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Research paper

Influence of the Housing Development Type on the Living Environment Comfort

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Abstract

The article is devoted to the problems of rational use of urban areas, namely: the optimal planning of its residential development. Microdistrict and block housing development sites in the cities of Europe and Ukraine were researched. A city-planning assessment of population density and building density was carried out using a comparative analysis of microdistrict and block type of housing development of residential complexes and influence of the planning structure on the population living comfort was determined. The article presents the justification of the fact, that effective mass housing development is medium-floor block, with a convenient network of streets, designed primarily for pedestrians, dense, which in turn will significantly improve the comfort of the living environment in the cities of Ukraine.

Keywords: *planning structure, microdistrict housing development, block housing development , population density, medium number of floors , comfort.*

1. Introduction

Currently, there is a great scientific and practical interest in the effective use of urban areas for building and landscaping precisely within the cities where the majority of the population of Ukraine is concentrated. High urbanization of city areas is the cause of degradation of the urban development situation, adversely affecting the development of cities, their transport infrastructure, landscaping, urban maintenance, as well as comfortable living conditions of residents, their mobility.

At present, residential development should be a full-fledged element of the urban environment, on which the quality of living of the population largely depends. Comfortable housing is an integral part of a comfortable living environment.

Relevance of the study:

The problems of the modern city are caused by the irrational use of urban areas, the unsatisfactory improvement of its territory, the unsuccessful planning of housing, the inefficient use of high-rise buildings and public spaces. It all causes pollution, exposure to electromagnetic waves and negative effects on the physical and psycho-emotional health of human settlements residents.

At the present stage of development of the urban planning situation in Ukraine, one can single out the main problems of the living environment: a high level of motorization, problems with parking spaces; lack of public spaces; lack of proper landscaping and land-improving; high building density; insufficient aeration and insolation of residential premises and territories; low level of maintenance of residential complexes.

Purpose of the study:

- compare the main technical and economic indicators of microdistrict and block housing development on the example of European and Ukrainian cities;
- to form optimal methods for planning residential development in modern conditions.

The task:

- to analyze and systematize the materials of foreign and domestic experience in planning microdistrict and block housing development;
- to develop recommendations for the design of residential formations in the modern conditions of development of the cities of Ukraine.

Object of the study:

- urban housing development in Europe and Ukraine.

Subject of the study:

- town-planning assessment of population density and building density using a comparative analysis of microdistrict and block housing development of residential complexes with an impact on the comfort of living of the population.

Research method - comparative analysis.

2. Comparative analysis of the of microdistrict and block housing development in the modern conditions of European cities

2.1. Selection of land sites for urban planning analysis

To carry out a city-planning analysis of microdistrict and block housing development, three land sites of block and microdistrict type of housing development with an area of 25–30 hectares were selected in European cities (figures 1, 2). The study was carried out using Google Maps. The following parameters were investigated: the density of buildings, the average number of floors, the

number and density of the population, the density of landscaping, the length of the road network, the density of the road network

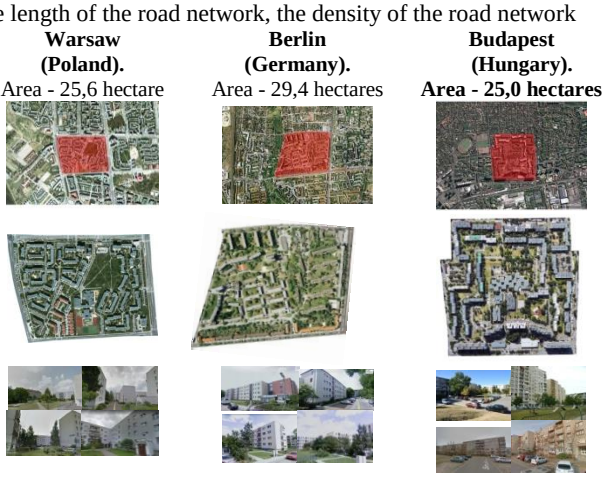

Fig. 1: Researched sites of microdistrict housing development in the cities of Europe

