

Principles of Urban Areas Reconstruction Ensuring Safety and Comfortable Living Conditions

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Abstract. A fundamentally new methodology for the study of the biotechnosphere and the functioning of life support systems on the principles of city symbiosis and the environment is proposed. This approach contributes to the formation of a new conceptual scheme of public interests rethinking and basing on it facilitates the development of urban environment reconstruction methods. The humanitarian balance of the biotechnosphere was adopted as the main criterion for the analytical assessment of the dynamics of system changes in the social, demographic, environmental and economic indicators of the state territories development. Balance relations of the biotechnosphere are based on the hypothesis of the presence of stable functional relationships between the changing in the course of time characteristics of the state of the components and the components of the socio-natural and technical life-supporting systems. As the variables of the quantitative analysis the author offers generalized indicators characterizing compatibility of the urbanized territories with the environment and the level of city functions realization, based on the values of normalized and necessary from the point of parameters of human potential development.

1. Introduction

At the turn of the twenty-first century, irreversible changes in the environmental parameters comparing with the pre-existing ones were experimentally confirmed. This leads to increasingly frequent environmental crises and disasters, both locally and globally. The resolution of the V International scientific Congress "Globalistics-2017: Global Ecology and Sustainable Development" says: "never before in the world history has there been such a powerful and contradictory process, when the huge opportunities of the mankind were accompanied by such serious potential threats and dangers" [1].

Environmental pollution affects the quality of life of the population in urban areas, the pace of economic and social development of the society, but above all it affects the human health and the gene pool. "The source of Biosphere degradation is located in the cities and here its consequence – namely people degradation which obtains the greatest manifestation..." [2]. It becomes clear that the city, as an artificial environment of human activity, is a territory of increased danger and discomfort, and anthropogenic and technogenic risk factors contribute to the emergence and development of emergency situations that were not typical for these areas earlier. This circumstance is partly due to the fact that in urbanism - city is considered only as an organizational and technical system - "...a developed complex of facilities and economy, which represents itself a cluster of architectural and



engineering structures..." [3]. On these grounds, the long-term development of the city's ecosystem is destroyed, which inevitably leads to the aggravation of psychological problems and social conflicts among the urban population [4].

Reconstruction of urban areas is a qualitative transformation of life, and is aimed at the renewal of urban built-up areas and change of human activity type and the existing industrial relations, as well as to the reduction of the negative impact on the natural environment¹. Today, the need for the reconstruction of urban systems is determined by the goals of ensuring a safe environment for human life and creating comfortable living conditions in cities and settlements against the background of the heightened challenges of our time.

The living space concept is of primary importance for the urban areas reconstruction. In recent decades, basic science has been dealing with the fundamental research on the concepts of self-sustaining development of urban areas (eng. sustainable development) [5, 6, etc.] and the formation of modern principles aimed at informational interaction between the human being and the natural environment [7, 8, etc.]. The limits of permissible impacts of human civilization on the environment ("growth limits") are determined in various branches of knowledge, [9, 10] and conceptual ideas concerning further development of modern society are developed, in which compliance with these limits is guaranteed due to the irrational structure of production and consumption.

Nowadays within the framework of sustainable development concept adopted by the world community and the imperative of acceptable risk, there were distinguished several areas, starting from a purely technocratic approach, according to which it is proposed to normalize risks in various spheres of life, improve technical means of protection, develop resource-saving environmentally-friendly technologies and search for the alternative sources of energy and technologies aimed at waste recycling and waste-free production and all kinds of other innovations, ending with new ideas to date, based on a balance of intellectual, natural and labor resources. At a UN summit on sustainable development, held in New York on 25 September 2015, UN Member States adopted the 2030 Agenda for Sustainable Development, which stipulates that cities and settlements are to be made "open, safe, vigorous and sustainable". One of the modern researchers of sustainable development and alternative energy J. Rifkin believes that " ... in the era of the third industrial revolution, reconstruction and urban planning embed urban and suburban spaces into the biosphere shell", and social integration and restriction of economic activity on the surrounding environment will entail the creation of "biosphere regions" [11].

Today, the scientific solution to the problem of urban areas self-development lies in the plane of interdisciplinary research. In fact, we are talking about a comprehensive urban reconstruction, which gives the urban environment its integral quality. That is why, nowadays, researchers make a special emphasis on the humanization of living space as the main task of socially oriented reconstruction of urban areas [12]. At present, the level of knowledge accumulated in the world shows that the problem of safety and comfort of urban areas lies in the sphere of interaction between civilization and culture, i.e. the issues of neutralizing certain dangers and risks of modern civilization can be solved, also by means of their thorough consideration in line with the common humanitarian values developed by the mankind [4, 12].

