 5"

[5] see Competition, 2016

[6] Modern art gallery Likovni susret, Subotica, Serbia

[7] see Filep, 2016, p. 59

About the project master plan, own facade volume and planning limits (Figure 4)

From the urban aspect, one must take care that the building fits into the boundary and frontage line of the street. Bearing in mind that the new building will be built on two lots of two former buildings, the outline of the interpolated building needs to be designed so as to fit in with the buildings in the surrounding area. The Competition committee announced a number of restrictions related to the construction zone site, located near the UNESCO monument protection zone. They concerned: the cornices line; the position of openings; the architectural design of the façade.

3. The Project's main idea

Research into architectural and spatial solutions of the residential-commercial building showed, that the main façade of the building which faces Petefi Šandor Street, has natural lighting only in the afternoon. This is a strong disadvantage. Most of the 2-room apartments are located in the north-western side, which is not recommended for families with small children and the elderly. Also, it does not give an opportunity to get required angular airing of the apartments in summer time. This arrangement of residential rooms usually leads to an unfavorable condition of the internal microclimate. In particular, doctor's epidemiologists often find frequent respiratory infections, psychological problems and depression among residents of these kind of apartments. That is why the main idea consists of three points: 1. Adequate, normative natural lighting and ventilation of residential rooms; 2. Mixed architectural-planning scheme of the building, using sectional and corridor type of the building for arrangement of highest plasticity of the main facade; 3. Preservation of the total retail space at the same level always (the level of +0.00 m.).

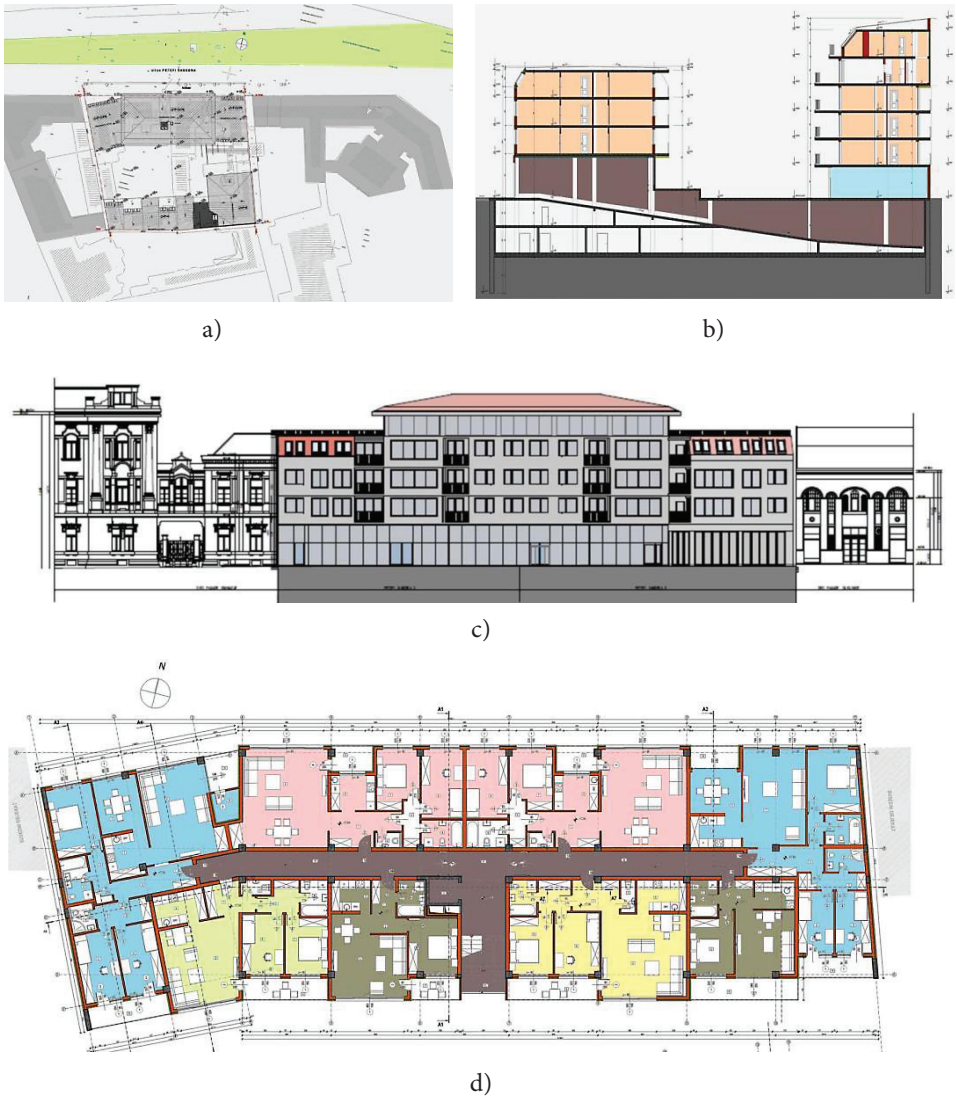
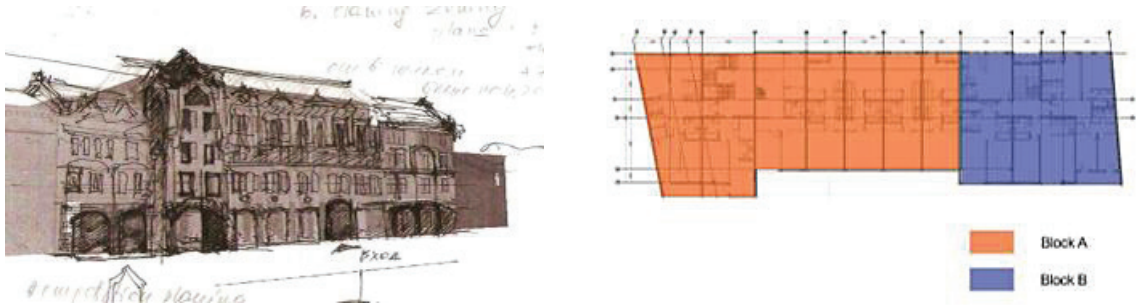


