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FORMATION OF THE METHODICAL-ANALYTICAL SYSTEM OF INDICATORS OF PROVIDING BIOSPHERE-COMPATIBILITY AT THE PREPARATION AND ORGANIZATION OF CONSTRUCTION

Abstract. *The article is devoted to the development of an innovative methodological base and applied tools «organization of biosphere compatibility building» (BCB), which is designed in the format of modern construction development to implement updated national standards of environmental and energy saving construction. In this study, biosphere-compatible building is grounded as a leading component of integrated organizational-technological reliability of construction projects and, at the same time, as a productive format for organizing the life cycle of construction projects on the basis of ecological and energy-saving, subject to the submission of modern organizational and informational and analytical technologies of construction development. Unlike traditional ideas in the organization of construction, the subject of consideration is not only the construction phase, but also pre-investment, including the beginning of an investment plan, where the requirements for biosphere compatibility are formed and consider the policy requirements for the bio-environmental environment of the project, agreed upon by the customer, investor and future consumers. The finished products of the project should continue to be respected during the cycle of the construction project, which is subject to modeling and subsequent adjustment of organizational and technical logical decisions.*

Keywords: biosphere-compatible construction (BSC); construction development; real estate development project; dominants of the BSC; integral indicator of the BSC

Introduction

In the European Union, innovative building programs and urban development projects are being gradually developed on the basis of the so-called "Biosphere compatibility". The key strategic determinants of such programs and projects are:

– organization of construction on a fundamentally innovative basis, aimed at the formation of a safe (and self-development) human life;

– ensuring the balance of bio-, techno-, and socio-spheres of urbanized territories;

– successful involvement of authorities, institutional participants, construction organizations and target consumers in the organization of the "start-investment-construction-operation" cycle of construction projects that are comfortably implemented in the existing ecosystem of the development territories (parameters of which in the conditions of the European Union are the subject of increased attention) [1-3].

In Germany and Japan, the bidder (developer), who has submitted a tender proposal, which includes decisions on target domains of biosphere compatibility of construction, receives a significant advantage, along with other competitors. In these countries, biosphere compatibility prioritizes even the criterion of "profitability / rationality of estimated expenditures".

In the context of the continued slowdown in the construction market activation, the decrease in the number of construction projects to be prepared and implemented, and the corresponding reduction in the volume of construction and special works, there is a system trajectory of the organization of construction to increase the demands of leading project participants on biospherous construction as a key component of reliability and competitiveness. construction projects, one of the key requirements for their successful implementation – throughout the entire duration life cycle.

In our country there are no effective mechanisms for increasing the motivation of construction participants to attract the principles of biosphere compatibility in the development of architectural and construction solutions. This tendency forms conflicting requirements and criteria for evaluating projects to create new products and services. In such conditions, innovative mechanisms of management of construction projects and programs based on the modernization of the investment-building cycle and the system of organization of construction on the principles of biosphere compatibility acquire a special significance. The implementation of these principles in the context of the ongoing decline in construction production is an important factor in attracting investment in domestic construction from foreign partners that adhere to the basis of biosphere construction and declare

strategic intentions to invest in Ukrainian construction on the above-mentioned principles [4].

Consequently, the transition to a biosphere – building construction in Ukraine should be considered as an important strategic perspective, which will affect the reformation of the content and architectural, constructive, technical and organizational-technological standards of construction.

The realization of the prospects of biosphere-compatible construction in the context of its organization is hampered by the lack of proper methodological, scientific, theoretical and applied developments. Therefore, the creation of a toolkit for building construction for the methodological substantiation and application support of "construction projects on the basis of biosphere compatibility" in the format of domestic construction development is an urgent problem that needs to be solved and defines the purpose, objectives of this article and the content of further research**.**

Analysis of the main achievements and literature

A more comprehensive development of the theory of the protection of the planet and mankind was in the 80s and 90s in the form of the concept of sustainable development, which consists in providing security in the implementation of urban development activities and favorable conditions for human life, limiting the negative impact of economic and other activities on the environment and ensuring the protection and rational use of natural resources in the interests of present and future generations. This concept – at the moment is the only one adopted in the Ukrainian legislation in the field of ecological construction and "green" standards. The concept of sustainable development has three components: economic, social and environmental or 3P in English – Profit, People, Planet.

