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Research Article

Agricultural Product Safety: Vertical Farm Project Concept

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Abstract: In this article, we propose the concept of developing a modular cell for the construction of a vertical truss, which is attached to the bulk of residential buildings. The main idea is to introduce a modular cell in the Kazakhstan market for the development of urban farming. Vertical farms made up of modular cells are designed for growing organic agricultural products in urban environments. It is proposed to place vertical trusses in the blind, functionally undeveloped ends of residential buildings.The relevance of the production of organic agricultural products is outlined in the strategic development plan of the country, as one of the important areas responsible for the growth of the well-being of the people and the health of the younger generation. One of the well-known methods of organizing organic agriculture in urban settings is the use of vertical farms. Vertical trusses are widely used in the form of separate equipment-racks located inside the room. There are design proposals for vertical trusses in the form of separate independent buildings. The vertical truss proposed in this study consists of modular cells, which allows you to apply different compositional solutions. This cell has the ability to be arranged in different ways and adapt to any area. Vertical trusses will be built into the blind ends of residential buildings. After all, it is known that the area under the blind ends of 5-9-storey residential buildings do not find their high-quality use and very often create unfavorable, to some extent criminally dangerous sections of the city. According to the latest statistics of criminology, most of the crimes committed in the city occur in areas with blind ends of residential buildings. The height and total area of the vertical trusses will depend on the height of the residential buildings and on the overall aesthetic design of the spatial organization of the environment. The competitive advantage of the developed modular cell is the versatility of its application, mobility, as well as the interdisciplinary basis of the combined areas-architecture, design, agriculture, healthcare, construction, etc.The expected result is the qualitative development of urban farming, which can become a new market niche for the production of organic products. Urban farming can become new jobs for the residents of the houses in which vertical farms are built. And also, one of the directions in solving the problems of creating conditions for the growth of the well-being of the people and the health of the younger generation.

Keywords: vertical truss, safety, architectural environment, composition, modular cell.

1. Introduction

The relevance of the program topic is justified by the high demand in Kazakhstan and around the world for the production of organic agricultural products. The scientific novelty of the research lies in the fact that for the first time in the world and Kazakhstan experience, the development of a modular cell for the construction of vertical trusses-stakes with their placement in the blind ends of residential buildings is proposed. The practical significance of the study lies in the expedient use of the blind ends of residential buildings and the volumes of undeveloped land created by them. Another practical significance of the study is to improve the quality of landscaping of residential buildings, increase jobs, and obtain organic agricultural products.

The study of the Kazakhstan market and the entire process of the relevance of the topic of the development of vertical farms in Kazakhstan showed the following results:

"The Kazakh-Russian company UrbaniEco presented a project of a high-tech city farm for growing herbs, herbs and berries in urban conditions. The greenhouse operates 365 days a year in any free space, without requiring a deep knowledge of agronomy for people who are interested in healthy, environmentally friendly products used both for their own consumption and as a new type of business. To date, UrbaniEco has installed a basic model of a "smart" showcase-greenhouse in Almaty, in the Zhibek Zholy business center. At the next stage, it is planned to build a pilot vertical city farm in Almaty, open an assembly plant for hydroponic equipment in the Almaty region and export it with a focus on the CIS countries. The company actively establishes cooperation with representatives of the HoReCa market and food retail" [1] .

According to experts in the agricultural field: "Traditional agriculture, as we know it, will soon become a thing of the past. In many countries of the world, new technologies are being developed and introduced, and in China, Sasaki has approved a plan for the construction of a huge agricultural complex. On an area of 100 hectares, there will be numerous multi-storey vertical farms and greenhouses with artificial lighting based on hydroponics. There will also be built whole aquafarms that will grow useful algae. Due to the fact that the farms are multi-storey, the usable area will be ten times larger than the allocated 100 hectares. In addition, the agricultural complex is going to conduct research and experimental work to develop and test the latest methods of growing plants – fruits, vegetables and trees. It is planned to create a large library of seeds. Of course, such scientific potential should be used for educational purposes. The complex will open its own institute and even a museum of science" [2] .

Kazakhstan has huge ecologically clean territories and we can produce environmentally friendly food products. An important direction of the political course of Kazakhstan in the rapidly changing historical conditions is to change the culture of agriculture, taking into account new scientific, technological, managerial achievements, as well as the latest agricultural technologies. The strategic development plan of Kazakhstan outlines the directions for providing comprehensive support to entrepreneurship, creating conditions for people to start a business. To give everyone the opportunity to become a full-fledged participant in the economic transformations being carried out in the country.