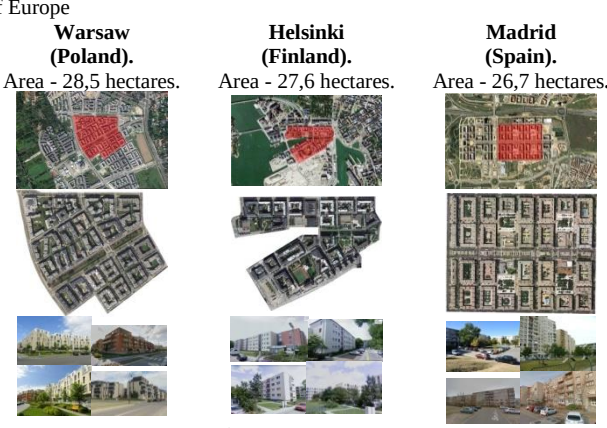

Fig. 2: Researched sites of block housing development in the cities of Europe

2.2. Research of the planning structure of territory development

Buildings density (ground space density) - an indicator of the territory use, expressed as the ratio of the total area of construction to the area of the site

Table 1: Buildings density (ground space density) of microdistrict and block housing development of the sites in Europe

Housing development type	Density, %
Microdistrict	
Warsaw Berlin Budapest	15 17 21
Average density - 18	
Block	
Warsaw Helsinki Madrid	31 25 31
Average density - 29	

2.3. Research of the medium number of floors

Medium number of floors is determined by the formula:

$$N_{af} = (s_f \cdot n) / N \quad (1)$$

where
N_{af} – medium number of floors;
S_f – area of buildings with the same number of floors, m^2;
n – number of floors;
N_t – total buildings density (ground space density), m^2.

Table 2: Medium number of floors in microdistrict and block housing development of the sites in Europe

Housing development type	Medium number of floors, f
Microdistrict	
Warsaw Berlin Budapest	4,6 5,8 5,5
Average number – 5,4	
Block	
Warsaw Helsinki Madrid	4,7 6,2 5,2
Average number – 5,3	

2.4. Calculation of population size and density

The interrelation between the plot area and the number of residents is due to the need to provide residents with a certain living space, level of cultural and community services, green space and recreation areas, aeration and insolation of buildings, as well as the requirements for effective use of the land plot - a decrease in investment in its engineering training, equipment, improvment.
The number of population in a residential housing is determined on the basis of its calculated density in the residential area.
For calculation, it is assumed 24.0 m2 of the total area on per resident.
The number of inhabitants is determined by the formula:

$$H = \frac{S_b \cdot n_f \cdot 0.7}{\sigma} \quad (2)$$

where
H – number of inhabitants, person;
σ – basis of calculated density, m^2 per person;
S_b – total buildings area, m^2;
n_f – medium number of floors;
0,7 - coefficient taking into account the area of walls in the buildings.

Table 3: Number of inhabitants of researched sites in microdistrict and block housing development in Europe

Housing development type	Number of inhabitants, persons
Microdistrict	
Warsaw Berlin Budapest	4299 7623 6112
Average number - 6011	
Block	
Warsaw Helsinki Madrid	11325 8702 11523
Average number - 10517	

Table 4: Population density of microdistrict and block housing development of the sites in Europe

Housing development type	Population density, persons per hectare
Microdistrict	
Warsaw Berlin Budapest	168 259 244
Average population density - 224	
Block	
Warsaw Helsinki Madrid	397 315 431
Average population density - 381	

2.5. Research of the landscaping

Green plantings are an integral component of the environment, an important element of the urban planning framework, a factor that

plays an important role in the sanitary, hygienic, medical and ecological, recreational, architectural, structural-planning, decorative and artistic, socio-cultural aspect.

First of all, green plantings reduce the presence of dust and smoke in the air of the city, play the role of a kind of filter. They influence the formation of the microclimate in the city, because they affect the thermal regime, humidity and the degree of air mobility. Many types of ornamental plants create ample opportunities for architectural compositions and planning of the city as a whole.

Green areas are places of active and passive recreation of the population. Especially great is the role of parks of culture and recreation. In addition to them, in cities they organize squares, boulevards, children's parks, city gardens, botanical gardens, street green plantings along sidewalks, building surrounding plantings, front gardens, green plantings in industrial enterprises, hospitals, schools, etc

The optimal number of green spaces in the settlement, the ratio of these plantations in the overall balance of the territories and their rational distribution are determined by the norms and design techniques. Design standards are expressed in absolute and relative units. The number of green spaces per urban dweller in square meters shows the situation in the city with greenery. The area of greenery in the city, district, microdistrict, which is calculated as a percentage of the total area of development of the city, district, microdistrict, shows the level of landscaping.

