The Application of BIM Technology in the whole Life Cycle of Construction Project

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Abstract. In this paper, BIM (Building Information Model Building Information Modeling) technology is taken as the research object, and the development of BIM technology into the construction technology is the core. The emphasis is on applying BIM throughout the building's life cycle. Starting with the concept and main content of BIM technology, this paper analyzes the control and promotion function of BIM technology for quality, schedule, cost and safety in the whole life span of the building. In this paper, the characteristics of completeness, relevance and consistency of BIM model information are briefly described, and the bottleneck problem of informatization in construction field is also solved. This paper discusses the application of BIM in engineering projects, and expounds the application value of BIM from the aspects of construction cost, quality, schedule, safety, information management, etc.

1. Introduction
BIM technology will be an epoch-making change to the management of construction enterprises. It has completely changed the concept and mode of production and management of construction enterprises. It can reduce attenuation during information transfer. The application of 4D project management information system based on BIM technology in the construction process of large and complex projects realizes the effective visual management of construction projects. BIM has become the research and application hotspot of information technology in the field of construction at present [1].

BIM technology can be used in the planning, survey, design, construction, cost management, operation and maintenance, reconstruction and demolition of engineering projects, and realize the data sharing of all participants on the basis of the same building information model in the whole life cycle. It can also provide technical support for industrial chain, industrial construction and architectural creation and support the analysis, inspection and simulation of engineering environment, energy consumption, economy, quality, safety, etc. Moreover, BIM supports professional collaboration, project virtual construction and fine management, creating conditions for the construction industry to improve quality and efficiency, energy conservation and environmental protection.

2. Application of BIM technology in the design stage

2.1. Provides a new design method for visualization in 3D state
The modeling design process under BIM technology is based on the 3D state, which is different from the design based on 2D state of CAD. In the design of the conventional CAD state, the components such as the wall and the column are drawn without the attribute of the member, and only the closed figure composed of points, lines and faces is used. The components drawn under BIM technology have their own properties, and each component passes its independent properties of X, Y, and Z coordinates in
space. During the design process, the designer conceived that the 3D graphics can be virtualized on the computer screen to achieve the design under 3D visualization.

2.2. Provide data sharing platform for collaborative design of various professions
First of all, under the traditional conditions, the building model design data of each profession cannot be exported and imported from each other, so that there is no mutual cooperation among the various professions. For the hydropower, HVAC, and the structural conflicts between buildings and structures, it can only be carried out during the construction process. Therefore, there are many contradictions among the professional drawings, which leads to more changes into the construction process and more difficult coordination in the construction process. At the same time, the design unit also needs to constantly adjust the design, which not only increases the workload but also increases the project cost.

Secondly, under the BIM technology design, each professional works together through the relevant 3D design software to maximize the design speed and establish a data platform for mutual enjoyment among various professions, which realizes organic cooperation of various professions and improves the quality of drawings. After the completion of the architectural and structural professions, the BIM information containing the professional data of the building and structure is imported into the hydropower, HVAC, elevator, and intelligent professional to optimize.[2] At the same time, professional BIM information such as hydropower, HVAC and equipment, can also be imported into architecture and structure, which can achieve data sharing and intercommunication among various professions, truly realize collaborative design under the shared platform, and can carry out the design of multiple different areas simultaneously in the design process. Such effective coordination avoids component conflicts between the various professions.

2.3. Provide the basis for design optimization in the design phase
Convenient and rapid optimization of the program economy and technology during the design phase: Designed under BIM technology, after the professional design is completed, the basic data of each component of the project is established. When the special engineering quantity calculation software is introduced, the project budget and economic indicators of the proposed building can be analyzed, and the economic optimization design of the building can be carried out immediately to realize the rationality of the project selection.

3. Application of BIM in the whole process cost management

3.1. BIM technology in the estimation of investment cost and comparison of programs
The application of BIM technology is conducive to the accumulation of historical data, and based on these data to extract cost indicators. In this way, the project can be quickly guided to estimate the price and make the best choice.

3.2. BIM technology application in the design budget phase
The design phase is the key to controlling the cost. It is very difficult to do the quota design by way of traditional manual calculation and pricing. Using BIM technology, BIM model integrates 3D model, engineering quantity, cost, price and other engineering information and business information, effectively solving the design budget calculation design.

In the design budget stage, using BIM's computing power, quickly analyzing engineering quantities, and analyzing BIM historical data to analyze cost indicators can help us quickly and accurately analyze design estimates and greatly improve the accuracy of design estimates.

3.3. BIM application in the bidding stage
In the bidding stage, the calculation of engineering quantity is the work that cost engineers spend the most time and energy. The promotion and application of BIM technology will be an innovation of the bidding process. The construction unit or the cost consulting unit can quickly and shortly transfer the
engineering quantity information according to the BIM model provided by the design unit with various
data information and compile an accurate engineering quantity list according to the specific
characteristics of the project to effectively avoid missing items and miscalculations. Therefore, the
disputes caused by engineering problems can be reduced during the construction phase. In the bidding
process, the construction unit may also send the BIM model of the proposed project to the bidding unit
in the form of a bidding document to facilitate the construction unit to use the design model to quickly
obtain the correct quantity of engineering information and compare it with the bill of quantities of the
bidding documents, which can develop a better bidding strategy.

