

Environmental aspects of densification of residential development in urbanized territories (Case study: Kazan City)

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ABSTRACT

The article discusses the features of the impact of compaction of residential development on the most important environmental component of the urbanized system – landscaping of house territories. Using the example of the city of Kazan, the study considered the environmental consequences of compaction and compared two types of development, that is, complex and point-based, implemented in different historical periods: 1959-1979 and 2000-2019. Digital models of courtyards and land plots containing residential objects and green spaces created by the authors allowed us to make calculations and further comparisons of specific indicators that characterize the main features of the point and complex buildings. Within the limits of residential development formed in the period 2000-2019, the specific indicators of local greening do not correspond to the approved urban planning normative values. This fact leads to negative consequences, which include the destruction and suppression of existing landscaping, reducing the area of green zones, increasing the anthropogenic load on the territory, etc. These processes affect the quality of the urban environment for both residents of new buildings and residents of the compacted area. The world experience of urban development shows that "compact" building is a means of solving many problems that arise in a dynamically developing urbanized territory. However, Russian practice shows that spot or compaction construction, as one of the means of implementing compactness, usually leads to a deterioration in the quality of the urban environment.

Keywords: Urbanized territory, Compaction, Spot development, Residential development, Urban planning, Greening of local territories.

INTRODUCTION

A dynamically developing city sooner or later faces the issue of lack of territorial resources and has several options for its solution: it can grow wider or up, compact existing buildings or implement programs to replace existing housing stock, create (where possible) artificial land plots (Motamed & Golmohammadi 2010; Peshina & Ryzhenkov 2013; Safina *et al.* 2016; Medvedeva *et al.* 2017). Therefore, we decided to take a close look at this fast-paced phenomenon and draw some constructive conclusion. The densification of residential development is closely related to the transformation of urban planning norms. In Russia, the change in the state system that began in the last century was accompanied by changes in land ownership rights and, as a result, changes in approaches to urban design and development. Small - and medium-rise buildings, which were common in the pre-revolutionary period in the major cities of the Russian Empire, are replaced by quarter buildings of the early Soviet period, the scale of which increased in the 1930s and 50s, and then in the 1960s. Residential blocks of these times (the so-called "khrushchevki") are integral self-sufficient elements of the urban environment, which have in addition to housing the necessary set of service functions – clinics, schools, kindergartens, shops and other objects, extensive "green" spaces calculated under urban planning standards. In the later years of the Soviet Union, block construction was also widely used, with changes in the quality and height of buildings. Later "panels" with a large number of floors were used, which is reflected in the size of the blocks.

The consequences of displaying for association of working and intellectualization of robotized frameworks of environmental circumstance control in the urbanized regions were presented (Ivashchuk & Ivashchuk 2013). Private allure is associated with the region's solace, which is controlled by an assortment of monetary, social, ecological and climatic elements. The urbanized domains rating, in light of the dynamic changes in these components is determined in the examination paper (Semenova *et al.* 2017). In light of examining the segment measures and the current populace dispersion design, an evaluation is made of the issues and prospects of arrangement of agglomerations in Siberia (Lesyuta 2010). The pointers of lodging development are broke down, the job of enormous board lodging development in taking care of vital issues of lodging arrangement dependent on the climate comfort is thought of. The acquired outcomes can be utilized to create strategies and devices for directing development exercises (Buzyrev *et al.* 2018).

In the 1990s, after the collapse of the Soviet Union, issues of land ownership again become relevant, which is reflected in urban development-intensive compaction development, which is more typical of the Central areas of cities, where there is a developed transport network, as well as a sufficient number of public, administrative and cultural and leisure institutions. The concept of point development does not have an exact definition in the Urban planning code of the Russian Federation, which makes it more difficult to regulate this phenomenon (Salahova 2003; Akimova & Chechulina 2015; Telichenko & Sumerkin 2015; Fedorova & Safina 2018). In Russia, the compaction (point) construction refers to the construction of new buildings in the conditions of existing development and is usually used in a negative context as environmental, socio-psychological, sanitary, and urban planning problems worsen. However, compacted housing is not always a negative phenomenon. If properly regulated, it can solve problems with dilapidated housing stock and contributes to the most effective use of infrastructure and potential of the urban area. This article mainly discusses and identifies the features of the impact of compaction development on the most important environmental component of the urban system - landscaping of local territories.

