

Urban densification: Features, environmental problems, and prospects

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Abstract

Aim and Scope: The article considers the ecological, social, and economic consequences of uncontrolled perimeter expansion of the city's area. An alternative to the process of increasing the urban areas, which allows to solve the problem of land deficit, is the possibility of using the internal urban potential. One of the directions is the concept of a "compact city," within the framework of which an effective, extremely possible use of territorial urban resources is expected. **Materials and Methods:** The undesirable impact from the infill construction is noted both during the construction of the facilities and in the subsequent period of their exploitation. Architectural practice shows the impossibility of infill construction neglecting within large cities; however, when implementing this process, it is necessary to take into account possible negative consequences and to make attempts to prevent and minimize them. **Result and Discussion:** The features, advantages, and disadvantages, as well as environmental problems of the process of urban development compaction, as one of the measures, allowing to solve the issues of land deficit, within the boundaries of the city, are considered in this paper, on the basis of the analysis and generalization of the world and Russian experience of urban development. Infill construction creates a higher anthropogenic load, leading to various negative consequences. **Conclusion:** In conditions of intensive urbanization of the modern world, the issues of the search for territorial reserves for the development of urban systems are topical.

Key words: City, compact city, ecological problems, infill construction, infill development

INTRODUCTION

At present, in the conditions of intensive urbanization, the issues of the search for territorial reserves for the development of urban systems are topical.

Gradual increase in the area of the city is inevitable until a certain stage of its development. However, the expansion of urban boundaries cannot take place indefinitely; at a certain stage, it becomes a source of environmental, social, and economic problems (traffic congestion, land use conflicts, the destruction of the natural framework, the transfer of agricultural and forest land to the category of residential areas, and the growth of anthropogenic impact,).^[1-3] Unhindered expansion of urban boundaries is not a factor, contributing to the sustainable development of the territory. In addition, the building of undeveloped territory is an economically expensive process because involves the creation of a certain infrastructure (sewage, water, gas, and electricity) and the construction of transport highways.^[4]

Thus, the impossibility of unlimited increase in the area of the city and the presence of "reasonable limits" of this process predetermine the need to use the internal urban potential for solving the problem of territorial deficit. It should be noted that the concept of a "compact city,"^[5-7] received in recent years, is widely used, according to which an effective and utmost possible use of territorial urban resources is expected.

MATERIALS AND METHODS

The research is based on the following theoretical methods: Analysis, synthesis, and scientific generalization.

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The empirical analysis of the disparate factual and literary material allowed to reveal a wide range of existing methods for solving the problem; structural-genetic synthesis afford to establish cause-effect relationships, to identify the main advanced directions in solving environmental problems, caused by the urban densification. Scientific generalization made it possible to define the unitary in a diverse, general in a single, regular in a random.

The authors relied on such aspects of scientific research as the principles of objectivity, the continuous development of the phenomena under study, and the systematic nature of the study.

RESULTS AND DISCUSSION

Among the internal urban, reserves for resolving of territorial problems are such processes as the transfer of industrial enterprises outside the city limits, high-rise construction, creation of bulk (alluvial) territories, development of underground space, demolition of obsolete and dilapidated buildings and structures, and urban densification.

The features, advantages, and disadvantages, as well as the environmental problems of the process of urban densification, as one of the measures, allowing to solve the issues of land deficit, within the boundaries of the city, are considered in this paper, on the basis of the analysis and generalization of the world and Russian experience of urban development.

Urban densification is an increase in the area, occupied by the buildings, in the conditions of reconstruction of the existing buildings. The synonyms of the urban densification are “infill development” and “urban compaction.”^[8]

It should be noted that the attitude to the infill construction in Russian and foreign practice of urban development is fundamentally different. For example, in the US and European countries, infill development is a significant element of “smart growth” of cities, representing a rational way of planning the territory, where special attention is paid to the implementation of special environmental measures, and the specific features of the area are taken into account. The problem of filling free spaces with objects of various functional purposes (residential, commercial, public, etc.) in sufficiently developed areas of cities is solved by means of infill development. In this case, we can talk about effective land use. Central historical parts of European cities (Paris, Copenhagen, Berlin, etc.) can be the positive examples of the developed hyperdense structure of urban areas. Analyzing foreign experience, it is possible to designate the main positive aspects of infill (compaction) development:

- Preservation of agricultural lands and forest fund lands
- Reduction of costs for construction and development of infrastructure, the possibility of using an existing network of facilities

- Reduction of traffic flows
- Increased opportunities for social interaction between people.

