Increasing habitat sustainability in residential areas of the first mass series

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Abstract. The purpose of this article is finding ways of increasing habitat sustainability in residential areas of the first mass series. According to the results of carried out studies on the basis of calculated assessment of habitat sustainability of residential development with 5-storey brick buildings of mass series 1-447 in the city of Volgograd, the following main conclusions are formulated. Before increase in habitat sustainability, residential buildings in the construction area have class E (S-factor is equal to 209 points). After increase in habitat sustainability, a grade is expected to rise to level C (S-factor is 341 points). Systematization and synthesis of data on “green” construction allow outlining principal ways of improving habitat sustainability of residential development and preserve the quality of environment for future generations.

1. Introduction
An actual problem of modern architecture is to reduce global risks and improve safety of people's livelihoods.

Buildings and structures produce a significant environmental impact. Meeting their needs in their habitat by constructing buildings, spending non-renewable energy sources and influencing environment, people should strive to protect functioning of the terrestrial ecosystem as a whole from their activities, ensuring sustainable development for future generations.

An effective tool for improving habitat sustainability is “green” building.

“Green” construction is developing in many areas [1-26]. Innovative solutions for low-energy buildings are being actively developed and implemented in modern practice. Components of “green” buildings such as “green” facades and “green” roofs are constantly being improved. Eco-sustainable city architecture is being formed. Improving energy efficiency during thermal renovation of civilian buildings and their facade systems is of paramount practical importance. For a more complete and accurate account of consumer characteristics of buildings, new rating systems for habitat sustainability are being developed. The development of “green” construction follows the way of improving both architectural design solutions [1-8], quality of internal environment [9-13] and methods for assessing energy performance of buildings [14-19], reducing the cost of construction [20-22] and increasing efficiency of engineering equipment of buildings [23-28].

Increasing habitat sustainability of residential areas in Russia’s regions is of great scientific and practical importance. One of these regions is the Volgograd Region, located in the south-east of the European part of the Russian Federation. Attractive competitive positions for investment activities in
Volgograd are associated with some advantages. Among them such as geographical location, industrial production, educational, scientific and labor potential including transport, innovative and institutional infrastructure. Favorable economic and geographical position, the status of capital million-plus city of the Volgograd region, significant in scope and resource potential, concentration of financial, administrative, logistics, cultural and educational resources provide a high competitive level of investment attractiveness among cities of the Lower Volga region and southern Russia.

Currently, the total area of Volgograd’s housing stock constitutes over 21.5 million square metres (figure 1). The most popular is housing of economy class, widely represented by houses built in 1960-80s (“Khrushchevka” and “Brezhnevka”). The total area of these buildings is estimated at 11.0 million square metres, representing 51% of the existing housing stock (figure 2). Most comfortable part of the housing stock of 1940-60s (“Stalinka”) has an area of about 3.9 million square metres (18%). The area of buildings with improved planning is 1.1 million square metres (5%). The area of modern buildings does not exceed 2.4 million square metres (11%). About 15% of the housing stock is formed by the “private sector”. Thus, the housing stock in Volgograd has unsatisfactory structure, primarily in terms of comfort of living in the first mass series buildings.

The purpose of this article is finding ways of increasing habitat sustainability in residential areas of the first mass series.

The object of this research is a fragment of residential development with 5-storey brick buildings of mass series 1-447 in the city of Volgograd.

Such buildings were built in the late 60s of the last century according to a standard design and have the following basic consumer properties.

The analysis of consumer properties of multi-flat residential buildings of this series, allowed concluding that it is necessary to increase habitat sustainability.

2. Methods

Rating assessment of habitat sustainability in residential buildings is made on the basis of Russian standard STO NOSTROY 2.35.4–2011. “Green Construction”. Residential and public buildings. Rating system for assessing environment sustainability.
The main aim of this rating system is to reduce consumption of energy resources. In addition, the important aspects are implementation of renewable and secondary energy resources, rational water use and reduction of harmful effects on the environment during construction and operation of the building. It includes local area, while providing a comfortable human environment and an adequate economic profitability of architectural, structural and engineering solutions.

