Methods of evaluating yard area development in the context of urbanization

O A Rastyapina¹, V G Polyakov¹, E V Kalashnikova²

¹Institute of Architecture and Civil Engineering of the Volgograd State Technical University, Akademicheskaya Street, Volgograd, 400074, Russia
²Operation support department of the Public Headquarters of the Statistical Information Management Division, State Budgetary Institution "Mosstroinform", 3/1, Likhov Pereulok, Moscow 127051, Russia

E-mail: O_rast@list.ru

Abstract. The article is dedicated to the issue of evaluating yard area quality of apartment buildings. According to the analysis of methods of evaluating quality of the urban environment as well as the analysis of urban residents, we have determined the factors contributing to the quality of yard areas and determining satisfaction of residents with their living environment. Using the method of qualimetry, we calculated weight coefficients of various factors from the point of view of their significance to urban residents. We suggest comprehensively evaluating yard area quality using significance (weight) coefficients. The results will allow defining a set of measures intended to improve yard area quality. From the point of view of their significance to urban residents, these coefficients may be used in the housing pricing policy.

1. Introduction
Development of various forms of settlements is associated with the urbanization process. The more developed the settlement is, the more urbanized is its area. It ought to be mentioned that urbanization and development of settlements have both positive and negative consequences [1-3]. These consequences directly impact life quality assessment. In the modern context of globalization, the life quality issue is rather urgent. Quality determination is subjective and depends on multiple factors characterizing the object under consideration. That is why we believe that significance (weight) coefficients of the factors determining quality of the object under consideration need to be calculated. Urbanized environment is quite multifaceted [4] and consists of multiple elements determining its quality. As observed previously, urbanized environment itself also affects life quality determination. That is why in the present context, we ought to strive not only to improve life quality as determined by social and material development of the society, but also to improve the living environment in separate urbanized systems taking into consideration the urbanized environment functions (labor, daily routine, rest).

In this study, we strived to determine all the daily routine parameters in order to ensure comfortable socially significant facilities and established the goal of the study, in particular, to evaluate development of yard areas of apartment buildings. The definition of yard itself involves formation of a relatively isolated space separated from public areas.
Modern urbanized environment is a complex system consisting of natural and artificial elements. Natural elements include greenery, water, and soils formed by natural factors. Artificial elements are man-made elements, such as engineering, transport, industrial, and housing infrastructure. Artificial urbanized environment causes factors negatively affecting elements of the natural environment, including people. Such factors ought to include increased levels of electromagnetic fields, vibrations, noise, high concentration of hazardous substance in the atmosphere, etc. On the other hand, all artificial elements are aimed at developing and maintaining a comfortable and friendly living environment. Given that artificial urbanized environment elements have not only a local effect on single areas, but also a global one, there is a number of developed methods of evaluating environment comfort. Numerous studies have observed the association with and impact of artificial elements on the climate change caused by altered thermal balance of urbanized areas [5-8].

We have developed a method of evaluating urban environment quality with the express aim of developing a friendly urban environment. This method involves the primary modern principles of urban development. Evaluation criteria include the following: safety, comfort, eco-friendliness and health, visual identity and variety, modernity and currency of the environment, as well as management effectiveness. The objects of evaluation include the following: housing and adjacent territories, green spaces, social and business infrastructure, social and recreational infrastructure, street network, and public areas. This method is aimed at comprehensive evaluation of the urban environment. However, it ought to be mentioned that yard areas constitute one of the main elements of the urban environment. Small social communities of people are formed on the basis of yard areas of apartment buildings, that is, on the territorial basis. Development of yard areas contributes to satisfaction of the residents with their living environment. Development of a pleasant yard area contributes to the communication of people within a limited area as well as to more ways of recreation for them. We ought to strive to form a pleasant area in order to develop communication between people, improve comfort and enhance satisfaction of residents with their living environment [9,10].

2. The essence of the method of evaluating quality of development of yard areas of apartment buildings
The method of evaluating quality of yard area development presented herein may supplement the existing method of evaluating the urban environment index. Furthermore, this method will help to determine priorities and spheres of development of yard areas in order to improve quality of development of yard areas. This method is based on the method of qualimetry. This method involves quantitative assessment of quality indicators [11-14].

First of all, it is necessary to determine the factors (indicators) contributing to the development of yard areas. Taking into account the modern requirements and the ongoing process of urbanization, we used the studies [15,16] describing quality parameters to distinguish between three groups of factors. These factors characterize development of yard areas on the first level. The first-level factors are as follows: multifunctional factors, esthetic and planning ones. These are the first-level indicators, because they characterize development of yard areas in the most general way. All development characteristics of yard areas are divided into four factor levels that characterize development of yard areas as detailed as possible and help to more precisely evaluate quality of development.

