

# Specific features of modern multifunctional high-rise building construction

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**Abstract.** The article analyzes the main reasons for the development of high-rise building construction the most important of which- is a limitation of the urban areas and, consequently, the high price of land reserved for construction. New engineering and compositional solutions for the creation of new types of buildings are considered - complex technical designs of a large number of storeys completely meet the new requirements for safety and comfort. Some peculiarities of designing high-rise buildings and searching for optimal architectural and planning solutions are revealed since, with external architectural simplicity, high-rise buildings have complex structural and technological and space-planning solutions. We consider the specific features of a high-rise housing in various countries around the world, including Russia, such as the layout of the multi-storey residential buildings, depending on the climatic characteristics of the regions, assessment of the geological risk of the construction site, the choice of parameters and functional purpose of the sections of the territory of high-rise construction, location of the town-planning object for substantiating the overall dimensions of the building, assessment of changes aeration and engineering and hydrological conditions of the site. A special place in the article on the problems of improvement of the territory, the device of courtyards, landscaping, the device of playing and sports grounds. The main conclusion in the article is the following problem - when developing high-rise housing construction, the development of high-rise housing, and an increase in the population density in the territory of large cities of Russia, necessary to create a comfortable and safe level of residents living and not a decrease, but an improvement in the quality of the urban environment.

## 1 Introduction

The current stage of development of large cities megacities in the world is characterized by the construction of high-rise buildings and structures. Not only developed countries in various volumes develop high-rise housing construction, but almost all developing countries, with the help of high-rise housing construction, claim the mastery of technical and financial potential. The main reasons for the development of high-rise housing construction consist

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primarily in the limited urban areas and, consequently, the high price of land reserved for construction [1].

In our country, high-rise housing construction has developed in the Soviet period. This, so-called "Stalin's skyscrapers", which were built in the fifties of the last century. These buildings were of different functional character: institutions (the building of the Moscow State University and the Ministry of Foreign Affairs), hotels (Ukraina and Leningradskaya) and a multi-purpose residential building on Kotelnicheskaya Embankment. The peculiarity of these buildings are not only in architectural planning, but also of spatial solutions.

It should be specially noted that Moscow is the only major northern city in the world, in which there are residential high-rises. Due to the fact that weak soils predominate in Moscow, limestones with karst voids, the construction of high-rise buildings in Moscow requires particularly complex engineering and technical constructions of foundations and volume-planning solutions, in contrast to New York, where Manhattan skyscrapers stand on granites. Perhaps for this reason the construction of high-rise buildings in Moscow was suspended for a long time and had not received its development [2].

Nevertheless, the development of the construction industry, the creation of new construction technologies, as well as the lack of free areas in the city prompted a return to the decision of high-rise housing construction, including high-rise apartment buildings. In connection with the development of high-rise residential buildings, it became necessary to search for optimal architectural and planning solutions that take into account the optimization of town-planning solutions for high-rise apartment buildings not only in the central, historical part of the city, but also in other administrative districts and districts of the city. Optimization of the structure of multifunctional high-rise residential complexes becomes the main one.

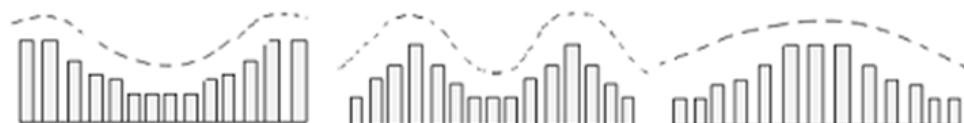
Multifunctional high-rise complex it is a structure that connects into a single composition residential and public elevated areas and underground areas, house territory, and external communications [3-4]. To create a safe and comfortable environment in a person's daily life with such an unfriendly format, needed arrangement multi-storey residential development, depending on the climatic characteristics of the area, character of the relief, the conditions of insolation, the influence of the wind, the proximity of reservoirs and green areas. Especially large role in the perception of a populated place of harmonic ratios of the elements, visual connections and free spaces.

## 2 Experimental section

According to the current "Standards and for designing the planning of the development of sections of the territory of high-rise buildings, high-rise town-planning complexes in the city of Moscow", the section of the territory of the it's a part of the city's territory within the quarter bordered by land. Quarter size when placing a section of the territory of the complexes of high-rise buildings in it should not be more than 2.5 hectares, a section of the territory of the high-rise town-planning complexes - no more than 5.0 hectares.

