



General analysis of the Application of the Architectural Bionics in the Renovation and Reconstruction of Building Objects

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Abstract

Bionic architecture brings new horizons to human beings that can be used to sustain and reduce environmental damage. Another advantage of Bionic architecture is that it utilizes natural biological methods to solve design problems in modern life. The aim of this paper is to discuss the general concepts of architectural bionics and environmental renovation of construction sites, analyses the stages of formation and development of these areas in the context of modern trends in the sustainable development of the North Caucasian territories. So, we have... As it observed, architectural and bionics practice gives rise to unusual architectural forms that can be considered original in their aesthetic qualities, while the functional and strength qualities are not lost. Moreover, trends in the modern construction industry are reduced to that the design and reconstruction of buildings are advisable within the framework of the environmentally friendly concept so that energy sources must be renewable, and the object used in construction, itself becomes part of the environment. It can be concluded that an environmentally-oriented approach to changes in urban infrastructure as a method of updating and modernization is becoming a priority in the construction industry of the North Caucasus region.

Keywords: Architectural Bionics, Renovation, Reconstruction, Environmentally Friendly Construction, North Caucasus

1 Introduction

Architects and building designers believe that nature-inspired designs can help reduce environmental damage from buildings. Jeronimidis believed that "Nature has provided us with the most versatile, practical, precise, harmless and environmentally friendly solutions. Just look carefully and identify them and then, with the technical understanding, apply them in the industry and give them a scientific perspective" [1].

The issue of preserving and maintaining the ecological balance is acute around the world due to the growing man-made impact on the environment. In developing the concept of sustainable development of human settlements, the policies of many states are aimed at creating the most favourable conditions for society. One of the modern architectural directions is bionics. Creating a comfortable urban environment for life is a set of spatial tasks to be solved in the field of architecture and urban planning. Thus, the application of the ecologically oriented approach in this area is becoming logical. Almost all the innovations of architectural and urban planning policies with the prefix "eco" carry a social aspect that is closely intertwined with the economic one [2-4].

From the earliest starting point, people have looked to motivate nature and the earth around them to assemble and plan their own places and gadgets. Meanwhile, bionic is a science that can tackle specialized and auxiliary issues in an organic manner, at the end of the day, it can rouse living examples. Furthermore, right now, engineering can impact the nature of the completed

item and make the procedure that enduring [5]. Scientists checked on the field of structural bionics and its verifiable foundation. They built up how different practical components of live structures, nature overall, and building shape development collaborate and connect. Furthermore, the essential elements, impacting the shape framing components of the design structure, were distinguished and the primary terms, related with bionic shape development, were demonstrated. Finally, the improvement of the bionic building style was studied [6]. The laws of formation of living organisms, their structure, design features and principles of operation in the design of structures and constructions has been studied considering different areas of bionics. Particular attention is paid to architectural bionics in terms of the choice of optimal design. They concluded that the combination of bionic principles and optimization methods creates the basis for developments of bionic [7]. Biomimicry or gaining from nature in engineering is a strategy that means to build up a manageable plan answer for present day world difficulties by copying models, frameworks, and components of nature. A combination approach between both biomimicry and vernacular design in cutting edge engineering as "Vernomimicry" was utilized to apply nature based and nature like arrangements in engineering effectively [8].

After World War II and the beginning of the sixties of the twentieth century, logical trades among regular and specialized sciences prospered. During a gathering in Ohio, sorted out by the US Air Force in 1960, a word called "bionic" was first

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presented. Bionic initially took a gander at machines that were planned and based on live frameworks, and now Bionic is about the craft of applying live frameworks information to taking care of specialized issues. Building inspiration is one of the tendencies of bionic architecture that the designers of the field achieve due to the strength of the structure for breathing, through straight lines or pure curves and a slow induction of structural integrity. The most important thing about bionic architecture is that the building can induce its viability. The point of this paper is to examine the general ideas of compositional bionics and natural redesign of building locales, investigations the phases of arrangement and improvement of these zones with regards to present day inclines in the practical advancement of the North Caucasian regions. For this purpose,

It is expected that a naturally arranged way to deal with changes in urban foundation as a strategy for refreshing and modernization is turning into a need in the development business of the North Caucasus area.

2 Methodology

2.1 Architectural-bionic

Bionics, also called biometrics or bioengineering, is the application of systems and biological methods found in the nature to modern systems engineering and technologies. Sometimes, bionics is considered as the art of applying live systems knowledge to solve new technology problems. It is believed that nature produces products without contamination that perform far better than human handmade products [9]. Some of the features of nature to the model include: (a) moving on to more optimization and effectiveness; (b) less energy use and higher efficiency; (c) less agglomeration and outflow of materials; (d) evolutionary growth and adaptability; and (f) self-organizing. Also, there is consensus that bionics could be structured in terms of applied analogical research into three main areas:

- Construction bionics: structures of nature;
- Processing bionics: methods and processes of nature;
- Information bionics: means of data transfer, developmental, and evolutionary strategies
- In a more detailed fashion, this classification may be further refined according to certain fields of applications (Fig. 1).