Historically, the first voluntary BREEAM standard [5] was created – in 1990, the British company BRE Global, as a method for assessing the ecological efficiency of BREEAM buildings (BRE Environmental Assessment Method), which is now used throughout the world. To date, the standard is the most common. More than 110,000 buildings have been certified in the world, and about 0.5 million buildings have yet to be certified.

In 1998, the US Green Building Council (USGBC) developed the LEED (Leadership in Energy and Environmental Design) standard [6], which translates into leadership in energy saving and sustainable design. The standard was adopted in France, Canada, Hong Kong and Taiwan.

Then the situation developed according to two scenarios: whether one of the two standards was taken as a basis, but the individual indicators were determined in accordance with the national legislation and strategic documents of a particular country, or developed its own national standard. And, in some countries there are several standards.

Research aim and task

Ecological construction uses renewable energy sources (sun, wind, heat and cold land and water), collect rainwater, apply local environmental and secondary materials, handle garbage, reduce emissions and pollution, take care of the health and well-being of building users [7].

It is interesting that the signs of the ecological building can be divided into visible (solar panels, wind turbines, roofing) and implicit (energy and energy saving, reduction of environmental impact, microclimate of the building). Quite often, "smart" buildings (where efficiency is achieved by controlling and saving energy and resources) and "passive" buildings (with minimal use of energy ") are not always" green "in full. The ideal "green" building does not consume energy and water from outside, but it produces and collects them; The shell passes inside necessary light and heat and provides natural ventilation; its emissions into the environment are minimal; after its physical aging, the structure can be completely utilized [8].

"Green", ecological construction:

– Reduce the cost of building maintenance by saving energy and water;

– Increase of working capacity and absence of harm to health of people due to improvement of a microclimate in a building;

– Reduction of the negative impact of the building on the environment.

The realization of the prospects of biospheric-compatible construction in the context of its organization is hampered by the lack of proper methodological, scientific, theoretical and applied developments. Therefore, the creation of a toolkit for the organization of construction for the methodological substantiation and application support of "construction projects on the basis of biosphere compatibility" in the format of domestic construction development is an urgent problem that needs to be addressed. Therefore, the purpose of this article is to find advanced analytical tools and methodological algorithmic techniques of organizational and technological and stochastic assessment, to overcome the risks and threats to biosphere-compatible construction projects, to harmonize the characteristics of the life cycle of these projects with the characteristics of the micro-environment of their implementation (Table).

The advantage of LEED is its tool, which allows you to optimize the process of preparing documentation and project management. On the other hand, the development of this tool is difficult for those who first become with the system. Some experts argue that the democratic principles of LEED encourage, rather, lobbying for the interests of large manufacturers of equipment and material suppliers, rather than research activities.