Figure 4. Initial project for reconstruction by DG (source: Competition. 2016); a) Situation plan; b) Cross section; c) Petefi SandorStreet view; d) Plan of typical level



a) b)

Figure 5. Main idea; a) Hand drawing by author, 2016; b) Building blocks

The idea of the project (Figure 5a) is to divide the building into two blocks A and B (Figure 5b). The length of the facade of the building is 55.5 m. According to the instructions of the design, the first floor of the house remains uninhabited. Entrances into the house are organized from Petofi Sandor Street. Entrance in Block A is at the main and the only passage in the green atrium patio. The entrance into Block B is from Petofi Sandor Street. Parking is better remaining at the same place; there are 2 entrances/exits.

Planning solution (Figure 6, 7a, 7b)

The building fits into the front line of historic facades (the red line of buildings in the historic environment) on Petofi Sandor Str. It occupies an area with dimensions of 14.94 m to 55.5 m in the plan. Block A (corridor-sectional) has a spacious half turn stairwell and elevator. The Western part of the block consists of three 3-bedroom and 2-bedroom apartments. The Eastern part of Block A (axes 4-9) consists of a block with 10 duplex apartments. The distance between the axes 5–9 is reduced to 4.5 m, for optimal living space and compositional unity. The access to the duplex unit is via the common corridor on the 3rd and 4th floors. For reducing the hours of overheating in summer, there are balconies designed on the south side of the apartments.

Block B is sectional and has half-pace fire stairwell. It consists of three 4-bedroom, six 2-bedroom and two 1-bedroom apartments. On the 4th floor of block B is arranged duplex apartment suite with 6 rooms, autonomous day and night area and panoramic windows on the 2nd level.

