Ecological approaches to creating architectural objects as basis for formation of living environment

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Abstract. The article is devoted to the urgent problem of developing an evolving progressive trend in architecture, related to energy saving, saving resources and the resources, spent in the construction and operation of buildings. The purpose of the article is to identify innovative concepts for solving the problem associated with the measures to preserve the habitat, maintain the ecological balance and reduce the negative impacts of human activities on the natural environment. The leading approach to the study of this problem is based on the tendency to involve new areas of knowledge in architectural research under the conditions of the development of scientific and technological progress. This allows us to outline the contours of the material and technical equipment of a completely new eco-space that provides a quality of life. The materials of the article and the given examples can be useful for the theory and practice of the formation of architectural objects on the basis of ecological approaches to their creation, which can be the key to the development of innovative technologies.

1. Introduction
With the recent appearance of a number of signs of an ecological crisis, fundamentally new trends in the socio-ecological development of mankind and architecture are emerging in society. Recently, the problem of energy saving, saving of resources and funds spent in the construction and operation of buildings has become especially acute for the world community.

Preservation of natural conditions for a normal life on Earth makes us pay more attention to the study of the problem of the ecological stability of the Environment. The development of the concept of sustainable development of architecture and urban planning requires conducting in-depth studies in connection with the exceptional complexity and urgency of this problem.

2. Relevance of the issue
The concept of sustainable development adopted by the whole humanity as an ecological and humanitarian challenge to civilization, in the new information and technological conditions, puts the community in front of the need to find new approaches to using the available resources of the environment. This is due to the recent environmental, socioeconomic and, especially, energy-related changes that have prompted the search for new, including non-traditional solutions to the dwelling and its life support systems. The problem of developing ecological approaches to the creation of architectural objects is a developing progressive trend in architecture and requires the determination of trends in the development of ecological approaches, as well as the identification of the most rational ways of using them in design practice.
Developing progressive direction in the development of architecture, applying new technologies in the creation of architectural objects, is associated with a new attitude to the value of the environment, conservation and conservation of energy. This formulation of the problem attracts many specialists engaged in the formation of a spatial environment in the context of the concept of sustainable development [1-12], as well as specific design solutions and numerous developments made within the framework of this concept [13-20].

The environmental challenge faced by mankind poses a challenge for architects - creatively master advanced technology, and one of the main objectives of architecture in the near future is the full use of technological innovation. The introduction of environmental principles opens great prospects for the use in the architecture of future scientific and technological developments that generate new ideas, which allows revealing the potentialities of architecture and most fully meeting the needs of society.

3. Problem statement
The main goal of the article is to identify innovative concepts for solving the problem related to measures to preserve the environment, maintain the ecological balance, reduce the negative impact of human activities on the natural environment, restore nature using environmentally friendly and restorative methods of management, and improve resource efficiency and preferential treatment consumption of renewable resources.

4. Theoretical part
Architecture as a system for the formation of artificial space is under the influence of the innovative revolution that is taking place in the world. In the conditions of development of scientific and technical progress, new areas of knowledge are attracted to architectural research. This allows us to outline the contours of the material and technical equipment of a completely new eco-space that provides a quality of life. In this regard, it is very important to carefully introduce technological innovations, which often does not pass without leaving a trace for the environment. Therefore, the society has long been facing the problem of ensuring sustainable coexistence of cities with the environment without causing critical damage to it [1].

4.1. Innovative approaches to the creation of architectural objects
Implementation of an eco-system approach to the formation of a quality sustainable human life environment cannot be worked out without providing a huge role for innovation. Developing progressive direction in the development of architecture, applying new technologies in the creation of architectural objects, is associated with a new attitude to the value of the environment, conservation and conservation of energy. In the context of the problem under study, two sections of eco-sustainable development are identified - traditional and prospective.

The traditional approach is connected with the reduction of greenhouse gas emissions, the economical use of resources and energy, the maximum conservation of energy, biological, geophysical resources, minimizing the impacts of negative habitat, environmental of materials.

A prospective approach is characterized by the formation of a new artificial habitat as an integrated ecological system based on the principles of cyclist, migration of functions, dynamic normatively, which achieving ecological balance. In this case, the ecological balance for the formation of eco-space as a new habitat is achieved through conscious intervention, active participation and management of a person and manifests itself in the following forms:

- Design and integrated methods of managing the architectural space, taking into account the principles of self-organization and self-sufficiency;
- Use of the principles of metabolism - feedback and reaction to changes in external influences, self-development and decomposition after the end of life, the possibility of reutilization;
- Application of innovative high-tech means ("smart" buildings and facilities, multimedia facades, interface and sensor systems);
Use “arkology” approach as a balance of environmental and technological, which in research and practice is associated with the concept of architecture and the construction of the future. Consideration of the listed ways to achieve ecological balance for the formation of eco-space requires a deeper reflection of these concepts.