The three-dimensional solution of the vertical trusses used in the world experience have different design solutions and are carried out with the participation of architects, designers and constructors. For example, "Vertical farm" Dragonfly " by the Belgian architect Vincent Callebaut (Vincent Callebaut). **The vertical farm-**skyscraper received its name "Dragonfly" for its shape in the form of giant dragonfly wings, folded together at a height of 600 meters. The number of floors of the building is 132. It is assumed that the building will fully provide itself with energy from the sun and wind. The site for the construction is provided on Roosevelt Island, almost in the center of New York (between Manhattan and Long Island) [3].

The vertical farm "Plantagon", the concept of which was presented by the Swedish-American company "Plantagon", is a spherical dome, inside which a spiral platform is placed, on which plants are grown.

Vertical truss Circular Symbiosis Tower, a concept by South Korean architects. Unlike all similar projects of vertical farms, which provide for their placement in an urban environment, the project of South Korean architects "Circular Symbiosis Tower" is intended to create a new look of rural settlements. The skyscraper consists of platforms arranged in a spiral around the supporting core of the building. Breeding of forage plants and free grazing of cows are planned on these platforms. After thirty days of grazing cattle, it is transferred to another level, and this is started by sheep or other animals that are able to eat the shortened parts of green plants. The project of the vertical farm "Circular Symbiosis Tower" is the winner of the "2011 Skyscraper Competition".

2. Method

The high-rise farm house "R4 apartment" from the Singapore company "Surbana International Consultants" can also be attributed to the category of high-rise farms. This project won the main prize of the "Skyrise Greenery Awards" * 2010, an award awarded for the creation of eco-friendly buildings [].

Vertical farm "OR OTEK" from the Russian company LLC "Agrorus", located in the city of Bryansk on the territory of the former workshop of the machine-building plant. According to the latest estimates, the farm is the largest in Russia and Europe. The total area of the sown area is 3,500 square meters, which is located on 300 square meters of the actual area. Also, the company Agrorus is actively building the first farms in the Far East.

As noted above, the construction of vertical farms, the development of urban farming is an urgent issue for Kazakhstan. The development of the industry for growing organic products in urban conditions requires the mandatory participation of architects, designers, and constructors.

At the present stage in Kazakhstan, there is a process of active development of a large number of residential buildings and entire new areas. The study of the development of housing issues also actualizes the migration situation in Kazakhstan. The migration process makes its own adjustments to the ethnic culture, socio-economic aspects and state policy. Provision of the increasing population of the city of Almaty is supported at the state level. These are the introduction of the State programs "Affordable Housing-2020", "Housing Program 7-20-25", "Nurly Zher", "Almaty Zhastary", rental housing for a period of 20 years, etc.

According to the results of many studies, it is revealed that in solving this issue, a very important factor is the sense of ownership of the purchased housing. In this case, it should be noted that all social housing facilities in Kazakhstan are focused on acquiring their own housing.

The above-mentioned state programs offer citizens safe and not expensive housing. There are various types of lending that take into account the income, family composition of consumers. Large families can get preferential loans from banks with the lowest annual interest rate.

The experience of designing social housing in Kazakhstan is developing in two types – the construction of residential areas and residential complexes. The territories of all residential areas provide for the construction of schools, kindergartens,retail and consumer services. Schools and kindergartens are built at the expense of budget funds, and shopping centers, administrative buildings, and medical centers are built at the expense of investments.

Despite all the above-mentioned positive characteristics of architectural solutions that contribute to improving the quality of life of residents of social housing, there are a number of recommendations for introducing new areas into the spatial and environmental structures.

Despite the novelty of the construction period, social housing buildings have similar principles of spatial and urban planning organization with panel housing of the post-Soviet period. For example:

- - blind ends of residential buildings, creating large unused areas of land;
- blind doors that are not visible in the entrances of residential buildings;
- there are no distinctions by zones that take into account the age and interests of residents;
- use of blind-long corridors with apartments on both sides.

According to the researchers, the application of the principles of ecological design in the structure of social housing in Almaty will improve the quality of the living environment. Such principles as natural supervision, access control and territoriality can provide not only comfortable living conditions, but also become examples of the organization of spaces for commercial functions. For example, for the development of urban farming, various greenhouses.