All small-room apartments of residential A and B units are oriented to the southwest, multi-room apartment are arranged in the corners of the house and have a cross-ventilation as well as enough sun exposure throughout the day. All apartments of residential A and B blocks are divided into day and night area. The day area includes a living room, a spacious dressing room, a guest bathroom, a kitchenette, a dining room and a living room. The night area includes a spacious bathroom with bath, dressing room and a living room. All apartments have a flexible layout. The duplex apartment daily zone is located at the level of common intrahouse corridors (3rd–4th floors); sleeping area is located at the next level (1st and 5th floors).

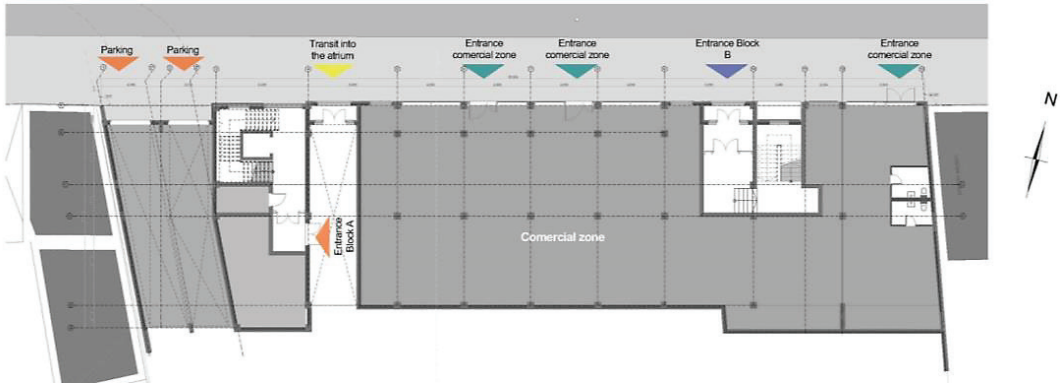


Figure 6. Incoming zone plan (source: Design proposition by author, 2016)

a) b)

Figure 7. Planning solution of the building (source: Design proposition by author, 2016); a) 2nd and 3rd floor plans with duplex apartments; b) 4th and 5th floor plans with duplex apartments

Architectural and compositional solution of the residential building. Organization of the facade composition

To determine the main emphases, as well as the organization of basic composite masses of the residential building I carried out morphological analysis of the object in the historic environment (Figure 8a, b, c, d, e and g).

- The first step is the installation of the vertical levels of facade spots: 1st floor 4.2 m, 2–5 minutes to 3 m high. It has allowed reaching the maximum height of the roof 18.96 m, which is less than 0.30 m height of the boundary gymnasium roof.
- The second stage is the analysis of the cornice line of the building. It showed that over a third part of the street cornice monotonically followed one line on the same level. This is shown in the scheme of analysis. It leads to the frequent repetition of plastic elements on the facade, as well as quick loss of interest by residents of the city to build. That is why, I propose to dilute the monotony of the cornice line by triangular and semi-oval cornice elements; to split the building into three main façade units and thereby to give the dynamic, horizontal rhythm of the façade, and in particular, lines of its completion. To leave 4-floors in two front units, that flank the buildings of Clinics and Gymnasium, and to raise one central front size to 5 floors, with setting up of mansard and luxury apartments.
- The third step is the definition of vertical rhythms of construction. It showed that the distance between the main plastic elements adjacent buildings is almost identical (between the columns and facade pylons). These vertical rhythms are successfully connected and achieved the total asymmetry of the facade spot, in which the main accents of the facade of Gymnasium and the main vertical elements of the designed building are emphasized.
- The fourth stage is studying horizontal rhythms of the windows, which showed, that it is necessary to supplement the general street facade line by continuous glass surfaces that enter into intermediate compositional vertical rhythm and serve for the coverage of the two stairwells. Also, it is needed to make three-part and oval window apertures.
- The fifth step is proportioning of the facade masses by taking into account the previous stages of analysis. The main facade element is the entrance area in residential block B, to which the vertical and horizontal rhythms of the block A, as well as 4-storeyed parts of the house, are subordinated. This provided an opportunity to obtain an overall asymmetrical composition of the façade and identify the main vertical axis and accents in the silhouette of the roof.
- The sixth stage is organizing of the plasticity of facade (shadow), which is detected by falling shadows of protruding facade elements. The conclusion of the analysis is a scheme that shows the range of limits of the building's height. The height of the cornice of the designed residential building's main compositional element is an extension of the main cornice line of Gymnasium (+16.31–16.34 m). The height of the cornice of the main decorative elements of the block A and the cornice line 4-storeyed part of the block B is a semantic extension of the cornice line of annexed of Gymnasium (+11.5–11.87 m). The height of the basement zone of Policlinics is +1.84 m and window sill plates of Gymnasium are +1.64 m, this is the 1st altitudinal limit of the facade spot, it is emphasized by the line of window layout and facade facial stones. All the high-rise building limits are designed to achieve maximum harmony and compositional coherence with the existing historical environment of Petefi Sandor Street.

