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BUILDING INFORMATION MODELING (BIM): DEFINITION, ORIGINS AND ELEMENTS, BRIEF HISTORY AND FUTURE PROSPECTS

ВНТУ

Анотація :

У статті розглянуто наукові підходи до визначення понять «інформаційне моделювання», «інформаційна модель» та обґрунтовано зв'язок між ними. Досліджено еволюцію, етапи становлення та перспективи розвитку інформаційного моделювання в будівництві.

Ключові слова : інформаційне моделювання, інформаційна модель, BIM, етапи розвитку

Abstract :

In the article the scientific approaches to the definition of «building information modeling», «building information model» are given and the interconnection between these notions are grounded. Origins, brief history and future prospects of building information modeling in the construction industry are studied.

Keywords : information modeling, building information model, BIM, stages of development.

Building Information Modeling (BIM) is a digital representation of the physical and functional characteristics of an object that creates a shared information resource of the object and forms a solid basis for decision-making throughout its life cycle: from early concepts to disposal

BIM is one of the most promising approaches, which allows the development of one or more accurate virtual, digitally constructed models of the construction site to support the design, construction, production and procurement activities through which construction is carried out directly.

The abbreviation for information modeling "BIM" appeared in the lexicon of specialists relatively recently, although the very concept of computer modeling with maximum consideration of all information about the object began to take shape and acquire specific shapes much earlier. The term BIM has reflected different directions over the years and no longer has a single, universally accepted definition. The idea of BIM dates back to the beginning of CAD (80s of the XX century), when it was first conceptually described by scientists and introduced into the software of the first versions of CAD programs. During this period, BIM actually meant three-dimensional graphical modeling, enriched with additional features. The basis of this technology was information about the graphic model, which combined the geometric model of the building, its physical characteristics, names and functional features of individual elements. Analysis of recent research and publications. The question of the need for the introduction and development of information modeling in construction is quite actively studied by foreign scientists, in particular V. Talapov, K. Sukhachev, A. Toman, L. Ustinovicus and others. In Ukraine, A. Bilyk, M. Belyaev, A. Tesyolkin, M. Barabash, K. Kyivska are engaged in research of BIM issues.

Highlighting previously unresolved parts of the overall problem. At the same time, there are still many issues that need to be scientifically substantiated and resolved. One of them is the study of the essence, origin, current state and prospects of information modeling in construction (BIM). The purpose of the article. The main purpose of this work is to study the nature, formation, current status and prospects of information modeling in construction (BIM). Presenting main material.

BIM technology is based on the concept of object-oriented parametric design (modeling) of buildings. And this parametric modeling is one of the fundamental features that distinguish VIM programs from all other CAD design systems, if they are not called. Initially, this approach has become widespread in mechanical engineering, and in the last decade has been particularly active in architectural and construction design.

BIM is a numerical representation and properly organized information about an object that is used at all stages of its life cycle. An important component of this technology is a single information space, a database that contains all the information about technical, legal, property, operational, energy, environmental, commercial and other characteristics of the construction site. Due to the high accuracy and detailed description of the model, this technology allows you to perform various calculations (eg, energy efficiency and energy consumption of the building, complex calculations for durability, fire resistance and strength of the whole building and its individual elements) and analysis of results

Building information modeling (BIM) is a technology for optimizing design and construction processes, which is based on the use of a single building model and the exchange of information on any object between all participants, throughout the life cycle - from the owner's idea and first sketches architect to the maintenance of the finished house .

Analyzing the definitions of BIM, we can conclude that it is necessary to more clearly distinguish which object is in question. Yes, there are some definitions that directly relate to the Building Information Model, the Building Information Modeling process and the entire Building Information Management system. In our opinion, the most clear distribution of BIM definitions in the three above areas is given in the Building SMART International report : Building Information Model is a digital description of physical and functional properties of a building, which is a source of knowledge and various data about the object available to participants in the investment process and is the basis for decision-making in the construction process, from concept development to demolition of the building.

Building Information Modeling is the creative process of generating and using data about a building, its design, construction and operation during its full life cycle. BIM provides access to information about the object to all interested participants in the investment and construction process. Building Information Management is a system of organization and control of the investment and construction process by using the parameters of the digital model of the building to organize the exchange of information throughout the investment cycle.

The effects are due to: centralized data exchange, visual communication with three-dimensional objects, early recognition of opportunities, the use of sustainable, interdisciplinary and interactive design, control during and on the construction site, regular updating of documentation (design changes during construction and in operation).The emergence of new technology, which helps in the management of design, implementation and operational processes, causes many different opinions. But most scientists agree that BIM has become the definition of a digital standard of technological system of information modeling of buildings, the purpose of which is to achieve maximum integration between different stages of the construction investment process and create models of "smart" parameterized objects. With the development of construction technologies, all design documentation changes and becomes more complicated, while its volume is steadily growing. Designers are forced to process more and more information that precedes and accompanies the process of working on the project. The flow of information continues to flow after the commissioning of the facility, as the erected building interacts closely with the environment and other facilities. Also do not forget about the livelihood of the building, the management of internal processes.