In the current Urban Development Code of the Russian Federation, there is no definition of point development. In town-planning practice of the Russian Federation, infill development is the construction of new facilities, not provided for by town-planning documents, in the historically developed residential area, i.e., it is a certain deviation from the existing architectural plan.

As a result of infill development, the territory of the region, where it is carried out, is experiencing a higher anthropogenic load, which leads to a number of negative consequences. Moreover, the undesirable impact from infill development is noted both in the period of construction and infrastructure development and in the subsequent period of their exploitation.

The construction of new facilities in the already functioning and “living their own life” area creates discomfort to local residents, as a result of the work of equipment, which acts as a source of noise and air pollution. Construction machinery increases the load on transport routes during the construction period, resulting in congestion and “traffic jams.” In addition, the creation of risks for the construction of neighboring houses cannot go unmentioned. Certain difficulties in the implementation of projects arise due to a predetermined, limited area, allocated for building, which makes the mobility of the equipment difficult during the construction period. Often, the sites of infill development are located in the territories of green zones or in the immediate vicinity of them, leading to the destruction or suppression of vegetation.

The exploitation of the objects of “infill construction” also introduces additional difficulties into the established life of the district. The problem of increasing the load on the transport infrastructure becomes the most acute; the problems of accessibility of territory and parking are aggravated because the existing parking lots cannot place an additional number of cars. The increase in road traffic leads to an increase in time, spent on transportation, increased fuel costs, and increased noise and emissions. It should be noted the increased load on the existing network of utilities which can cause the accidents with water and electricity.

Separately, it should be mentioned the change in the insolation of rooms and natural lighting in a conditions of urban densification. Current normative documents of the Russian Federation regulate such indicators, characterizing the insolation of premises, as the duration of insolation, the orientation of buildings on the sides of the world (for example, for residential rooms, north orientation is not recommended), and the ratio of window openings to the area of the room (should correspond to 1:8). As a result of implementing the measures to infill construction, such conditions are often

created in which the standard indices of insolation are violated.^[9]

One of the consequences of infill development is the reduction of open urban spaces and recreational areas, as a result of the expansion of investor-developers to green territories.^[10] This circumstance negatively affects the quality of the urban environment and the health of the residents.

The example of the attempts to solve the problem of infill construction is the document “Local Norms for Town-Building Design of the Urban District of Kazan,” approved and effective from 1.07.2017.^[11] This document has united all spheres of life in the city, including the development of social, engineering and transport infrastructure, the natural and recreational complex, and the requirements for the development of low-rise buildings.

In accordance with this document, the following measures will be implemented:

- Regulation of town planning activity in the areas of new construction, both in the newly built areas of the city and in the conditions of the existing construction
- To provide the city’s population with affordable housing and to stimulate the development of areas with low efficiency of use, the additional coefficients have been set, which allow to increase the density of buildings by 20%, in case of housing construction under the social mortgage program, as well as in the conditions of the territory reorganization with the need to demolish capital construction projects.

Federal, regional, and local standards for urban planning, recommendations for land use and development, general plans of the cities, and plans for socioeconomic development must necessarily include a variety of forms of reconstruction organization, to slow down the process of destruction of residential environments.^[12] As a result, the maximum possible use of land within the city limits, by virtue of infill construction, taking into account environmental requirements and preserving the high quality of the urban environment, allows more efficient management of urban areas.

Infill development is a process of renovation, rehabilitation, and restoration of the attractiveness of urban areas. It should be noted that, among Russian scientists, there are also supporters of “infill construction” of cities. Thus, Pavlova considers a compact city with a dense urbanized structure as an optimal concept of urban development. At the same time, she believes that infill development is effective enough to solve the problem of a specific area of the city. Pavlova draws a parallel with medicine, where is a pointwise method of treatment (acupuncture). As a result, the infill development is not only limited to the construction of individual buildings but also it involves the creation of a single landscape and urbanized space.^[13]

SUMMARY

Hence, despite these negative consequences, it is difficult for a large city to avoid compaction, because, in the already developed regions, there is a periodic need to resettle ramshackle buildings, renovate housing stock, and construct social infrastructure facilities (schools, kindergartens, polyclinics, parking lots, etc.). All specified facilities will be the elements of infill development.

CONCLUSION

Currently, town planning practice shows the impossibility of infill construction neglecting within large cities; however, when implementing this process, it is necessary to take into account possible negative consequences and to make attempts to prevent and minimize them.

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