DOI: https://doi.org/10.32347/2077-3455.2025.74.435-445
УДК 711.1

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INTEGRATED DEVELOPMENT OF VERTICAL CITY

Abstract: the study is devoted to the analysis of the effectiveness of the application of urban planning design measures: integrated development of the territory object and planning - in the implementation of a vertical city project. However, the implementation of mega-projects may result in urban planning, social, environmental, and economic problems. Today, the use of vertical cities as tools for territory planning has become a frequent phenomenon in the world. Mega-projects (vertical cities) are created when a qualitative leap in development is needed or when a point consolidation of financial resources is required in the territory under consideration. Vertical cities are created as drivers of city/region/country development. If a mega-project is implemented effectively, the surrounding area becomes attractive to developers and business communities, as well as to residents and tourists (users), resulting in an increase in the city's population, a rise in tourist traffic, and an increase in investment. Nevertheless, as modern architectural scholars point out, not all megaprojects succeed. In case of failure, vertical cities can become catalysts for negative processes: economic crisis, social tensions, environmental and planning problems. The mega-projects of sports facilities after the Olympic Games, for example, are illustrative, in which a large number of facilities were not in demand, and the rest remained unrealized in the surrounding buildings. The study describes the positive aspects of the use of project quality tools and their shortcomings, which do not allow to completely neutralizing the problems that arise during the implementation of megaprojects. The conclusions propose to supplement the structure of documents for the integrated development of the project area and provide specific recommendations. The catalyst for the multi-tiered planning of the urban structure was the chaotic conquest of the ground tier by road

transport, which in various utopias was assigned a place on the roofs of buildings and at the underground level, along with utilities.

Keywords: vertical city; megaproject; large territorial projects; master planning; urban planning integration of the project; integrated project development.

Formulation of the Problem. The intensification of functional processes, the search for sustainable development of high-density urbanized areas in contrast to the limited land resource are increasingly drawing the attention of designers to the concept of the “vertical city”. Its structure is based on the multiple replication of a land plot with the replacement of territorial zones with tiers and the spread of citywide processes to the underground, ground and aboveground levels, which are subdivided according to the principle of functional affiliation and may include several floors. In this article, in the chronological order of the stages of city formation, examples of conceptual ideas and implemented solutions are considered, the planning organization of which is based on a multi-tiered structure. The most striking embodiment of this concept in architecture is the skyscraper, whose functioning involves the inclusion of all kinds of life processes within a single shell and ignoring the relationship with the street space and the buildings located nearby [1]. The analysis presented here has shown that the most vulnerable in this case are the horizontal links connecting autonomous urban structures and the ground level, which acquires a transitory nature of operation.

Today, the efficiency of urban space is often measured by various indicators of the intensity of land use: saturation and diversity of functions, traffic capacity, population density, etc. In the context of strategic planning, the achievement of the required indicators has led to the “squeezing” of the social structure up and down relative to the ground level, and, as a result, to the displacement of housing to the upper tiers (those that have no functional connections with it), with its displacement from areas with high activity of movement of people, goods and services. The multiple layering of social, economic, and cultural processes of life on a limited land area has provoked the development of vertical links of citywide functioning, which equalize horizontal (street) and vertical (elevator) communications. To characterize urbanized space, data on the number of storeys of a building and the number of integrated functions are no longer sufficient. The main reason for this is the spread of city-wide processes to the underground, aboveground and aboveground levels, which, in turn, are divided into functional tiers, subdivided by purpose: public, transport, residential, sports, retail, office, etc.; occupying a certain height and several floors.

Analysis of research and publications. The first example of the development of functional tiers is the high-rise residential development characteristic of the largest urban centers of Ancient Rome (II-III centuries BC). In the ground tier of this building, it was customary to locate trade and craft workshops, taverns and eateries involved in

the scenario of street life through open doorways. This tier, as a rule, was divided into two floors, the second one being a mezzanine type, intended for the owner's family. On the next tier, which started from the third floor, there were living rooms intended for renting to tourists. The multi-story building contained functional tiers: a public tier at ground level and residential tiers, which differed in the ownership of the premises and the principles of their operation. The vertical distribution of functions was also characteristic of the European city of the medieval period and was realized through the integration of shops of traders and artisans into the first floors of two-story dwellings located along the busy central streets.

