Application of BIM Technology in Construction Engineering

Shiyu Qiu*, Hao Xu, Ju Jin, Hao Zhang and Kai Sun

School of Civil Engineering and Architecture, Jiangsu University of Science and Technology, Zhenjiang, Jiangsu, 212003, China

*Corresponding author’s e-mail: 492217649@qq.com

Abstract. The development of the construction industry has benefited from the ever-increasing demands of people for living conditions, both safe and comfortable. In order to complete the quality and quantity of the house, new technologies are continuously developed and used, such as the current BIM technology, which can be used well throughout the life cycle of the construction. This paper mainly analyses the use of BIM technology in construction engineering and explains the benefits of BIM technology in all walks of life.

1. Introduction

The BIM (Building Information Modeling) building information model is an engineering data model that integrates various related information based on three-dimensional digital technology. At the same time, BIM technology covers the digital technology of the entire project life cycle management[1]. BIM technology originated in the United States and was introduced to China in 2004[2]. China has only used more than 10 years from the introduction of the BIM concept to the current booming development. However, we only use it as a new technology to replace CAD technology, and change the map from 2D to 3D. It does not combine model and management, which is a big drawback in the construction of the project. Therefore, many unforeseen problems have not been effectively solved before and during construction. The current construction project is mainly completed by the owners, surveying units, design units, construction units and supervision institutes. Therefore, this paper mainly discusses the necessity of using BIM technology in these different industries.

2. Application of BIM technology in the design industry

The owner first entrusts the surveying unit to conduct survey and analysis of the geology, and obtains the survey report, and then the owner submits the survey report to the design unit to design the building. The traditional construction drawings are drawn and drawn by the design unit using CAD according to the requirements of the owner. The result is often that the design requirements cannot meet the actual needs of the owner. There may be two reasons for this: First, the construction unit does not know how many things it needs to build, and cannot inform the design unit of all the things it needs to build and add new requirements to the construction, which often leads to the demolition of some buildings for re-construction; Second, because the two-dimensional drawings are not highly embodied, it may occur that the lower-level objects are higher than the floor height, resulting in subsequent modifications, failing to achieve the integrity of the building, and posing a hidden danger to the structural safety. The use of BIM technology will eliminate these hidden dangers and enable better construction.
2.1. Model operation visualization
When planning the layout, the environment around the project is drawn, which is convenient for construction. Because the buildings in our country are relatively dense, and the road traffic in many places is relatively tight, if the road conditions around the entire project can be drawn in, then the driving route simulation will be carried out. This can better schedule the construction of the site and also reduce the occurrence of traffic accidents.

Designers design projects that meet the requirements of the owners, including buildings, structures, water supply and drainage, heating and ventilation. The owner will coordinate the overall situation, check whether the actual needs are met, and then make changes until the desired result is achieved. At the time of design, the design unit uses the BIM technology to draw the entire building in 1:1, including all the information of the materials. It is possible to visually see the final result and make a model that makes the owner satisfied and has no errors[3].

2.2. Completeness of model information
When designing the unit, the structural type, building materials, engineering performance, manpower, materials, machinery, engineering safety performance and material durability performance of the entire building are reflected in the model, which can guide the construction unit to purchase correctly. Materials, material problems are found during acceptance, and the construction unit is also responsible.

3. Application of BIM technology in supervision industry
Supervision is an institution that is under the supervision and authorization of the owner to supervise and manage the project, but does not completely obey the construction unit[4]. When carrying out construction project supervision activities, it must appear as an impartial third party. It does not care about the owner or the construction unit. The activity covers the whole process of the project. Supervision is a participant in the entire construction process and fits perfectly with the application of BIM technology in engineering[5]. The main task of supervision is to control the three aspects of schedule, cost and quality.

3.1. The role of BIM technology in schedule control
In the BIM model given by the design unit, only the time dimension needs to be added to it, and it will become a 4D model. In the model, the construction can be simulated using different time units. For example, time, day, week, month, quarter, etc. can be used to simulate the construction plan, and the selection can be made according to the actual situation. In the process of simulation, it is possible to point out possible problems and risks in a virtual environment and solve the problem by adjusting the model modification plan. Through numerous simulation checks and adjustments to the model and plan, the model and plan will be optimized to better control progress.

3.2. Application of BIM Technology in Cost Control
In the project investment decision-making stage, the supervision unit will summarize the fraud data of nearby projects according to the BIM model given by the design unit, and call the price of people, materials and machines according to the latest market conditions, or directly press each the cost of the square meter is estimated on the total investment amount. Because of the clear amount of engineering, this makes the supervision unit's advantage in assisting the owner to do the bidding work and effectively reduce the project cost.

In the construction phase, the supervisor can encode each component in the BIM model and add time, space, and process information to it so that it can be classified according to the corresponding conditions. At the same time, with the support of the database, the number and price of people, materials and machines required for the components classified according to the corresponding rules can be automatically calculated according to the engineering price, list and specifications, and the data can be summarized.
In the completion and acceptance stage of the project, the supervisory unit will use the BIM technology to summarize the information involved in the whole project and make claims for the disputes arising in the contract. The completion data and the project supervision archive file are submitted to the owner, so that the owner can have both the paper data and the electronic version of the data, and can view it anytime and anywhere.