Table – ***Comparison of the standards of "green construction"***

Standards	Strengths	Weaknesses
LEED	– a system of promotion at a transnational level; – there is no need to organize the training of appraisers; – the universalization of processes and schemes; – Increased requirements for energy efficiency at all levels of evaluation; – a system-based integrated approach has been implemented, which allows reducing costs both in the construction process and in the process of operation; – is consistent with technology, engineering systems, innovations, building materials, etc., sold in the US market and the trans-Atlantic space; – - does not contradict the international technical regulations and norms on the basis ISO	– adapted to the social and economic realities of the USA; – excessive requirements for documentation; – rigid connection of functional purpose with architectural forms
BREEAM	– applicable to various types of buildings; – adapted to the British legislation in the field of construction, ensuring high quality of construction and compliance with the claimed project at the stage of operation; – the possibility of adaptation to the building regulations of a specific country; – the possibility of forming programs for assessing the building, taking into account its individual features and qualities	– stringent requirements, not allowing deviations; – Weak marketing; – Significant cost of obtaining approvals
DGNB [9]	– considers the building throughout the life cycle; – allows you to quantify the impact of the building on the environment and society; – The process of integrating planning allows minimizing the consequences from the onset of a risk event at all stages of the building's life cycle (construction, operation, restoration, dismantling); – The awarded certificate includes not only the level of the object evaluation according to environmental criteria, but also additionally takes into account economic performance, socio-cultural and functional aspekty of buildings; – easy to improve and adapt to technical, social and international developments	– there is no account for the passive method of energy saving

In favor of BREEAM says the scientific approach, research activities, which are the basis of a set of criteria, as well as a methodology aimed at solving a wider range of environmental problems.

To date, in 24 countries there are 32 national standards systems [10].

1. Malaysia: GBI Malaysia;
2. Mexico: Mexico GBC
3. Netherlands: BREEAM Netherlands;
4. New Zealand: Green Star NZ;
5. Portugal: Lider A;
6. Singapore: Green Mark;
7. USA: LEED / Living Building Challenge / Green Globes / Build it Green / NAHB BS;
8. Taiwan: EEWH;
9. Philippines: BERDE / PHILGBC;
10. Switzerland: Minergie;
11. South Africa: Green Star SA;
12. Japan: CASBEE.
13. Australia / Green Star;
14. Brazil: AQUA;
15. United Kingdom: BREEAM;
16. Finland: PromisE;
17. France: HQE;
18. Germany: DGNB / CEPHEUS;
19. Hong Kong: HK BEAM;
20. India: GRIHA;
21. Italy: Protocollo Itaca / Green Building Counsil Italia;
22. Spain: VERDE;
23. Canada: LEED Canada / Green Globes;
24. China: GBAS;

All systems have a number of common features, primarily target groups (those for whom the standards are created – investors, developers, designers, builders, management companies, the population) and the principles of building assessment systems themselves.

Systems differ in the assessment of buildings, usually in the following: countries with more stringent building codes and regulations have a more demanding certification system for green buildings (in Europe, stricter standards than in the US). For example, according

to BREEAM Center estimates, the buildings that received "PLatinum" according to the LEED rating (USGBC), according to BREEAM, will receive only the 2nd place in the rating ("Very Good").

In Europe, the life cycle analysis (LCA) methodology, which is one of the European Environmental Product Declaration (EPD) standards, is more often used. The EU Directive on Construction and Energy Efficiency (European Union's Energy Performance of Buildings Directive) requires that all buildings be labeled for energy consumption, which will inform consumers and influence the further development of the industry.

The weight system, which can be used in different categories, is also significantly different. For example, in Japan, the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) assigns a factor of 2-3 times the weight of land use than certification systems in Western countries.

Another example is Australia, whose Green Star system is based on BREEAM and LEED, but modified to reflect the hot climate. This system uses a rating system in 9 categories, some of them – indoor air quality, water, energy, materials, site use, transportation and innovation – are similar to LEED categories. Green Star also assigns points depending on the decrease in greenhouse gas emissions and the application of sustainability principles at all stages, from idea to operation of objects. The system assigns a rating to the facility prior to its operation, then the National Australian Built Environment Rating System (NABERS) measures the actual efficiency for the environment. New Zealand and South Africa recently adapted the Green Star system for their countries.

China used LEED, but in 2007 the Chinese Ministry of Housing and Urban Development (MOHURD) developed an official system for assessing the green buildings of Three Star. . It consists of six categories – land, conservation of energy, water, resources, environment and exploitation – and forms an assessment in three categories, One-, Two- or Three-Star, based on the achievement of minimum values for each component, and not by the total score.