Norms regulate the factors taken into account when selecting parameters and functional designation of sections of the territory of high-rise construction, including:

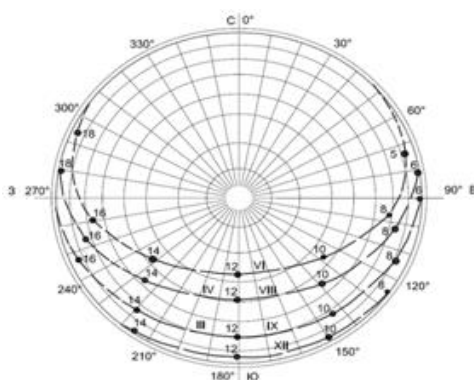
— Visual and landscape analysis of the location of the town-planning object for substantiating the dimensions of the building.



**Fig. 1.** Compositional methods of residential development of different altitude

High density of the population leads to complex compositions from vertical and extended volumes of apartment houses [5]. At engineering of city quarters of mixed number of storeys, this task is solved by compositional methods, combining low and high-rise buildings of the city.

- Analysis of the possibility of geological risk on the basis of geological survey data; is made on the basis of the "Recommendation on the assessment of geological risk in the territory of the city of Moscow."
- Calculations of the carrying capacity of the transport network, taking into account the additional load from the object with the purpose of excluding overloads of road and transport communications, are conducted on the basis of MGSN 1.01-99.
- Predictive assessment of changes in aeration conditions and engineering and hydrological conditions of the site. It is carried out in accordance with the provisions of the Federal Law "On the Protection of Atmospheric Air" and San Pin 2.1.6.1032-01.
- Light-climatic calculations of the insolation level and natural illumination, according to San Pin 2.2.1 / 2.1.1.1076-01.
- Rated duration of continuous insolation for residential and public buildings is differentiated depending on the type of flats, the functional purpose of the premises, the planning zones of the city, the geographical latitude for the central zone (58 ° N - 48 ° N), - at least 2 hours a day from 22 of March to September 22<sup>nd</sup>;



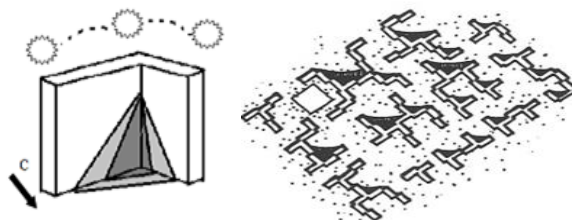
**Fig.2.** The solar map of Dunayev for 50 ° N. w.

Characteristics of comfort, in the same climate, may not be suitable for other climatic regions. In the northern latitudes, the buildings and territories on which they are located require as much sunlight as possible, heat; in the southern regions, conversely, they must be protected from overheating [6].

**Table 1.** Preferred orientation of residential development for different climatic zones

Orientation	Climatic zones			
	Tropical		Moderate	Polar
	Humid	Dry		
Solar C IO				
Wind				

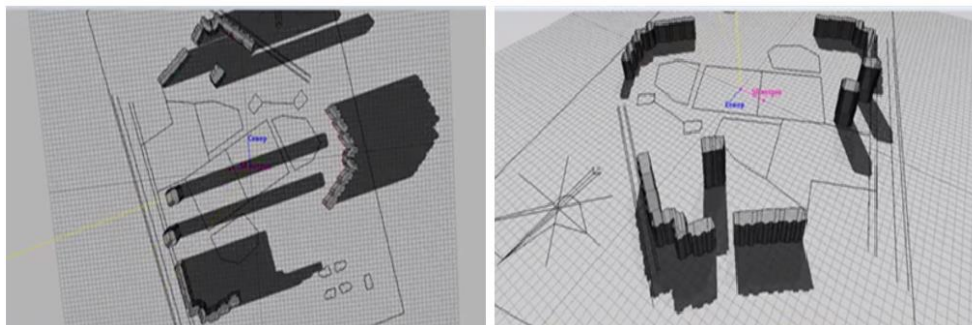
In the territories of children's playgrounds, sports grounds of residential buildings; group sites of pre-school institutions; a sports zone, a recreation areas for general education schools and boarding schools; recreation areas of hospital facilities of stationary type, the duration of insolation should be at least 3 hours for 50% of the area regardless of geographical latitude [7].



