Formation of competitive skills of civil engineers in the field of BIM technologies

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Abstract. Building and designing of buildings is impossible without the introduction of modern computer technologies, which in turn makes high demands on the level of training of personnel engaged in construction and design. The use of modern information technologies is impossible without improving the approaches to the teaching process and teaching methods, with the use of which training and retraining of construction specialists is carried out. In the article approaches to introduction in the educational process of BIM of the technologies of building design, developed as a result of many years of experience in the training of bachelors, masters and specialists in the courses of advanced training in construction, are considered.

1 Introduction

Building information model (BIM) in the construction proved to be a good tool to support building solutions, by virtue of their ability to store all the information in a single digital model and the possibility to organize the interaction between all participants in the project [1,7,9]. Training in building design of buildings requires constant updating of knowledge about the procedures and technologies used in the construction industry. The construction university must constantly strive to adapt its curriculum to the innovative needs of the industry in order to introduce new technologies.

2 Experience in implementing BIM technologies in the learning process

At the National Research Moscow State Building University, the Department of Information Systems, Technology and Automation in Construction has been working for many years to introduce knowledge of BIM technology into the learning process [2,3,5]. Within the framework of the curriculum and scientific research, students develop design solutions for multi-storey buildings using BIM applications:

- generation and use of the 4D BIM model to support construction planning;
- 3D visualization of the project solution;
- Coordination of the construction project based on the BIM methodology;

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• Conflict analysis based on the architectural model of 3D / BIM.

Many years of experience show the advantage of using BIM in designing in comparison with the traditional process, and in the light of the educational process it solves one of the main tasks of the educational process - adding competitive skills to the training of future construction engineers.

Building information modeling or Building Information Model (BIM) is defined as the process of generating, storing, managing, sharing and sharing information about a building in a multi-user access mode. BIM is the process of developing and using a computer model for modeling the planning, design, construction and operation of the facility. The resulting information model of the building is a data-rich, intelligent and parametric digital representation of the building project [8]. Thus, BIM can be viewed as a digital representation of a building, an object-oriented 3D model, and a repository of project information to facilitate interaction and exchange of information with relevant software applications. The created model BIM, allows you to access not only the three-dimensional model, but also to the plans and sections of the building, as well as information about the elements of the building and other information that meet the needs of various users. The data can be extracted from the model and used to make decisions to optimize the design, construction and management of the construction site. An important point is that the BIM methodology covers various sectors of the construction industry. It should be understood that the BIM model is not only the most visible part of the project - a geometric model, but also a database of materials used in the building with a description of their mechanical properties and physical characteristics. BIM is applied at all stages related to the construction project:

• the initial stage of creating a form (architectural design);

• various stages of the project (design of design solutions, analysis and development of technical drawings);

• Quantitative evaluation of materials and budget;

• the process of building planning;

• operation of the building (management and maintenance) at a later stage.

BIM can generate and maintain information received throughout the entire lifecycle of the construction project, from design to maintenance and can be applied to different areas [6]. Thanks to the consistency of design data with updated data during construction and quality control, the potential for implementing BIM in quality management is enhanced by the ability to present multidimensional data, including design data and the time sequence of object erection [4,10].

3 Using BIM in project management

From the point of view of BIM's consideration, in its annex to the management of building construction projects, the following models are considered:

1. The 3D / BIM model refers to all three-dimensional building components (architectural, structural, mechanical, electrical, etc.) and includes all aspects of the building, including geometry, spatial relationships, properties and dimensional values.

2. The 4D / BIM model refers to a building process that can be visualized by building a 3D building model over time in accordance with the critical path schedule (the model supports dynamic site security management, scheduling and estimating, tracking and managing changes and logistics).

3. The 5D / BIM model is associated with costs (quantity of materials, planning and cost estimation, verification and safety analysis).

4. The 6D / BIM model is designed to support management and maintenance facilities throughout the life cycle of a building during its operation.

The prospects for using BIM in N-D (multidimensional) design should be based on the relationship between the members of the project team, which allows improving the joint project. The development of information technology has made a great contribution to new opportunities for integration and communication at a distance. In the field of designing buildings and facilities, the ability to communicate at a distance is of fundamental importance for the exchange of information. However, for this it is very important to ensure the interaction between several software solutions that are used to develop the project. The BIM methodology, which combines parametric design, three-dimensional (3D) models, element-level information, coordination, communication and visualization throughout the entire life cycle of a building, allows a profound change in the way information is managed in the construction sector. The BIM concept is aimed at improving the working methods currently used. This new approach is based mainly on the integration of processes supported by a 3D model saturated with information that makes it easy to track the entire life cycle of an enterprise. Thus, it is obvious that the whole process of design and construction will become more accessible for several organizations that interact during the construction of a building object, either in its design and design development, or in subsequent phases of building management.