Most world systems have a rating structure in categories similar to LEED – points are assigned for each category, and the rating is based on their sum. At the same time, the essential distinction of LEED is the freedom that is given to the architect in choosing the criteria that will be taken into account. If the building does not have any parameter, it does not lose the right to rating.

In Japan, the most rigorous assessment of each category is due to the unique structure of the certification system, which is both rigorous in the assessment and clear in describing the equilibrium of the positive and negative impacts of buildings. The Japanese CASBEE was created to combine two long-term industry goals: increasing the comfort of living and reducing the impact on the environment.

The system establishes a hypothetical boundary around the building and its site. Within this boundary, the task is to maximize the quality of consumer benefits (Q). Q measures, for example, acoustic and light comfort, durability and compatibility of interior elements and the beauty of the environment. Beyond the limits, a goal is set for minimizing the negative environmental load (L), and factors such as energy efficiency, recycled materials and pollution reduction are taken into account. The Q / L ratio is defined as the Environmental Environmental Efficiency (BEE). The higher the indicator, the more positive parameters for the project. This system of evaluation in the graphic image clearly shows the advantages of more "green" buildings, but direct comparison with the LEED estimate is difficult.

In South Africa, the Sustainable Building Assessment Tool (SBAT) certification system includes consideration of economic, health, education systems and the involvement of the local community in the processes associated with enhancing social sustainability. Buildings are considered in terms of how they affect broader goals. The system includes 15 parameters in three categories:

– social stability (comfort of living, accessibility of goods, control, education, health, safety);

– economic sustainability (local economy, efficiency of use, costs, capital costs, etc.);

– environmental sustainability (water, energy, waste, territory).

The system is now being used on pilot projects.

In Germany, one of the first successful countries in the issues of energy efficiency in construction, only recently the certification system of the Sustainable Building Certificate from the German Sustainability Building Council (DGNB) has appeared. This voluntary certification system, built on six categories – ecology, economics, society and culture, functionality, technical quality, processes and territory. Constructed on the basis of local regulations and rules, the system estimates the overall efficiency of the building and the life cycle, rather than individual metrics.

In the United States, the process of incorporating LEED standards into building codes is underway. So, the International Green Construction Code, prepared by the International Code Council, was recently released, which corresponds to the established goals of achieving by 2030 carbon neutrality (C-zero).

Currently, there is a process of developing commonly accepted metrics for rating systems within the framework of the Sustainable Building Alliance (SBA), located in Paris.

In the light of the UN recommendations in European countries, rating systems for assessing the quality of design and building solutions for buildings have been widely used according to the criteria of energy efficiency, ecology, comfort, resource saving, economy. Moreover, the beginning of the process is a natural continuation of the practice of self-regulation of market relations between the subjects of investment and construction activities in the direction of their efforts toward the trends stipulated in the UN program document, which assesses the economic and social situation of the world economy [10]. This review highlights the urgent need to search for development paths that guarantee environmental sustainability in the light of the implementation of the concept of sustainable development of the world economy: "Reducing energy consumption and emissions of greenhouse gases due to growth and increasing urbanization of the population will require a radical changes in consumption patterns, transport systems, residential and construction infrastructure and water supply and sanitation systems".

Differences in the domestic standards of "green construction" are in the number of applicable criteria, the boundary values of the indicators of compliance, the names and the number of points, the grading system.

Despite regional preferences in the application of national certification systems, BREEAM and LEED systems are currently dominant.

Adherence to these standards is understandable from the point of view of international investors seeking to assess their portfolios of real estate on a single and understandable criteria in any country.

On the other hand, the presence of competition in the certification market is seen as a positive factor in terms of progress and adaptation of systems.

The state is the main interested party in the development of the construction of "green" buildings [4; 7]. Rating evaluation systems not only contain the requirements of normative documents, but, above all, they orient and stimulate the solution of state problems aimed at improving the ecological situation, reducing the harmful impact on the environment in the process of building and operating buildings, developing economic profitability of architectural, constructive and engineering solutions, increasing the comfort of human habitat and saving fuel, energy and water resources [11].

