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TÍTULO: La arquitectura y los problemas de las innovaciones del agua dulce.

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RESUMEN: Los problemas de la influencia de la crisis del agua dulce en la arquitectura ambiental innovadora se han considerado en el presente documento. El autor da la característica generalizada de las crisis globales agudas que enfrenta la humanidad, destacando las características de la crisis de agua dulce. En conclusión, se revela la predicción de un problema emergente y el orden de investigación, así como se identifican tendencias en el desarrollo de tendencias arquitectónicas innovadoras en el aspecto de su influencia en la crisis del agua dulce.

PALABRAS CLAVES: Arquitectura, crisis, agua, innovaciones, cambio climático global.

TITLE: The Architecture and the problems of innovations of Fresh Water.

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ABSTRACT: The problems of the influence of freshwater crisis on innovative environmental architecture have been considered in the present paper. The author gives the generalized characteristic of acute global crises faced by humanity, highlighting the characteristics of the freshwater crisis. In conclusion, the prediction of an arising problem and the order for investigation are revealed, as to identify trends in the development of innovative architectural trends in the aspect of their influence on the freshwater crisis.

KEY WORDS: Architecture, Crisis, Water, Innovations, Global climate change.

INTRODUCTION.

Architecture cannot develop without restrictions. Gravity, anthropometry, ergonomics, society, economy, geography, climatology and thousands of other factors have formed the architecture and its archetypes in their present form.

The aggravation of global crises makes modern architecture adapt to a rapidly changing environment, taking on previously unusual functions. The complexity of the problem is that, because of the massiveness and high cost of architectural structures, we cannot conduct experiments similar to experiments on Drosophila in genetics. Nowadays each environmental architectural project is becoming an attempt to guess the scenario of the future life and future functioning, the contours of which cannot be predicted even approximately.

Many scientists believe that the architecture can and must become a universal medium, a "buffer" between humanity and nature. Extending the idea of architecture, we are stating that it is possible to create an artificial habitat that will eliminate the harmful effects on the nature caused by the satisfaction of vital needs of 7 billion people living on our planet today. But one certainty, that the architecture can be a panacea for numerous global problems of mankind, is not enough, it is necessary to have a clear idea about the means and methods of creating an environmentally positive architectural environment. Today no one possesses such a representation. Fragmentarily, we have learned to successfully solve some problems, but it is impossible to imagine the behavior of a whole architectural system, which became the super complex conglomerate of technologies, concepts, and, oddly enough, the environmental ideology (Abishov et al, 2018; Barreto & Alturas, 2018; Shirvani et al, 2015; Ajallooeian et al, 2015; Bakhmani & Singla, 2019).

The works of following scientists arise interest in the context of present research: Sosa-Nunez et al, S. Silverstone et al, Weizman et al, Newman et al, Kassam et al, Evans et al and many others. The analysis of the impact of a freshwater crisis on innovational eco-architecture presented in the article resonates with the abovementioned developments (Sosa-Nunez & Atkins, 2016; Silverstone & Nelson, 1996; Weizman, 2012; Newman & Jennings, 2012; Kassam et al, 2009; vans & Davies, 2014).

DEVELOPMENT.

Research results.

Equitable distribution of fresh water poses the same explosive and far-reaching political puzzle as global climate change (Sosa-Nunez & Atkins, 2016; Cosgrove & Cosgrove, 2012; Marino & Ribot, 2012).

The project "Biosphere 2" is a great example of how difficult it may be to create a super complex, functioning architectural system - the construction simulating a closed ecological system, built by «Space Biosphere Ventures» company and billionaire Edward Bass in the Arizona desert (USA). The main objective of the experiment was to find out whether the person would be able to live and work in a closed environment. In the distant future, such systems may be used as standalone settlements in space, and in the case of the extreme deterioration of the living conditions on the Earth (Silverstone & Nelson, 1996).

The laboratory is a network of sealed buildings with a total area of 1.5 hectares of lightweight materials, with greenhouses containing about 3 thousand species of animals and plants, with the volume of the atmosphere about 204 thousand M3 of air (Dickson & Fanelli, 2013).