MATERIALS AND METHODS

To run this survey, we selected two predominant districts in Kazan. The studied territories, two administrative districts of Kazan — Vakhitovsky and Sovetsky — were chosen, which was due to the implementation of different approaches to the development of the territory. So, the Vakhitovsky district is located in the central part of the city of Kazan, it has historically been sufficiently developed and densely built up, which did not make it possible to implement integrated housing construction. The Soviet district, located on the outskirts of the city, had sufficient space for large-scale integrated residential development of the 1950-60s, and since the mid-1980s, the construction of the Azino-2 and Azino-1 micro districts was carried out here. Satellite maps from the Google Earth program, as well as satellite images and maps from the Google Maps, Yandex. Maps, and 2gis services, were used as initial cartographic materials in the work. An important source of information about the main residential facilities (years of construction, number of floors and living space, etc.) was the data of the Ministry of Housing and Communal Services of the Russian Federation, presented on the portal Dom. MinZHKH (<http://dom.mingkh.ru/tatarstan/kazan>), as well as the site data “Public Cadastral Map of the Russian Federation”. By deciphering satellite images by direct and indirect signs, digital models of courtyards and house adjoining territories have been created, which are examples of complex and point buildings implemented in different periods: 1959-1979 and 2000-2019.

Using the SAS Planet program, geo-referenced rasters were created, after which they were loaded into the MapInfo program. The research factored in the digitization of houses by creating polygons on the roofs. When determining the boundaries of green zones, the territories of open unasphalted land plots were taken into account, while the crown areas of trees were excluded. Google panoramas were used as auxiliary tools. The result was digital models of courtyards or land with allocated layers containing residential objects and green areas. Based on the obtained digital models, the calculation and comparison of indicators characterizing the main features of the point and complex buildings were made.

RESULTS AND DISCUSSIONS

An analysis of the situation in the residential development of the Vakhitovsky and Sovetsky districts of Kazan made it possible to conclude that the most intensive processes of its compaction are noted within the Vakhitovsky district. The density of residential development in the Vakhitovsky district is $362 \text{ m}^2 \text{ ha}^{-1}$, which is 3.8 times higher

than the similar indicator of the Soviet district (96 m²/ha). As a rule, the process of building up densification in large cities is uneven - in most cases, it covers the most valuable, for investors, central areas of the city, in which a significant number of different cultural and socially significant objects are concentrated. In this aspect, the city of Kazan is no exception, in which the processes of compaction of urban fabric are characteristic mainly of the Vakhitovsky district, which is the central, historical part of the city. It is here that the maximum concentration of cultural, educational, and scientific institutions is noted. The most common buildings constructed in a "point-like manner", as a rule, include residential buildings, and less commonly, objects serving the branch (shopping centers, cafes, shops).

The problem of compaction facilities lies in multifactorial discrepancy with an integrated approach to the development of the city. One of the most important factors is the non-compliance with the urban development plan created earlier, taking into account the potential of the adjacent territory as part of the development of the city. Developers often ignore the altitude limit affecting the urban ensemble (the formation of the city landscape), and the appearance of the building, often out of the general context of the city. A striking example of sealing development, which changed the face of the central part of the city of Kazan, is a 26-story residential building located at ul. Shcherbakovsky Lane, 7, which illustrates the developer's desire to maximize the benefits of the most attractive central areas of the city.

As a rule, building up densification occurs at the expense of public spaces, since it is the easiest to implement and the least expensive for the city budget, unlike, for example, compaction due to demolition and replacing the existing building with a new denser one. It should be noted that during the development of the city, public spaces are differentiated into public spaces of city-wide significance, which are formed in the historical center of the city and broadcast to peripheral areas along major city highways, and local public spaces that are formed in residential entities - a private courtyard, public courtyard, boulevard, alley, lane, square. Practice shows that the main types of local public spaces in a residential environment, in the territory of which development is underway (sealing or spot), are a public courtyard, lane, square (Filanova & Shuruev 2015). The relatively low-density indicators of residential buildings in the Soviet district of Kazan are due to the large area underdeveloped territories that were attached to the city of Kazan in 2004 and have not yet been built up. The calculated specific indicators of house gardening of two time periods - 1956-1972 and 2000-2019 for the Vakhitovsky and Soviet districts of Kazan are presented in Table 1.

Table 1. Indicators of local greening/green area.

Period	Specific indicators of the area of green zones, m ² /per100 m ²	Area of local greening, m ² per 100 m ² living space	Percentage of green areas from the total local area, %
Vakhitovsky district			
1956-1972	<u>5.9-19.4</u>	<u>23.3-76.1</u>	<u>33.9-71.9</u>
	12.5	49.1	55.6
2000-2019	<u>0.4-4.3</u>	<u>1.4-16.9</u>	<u>7.4-31.4</u>
	2.2	8.7	18.6
Soviet district			
1959-1972	<u>11.9-20.5</u>	<u>47.0-80.7</u>	<u>19.8-39.6</u>
	15.6	61.6	58.2
2000-2019	<u>0.5-5.5</u>	<u>2.0-21.7</u>	<u>12.0-24.7</u>
	2.6	<u>10.2</u>	19.8
Normative Value (Local standards for urban planning in the Kazan city district, 2016)			
	5	22	-

Note: the numerator shows the minimum and maximum values, and the denominator shows the average values.