2. Statement of the research problem and the results

An important role in the scientific solution of the problem of urban areas reconstruction, providing security and comfort, is given to the research of the new concept of human activity on the basis of interaction with the environment and overcoming the antagonistic attitude to the nature. The Russian Academy of Architecture and Construction Sciences (RAASN) proposes a fundamentally new scientific approach to the reconstruction of urban areas, the essence of which lies in the study of

¹ *reconstruction (from lat. reconstructio – building, construction) in urban planning is a radical change in the planning structure of the territories in order to improve the functional comfort of their usage*

certain theoretical foundations of the biotechnosphere development and the functioning of life support systems on the principles of symbiosis of urban systems and their natural environment [13]. This approach is aimed at changing the philosophy of objective reality, forming of the human worldview, in frames of which all the global problems of the modernity - economic, social, political, environmental and many other ones taking into consideration all their diversity appear not to be problems, but the consequence of one thing – the vicious relations between the human being and nature. The whole economy of the city is built on the foundations of the mentioned above approach, basing on the laws of the functioning of socio-natural and technical life support systems, providing progressive self-development of urban areas. To consolidate the priorities of safety and comfort, a system of economic and technological principles of urban planning aimed at strategic planning and settlement system is proposed [2]. On the basis of these principles, settlement master plans and urban areas reconstruction projects can be worked out, taking into consideration the fact that human development should be the main criterion.

The fundamental and goal-setting principle of urban areas reconstruction is the principle of unity of the city, nature and human consciousness, excluding the destruction of "the main productive force – the Biosphere" [13]. On the basis of this principle, should be made the choice of the direction of urban areas transformation, in which the emphasis is made on the formation of a safe environment as an integrated space of human activity and the natural environment.

In the system of the principles under consideration, the basic element of urban area reconstruction, ensuring safety and comfort, will lay the principle of making up balance of the biotechnosphere in the urbanized territories, which will determine the limiting dimensions of the techno sphere with the available potential of the biosphere. The balance establishes harmonious proportions between the different parts of the biotechnological sphere, including the population, as well as the list and number of withdrawn resources per unit time with a reference to a particular territory. If the ratios of the biotechnosphere balance are not met, it is necessary to carry out the reconstruction of urban areas, including the reprofiling of industries and introduction of innovations. The "green standards" introduced today in the organization of public space of the built-up areas are designed to ensure their improvement, and can be considered only as the elements of balance but do not replace the balance of the biotechnosphere as a whole.

Therefore, in order to ensure the safety and create comfortable living conditions in the urban areas being reconstructed it is essential to strengthen the balance ratios of the biotechnosphere as regulatory ones while developing of a new generation documents, which will legislatively provide a gradual transition to balance achievement.

Basing on the regulatory framework of the new generation, the implementation of the strategy aimed at urban territories reconstruction can be achieved through elaboration of special development programs, which represent the result of knowledge and professionalism, as well as creative, business activity of scientists, engineers, authorities and other participants taking part in the development program. Such disproportions as overpopulation, environmental pollution, resource dependence, etc. can be eliminated with the help of program activities. In this sphere, the world has developed proposals that illustrate the economic efficiency of industrial and domestic waste usage, low-quality raw materials and renewable materials for the production of high-quality products that are able to compete with traditional products originally derived from natural resources [14]. The Russian Academy of Architecture and Construction Sciences (RAASN) proposed technologies ensuring the reproduction of utilized natural resources; these technologies have also proved their investment attractiveness.

In this respect, special significance can be given to the vast practical experience of Germany, for example, in the field environmental remediation of the Ruhr region - the largest industrial region of the country, with regard to the energy rehabilitation of buildings, the use of new energy sources and waste management technologies, the organization of modern wastewater systems and climate control and the regulation of the housing environment.

The above mentioned and other principles of urban areas reconstruction, providing safety and comfort, were used while the process of quantitative evaluation of the projects of new residential areas such as "Botanika" and "Zarechensky" in the city of Orel.

The purpose of the development of planning and housing projects was the traditional market economy aspect of housing commercialization. In terms of the purpose spatial zoning of the built-up area was made with the distribution of urban areas in accordance with their different functions: residential, public, transport, recreational.

The project of the microdistrict "Zarechensky" provides for the construction of 47.4 hectares of residential and commercial real estate and is designed to accommodate 15,200 people. In the area planning scheme (figure 1) the building area is divided into six large blocks.