It was assumed that in case the project would be successful, its achievements might have been used to create stand-alone settlements on distant planets of the solar system. In addition, the "Biosphere 2" complex could be used in the case of global environmental degradation on the Earth itself (Wall & Gong, 2001; Marino & Odum, 1999).

For the life of four women and four men, several different biomes were created in the Biosphere 2 complex, including desert and savannah, rainforest and ocean with a coral reef (Nelson et al, 1993). Besides it naturally contained a residential unit, an agrocenosis module where settlers have been growing fruits and vegetables, and the place where the goats, other members of the project, were grazing.

Researches paid special attention to the species composition of the project to reproduce the natural cycle of substances as carefully as possible (Mazzoleni, 2013). This process included a decomposition of organic matter, including wastes of the participants of the project (Giffaut et al, 2014). From an architectural point of view, there were no complaints against developers of the architecture of the project, but it turned out to be extremely difficult to simulate terrestrial biosphere.

The list of problems was headed by the lack of oxygen. As it turned out, the plants despite the thorough preliminary calculations could not provide normal oxygen content in the project modules. Gradually, with the first weeks of the start of the project, oxygen levels started to drop. As it was proposed by the scientists working in the project, it became the result of the activity of soil microorganisms. As a result, the decision had been made to pump oxygen from the outside.

Another problem faced by the participants in a closed ecosystem was the lack of food (Gitelson & Lisovsky, 2003). It turned out that the area set aside for agrocenosis was too little to be able to feed 8 people. To solve the problem, it was necessary to increase the density of grain showing and as for the tropical forest, the settlers had planted bananas and papayas there.

The third problem faced by the participants of the "Biosphere 2" artificial ecosystem is the inability to control the growth of pests, the number of which was constantly increasing (Gitelson & Lisovsky, 2003). According to the terms of the project it was not allowed to use pesticides - and the participants had to manually collect the pests, and in addition, breed their natural enemies.

During this large-scale experiment, it has been found that the lack of wind had a detrimental effect on the trees (Bolund & Hunhammar, 1999).The lack of pressure from the wind on the tree trunk results in the softening of the trunk so that it breaks under its own weight (Mattheck, 2012).

Besides the psychological discomfort in a small group of people living closely together had its effect as well. Firstly, one of the participants of the experiment had a serious injury during the first month of the project - a woman cut off her finger, and doctors fell to sew it properly, as a result, she had to leave the project. A situation between voluntary settlers escalated to such an extent that they have split into two camps - hardly standing each other's company (Weizman, 2012).

Turning to the environmentally bio-positive architecture of sustainable development, which is capable of operating in a wide range of emerging crises, a number of issues that cause some difficulties appear (Hall & Tewdwr-Jones, 2010). Considering the modern city as a single, super complex system of an interweaving of thousands of related data, sometimes mutually exclusive, we can say that according to the level of organization and the forecasts of problems in operation, eco-area and eco-city are not simpler and sometimes even more complex than the "Biosphere 2" project. As a result, it cannot be stated that we fully imagine what reaction can the system "eco-area - environment - society" have, when the system is subjected to the perils, to stand against which it was actually made for, Therefore, it is important to first divide the problem into basic components and then start analysing the problems of their combination and interaction. In our opinion, the review of the architecture of sustainable development in terms of its resilience to the global crisis bears much interest (Escobar, 2011).

Today, scientific research in the field of sustainable architecture is deployed so widely, that, in fact, has affected all areas of human activity (Hall & Tewdwr-Jones, 2010). Summarizing opinions of the majority of researchers of architectural perspectives of sustainable development, the concept can be described as the organization of artificial human environment so that it is capable to indefinitely long maintain the life potential of its users in the face of the deteriorating global crises and scarcity of vital resources without causing damage to the environment.

The main crisis, which became the source of all others is the demographic one (Newman & Jennings, 2012). Under the demographic crisis, we understand the discrepancy between the population of an occupied territory and its failure to provide residents with vital resources (Kassam et al, 2009). Demographic crises cause global crises: environmental, social, economic, energetic, cultural and informational ones.