Specified standard:

- Determines principles, categories, assessment criteria, indicators of habitat sustainability, as well as weight values of indicators for rating object.
- Includes a system of basic indicators (indexes), which, if necessary, are adjusted by coefficients or supplemented by parameters reflecting regional or local climatic, energy, economic, social, and object features.
- Establishes habitat sustainability classes for constructed, reconstructed or overhauled residential and public buildings, as well as for their project documentation.

The standard applies to all categories of designed, built and commissioned residential and public buildings of various functional purposes.

Habitat sustainability in this system is estimated by combination of ten basic categories (figure 3).

**Figure 3.** Basic categories of habitat sustainability (STO NOSTROY 2.35.4–2011): 1 – quality and comfort of environment; 2 – quality of architecture; 3 – ecology and indoor climate; 4 – quality of waste disposal and sanitary protection; 5 – rational water use; 6 – energy saving and energy efficiency; 7 – implementation of alternative and renewable energy; 8 – ecology of development, operation and disposal of object; 9 – economic efficiency; 10 – quality of project development and management.

The largest share in this system, as figure 3 shows, has the category “Energy Saving and Energy Efficiency”.

Each category is represented by a separate group of criteria defining it. Each of the criteria is expressed by one or a group of indicators. Each of the indicators has its own numerical definition in the form of a parameter, a parametric series or a parametric characteristic, which corresponds to a point equivalent of an estimate. The sum of the scores on the criteria determines the score value of the category as a whole.

The sum of points of all categories determines the total (integral) value of quality of the habitat sustainability, the numerical value of which is denoted as “S-factor” (“Sustainability-factor”).

The final rating of habitat sustainability is carried out on the basis of obtained total S-factor. Depending on the amount of points scored as a result of determining S-factor, the project (building) is assigned a habitat sustainability class.

The system of rating assessment of habitat sustainability is an innovative toolkit that stimulates “green” construction.

3. Results and discussion

According to the results of this analysis of basic categories of rating system, the principal ways of increasing habitat sustainability of the object of study were outlined:
- Landscaping of the local area.
- Structuring courtyard space.
- Creating parking spaces for cars.
- Availability of parking spaces for people with limited mobility.
- Placement of bicycle paths in residential area.
- Parking design for bicycles and wheelchairs.
- Creating an aquatic environment in the yard area.
- Disposal of separate waste containers.
- Thermal insulation of external building envelope.
- Building superstructure using attic.
- Placement of solar elements on roof of a building.
- Placement of solar elements on fences the of balconies.
- Examples of increasing habitat sustainability of an object are shown in Figures 4–6.

![Figure 4. Structuring courtyard space.](image)

![Figure 5. Building superstructure using attic.](image)

![Figure 6. Placement of solar elements on roof of a building.](image)

The habitat sustainability rating was estimated on the basis of the authors' comprehensive assessment of urban development potential of the considered building fragment, insolation and natural light calculations, estimation of availability of infrastructure facilities, definition of architectural, planning, design, engineering and technical characteristics of buildings, calculation of geometric, heat engineering and energy indicators of buildings (figure 7).
It has been established that before increase in habitat sustainability, residential buildings in the construction area have class E (S-factor is equal to 209 points).

![Figure 7. Rating assessment of habitat sustainability in residential development (I–X – basic categories, 1–46 – criteria: 1 – before increase in sustainability; 2 – after increase in sustainability; 3 – according to STO NOSTROY 2.35.4–2011.)](image)

After increase in habitat sustainability, a grade up to C level is expected (S-factor is 341 points). Thus, the principal ways outlined by the authors create wide opportunities for increasing habitat sustainability in residential buildings of mass series 1-447 in order to preserve quality of the environment for future generations.

4. Conclusion
According to the results of carried out studies on the basis of calculated assessment of habitat sustainability of residential development with 5-storey brick buildings of mass series 1-447 in the city of Volgograd, the following main conclusions were formulated:

1. Before increase in habitat sustainability, residential buildings in the construction area have class E (S-factor is equal to 209 points).
2. After increase in habitat sustainability, a grade is expected to rise to level C (S-factor is 341 points).
3. Systematization and synthesis of data on “green” construction allow outlining principal ways of improving habitat sustainability of residential development and preserve the quality of environment for future generations.

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