The urgency of the issues under discussion determines the need for studies that allow us to consider the scope of application of domestic and international environmental standards in the territory of the country. The importance of this problem increases in connection with the need for an in-depth analysis of the causes and problems.

The modern trend of ecological construction is a large-scale transition from a separate building with an adjacent land to the whole "green" neighborhoods and cities, built on the principles of sustainable development. From the elementary green technologies of the present (passive houses and zero energy consumption) town planners are moving to the cities of the future. At the level of quarters and houses, this is in principle a "triple zero" – zero external energy consumption, no greenhouse gas emissions and complete waste-free operation.

In our opinion, the concept of biosphere compatible construction is a combination of components of the building ecology, namely urbecology, biopolitical construction, environmental reliability and safety, energy-efficient and energy-efficient buildings, resources, waste production, waste management and eco-monitoring.

According to statistics provided by the Ecological Council Construction (RuGBC) is today the building of the entire world use about 40% of all consumed primary energy, 67% of all electricity, 40% of all raw materials and 14% of all stocks of drinking water water, and also make up 35% of all carbon dioxide emissions and almost 50% of all solid waste [9]. In this regard, on At the world level, the concept of "green" construction or another environmental, which is aimed at reducing consumption energy and material resources, as well as for reduction disruptive effect of construction activity on human health and the environment [10].

The development of principles of eco-sustainability, the definition of priorities is the main task of creating a certification system for the eco-stability of buildings. There are two approaches to the development of eco-sustainable architecture. The first approach is the active inclusion in the architecture of all the latest technological developments in energy efficiency, smart building management, the use of new materials. This approach leads to a sharp rise in the cost of construction and requires constant monitoring of equipment, which, in addition, has to be updated periodically. Such a system depends on very many factors and can not be considered sustainable, although from the ecological point of view it is "green". Another approach is the use of space-spatial, architectural methods that affect energy consumption and resource-saving, as well as maximizing the use of natural, rather than mechanical, methods of operating utility networks. For example, a building can be cooled in summer using air conditioners that depend on electricity, or can be due to the natural movement of air through air ducts laid in cold ground under the building or on the bottom of the nearest pond.

The system of certification of eco-stability of buildings is the basis for integrated design, as it sets the parameters of buildings, defines tasks. If a team of designers, developers, builders initially determines the result to which one should strive, then in the design process there is no more controversy. This reduces design time, improves the quality of construction.

Conclusions

Generally proposed ways to stimulate environmental construction on the principles of biosphere compatibility can be formulated as follows:

– At the initial stage of development – the stimulation of business by the statedue to tax benefits, green tariffs, financial measures, etc.

– In the near future – the application of market factors, such as the formation of demand, the positioning of environmental construction as a generally accepted norm of modern society.

– Popularization of the idea – attracting the attention of the state, increasing investor interest, together with public education and education.

– Tougher requirements of legislation to environmental safety and through this – the introduction of norms and rules of green building, which allow projects to meet increasing demands.

– The emergence (education and professional development) of a large number of qualified "green" specialists: architects, designers, consultants, appraisers, auditors, experts.

– Simplification of the procedures for passing the examination and approval of the "green" projects.

– Accessibility and adaptation to the Ukrainian specifics and norms of foreign technologies; development and implementation of innovative technologies and materials. The introduction of this measure can be facilitated by the creation of the Green Book, a catalog of environmental technologies, products and services, and the development of Ukrainian and international materials certification systems.

– Development of the domestic eco-industry for the production of building and finishing materials.

– Creation of demand through stimulation of the population through mortgage benefits for the purchase of eco-friendly housing; subventions, subsidies and subsidies for the installation of energy-efficient equipment and the use of alternative renewable energy sources; tariffs for the consumption of ecological energy.