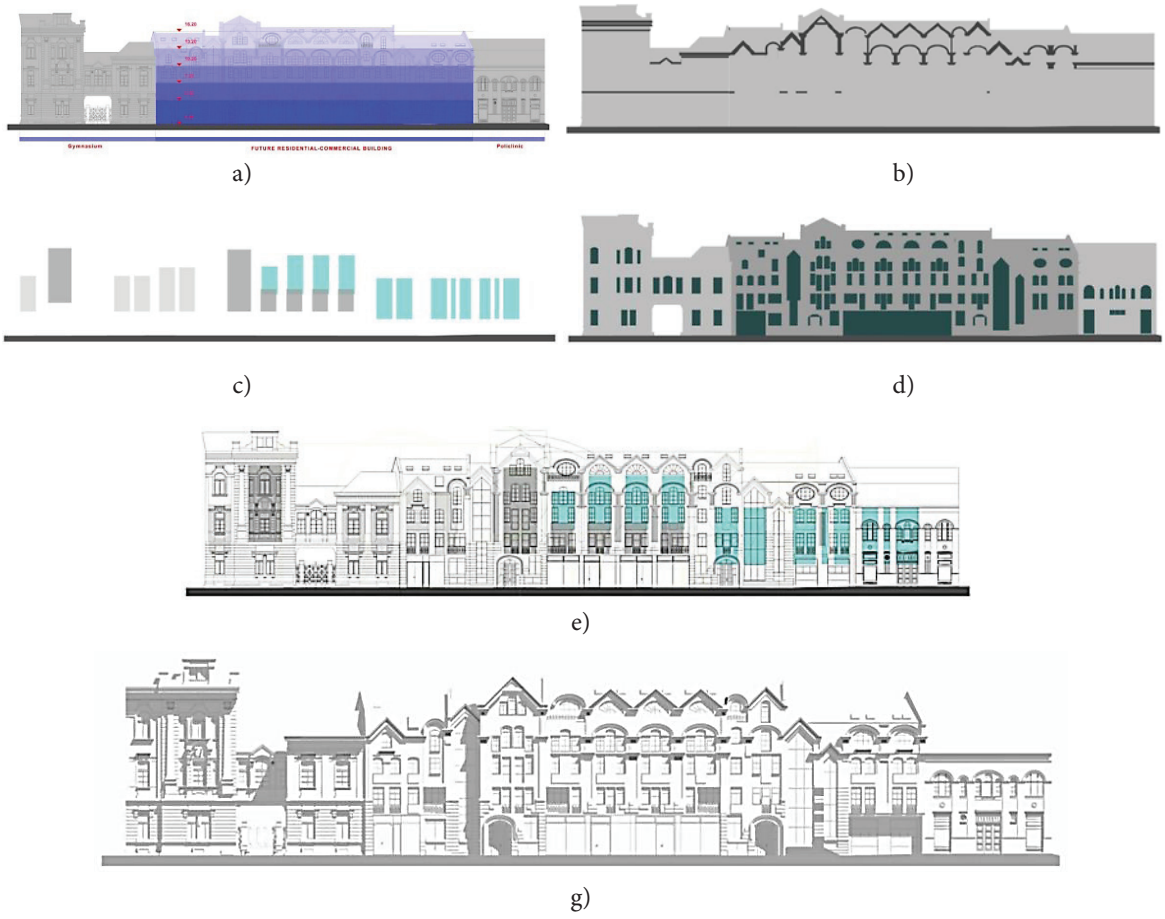


Figure 8. Morphological analysis of the facade in the historic environment. Petefi Sandor Street view. Polyclinic building on the right, Gymnasium on the left (source: Design proposition by author, 2016); a) Installation of the vertical levels of facade spots; b) analysis of the building cornice line; c) Vertical rhythms (light gray – Gymnasium rhythms, dark gray – proposal rhythms, blue – Policlinic rhythms); d) Horizontal rhythms – window rows; e) Proportions on the façade masses; g) Shadows (the plasticity of the facade)

The stylistic solution and details of the facade

As the dominant stylistic direction for solving the composition and details of façade, the residential building was adapted to the style of so-called "modernized eclectic". The style of "modernized eclectic" is characterized by: the usage of rough masonry rustic/hewn natural stone as facing material; the window apertures of rectangular or elongated semi-oval shape; simplified, emphasized rough decor or lack of it; creation of decoration plane of the facade by using a combination of natural stone and front brickwork; the usage of a simplified form of forceps and towers, compared to the "Northern Modern" (© Y.Ivashko[8]); active silhouette of the line roof; the dynamic asymmetry with a large number of major and minor axes, which pass through entrances, towers, forceps and a bay window. There were taken the best examples of Kyiv and Moscow architecture (Figure 9), as an analogy of "Northern Art Nouveau" and vertical and horizontal facade details for keeping harmonious unity in the existing historic environment "modernized eclectic". Great attention was given to importance of the number of stories, building silhouette and the magnitude of construction in general, for the development of architecture and facade details of the residential building on Petefi Sandora Str. The main idea of the facade