The level of landscaping of the territory is the basis for determining the standard indicators of urban landscaping. The area of the greened territory of the microdistrict (block) should be at least 6 m^2 per person (excluding school and kindergarten areas)

The area of green areas of common use for cities - 7-10 m^2 per person, in rural settlements - 12 m^2 per person. The level of greening of the residential area should be at least 40%, industrial enterprises - 30%, school and kindergarten areas - 80% , hospitals - at least 60%.

Landscaping density is determined by the formula:

$$Q = \frac{Sg}{S_s} \cdot 100 \quad (3)$$

where

Q - landscaping density (%);

S_q – area of greenery of a site within the red line, m^2;

S_s – area of a site within the red line, m^2.

Landscaping area per person:

$$T = \frac{S_g}{H} \quad (4)$$

where T – landscaping area per person, m^2 per person

S_q – area of greenery of a site within the red line, m^2;

H – number of inhabitants, person.

Table 5: Landscaping density of microdistrict and block housing development of the sites in Europe

Housing development type	Landscaping density, %
Microdistrict	
Warsaw Berlin Budapest	40 55 34
Average landscaping density - 43	
Block	
Warsaw Helsinki Madrid	36 20 21
Average landscaping density - 26	

Table 6: Landscaping area per person of microdistrict and block housing development of the sites in Europe

Housing development type	Landscaping area, m^2 per person
Microdistrict	
Warsaw Berlin Budapest	24 21 14
Average landscaping area - 20	
Block	
Warsaw Helsinki Madrid	9 7 6
Average landscaping area - 7	

2.6. Research of the road network

The street-road network is a network of streets, public roads, local and yield streets, sidewalks, pedestrian and bicycle paths, as well as embankments, squares, street parking lots with engineering and auxiliary facilities, traffic control devices.

When designing the city, a single road transport network is foreseen, providing convenient and safe transport links with all functional areas, with other settlements of the urban system, and places of recreation. At the same time, architectural and engineering solutions of the transport network take into account the peculiarities of the landscape and the requirements for environ-mental protection of human settlements.

For the service of passenger and freight traffic within the city and the surrounding area, the development of a system of long-distance and suburban transport is envisaged. Their purpose, capacity and location are determined by taking into account the role of the external transport hub in the regional transport network.

The network of streets and roads of the city is designed as a single system, taking into account the architectural and planning organization of the territory, the type of the housing development, the functional purpose of individual streets and roads, the intensity of traffic and pedestrian traffic and the requirements of environmental protection.

Road network density is determined by the formula:

$$D = \frac{\sum L}{S_s} \quad (5)$$

where

D - road network density, km/km2;

$\sum L$ – total length of the road network, m;

S_s – area of a site within the red line, m^2.

Table 7: Length of the road network of microdistrict and block housing development of the sites in Europe

Housing development type	Length of the road network, m
Microdistrict	
Warsaw	main streets- 1058 local streets - 1032 yield streets - 5850
Berlin	main streets -1137 local streets - 1119 yield streets - 2141
Budapest	local streets - 1227 yield streets - 6622
Average length - 6730	
Block	
Warsaw	main streets- 675 local streets - 1740 yield streets - 3265
Helsinki	main streets- 144 local streets - 1806 yield streets - 3780
Madrid	main streets- 458

	local streets - 3697 yield streets - 3001
Average length - 6190	

Table 8: Road network density of microdistrict and block housing development of the sites in Europe

Housing development type	Road network density, km/km2
Microdistrict	
Warsaw Berlin Budapest	31 15 31,4
Average road network density - 26,0	
Block	
Warsaw Helsinki Madrid	19,9 20,7 26,8
Average road network density - 22,5	

Table 9: Number of parking places of microdistrict and block housing development of the sites in Europe

Housing development type	Number of parking places, p.
Microdistrict	
Warsaw Berlin Budapest	1001 615 1155
Average number - 924	
Block	
Warsaw Helsinki Madrid	495 746 1155
Average number -799	

Table 10: Number of parking places for one apartment of microdistrict and block housing development of the sites in Europe

Housing development type	Number of parking places, p.
Microdistrict	
Warsaw Berlin Budapest	0,7 0,24 0,57
Average number - 0,5	
Block	
Warsaw Helsinki Madrid	0,13 0,26 0,3
Average number - 0,23	

3. Comparative analysis of the of microdistrict and block housing development in the modern conditions of Ukranian cities

2.1. Selection of land sites for urban planning analysis

To carry out a city-planning analysis of microdistrict and block housing development, three land sites of block and microdistrict type of housing development with an area of 25–30 hectares were selected in Ukrainian cities (figures 3, 4). The study was carried out using Google Maps. The following parameters were investigated: the density of buildings, the average number of floors, the number and density of the population, the density of landscaping, the length of the road network, the density of the road network
The results of the research and calculations are presented in tables 11 ... 18.