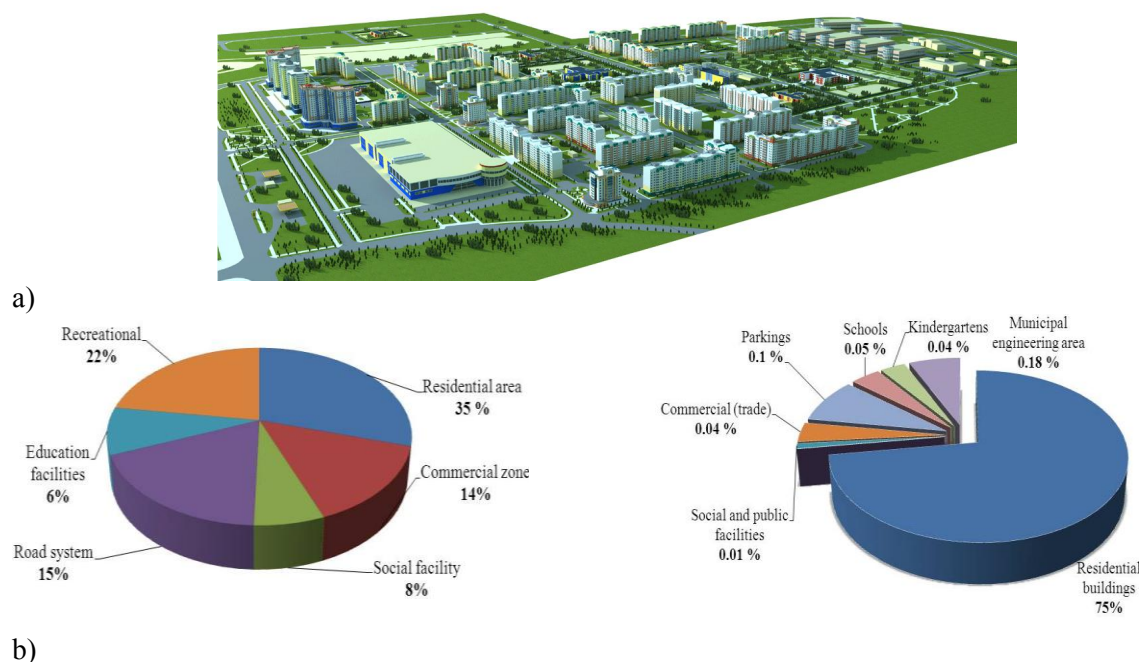


Figure 1. The general view of the "Zarechensky" microdistrict design planning (2012), and the ratio of the functional zones in the project: a) a "bird's eye view", b) the ratio of the functional zones in the project and within the building zone.

As it follows from the figure, preference is given to residential development and commercial real estate. At the same time, the project includes public and social facilities, shopping and entertainment complexes. Public and public-business areas are represented by the construction of office and retail built-in premises and individual buildings with a number of storeys from 3 to 5 floors.

The quantitative assessment of the enlarged ratio of the territory usage in the project "Zarechensky" showed that 62% of the total planning area is allocated for construction (see figure 1, b). Green areas account for 22 %. The rest of the construction area is allocated for transport infrastructure -15 %. In principle these indicators correspond to the current Russian norms of urban design. However, from the perspective of the pending principles of urban areas reconstruction, the proposed development version does not provide a balance of biotechnosphere considering that the ratio of the area of recreational zone, including parks, gardens, squares and boulevards, is not commensurate with the area of development. The action of this element of balance is aimed at health improvement, rest, restoration of efficiency and mental health of a person. As a rule, the recreational zone is placed in the structure of the residential zone in the vicinity of it, thereby forming a system of open spaces, a kind of elements of a harmonious proportion between the different parts of the biotechnosphere of the urban area in question.

The next most important principle of urban development reconstruction from the perspective of symbiosis of urban systems and their natural environment is the quantitative assessment of the most complete implementation of the city's functions. It is important to provide a favorable environment for human development based on the projection of rational human needs and city functions starting from life support and up to the connection with nature.

The "Livelihood" function includes the availability of decent housing, jobs and their transport accessibility, provision of food, living and household items, affordable medical care.

The "Entertainment and emotions" function is presented by the recreational area, theme parks, public gardens, sports facilities and playgrounds, as well as bars, restaurants, dancing halls, etc.