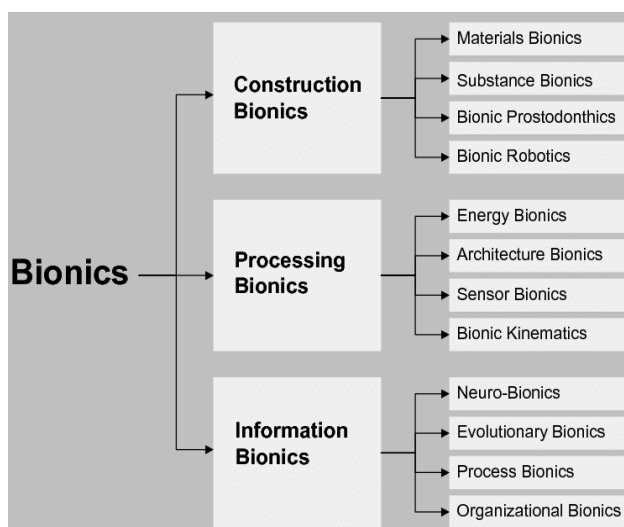


Figure 1: Bionics – its main areas and fields of applications

Bionic is derived from the Greek word bion, meaning the unit of life. Others see the term as a combination of biology and electronics. The idea of using natural patterns in modern technology seems to work very well because these patterns have evolved and are unique in every respect. Bionic architecture is a method for plan wherein the making of compositional spaces with mechanical methodology and supportability is done from the method for development and arrangement, vitality supply and digestion, the method for the appropriation of powers, and etc. in living organs. This combination of biology and technology has enabled new innovations in energy production, ecological support and economic-ecological programs [1, 3].

Architectural-bionic science is a synthesis of relevant practice and theory. If the architectural-bionic practice is a process of using the shaping laws from living nature, which has occurred and is often happening intuitively, unconsciously, then architectural-bionic science is aware of this process and directs it according to the laws of modern construction and architectural practice. Architects emphasize that the use of designs on nature and natural patterns is a vital and economically viable issue. With a new approach to design and architecture, these architects are trying to bring the artificial environment and nature together. Bionic architecture is not limited to the use of natural elements in architecture, but rather the rules within the natural components of the organism's body structure to the molecular arrangement of viruses to create habitable spaces for humans.

Architects aim to enter the bionic world of innovation in architecture. By exploring common areas between architecture and biology, architects seek to identify suitable patterns and discover novel ideas and transfer biological properties to architecture. Transferring biological criteria to architecture requires consideration of common areas of architecture and biology. Their goal is to use bionics as a tool in architectural design. It is obvious that common issues in architecture and biology have not yet been fully explored. Many researchers around the world are investigating and discovering these commonalities, which many of them have led to successful architectural advances. Previous studies indicated that solving some of the architectural issues is only through innovative solutions. Nature-inspired patterns can give rise to creativity and innovation in the mind of an architect. The first step is to apply biology to architecture or, in other words, to bionics in architecture when a project requires sensory innovation. Especially in cases like: (a) architectural design for new environments; (b) architectural design for the renovation; (c) problems that cannot be solved by common knowledge; and (d) better communication between architecture and the environment.

2.2 Renovation

The society and civilization development level require new conditions for the formation of the urban environment; the old methods of forming cities are beginning to become obsolete. In modern construction, various approaches to the transformation of cities are used - reconstruction, renovation, modernization, re-functioning, and revaluation. Renovation, as the most humane approach to the transformation of the urban environment in its essence, allows implementing environmentally friendly principles to a greater extent among all methods.

Application of architectural bionics to urban renovation territories is exclusively focused on increasing their social value, creating environmentally safe and comfortable conditions for residents to stay at all levels of life in a city. Thus, environmental renovation is such an approach to transforming the urban environment that unites people and wildlife, creating environmentally friendly living conditions for the urban

population, and minimizing negative environmental impacts. The goal of ecological renovation and architectural bionics is to change the technical characteristics of objects in such a way as to increase their level of environmental friendliness, and to maintain the ecological balance within urban entities with the help of modernization. The objects are residential, public and industrial buildings and structures, and various infrastructure objects. This direction should meet the ecologically oriented sustainable development urban policy in the North Caucasus, which provides for a combination of economic development, sociocultural progress, nature conservation, and environmental optimization [3-5].