The development of the vertical structure of urban space was noted in the works of Leonardo da Vinci. His sketches of streets in section are known and are preserved in his works on the arrangement of an ideal city. On several of them, “communications are depicted on two levels, and the division of traffic not only concerns pedestrians and vehicles, but is also associated with different social statuses of people” [2]. The ideas of multi-level exploitation of space are reflected in a large number of urban planning and architectural utopias dedicated to the principles of a just society in general and the convenience of exploiting the urban/rural environment in particular. Franç ois Marie Charles Fourier pays special attention to the multilevel distribution of functions in the period of utopian socialism in his theory of the self-sufficient commune “Phalanx”. The underground level is reserved for kitchens, baths, and other household facilities, the first ground floor is for the elderly, and the second ground floor with a built-in mezzanine for children is for residents with families and honored guests. To move around the commune, Fourier envisages a system of covered galleries connecting the Phalanx residential buildings with a central multifunctional block called the Phalanx era. However, only wealthy residents of the community are allowed to use the aboveground part of the pedestrian arteries; separate stairs and underground tunnels are provided for the movement of the poor.

The statement of the research problem is expressed in the fact that the catalyst for the transition from the theory of multiple copying of tiers to its implementation was the invention of a safe lifting mechanism by Elisha Graves Otis in 1852. The largest experimental site for the development of a vertical city was set up on the island of Manhattan in the early twentieth century. By 1909, the constant search for efficiency in the use of limited land resources led architects and engineers to formulate “the theorem of skyscraper architecture as a structure with autonomous contingencies on each tier” [3]. Remment Koolhaas in his book “New York Beyond Itself” presents this concept as a fusion of "three revolutionary urban planning ideas 1 - repeated reproduction of the world, 2 - capture of the tower, 3 - house-quarter" [4]. In this context, the structure of urban space implies unlimited replication of the building area, which is layered on top of each other and multiplies the city's economy.

The “house-quarter” meant that all kinds of life processes were enclosed within a single architectural shell, with large-scale production functions, public spaces, offices above them, and residential apartments above them located on the lower levels. «The «apotheosis» of the initial «theorem» was the construction of the Downtown Athletic Club building in 1931. Designed by the Starrett & Van Vleck firm, the skyscraper is located in the southern part of the island near the banks of the Hudson River. The 22×54 m foundation has 38 floors (162 m high) with different and not always natural for architecture operating scenarios.

The purpose of this study is to reveal the processes of forming the integrated development of the territory of a vertical city.

The object of the study is master planning tools and integrated project development. *The subject* of the study is the degree of their effectiveness in the implementation of vertical cities.

Main part. Architectural forming was subject to the principles of maximum possible filling of the building volume, which, according to the rules of land organization, implied total development of the block area with the structure «squeezing» upwards. The dimensions of the block were limited to a grid of constant 60 meters wide and variable lengths of 30 or 18 meters, depending on the importance of the avenue adjacent to it. Due to the feeling of discomfort experienced by people at ground level and the falling value of shadowy areas of neighboring neighborhoods, the New York Zoning Resolution was adopted in 1916, which provided for the organization of open public spaces and parking areas within the projected block [5].

In the context of the intensive growth of large cities in the late nineteenth century, engineering systems could not cope with the increased load on the public utilities, and street space was chaotically conquered by transport [6]. Attention to the problem was drawn by the French urban architect Eugene Henard in his speech at a conference in London in 1910. In the schemes proposed by Henard, the separation of “dirty” and “clean” streams was fundamental.

Scientists and urban planners identify planning problems:

1. Inconsistency of technical and economic indicators with the existing vertical city documentation developed earlier for the territory in question. As a result, the capacity of the project is often overestimated for existing urban needs. For example, stadiums built for the World Cup.

2. During the implementation of projects, the load on the city's infrastructure increases. In the absence of a comprehensive analysis and implementation of additional measures to address the resulting deficits, there is a shortage of transport, engineering, social, and other services in the city. For example, when building a vertical city, it may be necessary to modernize the street and road network, update and change public

transportation routes, etc. This problem is discussed in his research by O. Aoun discusses this problem in his research, considering the mega-projects of the city [16].

3. Mismatch between the global goals of the vertical city and the local needs of the local population. The example of the previously described Azzali stadiums in Qatar shows that not only the size of the facility does not meet the required one, but also the function: Qatar has a shortage of cultural and entertainment spaces [7].

According to their functional purpose, vertical cities are divided into facilities for large-scale events (Olympics, World Cups, etc.), for the development of culture, sports, science (theaters, museums, innovation centers, etc.), large residential complexes or infrastructure facilities (including transport mobility facilities) [8]. The key characteristics of a vertical city are its scale, high labor intensity, cost, significance for society, and publicity.

As noted earlier, the implementation of a megaproject (vertical city) often requires changes to existing urban planning documentation, and therefore requires a tool to implement these changes. In international practice, such a tool is mostly a planning object. In domestic practice, as of 2025, the most popular tools are integrated territorial development and object planning.