The group of multifunctional factors includes the indicators characterizing eco-esthetical and eco-technical peculiarities of yard areas of apartment buildings. In order to more precisely characterize factors of this group we determined the characteristics that help to reduce the impact of artificial development and improve environment in yard areas by planning elements of development of yard areas. Naturally, this group includes greening and parking parameters, as well as the energy-efficient technologies used within yard areas. These are the second-level indicators. Greening is one of the indispensable elements of development of the urbanized environment. Apart from esthetic functions, greenery is capable of improving area microclimate and positively impacts psychoemotional condition of people. Significance of this factor has been reflected in multiple studies [17-19]. In order for the greenery to perform its esthetic role, it is necessary to comply with the requirements to the variety of
trees and shrubs as well as to control condition of the greenery. In order to perform ecological functions and improve the microclimate in yard areas, it is necessary to comply with the requirements to the amount of various plants. According to the requirements of regional regulatory documents, the amount of plants depends on the settlement type and the number of storeys and varies from 7 square meters per person (16-storey-high buildings) to 19 (3-storey-high buildings). To ensure a wide range and variety of plants, the dendrological composition ought to be determined according to climate and environmental conditions and recommendations of local regulatory documents. These considerations define the third-level indicators. They include variety (trees, shrubs, flowerbeds), condition, and amount of plants.

Availability of parking lots is another important element of yard areas. Moreover, the number of parking spaces must be based not only on the housing class and requirements of regulatory documents; guest parking spaces ought to be taken into account as well. Given the growing car ownership level, negative impact of vehicles on the city environment on the whole, as well as maintenance of the necessary road traffic safety level, the location and type of parking must be chosen very carefully. In the current context of development, the most acceptable option is to build underground parking lots under yard areas. However, it is only possible in newly built areas and if climate and environmental conditions are favorable. It is also possible to build multi-level parking lots to ensure less area is covered by elements of infrastructure [20-23]. In order to reduce ecological impact on the environment and ensure safety of yard areas, it is recommended to locate parking lots outside of yard areas. These considerations define the third-level factors characterizing parking lots. They include capacity of parking lots given the state of real estate development and distance from parking lots to building entrances.

The current requirements aimed at minimizing the negative impact of the urbanized environment on the nature and the environment on the whole as well as the resource-saving requirements must be taken into account. The group of multifunctional factors includes the indicators characterizing use of energy-efficient technologies. The most acceptable technologies in terms of implementation and operation in the current context of real estate development involve lighting systems based on movement sensors to turn the light on as needed. They also involve separate waste management systems. In this case, two second-level indicators used to characterize energy efficiency of a yard area are concerned. These factors are included, because the other technologies satisfying the requirements to energy efficiency used when developing new yard areas must be defined in the project.

The second group of factors characterizing esthetic properties of a yard area is rather wide. In order to characterize this group, the third-level indicators were defined—these are the primary elements of improvement of yard areas the availability whereof in yard areas is covered by regulatory documents, such as functional zones and street furniture. We distinguished between three types of playgrounds: children's playgrounds, utility grounds, and sports grounds (these are the third-level factors). Children's playgrounds are characterized by the fourth-level indicators: age-based division of playgrounds, type of surfacing, distance from playgrounds to building entrances. Utility grounds are characterized by size and distance from residential buildings according to the established norm (50-100 m). These are the fourth-level indicators. Sports grounds are characterized by accessibility to local residents, condition of the ground (safe surface and equipment satisfying the intended use of the ground), as well as the possibility to transform the ground for year-round use.

To ensure due development of urban areas, practical and decorative street furniture must be used. The division into groups presumes distinction of the third level of indicators. All street furniture is characterized by the fourth-level factors and presumes analysis of the variety of used furniture on the basis of intended use and its condition.

The third group of the first-level factors presumes analysis of planning indicators. To characterize this group, the second-level factors were defined: isolation of a yard area in terms of separation of some area, transport banned in yards (except for special services) with parking lots outside the yard area, visual and color scheme of buildings, perception of scale of buildings on a short distance from the object (long low buildings and high "towers"). It is the visual perception of buildings and yard
areas that forms a specific psychoemotional state. Yard pathways may be characterized by convenience of use (connection of various zones) and paving

3. Final evaluation of quality of development of yard areas of apartment buildings

As a result, we designed a questionnaire about the indicators that characterize development of yard areas of apartment buildings in most detail. We determined the experts to evaluate these factors in terms of their significance as an element of improvement and necessity. After that, according to the method, we calculated the average factor significance coefficients provided in Table 1. The second-level factors are provided for more precise description and the possibility of objective comparison. All the three pre-established factor groups are determined on this level.

Table 1. Significance of yard area development factors.

| Yard area development factor       | Significance coefficient (%) |
|-----------------------------------|-----------------------------|
| Use of energy-efficient technologies | 12.75                       |
| Greenery                          | 12.04                       |
| Availability of parking lots      | 11.61                       |
| Availability of yard grounds      | 11.34                       |
| Color scheme of buildings         | 11.00                       |
| Street furniture                  | 10.07                       |
| Yard area isolation               | 8.07                        |
| Perception of scale of buildings  | 7.74                        |
| Availability of pathways          | 7.70                        |
| Transport ban                     | 7.69                        |

In order to evaluate development of a given yard area, it is necessary to determine a group of experts to evaluate all the aforementioned factors. After that, it is necessary to calculate the factor quality coefficient using reference and rejection coefficients. 100% ought to be taken as a reference (ideal) value. Therefore, rejection coefficients ought to be 0%. Given the factor significance coefficients provided in the article, quality of development of yard area of an apartment building may be determined. The sum of the calculated parameters reflects the aggregate evaluation of development of yard areas. Evaluation of quality of development of yard areas must take into account climate and environmental peculiarities as well as demographic characteristics of residents, because many elements of improvement are determined on the "as needed" basis according to the local customs.