**Fig.3.** Nature of the darkening of territories

## Result section

The minimum distance between houses is determined is determined by the number of storeys of the house, which can obscure the building, the location and orientation. With a complex orientation, special calculations by means of special software [8-9].



**Fig.4.** Calculation with the help of the program "Sitis Solaris"

High-rise buildings cast shadows, the length of which depends on the time of the year and the position of the sun, this significantly affects the microclimate of the yard area, so it is necessary to investigate the influence of cast shadows on the house area, at an early stage of design and to develop various options for the location of the building on the site.

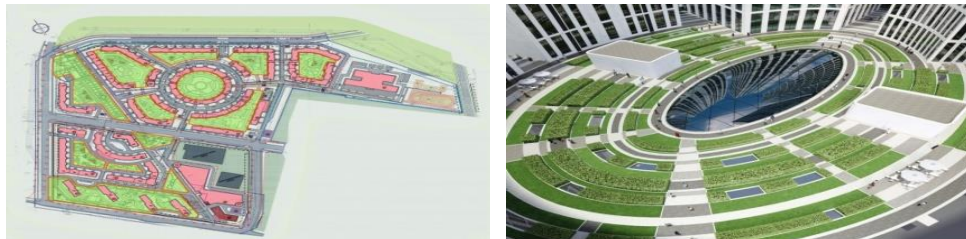


**Fig. 5.** Variants of location of the complex on the site

Calculations of the population's security in the adjoining territories by gardening and public service facilities within the boundaries of the site of high-altitude education [10]. The area of gardening on sections of high-rise buildings, high-rise town-planning complexes is determined from the calculation of not less than 5.0 m<sup>2</sup> per inhabitant, considering landscaping of exploited roofs and special recreational spaces (winter gardens) distributed on the floors of the building. The area of the winter garden should not be less than 50 m<sup>2</sup>.

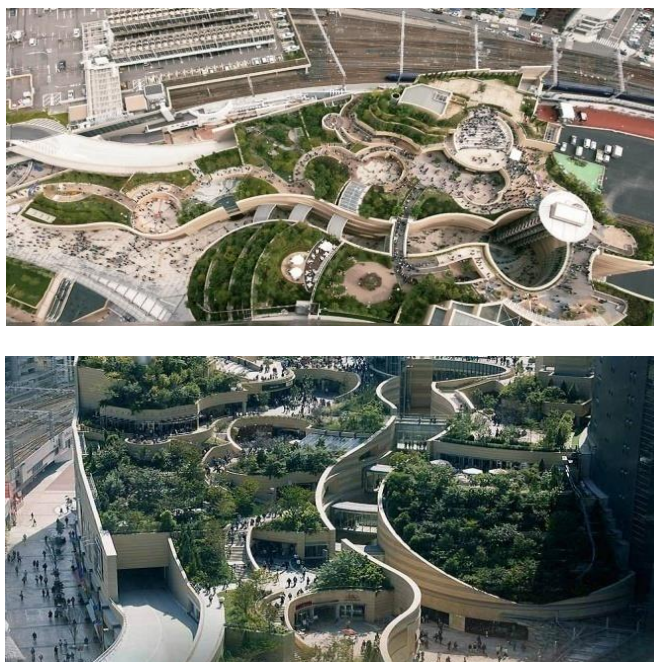
## Discussion section

Ideally, yard appears as the collective space intended solely for gaming and communication, so the yard spaces of multifunctional high-rise complexes should be clearly divided into internal and external [11]. This leads to the fact that the yards are even more separated from the street, which gives a sense of security and coziness.



**Fig.6.** Options for the layout of the yard area

Landscaping involves the construction of courtyards, landscaping, the installation of playgrounds and sports grounds for children of different ages and parking [12]. Preferably, pedestrian areas, courtyards, playgrounds and boulevards are at different levels with the roadway this can be achieved with the help of a system of stylobates and pedestrian bridges connecting all the sites and pedestrian zones [13]. That is, you can get round whole residential complex with an interesting scenic route, nowhere crossing the roads.



**Fig.7.** Accomplishment of a residential complex (Osaka city)

Such decisions have been applied in single flagship projects of world architecture, which are being built in countries with a huge experience of high-rise construction in Singapore, the United States, and China [14]. It will raise comfort and safety to a new level and completely



free the yard from the machines, because Parking is located underground, and cars leave only on the outer street of the residential complex [15].

One of the most acute and current urban development problems of high-rise buildings and complexes in Russia is the actual non-compliance existing standards and construction regulations.

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