Within the residential area formed in the period 2000-2019, the average specific indicators of the area of house gardening are 2.2 m²/person (Vakhitovsky district) and 2.6 m²/person (Sovetsky district), which is 1.9 - 2.3 times less than the normative value approved in Kazan (5 m²/person). When considering residential development, formed during the period of the mass typical construction of "Khrushchev" in 1956-1972, we can see that the average specific indicators of local greening are 5-6 times higher than the similar values of modern residential complexes

and amount to 12.5 m²/person (Vakhitovsky district) and 15.6 m²/person (Soviet district). The indicator analyzed in the article, reflecting the ratio of the area of local greening to the total area of apartments, calculated for the period 1956-1972 reaches 49 and 62 m²/100 m² in the Vakhitovsky and Soviet regions, respectively. In the adjoining territories of modern buildings (2000-2019), this indicator is 8.7 m²/100 m² (Vakhitovsky district) and 10.2 m²/100 m² (Sovetsky district), which is 2.2-2.5 times less established standard (22 m²/100 m²). Thus, the specific indicators reflecting the greening of the adjacent territories of residential buildings of different periods of construction differ significantly, moreover, this fact is characteristic of the two studied regions. Among the main factors determining this circumstance are the following:

A significant number of houses built in the period 2000-2019 are located within new housing estates or residential complexes, in which the main attention is paid to the development of infrastructure, the construction of social facilities and, to a lesser extent, to the conservation or planting of green spaces.

The level of "maturity" of green spaces (height, crown density, number of trees) located within the modern buildings of 2000-2019. significantly lower than in the "Khrushchev" quarters, because tree crowns did not have time to form until the end.

Some of the houses built in the period 2000-2019 are elements of compaction development, which is often erected through expansion into green spaces or are built on existing spaces, which leads to the destruction or oppression of vegetation.

SUMMARY

Thus, some differences in approaches to the construction of residential facilities, characteristics of Vakhitovsky, and Sovetsky districts have the same negative impact on the urban environment. The negative consequences are the destruction and suppression of existing landscaping, reducing the area of green zones, increasing the load on the territory, reducing insolation, which is due to non-compliance with urban development standards. These processes affect the quality of the urban environment for both residents of new buildings and residents of the compacted area.

CONCLUSION

"Compact" urban development is a means of solving many problems of a dynamically developing large city (Newton 2000; Ben-Joseph 2004; Mike Jenks *et al.* 2005). However, Russian experience shows that point-and-seal construction, as one of the means of implementing compactness, usually leads to a deterioration in the quality of the urban environment. The negative consequences are the destruction and suppression of existing landscaping, reducing the area of green zones, increasing the load on the territory, reducing insolation, which is due to non-compliance with urban development standards.

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ابعاد زیست‌محیطی متراکم شدن پروژه‌های مسکن در قلمروهای شهری: مطالعه‌ی موردی شهر کازان

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چکیده

این مقاله به بررسی ویژگی‌های اثر متراکم سازی پروژه‌های مسکن بر روی مهم‌ترین مؤلفه و جزء زیست‌محیطی سیستم شهری- فضای سبز مناطق مسکونی، می‌پردازد. با استفاده از مثال شهر کازان، این مطالعه، اثرات زیست‌محیطی فشرده‌سازی را در نظر گرفته و دو نوع پروژه‌های مسکن مجتمع و نقطه‌ای را که در دوره‌های زمانی متفاوت اجرا شده است مقایسه می‌کند: ۱۹۷۹-۲۰۰۰ و ۲۰۱۹-۲۰۰۰. مدل‌های دیجیتال نقشه‌های زمین و حیات‌داری سازه‌های مسکونی و فضای سبز ایجاد شده توسط نویسندگان، امکان محاسبه و مقایسه‌ی شاخص‌های خاص برای مطالعه‌ی ویژگی‌های اصلی ساختمان‌های نقطه‌ای و مجتمع را می‌دهد. در چارچوب پروژه‌های مسکونی تشکیل شده در دوره‌ی ۲۰۱۹-۲۰۰۰، شاخص‌های خاص پروژه‌ی فضای سبز محلی متناظر با ارزش‌های هنجاری طراحی و برنامه‌ریزی شهری نیست. این موضوع منجر به بروز پیامدهای منفی شده است که شامل تخریب فضاهای سبز موجود، کاهش پارک‌ها، افزایش فشار فعالیت‌های انسان بر روی قلمرو و زمین است. این فرایندها بر کیفیت محیط‌زیست شهری برای هر دو ساکنان ساختمان‌های جدید و ساکنان مناطق متراکم اثر دارند. تجربه جهانی توسعه‌ی شهری نشان می‌دهد که ساختمان فشرده، ابزاری برای حل بسیاری از مسائل ایجاد شده در توسعه‌ی مناطق شهری است. باین‌حال، برنامه‌های کشور روسیه نشان می‌دهد که ساخت‌وساز نقطه‌ای یا فشرده، به‌عنوان یکی از ابزارهای متراکم سازی، معمولاً منجر به کاهش کیفیت محیط شهری می‌شود.

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