Kyiv.
Area - 25,6 hectares.

Lviv.
Area – 28.0 hectares.

Ternopil.
Area - 27,7 hectares.

Fig. 3: Researched sites of microdistrict housing development in the cities of Ukraine

Kyiv.
Area - 25,0 hectares.

Poltava.
Area - 29,9 hectares.

Odesa.
Area - 25,1 hectares.

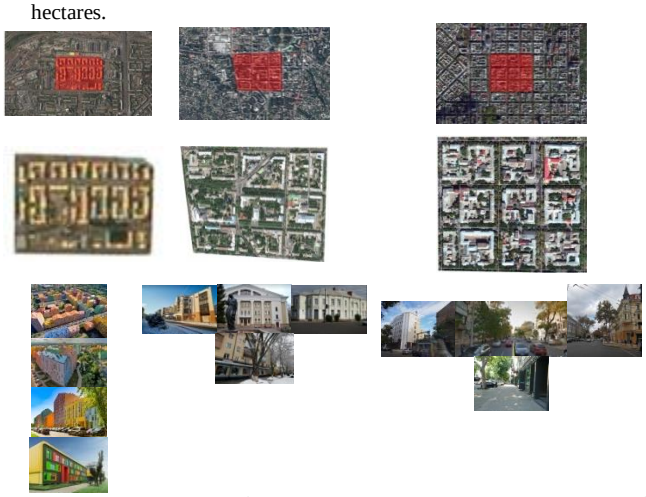

Fig. 4: Researched sites of block housing development in the cities of Ukraine

3.2. Research of the planning structure of territory development

Table 11: Buildings density (ground space density) of microdistrict and block housing development of the sites in Ukraine

Housing development type	Density, %
Microdistrict	
Kyiv Lviv Ternopil	17 16 16
Average density - 16	
Block	
Kyiv Poltava Odesa	27 30 49
Average density - 35	

3.3. Research of the medium number of floors

Table 12: Medium number of floors in microdistrict and block housing development of the sites in Ukraine

Housing development type	Medium number of floors, f
Microdistrict	
Kyiv Lviv Ternopil	13,6 8,9 9,1
Average number – 10,5	
Block	
Kyiv Poltava Odesa	9,3 3,3 2,8
Average number – 5,1	

3.4. Calculation of population size and density

Table 13: Number of inhabitants of researched sites in microdistrict and block housing development in Ukraine

Housing development type	Number of inhabitants, persons
Microdistrict	
Kyiv	9140
Lviv	8561
Ternopil	7038
Average number - 8246	
Block	
Kyiv	14511
Poltava	5437
Odesa	7927
Average number - 9291	

Table 14: Population density of microdistrict and block housing development of the sites in Ukraine

Housing development type	Population density, persons per hectare
Microdistrict	
Kyiv	357
Lviv	305
Ternopil	254
Average population density - 305	
Block	
Kyiv	580
Poltava	182
Odesa	316
Average population density - 359	

3.5. Research of the landscaping

Table 15: Landscaping density of microdistrict and block housing development of the sites in Ukraine

Housing development type	Landscaping density, %
Microdistrict	
Kyiv	52
Lviv	45
Ternopil	52
Average landscaping density - 49	
Block	
Kyiv	25
Poltava	39
Odesa	26
Average landscaping density - 30	

Table 16: Landscaping area per person of microdistrict and block housing development of the sites in Ukraine

Housing development type	Landscaping area, м²/ per.
Microdistrict	
Kyiv	14
Lviv	15
Ternopil	20
Average landscaping area - 16	
Block	
Kyiv	5
Poltava	22
Odesa	8
Average landscaping area - 12	

3.6. Research of the road network

Table 17: Length of the road network of microdistrict and block housing development of the sites in Ukraine

Housing development type	Length of the road network, m
Microdistrict	
Kyiv	main streets- 1048 local streets - 1139 yield streets - 2750
Lviv	local streets - 2530 yield streets - 3170
Ternopil	main city streets- 608 main streets- 600 local streets - 975 yield streets - 5149
Average length - 5990	
Block	
Kyiv	local streets - 997 yield streets - 5151
Poltava	main city streets- 682 main streets- 509 local streets - 3788 yield streets - 6804
Odesa	local streets - 4124 yield streets - 6804
Average length - 7460	