The research methodology is based on the analysis of the structure of the two tools (integrated development of territories) and the planning object and a comparison of the tools' capabilities in solving the main urban planning problems that arise when creating a vertical city [9].

Vertical cities are implemented through the mechanism of integrated territory development projects. Not all types of vertical cities can be implemented through the mechanism of integrated territorial development. The legislation describes a limited list of areas to which it can be applied: residential development areas, non-residential development areas, undeveloped areas, and areas that are included in the integrated territory development project at the initiative of the right holders (Table 1).

Table 1. Boundaries of application of integrated development of the territory

Unused / Abandoned Territories		
Industrial Zones		
Inefficiently Used Territories		
Residential Buildings	Shopping Centers Real Estate,	Warehouses
Business Buildings	Urban Households. Objects	Manufacturing

Mechanism for integrated development of territories. A mechanism has been developed to implement large territorial projects in Ukraine. The mechanism of integrated territorial development was created because of integrated and sustainable

development of territories in 2020. Unlike the previous mechanisms for the integrated development of territories and the development of undeveloped territories, the integrated territorial development mechanism allows not only local authorities but also land plot owners to implement large-scale territorial projects. As of 2024, more than 51 integrated territory development projects are being implemented in Kyiv.

For the complex development of non-residential territory: making a decision on the development of an undeveloped territory, holding a tender, concluding a contract, leasing a land plot, making changes to urban planning documentation (master plan), and implementing activities (design, construction) (Table 2).

Table 2. Procedure for implementing the mechanism of integrated development of the territory

<table>
<tr><th>Housing In A Vertical City</th><th>Undeveloped Areas</th></tr>
<tr><td>Preparation for the Decision
on Integrated Development of the Territory</td><td rowspan="4">A Promising Solution for the Development of Undeveloped Territory</td></tr>
<tr><td>Draft Decision on Integrated Development
of the Territory</td></tr>
<tr><td>Holding General Meetings
on the Issue of Integrated Development
of the Territory</td></tr>
<tr><td>Decision on Integrated
Development of Residential Buildings</td></tr>
<tr><td>Conclusion of Agreements on Integrated Development
of Residential Buildings</td><td>Implementation of Agreements
on Integrated Development of
Residential Buildings</td></tr>
<tr><td>Stages of Implementation
of the Decision on Integrated Development
of the Territory of Residential Buildings</td><td>Amendments to the General Plan</td></tr>
<tr><td>Implementation of Measures Related to the Design and
Construction of a Vertical City</td><td>Implementation of Measures Related
to the Design and Construction of a
Vertical City</td></tr>
</table>

The document of the vertical city of territories should contain a complete list of analytical schemes and explanatory notes that reveal the existing state of the territory [10]. It should also include a proposal of architectural and spatial solutions, with justification of technical and economic indicators, construction phasing, calculation of the population's provision with the necessary social facilities, and development of transport and engineering infrastructure.

Disadvantages of implementing vertical bridges. However, despite the fact that the integrated development of the territory solves some of the problems that arise in

spot construction, the mechanism is not without its drawbacks. First, as described earlier, not all mega-projects can fall within the scope of this tool.

The integrated development of the territory mechanism makes it possible to create complex modern neighborhoods in the existing urban development, but it does not allow to resolve the issue of mismatch between the megaproject's capacity and the city's resource capabilities, as to ensure a comprehensive analysis and creation of additional infrastructure in the city that would ensure the operation of the facility in the city.

Recommendations. To offset the problems described earlier, it is proposed to include the following points in the structure of the integrated development of the territory mechanism: - Introduce a mandatory point to analyze the capacity of the megaproject and the target audience. This point will help to offset the problem of a mismatch between the capacity of a project and the capabilities and needs [11].

In the event that disproportions are identified and there is social and economic growth in the city, it is proposed to use the facility to plan activities related to the megaproject. In the absence of socio-economic growth, use temporary structures to create a megaproject or create a phased plan for the use of the facility, with the re-profiling of functions (for example, after a mega-event to which the construction of a megaproject may be timed to meet the needs of the population), which, in turn, will help solve the frequent problem of the mismatch between the functions of a megaproject and the needs of local residents [12].

Consider the megaproject object not only within the site, but also on a citywide scale. Based on the information received about the maximum capacity of the megaproject, it is necessary to determine the sufficiency of the existing engineering, transport, social, in some cases tourist and other infrastructure to meet the needs of the temporary and permanent population that is increasing due to the creation of the megaproject. Thus, the allocation of additional plots for renovation or creation of new infrastructure in the city will help to solve the problem of the megaproject's mismatch with the city's resource capabilities [13].