4. Conclusion

The expert-defined factor values for a given territory may be compared with the reference value, and the comparison of factor values may help to determine the measures needed to develop and improve quality of development of a yard area. In general, evaluation of quality of development helps to determine the level of introduction and use of modern requirements to quality of life, as well as improvement of the elements determining quality of development. As development of yard areas is indispensable for groups of apartment buildings, in the future, specific quality levels may be used in the housing pricing policy. Development of pleasant yard areas will help to improve quality of life, which, in turn, will favorably affect perception of the urban environment comfort.

References

[1] Rastyapina O A 2016 The impact of urbanization on the well-being of an urban settlement Volgograd State University of Architecture and Civil Engineering. Series: Civil Engineering and Architecture 45 168–87

[2] Kolomak E A 2011 Evaluation of the impact or urbanization on the economic growth in Russia. Region: Economics and Sociology 4 51–69
[3] Aleksashina V V 2009 Urbanization and its impact on the biosphere *Construction and Reconstruction* 5(25) 4–8

[4] Rastyapina O A and Koronova E N 2018 Assessment of the urbanized territory improvement rate *IOP conference series: materials science and engineering*

[5] Dolgacheva T A and Brutskaia N V 2006 On the issue of evaluating urban environment comfort *Geographic Issues of the Ural and Adjacent Territories* pp 185–9

[6] Semina I A and Folomeikina L N 2016 Urban environment quality evaluation in terms of daily living activities and living comfort (city–district–yard) *Mosaic of Urban Spaces: Economic, Social, Cultural, and Ecological Processes* pp 253–7

[7] Fedotov V I, Kurolal S A and Nesterov I A 2005 Regional evaluation of environmental comfort and public health *Ecology, Environment, and Public Health in the Central Black Earth Economic Region* pp 75–7

[8] Order No 371 of the Ministry of Regional Development of the Russian Federation *On the Approval of the Method of Evaluating Urban Environment Quality* Dated September 2013

[9] Lavrov L L and Perov V F 2015 From shopping centers to community centers *Civil Engineers Review* 5(52) 46–54

[10] Fedorova V A, Safina G R and Alekseev S A 2017 Urban environment quality with a millennial's eye through the example of cities in the Tatarstan Republic *Sustainable Development Management* 4(11) 75–81

[11] Gocharova A M 2019 The definition of qualimetry *Quality Management in the Lifecycle Stages of Technical and Technological Systems* pp 215–7

[12] Sokolova E A 2019 Quantitative quality assessment, or qualimetry *International Academic Review* 9(41) 24–6

[13] Rastyapina O A, Ganzha O A and Babenko K V 2018 Development of a method of evaluating visual image quality of the urban environment *Review of the Volgograd State University of Architecture and Civil Engineering. Series: Civil Engineering and Architecture* 52(71) 188–98

[14] Azgaldov G G 1989 Qualimetry in architecture and civil engineering design (Moscow: Stroiizda) p 264

[15] Pokatilovskaia E N and Shibaeva L V 2018 Variability of the living area image among urban residents with different social attitudes *Scientific Result. Educational Pedagogy and Psychology* 4 77–86

[16] Sikushina I A and Kozhevnikov S A 2018 The issues of comfortable living in a big city through the example of Vologda and Cherepovets *Area Development Issues* 6(98) 42–63

[17] Sheina S G and Chubarova K V 2015 Urban gardening as a sustainable area development factor *Civil Engineering and Architecture* pp 217–8

[18] Rastyapina O A 2016 The role of greening in planning settlement safety *Modern Science Advances* 4 70–2

[19] Rastyapina O A 2003 *Design improvement of urban green zones for gas protection against vehicle emissions Diss* (Volgograd)

[20] Iarkov S A, Liseenkov V I, Khilobok N A and Dukhanin M A 2018 On the issue of the need in improving yard vehicle parking regulation *Road traffic organization and safety. A conference paper* pp 184–7

[21] Buryi A S and Mikhailichenko K I 2014 Parking lots in the context of the existing real estate development as one of the possible ecological risk factors *Urgent issues of ecology and natural resource management* pp 309–12

[22] Zorin R N and Sarychev E I 2014 Effective use of roofing over underground parking lots *Scientific Review of the Voronezh State University of Architecture and Civil Engineering. Series: High Technologies. Ecology* 1 47–9

[23] Maksimenko A T and Erikenov B P 2019 Comparative analysis of surface and underground parking lots *Urgent issues of engineering sciences* pp 210–4