1. At present, individual aspects of the problem of modeling a self-adapting spatial habitat attract architecture theorists to their fundamental novelty as a source of new ideas when solving the problem of creating a comfortable artificial habitat [2-4]. The need to use the principles of self-adaptation of architectural objects is especially acute when creating an autonomous habitat.

2. The use of the synergetic approach to solving this problem allows us to address the formation of the habitat space to the concept of fractal self-organization, which considers the organization of a spatial environment on the basis of the fractal-module principle, which is repeated at different levels and on different scales [5]. This approach provides maximum flexibility of the architectural object in relation to the external environment and uses methods of quick build and modularity [6].

As integrating science, synergetic has developed universal principles of self-organization of complex nonlinear open no equilibrium systems [7]. The development of synergetic and its interdisciplinary nature allow us to apply individual approaches and methods in the formation of eco-space. Among them, strategic management from the future assumes the forecast and construction of ideal habitat models that can meet the needs of people at this stage of society development [8].

3. When creating environmentally friendly objects of architecture, attention is attracted to the principles of metabolism - feedback and reactions to changes in external influences, self-development and decomposition after the end of life, etc. [9]. The use of these principles in architecture will allow in the future achieving ecological balance by technological means, application of high technologies. This includes "smart" buildings and structures with sensor and feedback systems that react to changes in external influences and create objects that grow by the program, as well as self-destroying and self-destructive after the expiration of the operation of the building, etc.

4. One of the trends in architecture, whose followers strive to achieve a balance of technicality and environmental friendliness, is called "arkology", which offers not only new architectural solutions for architects and town planners, but a completely new way of life, using the principles of habitat formation based on the results of technological development and balance with nature in the struggle for new living spaces [10].

4.2. Alternative methods for improving the energy efficiency of buildings

Solving the problem of energy and resource saving entailed the development of architectural and construction methods for improving the energy efficiency of buildings. In this regard, the manifestation in the architecture of the concept of the formation of eco-objects occurs using the following energy-efficient principles [11]:

- energy efficiency - the maximum number of measures aimed at saving fuel and energy resources is carried out in the design, construction and operation of buildings;
- energy activity - it is envisaged to use devices equipped with the ability to capture, convert and transfer energy from renewable primary and secondary sources.

The development and creation of ecological systems based on the use of renewable energy sources have emerged as an alternative trend in architecture. This was dictated by the need to implement activities related to minimizing the impact of negative habitat, as well as the development of a strategy for the economic use of non-replaceable sources, such as raw materials, products and energy sources. Renewable energy sources, in particular, include: solar energy, wind energy, hydropower, tidal energy, geothermal energy, biomass energy.

In the practice of designing and constructing architectural objects, many solutions have emerged that use a variety of renewable energy sources and new energy technologies that manifest themselves in certain properties.
1. "Helioenergetic" activity is manifested in buildings and structures designed to generate other types of energy through the capture and transformation of solar energy, which is one of the most rational alternative energy sources.

One example of the collection of solar energy is the "Artificial Lilies" complex floating on the River Clyde in Glasgow, which will also provide electricity to municipal institutions (the project of the Scottish architectural firm ZM), by using special solar batteries floating on the water where it concentrates more sunlight [12].

Another example is the object "Solar Stadium", where all devices that require power supply, will receive it directly from the photocells. Such a stadium performs a dual function - at a time when the stadium is not in use, its accumulated solar energy meets the demand for electricity in 80% of neighboring buildings [13].

2. Wind "energy activity" is associated with the allocation of architectural objects with an additional function to capture and convert wind energy to other useful types of energy - electrical, thermal, mechanical, etc. To enhance the effect of collecting wind energy, methods of building up buildings are used. An example of the use of wind as an energy source for buildings in a modern city is the 25-storey COR tower - a "green" building designed for Miami (Chad Oppenheim architecture + design, Buro Happold and Ysreal Seinuk), where apartments, offices, cafes and the shops. In its composition, in addition to solar panels and collectors for water heating, wind turbines are also located, which are located in the upper part of the building [14].

This can also be referred to as the "Tower of Clean Technologies" - is a huge building of unusual shape, which is supposed to be built in the center of Chicago (American architects Adrian Smith and Gordon Jill). In connection with the use of wind and solar energy to obtain the necessary electricity and ventilation of the premises, the tower has a convex shape. At the corners of the building there are turbines that use wind energy to ventilate the interior space of the premises [15].

3. "Hydroenergy" activity is associated with the use of hydro and geothermal energy, which, as a renewable form of energy, is less potential, but is different seasonally-daily stability. Low-potential geothermal energy is used to reduce thermal loads on the building's heating system by extracting the unconverted heat of low potential from the ground and connecting it to the outer fence. Expanded use of low-potential geothermal energy for heat and cold supply of buildings occurs through systems with a heat pump.