3.4. BIM application of cost control in construction process

3.4.1. BIM-based 5D program management
The 5D application of building information model refers to the application mode of building 3D digital
model combined with project construction timeline and engineering cost control, namely 3D model +
time + cost application mode, which can be used to intuitively press monthly, weekly and press. The
daily implementation of the project and the cost data of the time node are obtained, which facilitates the
real-time modification and adjustment of the project, realizes the construction of the limit material, and
maximizes the effect of cost control [3]

3.4.2. BIM-based progress measurement and payment
The promotion and application of BIM technology brings convenience to us in terms of progress and
payment. BIM 5D can associate time with the model. According to the time period involved, such as
monthly or quarterly, the software can automatically collect the engineering quantity summary of the
content of the time period, and form a progress cost file to provide engineering progress measurement
and payment work.

3.4.3. BIM-based material cost control
Material costs often occupy a large proportion in project cost, generally accounting for about 70% of the
total budget cost. Therefore, the control of material cost is the top priority of engineering cost control.
Using the multi-dimensional simulation construction calculation of BIM 5D software, the consumption
standard of any detailed work is quickly and accurately split, summarized and output, so as to realize the
material saving. The process of material procurement planning, approach planning, and consumption
control can be optimized, and material planning, procurement, storage and storage can be effectively
controlled.

3.5. BIM in project completion settlement
BIM-based settlement management not only improves the efficiency and accuracy of engineering
quantity calculation, but also plays a significant role in the completeness and standardization of
settlement data. In the process of cost management, the BIM model database is also constantly revised
and improved.[4] The information related to the model, contract, design change, on-site visa,
measurement payment, material management, etc. are also constantly entered and updated. When the
completion settlement is completed, the information volume can be fully expressed. The completion
engineering entity, the accuracy of the BIM model and the completeness of the process record help to
improve the efficiency of settlement.

4. Application value of BIM technology in construction quality
The construction phase of the project construction is the key link to realize the planning and design. The
construction unit relies on the BIM technical management system to improve the construction level,
which can not only ensure the construction quality, but also obtain more benefits, which are embodied in
the following five aspects:
4.1. Three-dimensional rendering display, giving people a sense of realism and direct visual impact
According to the construction plan, visually display the layout of the site and large equipment, the construction plan of the complex nodes, the selection of the construction sequence, the simulation of the 4D, and comparison and selection of different construction schemes. The built BIM model can be used as the model base for secondary rendering development. The accuracy and efficiency of the 3D rendering effect are greatly improved, and the owner is more intuitively introduced and promotes the chance of winning the bid[5]. For example, Zhejiang Construction Engineering Group's Zheshang Bank Headquarters Building, Zhejiang News Building, and subway cover digging construction have all played a very good effect.

4.2. Fast calculation, greatly improving accuracy
The BIM database is created by establishing a 6D association database. It can accurately and quickly calculate the amount of engineering and improve the accuracy and efficiency of the construction budget. Since the data granularity of the BIM database reaches the component level, it can quickly provide the data information needed to support the management of each line of the project, and effectively improve the efficiency of construction management. Material is extracted through the BIM model and equipment statistics are obtained. Control costs and forecast costs, and provide a reasonable basis for the project bidding and construction cost control of the construction unit.

4.3. Precise planning to reduce waste
The fundamental reason why the fine management of construction enterprises is difficult to achieve is that massive engineering data cannot be quickly and accurately obtained to support resource planning, leading to the prevalence of empiricism. The emergence of BIM allows relevant managers to quickly and accurately obtain the basic data of the project, provide effective support for the construction enterprises to develop accurate personnel plans, greatly reduce the waste of resources, logistics and storage, and provide technology support for the realization of limit pricing and consumption control.

4.4. Virtual construction, effective collaboration, 3D visualization plus time dimension
The construction plan can be compared with the actual progress intuitively and quickly, and effective coordination can be carried out at the same time. The owner, the supervisor, and even the owner of the non-engineering industry are well aware of the various problems and situations of the project. In this way, through BIM technology combined with construction plans, construction simulation and on-site video monitoring, construction quality problems and safety problems are greatly reduced, and rework and rectification are reduced[6].

4.5. Collision check to reduce rework
The most intuitive feature of BIM is its 3D visualization, which enables collision checking in the early stages using BIM's 3D technology. As shown in figure 1 and figure 2. Optimize engineering design to reduce the possibility of false losses and rework during construction. The construction personnel can utilize the 3D pipeline scheme after collision optimization for construction and construction simulation to improve construction quality and communication ability with the owner.
5. Application of BIM in project schedule management

The project engineering model can be established by using BIM technology, and the construction schedule can be made by using the model, which not only improves the efficiency of making the plan, but also reduces the probability of error in the plan. The schedule of construction project should consider not only the owner's request for completion time, but also the actual construction quantity. In the traditional project management mode, the project schedule planning is manually operated by the technical personnel. Due to many factors involved in the project schedule plan, it is inevitable to make errors by manual operation alone[7]. After introducing BIM technology into project management, BIM solves the problem of schedule planning error well. Using BIM Technology to model the project can automatically calculate the project data, estimating the quantity of building materials needed in each construction link, and apply the project quota automatically to estimate the cost of labor, building materials and construction machinery of the project. Construction units can refer to the estimated data of BIM to recruit staff and purchase building materials to prepare for construction.

6. Conclusion

With the acceleration of the global informatization process, engineering and construction industry is undergoing an important technological revolution. The informatization level of the construction industry plays an important role in this revolution. Based on the review of a large number of domestic and foreign literature materials and time applications, this paper proposes the application of BIM technology in engineering projects, analyzing and explaining the engineering design and engineering application of BIM technology in engineering design. Therefore, BIM is considered to be of great significance to cost, safety and quality management and schedule control.

In conclusion, the application of BIM technology in the construction field will be an inevitable trend, and it will be widely used in future building design and construction. It is believed that with the development and improvement of BIM technology, engineering and construction industry will surely enter a new era.
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