4 BIM Technology Training

From the point of view of implementing the process of preparing builders for the application of BIM technologies for the design of buildings, step-by-step approaches were developed in the construction of the learning process with students.

Students stage-by-stage develop 3D, 4D and 5D project models, in addition, based on these models, a 3D video presentation of the project with the design of the premises is developed (Figure 1).

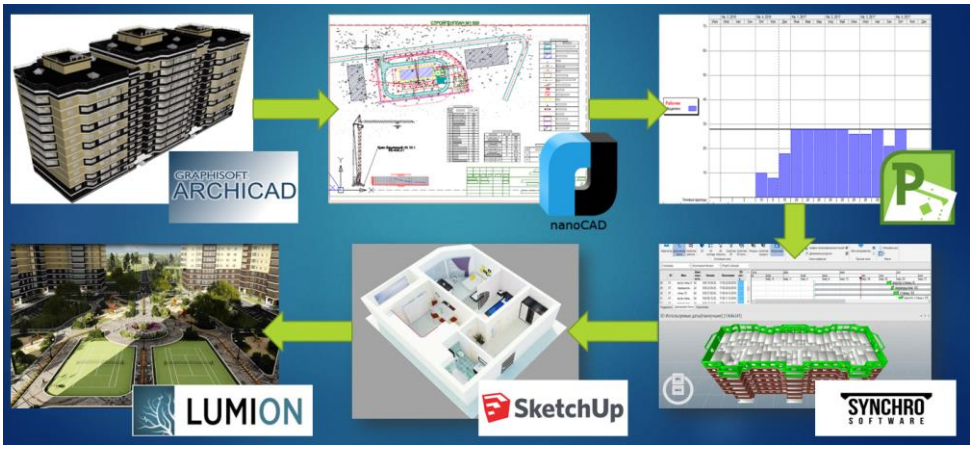

Fig. 1. Students stage-by-stage develop 3D, 4D and 5D project models

Without the use of BIM technologies, these tasks are usually solved on the basis of drawings presented on a sheet of paper or in digital form, requiring the understanding of drawings to identify conflicts and increased attention when making changes and updates to the project. In the process of working on the project, students are trained to develop parametric objects, from which they form 3D BIM models, analyze design errors and master technologies for exporting and importing data from different software complexes. The traditional process of designing an engineering project requires the participation of specialists from various construction specialists, and therefore the coordination of the

project is of great importance for the analysis of emerging conflicts based on 2D drawings, which leads to design constraints, delays in the construction process, project reworking to eliminate problems not identified in the design , enhanced surveillance of the site to identify conflicts in the field after approval of budgets, etc. The detection of conflicts based on BIM offers many advantages over traditional methods. The high level of detail and visualization provided by the BIM model provides better interaction between project participants, which leads to a significant reduction in potential errors during the construction phase. BIM tools allow the user to selectively check for conflicts between any systems. For example, between plumbing, heating, ventilation, mechanical, electrical, structural systems, etc. Thus, conflict detection can be performed regardless of the level of detail of the model and regardless of the number of systems that make up the building. When considering BIM models, you need to make sure that the building is modeled with an appropriate level of detail, since for effective conflict detection there should be a minimally detailed model for pipelines, structural elements and other components. If the degree of detail is inaccurate or inadequate, it can happen that real problems will be identified (discovered) only during the construction phase, and their elimination will be more expensive and time-consuming.

5 Conclusions

Based on the foregoing, it becomes evident that in addition to the practical implementation of BIM in the design of buildings, it is equally necessary to develop methodological approaches to training specialists to implement these approaches.

Long-term experience of teaching at the Moscow State University of Economics and Management of MGSU students on the specialty 09.03.01 "Informatics and Computer Engineering" allowed to develop a methodology for teaching BIM design technologies oriented to real activity. The studies that allowed the development of the methodology were aimed at forming competitive skills in the preparation of future construction engineers. According to the results of the study it was found:

• A good effect on the results of the training of students shows the use of BIM technologies in the analysis of conflicts based on a three-dimensional building model with a high level of detail;

• BIM methodology in comparison with the use of traditional design processes gives a complete picture of the representation of elements and 3D-visualization of the object, which allows students to quickly master the design technologies,

• The opportunities for simultaneous reconciliation of architectural, functional-technological, constructive and engineering solutions are rapidly developed through coordination of information models of buildings;

• The use of 4D / BIM models shows a very positive result in the learning process. provides an opportunity to visualize the construction process and provides a useful 4D simulation tool to support the planning of the project, as stipulated in the BIM methodology.

References

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