4. "Bioenergetic" activity is based on the principles of using biogas as the final product. Multistage conversion of solar energy initially assimilated in the biological mass and then converted into gaseous fuel. According to their architectural and planning solutions, such facilities do not differ from conventional buildings. An example is an ecological power plant that should be built in the UK and will work mainly on the corn kernels of palm fruits. This solution is very practical and inexpensive, as the aforementioned raw materials are abundant in the world market and its price is more attractive than traditional fuels from the bowels of the earth [16].

4.3. Technological methods of ecological balance of the natural and technological component

Among technological concepts in the context of the problem under consideration, it is necessary to distinguish [17]:

- Resource-saving concepts mean the maximum conservation of energy, biological, geophysical, etc. resources. Here one can single out the concepts of an "autonomous house" and a "zero house", consuming a minimal amount of resources and allocating waste that does not violate the circulation of substances;

- Reflection concepts provide for the organization of sensory systems that perceive external signals from the environment or the inhabitants of this environment, and then adjust it in accordance with the received data. These include the concept of "second skin", as well as the concept of "smart" house.

It is absolutely clear that the creation of an energy-efficient building is impossible without the use of technological and constructive solutions that solve a number of problems that have arisen as a result of exploitation. Technological methods are introduced into many building projects for the heat
protection of glass walls. One such technique was the use of a second glass shield behind a normal double glazing - the so-called "climatic walls". This technique was often used in office buildings, where behind a double glazing a composite layer was formed from the solar battery system, mainly controlled by special blinds. There were many projects of facades with "double skin". So, in the project of the new ING office, located near Amsterdam (Future Systems architectural group) - the task was to create a building with a high level of energy saving and noise protection.

2. To create a comfortable microclimate for human life and air-thermal regime, the so-called "thermos" effect can be used. This is achieved by the device of a high-efficiency double shell with a heat-insulating air layer. This method allows to achieve good tightness and heat protection of the internal volume and to accumulate heat from the environment in the form of passive solar energy conversion. Between the facade and the glass core of the building there is a distance of one meter, when heated, convective airflows arise that promote natural ventilation of the entire structure [18].

3. The principles of the use of ecological integrated systems for the creation of architectural objects find their embodiment in the work of the architect Ken Yang. The direction of his work is bioclimatic architecture, based on the principles of which it is planned to create a concept for the development of settlements in the future: economy, ecology, the use of passive energy. Young develops principles of construction and form for high-rise buildings in South Asia and calls them "bioclimatic" skyscrapers, develops principles of ecology [19].

His most famous works include the office tower in Tokyo in the Nara district (1994). A vertical green garden raises spiral around the tower to its top. On the garden there are loggias and terraces. The building uses a glass facade and sun blinds.

5. Practical the significance
The above examples of innovative concepts of habitat formation illustrate the paradigm of ecological balance of the natural and technological component of society. In this system, the architectural object of eco-sustainable development consumes a minimum amount of energy and water during existence; efficiently uses raw materials (eco-friendly renewable materials, has a long life cycle and the possibility of dismantling), produces a minimum amount of waste and pollution during life (longevity, reuse), uses the minimum amount of land and integrates well with the natural environment, satisfies the user's needs and creates a healthy internal environment [20].

In most modern buildings, such technologies do not have the necessary technical equipment and are rarely used in complex systems of the entire architectural object. Their huge potential, expressed in intellectual and material resources, can be the key to the development of technology.

6. Conclusion
As a result of the consideration of the problem of the formation of a resource-saving spatial habitat, ecological approaches to the creation of architectural objects as the basis for the formation of an environment for vital activity have been identified in the following areas:

1. In the context of innovative approaches to the creation of architectural objects, the following techniques are considered:
   – Design and complex management methods of the architectural space, taking into account the principles of self-organization and self-sufficiency;
   – The use of the principles of metabolism - feedback and reaction to changes in external influences, self-development and decomposition after the end of life, the possibility of reutilization;
   – The use of innovative high-tech equipment ("smart" buildings and facilities, multimedia facades, interface and sensor systems);
   – The application of the “arkological” approach as a balance of environmental friendliness and manufacturability. In addition, technological concepts of reflection and resource-saving were identified.
2. In the context of alternative methods for improving the energy efficiency of buildings, energy-efficient principles are defined: energy efficiency (aimed at saving fuel and energy resources) and energy activity (using renewable primary and secondary energy). In this regard, an alternative direction in architecture has been identified - the development and creation of ecological systems based on the use of renewable energy sources, manifested in certain properties: solar energy, wind energy, hydroelectricity and “bioenergetic” activity of buildings and structures.

3. In the context of technological methods of ecological balance of natural and technological components, innovative concepts are revealed: climatic walls and facades with "double skin", the effect of "thermos", and the direction of "bioclimatic" architecture.

In this way, the basis for the concept of the formation of the eco-space should be the vital factors for society to maintain the necessary balance between the developed and natural areas, achieving an ecological balance between the urbanized and natural environment. Technical progress has a huge impact on all areas of human activity and leads to the engineering of architectural thinking. This forces the architect to use innovative technologies from other areas of production and challenges the society with new architectural tasks.

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