3.3. Application of BIM Technology in Quality Control
Pre-existing prevention is the top priority of quality control, and early prediction is more alert than sudden learning. The supervision unit should strictly control the construction quality in accordance with the principle of being responsible to the owner, to itself and to the construction party as well. Before each construction, the model is checked for collisions to avoid rework.

Using BIM technology, a new model can be presented in front of the owner, supervisor, and construction party during the construction process, so that all parties can better communicate, so that the supervisor can make the most informed decision. At the same time, the use of Internet technology to real-time monitoring of the construction site to identify the source of danger, so that the quality of the project is better controlled.

In the case of each acceptance, BIM technology is used to draw a project according to the real construction, and the information of engineering safety performance, component size and position including production date and material durability performance are truly reflected in the model. The model will serve as a reference model for the final operational maintenance phase.

4. Application of BIM technology in construction industry
The traditional construction is that the engineer directs the workers on the spot according to the drawings provided by the design unit, and the mistakes will inevitably occur. The specific errors are as follows: (1) the drawings provided by the design unit are incorrect; (2) the construction personnel misread the drawings; (3) the worker is operating incorrectly during construction. Such results often lead to rework, which not only delays the construction period, but also wastes manpower, material resources and financial resources. These errors can be avoided by using BIM technology. Before the construction, the drawings have been carried out through BIM technology, such as the investigation of pipeline collision, the compilation of construction plan, engineering quantity calculation, etc. Due to the 3D model reference, workers can work more easily and clarify their work.

4.1. Application of BIM technology before construction
In the construction preparation stage of the construction project, according to the 3D model, the layout of the construction site is reasonably planned, including some areas such as the dormitory area, the office area, and the material stacking area, and the driving routes for the vehicles carrying the construction materials and the large machinery are planned. Using BIM technology for simulation, you can avoid traffic peaks.

In the procurement of materials, since all the information of the components has been completely defined during the modeling, only the accurate data of each part of the model needs to be obtained. It is also possible to purchase according to the actual required quantity at each stage, so that the piled storage space of the material is released, and it is not necessary to occupy the narrow construction site all the time. At the same time, the loss of materials is also reduced, and quality problems such as corrosion of steel bars are avoided. The material can be purchased from the actual amount of engineering required, so as to avoid material waste, thereby better controlling the project cost and saving money. At the same time, BIM technology can also be used for virtual construction, optimization of construction schemes, simulation of construction process, greatly reducing construction quality and safety issues, and reducing rework and rectification.
4.2. Application of BIM technology in construction

A more important aspect of construction is communication. The communication between the design party and the construction unit, the owner and the construction unit, and the supervision and construction unit are all necessary conditions for determining whether the project can be completed smoothly in accordance with the requirements of all parties[6].

BIM technology can clearly and intuitively express information in a dynamic and visual way. At the same time, adding the 4D model after the construction progress in the 3D model, the site layout information and the construction resources can be integrated into one, and the requirements of each stage of the construction can be visually simulated to meet the latest information of the participants on the construction site. To achieve information sharing among all parties.

At the same time, it can be combined with R technology to assist construction and simulate the generation of complex nodes, making engineering construction more efficient. When simulating the construction, the dangerous sources that may occur during construction should be discovered and removed in time to reduce the occurrence of safety accidents. This can better improve the safety management during construction and ensure safe construction[7].

5. Conclusion

The use of BIM technology in construction projects is the trend of the times, and our country is vigorously developing BIM technology. BIM technology will be the new tone for the healthy development of the construction industry, and it is also a soft power that construction companies can thrive in the future. By establishing a three-dimensional model, BIM technology integrates and visualizes information in front of people, avoiding many invisible and unnecessary troubles. This is a huge advantage that BIM technology can survive in the architectural environment.

References

[1] Zheng Huahai, Liu Yun, Li Yuanqi. (2015) Current status of research and application of BIM technology. J. Structural Engineers, 31: 233-241.
[2] Li Haifeng, Li Yake. (2018) Application of BIM Technology in Construction Project Construction. Henan Building Materials, 28: 23-24.
[3] Sun Dongdong, Li Zhiqiang. (2019) Application of Computer Information Technology in BIM Era in Construction Engineering. Information Technology, 17: 254-255.
[4] Yan Dexun. (2018) Re-understanding of supervision work in engineering construction. Agricultural technology and information, 36: 89-96.
[5] Zeng Qinghua. (2019) The necessity of engineering construction supervision. Technology Innovation and Application, 24: 195-196.
[6] Lu Xixin, Qian Hao, Fang Yijun, Sun Yahui. (2019) Application of BIM Technology in Construction Communication Management and Personnel Management. Journal of Information Technology in Civil Engineering and Architecture, 11: 83-87.
[7] Yan Long. (2018) Exploration of Application of Virtual and Augmented Reality Technology (VR/AR) in Construction Safety, 15: 165.