architecture formation (Figure 10) for the residential building has been the usage of active work of different-sized window apertures on the background of the front brickwork and granite facial plane. Rejection of excessive decoration and rich fretwork is for purity's sake, to achieve the vertical and horizontal lines and rods, and also for maximum reduction of the cost of subsequent construction work.

Materials and design solution proposals

The design solution of a residential building involves using a frame-monolithic system from pylons and columns as structural elements and double layer lightweight filling as the enclosing structure. The facade wall consists of foamed concrete blocks, the air layer and facing bricks. The roof is

[8] Yulia Ivashko – Prof. Dr. in Kiev National University of Construction and Architecture

a) b) c)

Figure 9. Analogs from Kyiv and Moscow architecture (source: photo by prof. Yulia Ivashko, 2005);
a) Modern building in Kyiv; b) Moscow modern building elements

supposed to be with two sloping surfaces. The small angle of inclined crowning slopes gives the possibility to place the alternative energy sources on their surface. At the first level (up to the mark + 5.69 m), as a decoration hewn granite panels are used, which are randomly distributed on the plane of the wall. The size of the main facade spot for emphasizing the rhythm of vertical construction is decorated by rectangular plastered pylons, with the projections and vertical elongated recesses which are deepened into the wall. As a decorative mural on the top floor of the entrance aperture in the B block there were used a plane plastered wall with recessed natural stones of different-sized fractions. The same decorative mural was used in repeated decorative inserts which were located across the horizontal line of the façade. The vertical rhythms of the street are underlined by plastered niches at the level of the 3rd floor.