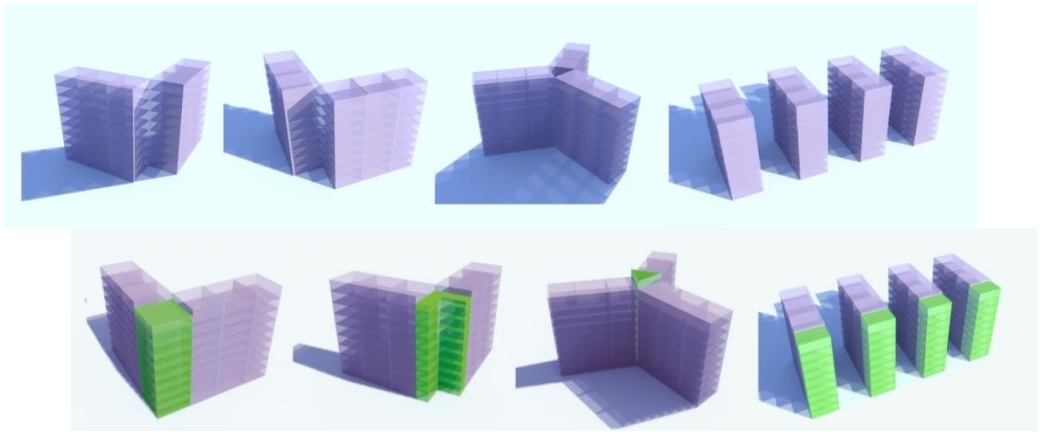

Figure 1. Модели организации вертикальных ферм в объем жилых зданий

Figure 2. Examples of modular cells, Author: N.O.Khasenov

In this study, it is proposed to use vertical farms in an open urban space. In the opinion of the authors of this study, the three-dimensional solution of vertical trusses should be able to have different compositional layouts.

The authors lead the work to develop a pilot modular cells, which allows the construction of various three-dimensional solution structures for the development of the idea of urban farming in areas of social housing. These are various vertical types of trusses-inserts for functioning in the blind ends of residential buildings. The three-dimensional solution of vertical trusses can be two-wall semi-open forms along the perimeter of the external walls of residential buildings, four-wall closed forms and three-wall closed forms. The spatial planning solution of vertical trusses depends on the urban-composite volume of residential buildings. In this case, it should be noted that the proposed schemes for placing vertical trusses can be applied not only in new residential buildings, but also in panel residential buildings built in the post-Soviet period. Currently, panel 5-9-storey residential buildings with blind ends occupy a significant part of the urban space of Almaty. After all, it is known that the area under the blind ends of 5-9-storey residential buildings do not find their high-quality use and very often create unfavorable, to some extent criminally dangerous sections of the city. According to the latest statistics of criminology, most of the crimes committed in the city occur in areas with blind ends of residential buildings. I would especially like to mention the Aksay microdistricts. In this area there are a large number of 9-storey panel houses, urban planning and composition description correspond to the ray-shaped shape in 3 directions. In the center of the ray-shaped shape, dark wells are formed for the width of a 9-storey building and for a height equal to a 9-storey building. It should be noted that between the 3 9-storey buildings there are narrow passages, which are used by residents of this area. These areas of the district are not lit, are not paved and create criminally dangerous areas of the district, especially in the dark. Therefore, the use of vertical farms in the structure of residential buildings and the development of the idea of urban farming to produce organic products is appropriate [5,6].

3. Conclusion

Vertical trusses-inserts will contribute to the manifestation of positive changes in parallel in several branches of science:

1. In architectural science - a method of modernization of residential buildings. The formation of new actively functioning public spaces, which are one of the methods in creating a criminally safe environment. Development of the direction of green architecture [8].
2. Functioning of aesthetically significant design objects in the urban environment.
3. In the construction industry - the appearance of a new structural object.
4. In the agro-industrial sector-the development of urban farming. The opportunity to increase the number of organic products in Kazakhstan. The appearance of a new laboratory site for conducting experimental research. The emergence of new territories for the development of agro-industrial activities.
5. The economic sector-the emergence of new opportunities for urban residents for entrepreneurial activity. Saving the family budget, consumption of organic products.

Therefore, in creating conditions for the development of this area, it is necessary to involve specialists from different industries. We need an interdisciplinary approach, the development of parallel methods in different areas of human activity.

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