Formation of sustainable improvement of buildings in arid zones of Karakalpakstan

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Abstract. The article is devoted to the study of ways to achieve sustainable development of landscaping and microclimate in the architecture of multi-storey residential complexes in arid zones on the example of the city of Nukus. Their town-planning, space-planning and functional solutions are considered.

1 Introduction

At all the time, people has been tried to explore and benefit from the climate and the natural environment in order to build a comfortable house, saving their energy. At the same time, the basic principles were preserved: attention to the peculiarities of the construction site, compactness of volumes, use of natural plant, constructive and decorative materials.

In response to the first energy crisis of the 1970s, corresponding to the "oil shock", there were "solar" houses, "passive" or "active". According to the concept of biosynthesis, they were created to receive, to store and to distribute natural energy. Due to the climate problems of the 80's.y (holes in the ozone layer, greenhouse effect), solar houses have become bioclimatic, integrating residents ' comfort, energy savings and environmental protection. It was determined both by the features of architectural improvement and used by the technical equipment.

Since 1980, two trends have been developing in parallel: low tech and high tech. Proponents of low tech, driven by the desire to preserve voluntary simplicity in their lifestyle, are convinced of the inevitability of an economic downturn in developed countries. High tech, supported by industry development, mainly focuses on energy optimization through the use of complex materials and sophisticated technical solutions.

Over time, a third path has emerged between them, a more pragmatic one that puts people in the center of attention. This is an "eco-responsible" architecture that takes into account socio-economic and environmental issues, asserting the social responsibility of the urban planner and architect in relation to future generations. Developers of such architectural objects show a respectful attitude to nature and have in mind the bioclimatic aspects. Optimized urban planning, architectural, design, structural and engineering decisions are made based on a comprehensive analysis of the dynamics of environmental and social development.

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The concept of sustainable development was appeared as a result of combining three main aspects of design: environmental, social-economic, and architectural. Reconciling those different views and translating them into concrete actions that are the means to achieve sustainable development is a huge challenge, since all three elements of sustainable development must be considered in a balanced way. Over the past decade, the territory of Nukus has been developing dynamically, which affects, first of all, the number of housing and public buildings being built, the nature and quality of urban development with specific (national and climatic) features of improvement. Currently, Nukus uses architectural planning and urban planning solutions with limited landscaping conditions, developed on the basis of the country's experience. Therefore, it is very difficult to talk about compliance with local historical traditions, as well as adaptation to local climatic conditions. But it is impossible not to take into account the design and construction of buildings in accordance with the rich thousand-year-old culture and architecture of Central Asia, its hot dry (summer) and cold (winter) climate with strong dusty winds, and the steppe landscape. The country's current regulatory documents and recommendations for changing the existing architectural and planning system are clearly not enough. As a result, more and more often recorded: the destruction of the urban structure of historical cities; mismatch of housing to climatic conditions, a decrease in the level of comfort of housing; the emergence of contradictions with the way of life of the population, its cultural traditions; a decrease in the socio-economic efficiency of development. Thus, the study of modern experience in the design and construction of housing, the use of an integrated approach in analyzing the conditions of its formation are extremely relevant in this region [1, 2].

Theoretical research on the matter of interaction anthropogenic space with natural space has been widely studied in various fields of knowledge, including an architecture. In these research works are mainly considered the theory and history of development preservation and reconstruction of house architecture improvement, related to its interaction with nature in arid zones, and the study of bioclimatic factors are covered in the works of theorists and outstanding masters. The new researching focuses on learning of the influence of climate on the formation of architectural improvement of residential buildings, where energy efficiency and environmental friendliness of buildings are considered, which mainly consider the rich experience of forming low-rise housing construction and its improvement where particular interest of the dense carpet construction of existing historical zones of cities and its social structure.

There are similar examples of improvement multi-storey residential construction in Nukus mainly four-story buildings were built, which unfortunately, is not sufficiently adapted to the conditions of the natural climatic zone. For multi-storey construction, is necessary theoretical and practical research base, which will allow to justify experimental scientific and practical and design-research works on improvement in this direction [1, 2].