In the geometric progression, the probability of errors increases, and with the increase in the cost of the project, the cost of errors increases. In response to the above problems was the concept of information

modeling of buildings. Information modeling as an approach to building design involves primarily the collection, storage and comprehensive processing in the design process of all architectural, technological, economic and other information about the building with all its relationships and dependencies, when the building and everything related to it, are considered as a single object. The rapid development of information technology requires fundamentally new approaches in architectural and construction design and development of design and estimate documentation, which consists in creating computer models of buildings and structures that contain all the information about future objects. The main principle of BIM is the cooperation of various stakeholders during the various phases of the life cycle of the object, which allows the implementation, retrieval and updating of information to support and reflect the role of each user. Thus, building information modeling is a system that allows digital description of many parameters of a building object at the stages of design, implementation and use. It is important that the description of BIM parameters is parametric, which is a fundamental advantage and innovative approach. But one of the main ideas of BIM is the ability to determine and describe not only the geometric and material parameters of the object, but also monetary and time factors. Due to this, BIM allows the description of the object, covering all phases related to its origin and operation, from the initial conceptual work, through the stages of design, implementation, operation, and even liquidation.

Today there is no generally accepted definition and uniform standards for building an information model of the object, but the basic principles have been formed, which it must meet: 1. A single information model is a consistent database of graphic and descriptive information, project database common to all parts and project stages. Information can be obtained from the model as needed. 2. Based on a single information model of the object, a single strategy is formed to manage the design, production and implementation of the construction object. 3. Distributed group support is provided: people, tools and tasks can effectively and share this information, which eliminates redundancy, re-entry and loss of data, errors in their transmission and conversion. 4. Universalization of data exchange formats between software packages for different purposes. Standard CAD systems allow the creation of three-dimensional models, which are called 3D models. The BIM system goes beyond these limits, providing opportunities for modeling, defined as 4D, 5D, 6D and even 7D. BIM technology from 4D to 7D can be described as follows: - 4D - virtual model of the building with construction plans and the ability to control the construction process, while visualizing the building at a selected time; - 5D - creates the possibility of producing more accurate estimate documentation, minimizing the weight of the error, as well as cost control during the construction phase; - 6D - compliance with the principles of sustainable development in the construction process. Thanks to this technology, the future building can no longer be assessed in terms of energy saving, use of solar energy; - 7D - Modeling based on Facility Management, which is the management of the construction site throughout the life cycle from design to liquidation. The integration of many design planes allows you to analyze things that until recently seemed out of design. Even with the lowest level of BIM 3D, current applications have much greater capabilities than standard CAD systems, which are often limited by determining the geometry and material of the elements being designed. BIM 3D systems allow parameterization of geometric and material features, allow the use of the latest available technologies related to the production and processing of building elements, such as processing on CNC machines or laser cutting. A significant advantage of BIM 3D systems is also the ability to create realistic photos through the use of appropriate software integrated with a central BIM application. "Above" 3D systems make it possible to include and take into account in the complex such parameters as time, cost, as well as other parameters aimed at sustainable development and management of the object. It is believed that BIM 4D allows you to combine geometric and material information with time parameters that help in planning and creating schedules related to the construction site. In the case of BIM 5D, together with the parameters specific to BIM 4D, it is possible to determine the cost parameters. This is so important that it allows you to model, and thus estimate and analyze the costs that are or may be generated during the entire life cycle of the object. Thus, BIM 5D allows the implementation of cost modeling, which is currently one of the most important factors that determine the entire construction investment market. BIM 6D allows you to calculate the energy efficiency and energy consumption of the building, as well as complex calculations of the entire building (including location) and all its elements simultaneously. With the use of BIM 6D and 7D, we additionally get the ability to collect and use a variety of information about the object in one central system, which allows efficient use of the building during its operation. Due to this, the main functionality of the BIM 6D and 7D systems is the use of object management. As you can see, CAD computer-aided design systems have evolved in a relatively short time to a very advanced building

information modeling system, the idea and capabilities of which are far beyond the description and modeling of geometry and materials at the design stage.

Given the above, BIM can be described as a way to: - develop a strategy for the construction project, namely its key stages: design, construction, operation through modeling and computer simulation of the object and its entire life cycle; - providing integrated management of graphic data and information flows in combination with a description of the process, within a single information environment; - transformation of individual performers into teams to solve complex problems and integrate individual tasks into processes; - faster, more efficient, less costly execution of various operations throughout the life cycle of the construction project.

Conclusions: thus, on the basis of the works of domestic and foreign scientists, scientific approaches to the definition of "information modeling", "information model" are considered. Regarding the definition of BIM, it is necessary to clearly distinguish which object it is: the building information model (Building Information Model), the building life cycle process (Building Information Modeling) or the entire system of investment and construction process (Building Information Management). The evolution, stages of formation (from 3D models to 7D models) and prospects for the development of information modeling in construction are studied.

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