The first and the most difficult crisis, which humanity will have to face is a freshwater crisis. Considering its relationship with the architecture it is necessary to allocate two basic parameter issues: quantity and quality. Actually, the core of the question is hidden in these two parameters and varies from region to region. In science, it is accepted to assess the problem of fresh water in the region by the number of the resource corresponding to a consumer standard and available per capita per year. This evaluation allows to obtain adequate data and build predictive assumptions about what innovations associated with fresh water are used to be placed in each specific location.

An example of Egypt clearly demonstrates the need to precisely assess the poll. Nearly the entire population of the country - 95% - is settled along the Nile (Milliman et al, 1989). The river is the only source of fresh water, giving both drinking water and moisture for irrigation (Postel et al, 1996). Fifty percent of a country's energy is produced by the country's hydraulic buildings (Evans & Davies, 2014).

The average annual flow of the river is about 7,000 km3. According to the Nile agreement (Agreement of 1959), annually Egypt can apply 55.5 billion cubic meters (Nile water). With a population of 30 million people (true for Egypt in 1959), there have been nearly 2,100 cubic meters falling to share of each citizen of the country, making Egyptians rich in water resources, even by international standards. According to the program of Water Resources Planning in Egypt "…in 2025, Egypt's population will be over 90 million people, this means that a share for each citizen will be equal to 337 cubic meters per year" (Simonovic et al, 1997).

In total, there are four main sources of demand for water: agriculture, power generation, industrial use, and domestic consumption. Taking into account all these needs, the minimum rate of water resources per capita is estimated at about 1,000 m3 / year (Marino & Ribot, 2012).

Considering the problems of the four major aspects of the provision of freshwater resources, the architectural concepts can be found for each of them. The area of problem coverage is impressive - from the concept of reducing the demographic pressure on the acumen through the growth of cities in the vertical to the local systems of water recycling in separate buildings. Most nominated architectural concepts are based on real technology. The range of data on the issue and the lack of methods and recommendations for dealing with them make many architectural schools seek their own, original way of working with environmental innovations.

Not without interest in the search for optimal solutions to environmental problems in architecture, and in particular, the problem of fresh water, is a system of voluntary environmental certification. The idea of green standards is interesting under the conditions when it is impossible to clearly and for a sufficiently long period legally formalize the environmental requirements for architectural objects. This system offers a scored assessment of the very principles and effectiveness of the technologies used. This system is unique thanks to its flexible impact of eco-positivity on the economic component of the architectural project. It is known that the market prices of buildings that had received the highest scores according to the voluntary environmental certification systems, for example, according to LEED, BREEAM, and DGNB, grew significantly since then.

Considering the requirements of the standards, it can be noticed how much attention they paid to the problem of fresh water. The main rating LEED New Construction and Major Renovation are divided into six groups of requirements:

- First group - location requirements.
- The second group -requirements of efficient consumption of water during the operational phase.
- The third group - energy efficiency requirements during the operational phase.
- Fourth group – the requirements for the use of building materials.
- Fifth group - requirements for the health and comfort of consumers.
- Sixth group - requirements for innovation and the complexity of the design.

LEED certificate may be platinum, golden, silver or basic. To achieve platinum certification, it is necessary to correspond to more than 73% requirements, to achieve the golden one - to 55% requirements. This means that to achieve a high level of certification one does not necessarily need to meet all requirements. But there are seven stringent minimal conditions (Dickson & Fanelli, 2013).

BREEAM rating represents the requirements in the following branches:

- Management.
- Health and comfort.
- Energy efficiency during the operational phase.
- Transport accessibility.
- The efficiency of water consumption during the operational phase.
- Use of building materials.
- Environmental pollution during the operational phase.

BREEAM assessment system, unlike the LEED, is characterized by the ambiguous structure of the LEED requirements. On the other hand, BREEAM (unlike LEED) does not require compliance with the minimum requirements for the maximum number of groups. BREEAM certification line is as follows: "outstanding", "excellent", "very good", "good" and "basic". It is necessary to carry out about 70% of the requirements to achieve a level of "excellent" (Wall & Gong, 2001).