The proposed legislative measures of state stimulation of environmental construction are designed to give a new impetus to the emerging trend towards innovative development of the construction and real estate sector.

The transformation of cities into biosphere-compatible settlement s is impossible without the construction of energy-efficient and ecological buildings.

Biosphere-compatible construction should meet the concept, which views it as a complex object, inextricably linked with nature, time and economic opportunitie. Further studies require the task of mathematical modeling, as separate components of the concept, and their combined consideration. Also, building standards require a significant improvement. They should be aimed at a comprehensive solution of all aspects of the design of energy-efficient buildings.

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ФОРМУВАННЯ МЕТОДИКО-АНАЛІТИЧНОЇ СИСТЕМИ ІНДИКАТОРІВ ЗАБЕЗПЕЧЕННЯ БІОСФЕРОСУМІСНОСТІ ПРИ ПІДГОТОВЦІ ТА ОРГАНІЗАЦІЇ БУДІВНИЦТВА

Анотація. *Стаття присвячена розробленню інноваційної методологічної бази та прикладного інструментарію «організації біосферосумісного будівництва», які у форматі сучасного будівельного девелопменту призначені для реалізації оновлювання національних стандартів екологічного та енергоощадного будівництва. У дослідженні біосферосумісне будівництво (БСБ) обґрунтоване як провідна складова інтегрованої організаційно-технологічної надійності проектів будівництва та, водночас, як продуктивний формат організації життєвого циклу будівельних проектів на ґрунті екологічності та енергоощадності, за умови підпорядкування сучасним організаційним та інформаційно-аналітичним технологіям будівельного девелопменту. На відміну від традиційних уявлень в організації будівництва об'єктом розгляду є не лише будівельна фаза, але й передінвестиційна, включаючи початок інвестиційного задуму, де формуються вимоги щодо біосферосумісності та розглядають директивні вимоги щодо біотехносередовища впровадження проекту, що узгоджено визначаються замовником, інвестором та майбутніми споживачами готової продукції проекту і надалі мають бути додержаними впродовж циклу будівельного проекту, що підлягає моделюванню та подальшому коригуванню організаційно-технологічних рішень.*

Ключові слова: біосферосумісне будівництво (БСБ); будівельний девелопмент; девелоперський будівельний проект; домінанти БСБ; інтегральний показник БСБ

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ФОРМИРОВАНИЕ МЕТОДИКО-АНАЛИТИЧЕСКОЙ СИСТЕМЫ ИНДИКАТОРОВ ОБЕСПЕЧЕНИЯ БИОСФЕРОСОВМЕСТИМОСТИ ПРИ ПОДГОТОВКЕ И ОРГАНИЗАЦИИ СТРОИТЕЛЬСТВА

Аннотация. *Статья посвящена разработке инновационной методологической базы и прикладного инструментария «организации биосферосовместимого строительства», которые в формате современного строительного девелопмента предназначены для реализации обновления национальных стандартов экологического и энергосберегающего строительства. В данном исследовании биосферосовместимое строительство (БСС) обосновано как ведущая составляющая интегрированной организационно-технологической надежности проектов строительства и, одновременно, как продуктивный формат организации жизненного цикла строительных проектов на основе экологичности и энергосбережения, при условии подчинения современным организационным и информационно-аналитическим технологиям строительного девелопмента. В отличие от традиционных представлений в организации строительства объектом является не только строительная фаза, но и прединвестиционная, включая начало инвестиционного замысла, где согласовано формируются (заказчиком, инвестором и будущими потребителями готовой продукции проекта) директивные требования к биосферосовместимости проекта, которые в дальнейшем должны быть соблюдены в течение полного цикла реализации строительного проекта, что влечет за собой необходимые моделирование и последующую корректировку организационно-технологических решений.*

Ключевые слова: биосферосовместимое строительство (БСС); строительный девелопмент; девелоперский строительный проект; доминанты БСС; интегральный показатель БСС

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