In the Karakalpak experience of formation, which is considered the issues of improvement of multi-storey architecture and a sustainable bioclimatic approach of development and design in arid zones were are considered insufficiently and discretely. The authors of the present researching put forward a hypothesis of a bioclimatic approach to the design of multi-storey dwelling beautification in arid zones, based on the principles of sustainable architecture, taking into account external factors of the Aral Sea region (and partly the city of Nukus) as well as the revival of traditional social relations and their development vertical of the "mahalla" in the residential complex [1].

Creating an enveloping shell of the complex and its streamlined three-dimensional shape, which ensures optimal adaptation of the building to climatic conditions will allow according to the laws of physics, to create a minimum external interface area with the aggressive external environment of the arid steppe zone with dust storms. A stable
microclimate is created inside the courtyard and atrium landscaped space of the complex and maximum isolation from adverse external environmental and anthropogenic influences. Identifying features of a sustainable architecture beautification in arid zones, the use of an ecological approach to the design improvement of a new type of high-rise residential complexes in Nukus is the purpose of the research.

To achieve this goal, the following tasks were solved:
- the prerequisites for a sustainable architecture of improvement in folk architecture were identified, where there should be an adaptability of building improvement to the challenges and risks of a natural and climatic nature;
- analyzed the main directions of implementation of the principles of environmental design in arid zones with maximum availability of resources and reduced energy consumption, should be self-sufficient from the point of view of energy;
- systematized ways of improvement and means of sustainable development as applied to the design of multi-storey multi-functional buildings to Nukus, which should be designed for future generations with the possibility of preservation of traditions and social needs at a high quality level;
- the basic techniques of architectural and spatial organization of landscaping and high-rise buildings and complexes in the conditions of hot dry climate;
- typological models of improvement of a multi-storey residential complex using energy-saving materials for environmental design in arid zones have been developed.

The origins of sustainable architecture are based in folk architecture, and the implementation of techniques for improving multi-storey architecture is possible only if traditions and modern high-tech environmentally sound approaches are used together (see Fig. 1) [1, 3-14].

The object of research is the improvement of the surrounding area, inside the courtyard and atrium spaces of multi-storey residential complexes, which built according to the principles of sustainable architecture, for countries with hot dry climates as well as areas and cities that meet the requirements of eco-sustainable design of the future.

The subject of the research is functional-planning, architectural-spatial methods and means of organizing the improvement of multi-storey architecture of open and atrium spaces for the hot dry and harsh climate of the Aral Sea region, searching ways to improve them within the framework of system proposed by the author (see Fig. 1).
Fig. 1. Examples of the formation of the appearance of landscaping complexes.

Scientific novelty of the work lies in the fact that the example of the oases of the Aral sea region for the first time the features of the formation of sustainable architecture in arid zones, preconditions of sustainable architecture and its improvement in the folk architecture of the Aral sea region, considered a bioclimatic approach to building design for a hot dry climate in the context of sustainable development.

The practical significance is determined by the possibility of using the results of the study for the design of multi-storey buildings, the development of environmental and bioclimatic standards for the city of Nukus and areas with hot, dry and cold climates with strong winds.

The prospects for further development of the topic lie in the possibility of using the results of the study for research on sustainable architecture in other countries and regions with hot, dry climates.

The concepts of ways and new methods of design and construction that lead to an environmentally, socio-economically and safe formation of the environment are considered on the example of oases in the Aral sea region. The prerequisites that determine the construction of energy-efficient buildings are identified: environmental, economic, natural and climatic, urban planning, planning, structural, engineering, stylistic, aesthetic, social.

It is proposed to place energy storage, wind reception and other innovative solutions in this shell; climate, urban planning, planning, structural, engineering, stylistic, aesthetic, social.

Based on these assumptions, the main ideas of sustainable architectural improvement are:
2 Conclusion

The research allowed us to solve an important task for architectural science to identify the features of the formation of a sustainable architecture of improvement in arid zones and the development of a bioclimatic approach in architectural design of buildings. The use of solar energy in southern cities to create a favorable microclimate in housing and urban development in summer which is one of the logical steps in solving the problem of improving the environment.

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