The "Authorities" function in the project is the embodiment of the city management function. Buildings and structures of public authorities (administrations of districts, cities, regions), legislative, law enforcement agencies (police, prosecutor's office, courts), state participation offices (post offices, banks, pension funds), having the appropriate architectural characteristics and location on the project of the territory planning.

The central function of meeting the rational needs of the person, namely "Beneficence" practically finds no representation in the project by means of relevant objects embodying and performing the functions of assistance to the needy: large families, the elderly, the disabled, families with adopted children. On the basis of this function a solution to the problem of accessibility of the urban environment objects to population groups from various social layers can be found. The limitation of modern approaches to the design of territories becomes apparent due to the fact that the availability of the environment is mainly reduced to the liberation from the "barriers" (hence its name "barrier-free environment") [15].

The human need for knowledge is satisfied by the educational system, so the project includes kindergartens, schools, higher education institutions, etc. These objects are an important part of the city and largely determine its architectural appearance, form the place of the city in the hierarchy of cities, including the level of human development.

The function titled "Cognition of the world and creativity", realizing the need for creativity, is displayed mainly in the buildings of educational complexes.

The natural need of the urban population to visually feel the natural landscape is realized by means of the function titled "Connection with nature", which creates additional and psychological support for the citizen. The esthetic component of perception of city landscapes and sceneries plays quite an important role.

Two project versions were compared for the "Botanika" microdistrict. In both versions of the project, the main attention is paid to residential development, in which there is no clear distinction between the types of housing (social, elite).

The peculiarity of the first project version (Moscow, 2001) was a significant territory of the recreational zone, organized in the floodplain of the Oka River in the southern and western parts of the master plan. From the perspective of transport accessibility, the territory is divided by intra-quarter passages closed into city highways.

The second version of "Botanika" microdistrict development (figure 2) was prepared by the "Orelproekt" design institute in 2007-2008. The main task while designing of this microdistrict was to preserve to the maximum the use of the existing natural park and the coastal zone by means of erecting a highway which will contribute to the reduction of traffic congestion.

The implementation of all these functions of the city does not allow talking about the achievement of indicators of comfort and safety in urban areas. These parameters should be determined numerically, for example, by means of using the integral indexes proposed in the article [16]:

η - is the index of biospheric compatibility of the urbanized area which characterizes the environmental situation in urban areas;

ξ - is the index of the level of the city functions implementation, including the parameters of space-time and territorial accessibility of vital and socially important objects to the urban population.

The necessary living standards should be established on the basis of statistical data for developed cities and depending on the living conditions. The obtained results can be compared not only for different cities, but also for one city in the historical context with the level of population development. These and other indexes should be used as normative indexes of the master plan and serve as substantiation for making managerial decisions.



Figure 2. The diagram of the general plan for the version of ‘Orelproekt’ project (bird's eye view).

While calculating the index of biosphere compatibility for the "Botanika" microdistrict such factors of environmental pollution as emissions from vehicles and household solid wastes were considered. The calculations showed that the values of the biosphere compatibility index of urbanized territories determined for two variants of the design solutions of the "Botanika" microdistrict ($\eta_1 = 0.18$; $\eta_2 = 0.24$), indicate the initial degradation processes of the environment in this very area as part of the city. Ignoring these factors while design solutions developing can lead not only to the deterioration of the environmental situation in the city, but also, as a consequence, to the degradation (biological, emotional, material) of the urban population as a whole.

The analysis of the city functions feasibility for the projects of residential neighborhoods being under consideration namely "Botanika" and "Zarechensky" showed that the main attention is paid to the "Livelihood" function (figure 3). The block of residential development mainly includes residential multi-storey buildings and commercial facilities-85% of the total amount. Social facilities, including schools, kindergartens, sports facilities and structures are present in the project, their share is only 1 %. Utility engineering zone amounts to 0.08 %. The rest is a recreation area.