Table 18: Road network density of microdistrict and block housing development of the sites in Ukraine

Housing development type	Road network density, km/km2
Microdistrict	
Kyiv	19,3
Lviv	20,3
Ternopil	26,4
Average road network density - 22,0	
Block	
Kyiv	24,6
Poltava	39,3
Odesa	17,7
Average road network density – 27,2	

Table 19: Number of parking places of microdistrict and block housing development of the sites in Ukraine

Housing development type	Number of parking places, p.
Microdistrict	
Kyiv	305
Lviv	465
Ternopil	174
Average number - 315	
Block	
Kyiv	1231
Poltava	367
Odesa	447
Average number -682	

Table 20: Number of parking places for one apartment of microdistrict and block housing development of the sites in Ukraine

Housing development type	Number of parking places, p.
Microdistrict	
Kyiv	0,1
Lviv	0,16
Ternopil	0,07
Average number - 0,11	
Block	
Kyiv	0,25
Poltava	0,2
Odesa	0,17
Average number - 0,21	

4. Research results

A research of the parameters of microdistrict and block housing development of European and Ukrainian showed the following:

4.1. Buildings density (ground space density)

Comparison of the building density revealed that with the block planning of the territories, the building density in all the studied areas is significantly higher (about 2 times) than in the microdistrict housing due to the larger ground space of the buildings. In the microdistrict building more territory is a large area of free space. This density indicator allows you to assess the quality of use of the territory - that is, its urbanization. Due to the high density can be achieved compactness of the city.

4.2. Planning structure

The linear, perimeter and group planning scheme prevails in the microdistrict development.
Linear housing development is used when placing houses along a transport, pedestrian highway. This technique gives a positive microclimatic effect only if the directions of the building line coincide with the azimuth of the optimal orientation of the types of buildings that are used.
Perimeter housing development is characterized by the placement of houses along the red lines of the streets, limiting the quarter. This technique is the most simple in terms of architecture, but has several drawbacks: the lack of communication between the inner block spaces and the street space, the forced unfavorable orientation of the living blocks in the cardinal directions, the poor ventilation of the blocks in the case of small sizes.
Group housing development is characterized by the placement of houses in separate groups with the formation of relatively small courtyards, gardens.
The principle of block development is to divide residential areas with a grid of streets into small sectors with courtyards. Thus, the building forms comfortable public spaces and social connections between residents, prevents the formation of abandoned areas between houses.

4.3. Number of floors

As a result of the study of the number of floors, it was revealed that the sections of the microdistrict and block development of Europe have the same average number of floors (5.3 ... 5.4 floors). In the Ukrainian case, in microdistrict development high-rise buildings dominate (10.5 floors.). In the block housing of Ukrainian cities the houses of the medium number of floors dominate (5.1 floors).

4.4. Population size and density

As a result of calculations of the number of residents, it was found that in the block development of European cities with the same number of floors with microdistrict development, the population is almost 2 times higher than in areas with microdistrict development. In the Ukrainian cities, in spite of the fact that the microdistrict buildings have 2-fold higher than the block height, the average population in the block building is still 12% higher. Population density in block housing is also higher.

4.5. Landscaping and recreational area

The study of green areas of the plots showed that the percentage of greening of the microdistrict development in Europe and Ukraine is 1.5 times higher than in the block development. But this fact leads to the fact that in microdistrict building large areas of free, unused areas are overgrown with wastelands, because municipal services or management companies have to spend enormous resources on the maintenance of these sites around houses.

4.6. Road network

During the study of the road network, it was found that in areas of Europe with microdistrict and block development, the length and density of the road network was not significantly different. The number of parkings in the microdistrict development is 15% higher, since in case of block development, the parking places are located only on the outside of the streets, and the courtyard is free from cars.
In case of microdistrict housing development, parking places are placed along the perimeter of the main streets that limit the microdistrict , as well as inside the microdistrict , which in turn makes it more difficult for residents mobility.
In the Ukrainian sections of the block type of building, the length and density of the road network prevails over the microdistrict. The number of parking lots in the block building is also higher.