Figure 10. Main façade perspective
(source: Design proposition by author, 2016)

Conclusion

In conclusion, it should be noted that:

- Contemporary architects and designers should remember that a person receives more than 80% of the information by his or her visual instrument (eye) that is scanning an external environment. In our case, this environment is architecture.
- According to the science of videoecology most of the facades with many similar elements in the modern architectural objects, especially objects that are built in the functional style, do not satisfy the physiological properties of human visual perception, and in the presence of a plurality of identical elements lead to death of the brain cells (Filin, 1997; Wilkins, 1995).
- Modern designers should depart from the practice of replicating the same identical elements on the facades of multistorey residential buildings, especially in multi-million city centers.
- The science of videoecology provides an opportunity to take a fresh look at the means and technologies that modern building production offers. And it proposes to isolate from the total number of new technological solutions those that satisfy the physiological and psychological requirements of a modern comfortable living environment.
- The contemporary architecture of a large city is formed in two main directions – it is kitsch of its architectural shell, or replicating the same identical elements, which are repeated on the facade to infinity. In this regard, the issue of organizing a comfortable visual environment of the city has become more urgent than ever. It is also a question of how comfortable a modern living environment is, both inside and outside, how much it positively affects a person, what informative and communicative active potential it brings to the consumer of this environment. The key to answering these questions is to use the principal of variability, which at the levels of the large, medium and small plasticity of the facade, makes it possible to ennoble (or humanize) the architectural organization of the facade of a residential building.
- When considering a residential building as an integral whole, in which its internal structure (a set of apartments, horizontal and vertical communications) is organically displayed on its facade shell, which in turn forms an original, new and interesting architec-

tural organization of its spatial elements (apartments and communications between them), the principle of variability should be used. Thanks to the principle of variability, the architectural component of the urban environment will acquire new visual connections with its residents and improve its communicative qualities, since, in essence, the main goal of creating an object by this principle is achieving an active connection between the consumer of the urban environment and the facade of the residential building (the tactile communicative component of the facade shell). Moreover, inhabitants are not indifferent to the visual appearance of their city, as shown earlier (Lynch, 1960; Kozlova, 2016, p. 32, 33).

- Competitive design on the basis of development in a real situation makes it possible to qualitatively improve the theoretical principles (in this case the principle of variability). As with the reconstruction object building on Petefi Sandora Street, the entire surface facade plane came out and, as a result of the analysis of the designed facade spot, I determined six stages (they are: installation of the vertical facets, analysis of the corneal line of the building, definition of the vertical rhythms of construction, studying of the horizontal rhythms (on the basis of shadows)), which should be taken into account when developing new objects of residential buildings and office functions located in a related environment.
- In the field of view of a person fall, as a rule, the elements of finishing the first floor of the building (taking into account the short distances along Petefi Sandor Str.), which are the entrances and exits from the apartment building, the entrance and exit from the underground parking, the design and shape of the window openings, and slopes in these openings, materials and the color of the walls. Also, the elements of the completion of an apartment house – that is, the outline and character of the roofline, which, as a rule, stops the viewpoints (saccades) of a person already interested in the architecture of a new object.
- Further research of the author will be devoted to synthesizing techniques, as well as drawing up scientifically sound recommendations on the architectural organization of facades of multistorey residential buildings, taking into account the requirements of videoecology.

Acknowledgements

This work was performed as part of the dissertation research by the author, without any external or any internal funding sources. I express special gratitude to the Organization Committee of the International Conference "Architectural Practice and Education" through which most of this article was announced. And also I am grateful to dr. Lada Markejevaite, dr. Vytautas Petrušonis and dr. Arnoldas Gabrėnas for their professional recommendations.

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