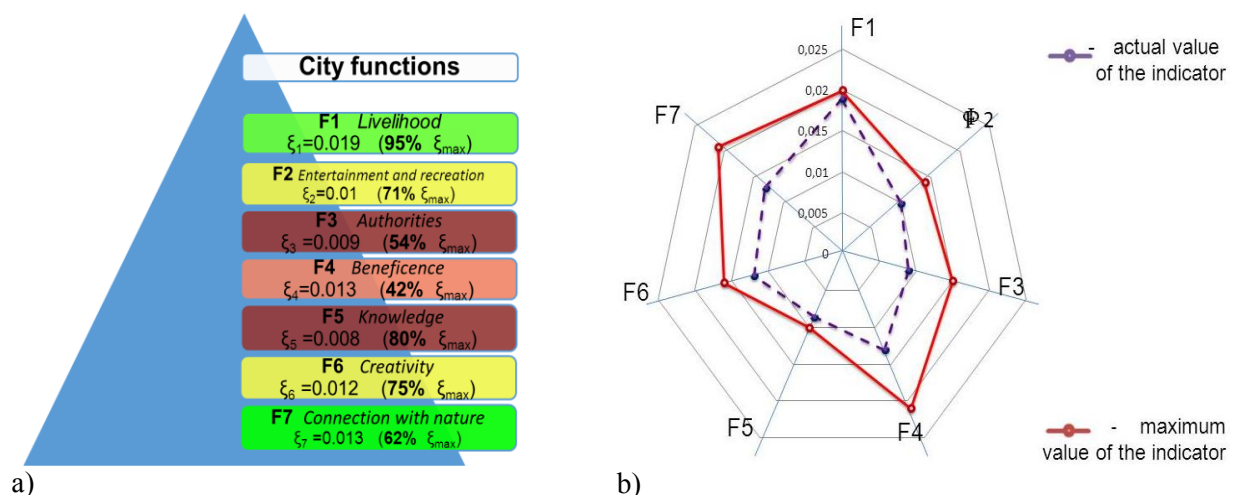


Figure 3. City functions: a) ‘Zarechensky’ development area; b) ‘Botanika’ development area.

As a result of the quantitative assessment of the city's functions for such projects as "Botanika" and "Zarechensky" it is obvious that such functions of the city as "Beneficence" and "Connection with nature" are implemented insufficiently. In the projects, the requirements of urban design standards for these functions are fulfilled at the expense of the availability of natural recreational areas and a harmonious combination of landscape and architectural objects, as well as the creation of "universal design" objects. However, there is an insufficient amount of urban planning solutions to satisfy not only the rational needs of the population from different social groups, but also to ensure the balance of the biotechnosphere on the areas that are being developed. The way out of this situation is to create as soon as possible real mechanisms and legislative framework in order to regulate the relations in the "environment-human" system and to develop conditions for the human potential development on this basis.

Urban areas cannot be considered comfortable if the quality indexes of the spatial urban environment in these areas do not include diverse conditions of public life, taking into account national, ethnic and religious interests. It is not necessary to mix the concept of "comfort" with the concept of "supercomfort", where exponentially growing human needs are realized at the expense of natural resources. From the position of the considered approach to the reconstruction the comfort of the urban areas is provided by the above-mentioned principles, as well as by means of social standards introduction in urban planning, which in every municipality, region or country are delivered to all and everyone at the expense of public resources, including their legislative consolidation [17]. State investment into the social and humanitarian development of the population can be realized through the national placement of funds into the basic infrastructure and social facilities, creating conditions for the attractiveness of projects aimed at urban areas reconstruction, but not only for developers, but primarily for the urban population.

Thus, the proposed principles of urban areas reconstruction on the basis of symbiotic relations of urban systems and their natural environment form the foundation for safety and comfort of living environment in urban areas. These principles can be applied to any settlement in any part of the world, but they are especially relevant for modern cities with a tense environmental situation. The principles of reconstruction contain indexes of the efficiency of urban planning solutions, identify problem areas in the organization of city life, change their spatial orientation, allow to quantify the opportunities provided by the city for the development of the person living in it, provide a reorientation of existing production to new directions and technologies of reproduction of the used natural resources.

If all the mentioned above principles are fulfilled, we can talk not only about a comfortable, but also a safe environment for human development.

3. Conclusion

The traditionally used term "reconstruction of urban areas" refers only to the technical component and does not reflect the systematic nature of this process – creation of the harmony between the population and the living environment. The proposed *principles of urban systems reconstruction providing safety and comfortable living conditions*, are based on the interaction with the environment; take into account social, demographic, environmental and economic indexes of conflict-free development with nature. The key element of the reconstruction on the principles of biosphere compatibility is *the balance of the biotechnosphere*, which establishes a development strategy (population size management, resettlement, migration) and reflects the introduction of innovations into the city's economy ("green" construction, renovations, and reorganization of urban areas, waste recycling).

The quantitative assessment of the fundamental characteristics of the life quality, aimed at ensuring the safety and creation of comfortable living conditions in urban areas, contains generalized indexes characterizing the compatibility of urban areas with the environment, and reflecting the level of city functions implementation, based on the values of normalized and necessary from the point of parameters of human potential development.

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