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Optimization of project solutions by means of BIM technologies

Building services projects are becoming more complex, and BIM technology is helping industry professionals work more efficiently and achieve better results. Rapid modeling allows you to analyze and optimize engineering systems at the design stage before they are installed in a building. The ability to quickly and clearly visualize a BIM model can be used for more effective negotiations between project participants. The BIM model can be used to transfer design information to the construction site. The ability to store all information in a model, from concept development to completion of construction and beyond throughout the entire life cycle of the building, provides more accurate estimates of materials and equipment. It also allows you to perform preventive maintenance and keep records of engineering systems equipment during the operation of the building, and reduces the overall level of project risks thanks to proven, accurate and optimized design solutions for engineering systems. Helps reduce construction time and reduce construction costs by reducing installation errors and material consumption, and at the same time, improves the quality and efficiency of buildings that have less impact on the environment[1,2].

A BIM object is an accurate three-dimensional digital representation of a physical product. In addition to geometric parameters, the object also contains the technical characteristics of the real product. BIM objects are used when building a BIM model. For example, in the design of building engineering systems, BIM objects are used as components for system modeling. If the BIM object contains technical information that can be used by calculation software, it becomes possible to optimize the systems being modeled during the design phase and improve the efficiency of the various engineering systems within the BIM model. Digital twins are gradually taking their place in the construction industry. A digital twin is a virtual model of a building that collects information using sensors, drones and other wireless technologies. The "double" is constantly learning, receiving information from various sources, including advanced analytics, machine learning algorithms and artificial intelligence. This provides extremely useful insight into the performance, function and profitability of a building, whether already built or under construction. In the future, graphical BIM models will provide information to building maintenance systems[3].

During the design and construction of a building, the BIM model collects a huge amount of information. Interpreting and learning from data obtained from BIM models and previous projects helps avoid future mistakes and improve design and construction processes. However, people cannot process such large amounts of information. The

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new trend of using BIM together with artificial intelligence technology makes it possible to fully utilize all information, speeding up data processing and significantly increasing the efficiency of the construction process. Using artificial intelligence, BIM software can learn from data and identify patterns. It can then independently make decisions about how to automate and improve construction processes.

All over the world, people are trying to build buildings using 3D printers. Benefits of using 3D printing include reducing waste and increasing recycling and reuse of materials. This technology also allows greater freedom for architectural designs, as 3D printers can handle curved shapes that are more difficult to make by hand. Thanks to advances in BIM, prefabricated and modular structures are once again gaining popularity. The ability to design building components accurately and in detail means that an increasing number of components can be manufactured off-site. The use of modular and prefabricated structures can reduce construction project time and increase efficiency because prefabricated components can be manufactured in optimal factory conditions and construction companies do not have to deal with limiting factors such as bad weather or short daylight hours. The use of virtual reality is becoming increasingly common in construction projects. For example, you can now take a virtual walk through a future building and see what it will look like after construction is completed. Virtual reality helps to better understand and present the project to all its participants: builders, investors and even future residents.

Augmented reality means the overlay of digital information on real objects in the surrounding world. There are countless options for using augmented reality in construction. This technology can be used to demonstrate the installation of new systems in existing buildings. For example, you can show how a pipe will pass through a roof or wall. Mixed reality is a combination of virtual and augmented reality. This means that the virtual object in question is so organically integrated into the real world that it appears to be part of it, like a hologram. This technology will also be important in the future for installation work.

BIM is a modern information modeling system at all stages of the life cycle of real estate. The introduction of BIM technologies ensures the completion of the entire chain of tasks (design-manufacturing – logistics-installation-control), improves the quality of control of construction work, implements many modern projects and brings the construction industry to a qualitatively new level. Most European countries introduced it widely at the state level in the past decade. With the help of BIM, a number of problems in the construction industry can be solved: low level of digitization and outdated technologies, low productivity, ineffective management and use of resources, information exchange, current issues of environmental friendliness and energy efficiency, safety and transparency.

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