Table 21: Influence of the housing development type on the living environment comfort

Positive	Negative
Microdistrict	
High landscaping density Low road density Sufficient insolation Sufficient aeration Various planning techniques of building Convenient entrance to each doorway	Low building density High number of floors Reloading of streets High speed Insufficient number of car places Parking in the courtyards Large area of unused territories Lack of places for small business There is no clear division into public and personal space All buildings are similar to each other
Block	
High building density Low number of floors Redistribution of traffic flows The yard is free of cars Secure streets and dwellings Combination of functions in one volume (commerce, offices, housing) Clear division between public and personal spaces	Low landscaping density Not always sufficient aeration High density of streets; Not always sufficient insolation

5. Conclusions

Studies show that with a free type of building, most of the territory is a large area of free space. As well as the territory near large houses, the free territory is filled with spontaneous temporary parking lots, which worsens the environment of the house adjoining territories, pedestrian accessibility, safety, availability of service transport, reduces social control over the housing stock and the house territory in particular.
So, in order for high density, not to turn the area into an "anthill", it is necessary to move away from the concept of exclusive zoning (sleeping area / business district) - they give rise to a concentrated mass pendulum migration inside the city (in the morning the whole population of the area goes to work, back in the evening). Which in turn leads to the fact that during the day sleeping areas are devastated - all working people leave them, and in the evening there is a return migration. Similar is to business areas.
In our opinion, the housing should be mixed. Conventionally, it can be a residential house or a block, followed by an office block, or a trading house, a university building, and so on. In this case, it will give an opportunity to weaken the pendulum migration, or at least “dissipate” it around the city, so that it is more or less uniform, to reduce the traffic problem (traffic jams in the morning and evening), due to the redistribution of traffic flows in favor of choosing walking or cycling It will help to improve the ecology and economy of the city, make the streets safer and more convenient for residents.
Another important factor is the number of floors. It is generally accepted to build up the housing with medium-sized residential buildings (up to about 5-7 floors), in that case visual contact of a person in the house with the street is possible and vice versa, that is, buildings do not turn into tall reinforced concrete boxes.
You should not use low-rise buildings either - the expansion of the city due to low-rise buildings has a negative impact on traffic intensity, because if the city is compact, you can quickly get anywere on foot / bicycle / public transport, but if you drive 20-30 kilometers, the choice will most likely fall on the individual car, which will lead to an increase in traffic intensity, and this in turn to congestion.

Therefore, the city should be dense, not vague, and with our climatic conditions, low-rise buildings require significant investment in laying utilities to each house, facilities for road network.
From the point of view of the number of floors, the block housing development, as compared with the microdistrict, is better because the same area of the territory can be provided with fewer floors.
Thus, it is efficient to arrange mass housing development is medium-floor block, with a convenient network of streets, designed primarily for pedestrians, dense, which in turn will significantly improve the comfort of the living environment in the cities of Ukraine.

References

[1] DBN B.2.2-12:2018. Planning and housing development of the territories . K .: Ministry of regional development. (2018), 179.
[2] Vukan R. Vuchic «Transport v gorodakh, udobnykh dlya zhizni». M.: Territoriya budushchego, 2011. 576 p.
[3] Daniel Brook «Istoriya gorodov budushchego». M.: Strelka Press, 2014. 436 p.
[4] Glen Bramley, Sinéad Power. Urban Form and Social Sustainability: The Role of Density and Housing Type // Environment and Planning B: Planning and Design, vol. 36, 1: pp. 30-48. , First Published January 1, 2009. https://doi.org/10.1068/b33129.
[5] Rowan Arundel, Richard Ronald. The role of urban form in sustainability of community: The case of Amsterdam. Environment and Planning B: Urban Analytics and City Science, vol. 44, 1: pp. 33-53. , First Published October 9, 2015. https://doi.org/10.1177/0265813515608640.
[6] Fedchenko, I.G. (2012). Microdistrict in the former Soviet space: social and planning changes and trends. Izvestiya vuzov. Stroitel'stvo. Issue 1, pp. 108–115. (in Russian).
[7] Cherepanov K. A. Problemy vybora optimalnyx parametrov zastrojki v zavisimosti ot socialnyx, ekonomicheskix i ekologicheskix svojstv gorodskoj sredy // Molodoj uchenyj. 2014. — №2. — С. 216-232. — URL https://moluch.ru/archive/61/9036/. (in Russian).
[8] Glazichev V.L – Gorod bez granic. - 2011p. URL http://books.totalarch.com/city_without_borders_glazychev. (in Russian).
[9] Tkachuk, A., Pilipaka, L., & Azizova, A. (2018). Optimization of city water supply networks on their structural and functional analysis base. International Journal of Engineering and Technology(UAE), 7(3), 680-685. https://doi.org/10.14419/ijet.v7i3.2.14613