DGNB is a German certificate of sustainable building. According to this rating, the characteristics of the object, its location and the respective processes inside and outside of the object are divided into the following groups:

- Environmental quality parameters of the object (the impact on the environment, the use of resources).
- Economic parameters (life-cycle costs and stability of the object value).
- Socio-cultural parameters (health and comfort, functionality and appearance of the object).
- Technical parameters (efficiency of the equipment, etc.).
- Quality processes (quality of design, construction and operation); качествоместорасположения (факультативнаягруппа, рассматриваетсяотдельно) (Marino & Odum, 1999).

However, with all the relevance and effectiveness of voluntary environmental certification systems, they cannot (and should not) evaluate the architectural object as an actively functioning part of the natural system. To illustrate this thesis, we will cite the concept of a vertical urban agricultural enterprise by Newman et al (Ewman & Jennings, 2012).

The concept of "vertical farm" is a highly agricultural complex, housed in a specially designed high-raised building. As to the technological basis, such well-established methods of growing plants as a hydroponic and aeroponic method can be applied there.

By maintaining a certain temperature and atmospheric microclimate inside the farm, it will be possible to grow certain cultures and gather harvest year-round, eliminating the need to purchase the missing products in other regions.

Vertical farms will help to return a significant portion of agricultural land back to nature, gradually recovering them after their aggressive agriculture with the use of chemicals and fertilizers. This step will increase the number of forests, which in turn will contribute to reducing CO2 levels in the atmosphere. According to currently available data, 1 hectare of a closed hydroponic greenhouse is equivalent, depending on the culture to 4-6 hectares of open space. For example, for growing strawberries, 1 hectare of closed area is equivalent to 30 hectares of open.

A completely independent eco-system is in-created inside the vertical farm. This eco-system creates favorable conditions for growing certain agricultural species and excludes not only negative impact of natural factors but also penetration of insects and diseases.

Vertical farms will allow to completely abandoning the use of herbicides, pesticides, and fertilizers, providing the population with natural organic products. The use of hydroponic and aeroponic technologies, precluding the use of the soil, will release the plants from numerous soil pests and diseases (mole crickets, nematodes, sciurid, rot, fungal disease, Phytophthora, etc.).

The projects of vertical farms suppose using equipment for wastewater collection and treatment systems. Moreover, it is planned to collect the water formed as a result of evapotranspiration - the evaporation from the surface of plants (Rasouli et al, 2019; Keerthana et al, 2017).

Vertical farms do not need tractors, combines, and other agricultural machinery. The finished products are delivered to the nearest shops and restaurants. All this will help reduce transportation costs and reduce consumption of the planet's resources, needed for the production of equipment and maintenance of its fuel (Mazzoleni, 2013; Hosseinzadeh et al, 2019).

Nowadays, when trying to prove the economic feasibility of building of vertical farms, the questions of water and surrounding lands renovation are not considered as a part of the economy. Moreover, the question is not considered in the context of the public good when potentially combining the economy of a vertical farm with sustainable forest management released as a result of creating a farm community, is potentially able to obtain a significant environmental and economic benefits. However, in order to approach the subject from the perspective of different investors (the farm alone, and the forest alone) the project turns out to be insolvent.

CONCLUSIONS.

Thus, considering the problem of the influence of freshwater crisis on the architecture, there reveals a number of problems, which the architect, as part of their profession cannot cope on their own, and as a result, a problem of prognosis and the order of studies start coming out to the forefront of the forecast.

We can say without overstatement, that nowadays the problem is technically solved, but from the point of view of society, it remains an open question. According to various prognoses, we will start feeling all the acuteness of the water crisis by 2025, and by 2050, it will reach the peak, which will determine the format of the existence of mankind in the future (Evans & Davies, 2014; Cosgrove & Cosgrove, 2012; Ahmadi Kamarposhti & Geraeli, 2019).

Architects need some boundary, quantitative parameters of the future, in which it is possible to design the architecture that, in a fairly wide range confront emerging crises. It is hoped that we will have time to reconsider our attitude to nature and our place in it and prepare a set of ideas about what should the architecture be like within the "green consciousness" framework.

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