At this stage, architectural practice is interested in energy-efficient and self-regulating systems. We can even assume that in the future the transition of the forms of matter will be relevant. It can be noted that over the past decades, the use of the wildlife morphogenesis laws has taken on a new quality, received the name of the architectural-bionic process, and has become one of the relevant and promising directions of the architecture development.

2.3 North Caucasus

The North Caucasus is the northern part of the Caucasus. As can be seen in Fig. 2, the Caucasus is an area between the Caspian Sea and the Black Sea. The North Caucasus is one of the four federal districts of Russia which communist era played a special role in the evolution of its architecture. At the beginning of this period, the traditional architectural trend was broken and new styles were introduced which were quickly forgotten after the collapse and new styles emerged.



Figure 2: The location map of North Caucasus [10]

The simplicity and popularity of the architecture of North Caucasus are evident at the beginning of communism and the grandeur and sophisticated decoration of the late period. The creation of vast urban spaces and wide and long streets symbolizes the power of communism. The ideal of communism for the masses in high-quality housing has been realized, regardless of indigenous identity and quality of life; creating compact, tall apartments and designing minimal-scale residential spaces that will serve as a hostel.

After about five centuries of confrontation with Russia and the Renaissance phenomenon and its implications and realities, and three centuries of modernization efforts, Russia is still struggling with the problem of modernization. This concept

seems to be an unresolved issue or a tragedy in the minds of statesmen and academics.

3 Discussion

As already mentioned, the concept of "Renovation and modernization" implies a paradigm shift. This concept has become a necessity for different countries, including the North Caucasus, following the Western Renaissance and under the influence of the Industrial Revolution and the growing trend of modernization in the West and the development of communications. Russia is one of the societies in which the issue of modernization is of particular importance. Among the many methods of transforming the urban environment in the North Caucasus region, renovation and reconstruction using the principles of ecological construction have recently become widespread. Renovation is the process of replacing the capital goods withdrawn as a result of moral and physical depreciation by new capital goods. It is important to note that this substitution process should be carried out without destroying the integrity of the structure. This is a key specificity of renovation.

Upon the complex transformation of the historical urban environment, it is necessary to consider this measure as an innovative process with the mandatory inclusion of new elements, patterns, methods, techniques, technologies and also the materials in conversion. Such an approach, inter alia, will make it possible to be included in the context of modern trends in the spatial organization of the environment in the North Caucasus region of the Russian Federation. Building renovation is carried out in different ways in a number of main areas - the renovation of the facilities themselves and the renovation of territories. This approach allows us to implement modern environmental principles in architecture and urban planning. Renovation is applied both in European countries and in various regions of the Russian Federation.

Reconstruction is a fundamental reorganization and alteration for the purpose of improvement of organizational and technical measures aimed at eliminating the moral and physical deterioration of buildings as a whole or their individual elements and systems. Reconstruction of an object, as a rule, is part of the general reconstruction of the urban area, housing estate, or a quarter of the historical core of a city caused by the improvement of the complex of its social and cultural institutions. Depending on a particular urban development situation, the availability of park zones, forests, water bodies, the proximity of public spaces and recreation areas to natural components, the remoteness of pollution sources, it is possible to identify areas or methods of ecological renovation used in the North Caucasus region:

1. Inclusion of water basins in landscaping;
2. The spatial separation of traffic and pedestrian flows, creation of pedestrian greened streets in a residential quarter;
3. Multi-level landscaping;
4. Noise pollution protection;
5. Flexible planning solutions for residential buildings with modern energy-efficient solutions.
6. Internal modernization of engineering communications and design features;
7. External upgrade.

An analysis of the construction industry in the North Caucasus region made it possible to single out a number of tasks necessary for the development of green construction and bionic architecture:

- creating a favourable human environment;
- solving problems of regional importance related to the implementation of energy conservation policies;

- stimulating the development of highly environmentally friendly production of materials and equipment in the region;
- professional development of specialists involved in the construction process;
- Development of the scientific base for "green" construction.

4 Conclusion

It can be concluded that an environmentally-oriented approach to changes in urban infrastructure is becoming a priority in the construction industry of the North Caucasus region. Subsequent improvement, popularization, and application of this approach in theory and practice are associated with the development and use of progressive domestic and foreign experience. Ecological renovation, the use of architectural bionics in the reconstruction and modernization of industrial and civil buildings and structures provides for the creation of an environment conducive to life, providing healthy and safe conditions harmoniously combining the social and engineering infrastructure produced by humans that supports the natural balance.

Ethical issue

Authors are aware of, and comply with, best practice in publication ethics specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests and compliance with policies on research ethics. Authors adhere to publication requirements that submitted work is original and has not been published elsewhere in any language.

Competing interests

The authors declare that there is no conflict of interest that would prejudice the impartiality of this scientific work.

Authors' contribution

All authors of this study have a complete contribution for data collection, data analyses and manuscript writing.

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