Positive application of the tool to the planning object in the implementation of a vertical city. The popularity of the master planning tool today may be due to the ease of communication of a large number of people involved in the project; the conceptual approach to determining city development scenarios, as well as the sectorial approach of the master plan (the document can be focused and specialized on one topic) [10]. In addition, the master plan documents prescribe a customer-friendly project roadmap, which describes all activities with periods for their implementation. Both private companies and government agencies can be customers of the document. Projects are the key objects of the master plan - the point drivers of the territory's development [12]. A mandatory comprehensive analysis of the city before identifying projects allows for a clearer description of the terms of reference, capacity, and functional content of the

megaproject. In addition, drawing up a roadmap makes it possible to organize the phased implementation of related master plan activities and provide the necessary amount of transport, engineering, tourism, and other infrastructure in the city [9].

Disadvantages of using the planning object tool in the implementation of the vertical city. The existing disadvantages of using the master plan are its recommendatory nature in terms of project implementation obligations, as well as the lack of an assessment of the maximum anthropogenic load on the city and nature in the developed recommendations. In the described structure, projects can be represented by key projects. It also does not provide for the mandatory phasing of the master plan with the development of variability and adaptability of each stage to urban needs in the relevant years. In the context of implementing mega-projects, the amount of financial resources for the creation of related activities may be limited, so it is important to identify priority areas for urban planning intervention. In addition, the document does not provide an algorithm for determining the boundaries of the planning object.

Conclusions. It is proposed to add the following recommendations to the design of a vertical city: 1. Analyze the “diagnostics” for the maximum load of a vertical city. The city as an object is aimed at an integrated analysis of the existing project situation. 2. The recommendation specificity of the documents is used, such as the absence of an available assessment of residents, which exceeds the resource capacity of the vertical city as the possible maximum capacity of the proposed facilities. 3. In terms of project implementation, the measures are a mandatory main part of the measures in the further design of the city. 4. Development boundaries were determined based on the analysis and identification of facilities and infrastructure. Because of the analysis of the existing structures of the vertical city and suburban planning objects, it was analyzed and proposed that all the revised urban planning measures allow finding solutions to issues that arise during the overall implementation of the city. The disadvantage of these existing structures is the insufficient consideration of the powerful load on the vertical city. As a result, recommendations are proposed that are solved with the help of the specifics of the analysis of the integrated load on the vertical city.

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Анотація

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Інтегрований розвиток вертикального міста

Дослідження присвячено аналізу ефективності застосування проєктних заходів містобудівного проєктування: інтегрованого розвитку об’єкту території та планування - під час реалізації проєкту вертикального міста. Однак у результаті реалізації мега проєктів можуть виникати містобудівні, соціальні, екологічні, економічні проблеми. Сьогодні у світі частим явищем з’явилося використання вертикального міста як інструментів планування території. Мегапроєкти (вертикальні міста) створюються, коли необхідний якісний стрибок розвитку або необхідна точкова консолідація фінансових коштів на розглянутій території. Вертикальні місто створюються як драйвери розвитку міста / регіону / країни. У разі ефективності реалізації мега проєкту досліджувана територія навколо стає привабливою, як для девелоперів і бізнес-спільнот, так і для мешканців і туристів (користувачів). В результаті відбувається збільшення чисельності населення міста, підвищується туристичний потік і збільшується приплив інвестицій. Але як зазначають сучасні вчені архітектури, далеко не всім мегапроєктам вдається стати успішними. В іншому випадку, вертикальні міста

можуть стати каталізаторами негативних процесів: економічної кризи, соціальних напружень, екологічних і планувальних проблем. Показовими є мега проєкти спортивних об'єктів, після проведення, наприклад Олімпійські ігри, в яких велика кількість об'єктів виявилися не затребуваними, а решта залишилась не реалізованими в навколишній міській забудові. У дослідженні описуються позитивні сторони застосування проєктних якісних засобів та їхні недоліки, які не дають змоги повністю нівелювати проблеми, що виникають під час реалізації мегапроєктів. У висновках пропонується доповнити структуру документів інтегрованого розвитку проєктної території та конкретні рекомендації. Каталізатором багатоярусного планування міської структури послугувало хаотичне завоювання наземного ярусу автомобільним транспортом, місце якому в різних утопіях відводилося і на дахах забудови, і на підземному рівні разом з інженерними комунікаціями.

Ключові слова: вертикальне місто; мегапроєкт; великі територіальні проєкти; майстер-планування; містобудівна інтеграція проєкту; інтегрований розвиток проєкту.