Research on fine management of construction project based on BIM5D technology

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Abstract. On the basis of the original BIM technology, the concept of continuous upgrading and development, increasing progress and time has become the latest BIM5D technology, which can not only simulate the appearance of the actual project after completion and make it visually displayed, but also increase the management of progress and cost. By using the latest BIM5D technology, the construction project can shorten the construction period, reduce the cost and ensure the quality, improve the working efficiency of the staff and enhance the competitiveness of the enterprise. Therefore, it is of heart value to study how to combine the BIM5D technology with the detailed study of construction project and how to manage it.

1. Introduction
Building information model (BIM) is an information model based on all kinds of relevant data of construction project. Building model is established by modeling software, and real information of building is simulated and exchanged through digital information. BIM Technology can not only integrate digital information, but also carry out the application based on digital information, such as the whole life cycle design of construction projects. BIM can be understood as the construction of a prefabricated corresponding information system in the whole life cycle of construction engineering entity to achieve information sharing and refined management. In the construction stage, the application value of BIM Technology lies in improving the management level of engineering construction, transparent management of its various management, and realizing the visibility of fine management of construction projects.

Fine management of construction project includes schedule management, cost management and quality and safety management. BIM5D model not only includes architecture, structure, decoration, HVAC, but also includes schedule management and cost management in construction stage. Combined with BIM5D technology, the paper can make practical application in the progress management, cost
management and project quality and safety in the construction stage by taking advantage of its building information integration advantages.

2. BIM5D technical analysis

2.1. Basic concepts of BIM5D

BIM5D technology is based on three-dimensional building information model. On this basis, the two elements of progress and time are integrated to become a new five-dimensional technology. BIM Technology also contains the information related to the construction project, which represents the physical and functional characteristics of buildings in a more straightforward and simple data form.

BIM5D technology manages engineering quantity, progress, cost and other information in an information way, and realizes information integration. It can not only calculate the engineering quantity, but also associate the three-dimensional model of the construction project with various work arrangements in the construction schedule, dynamically simulate the change process of the construction project, and monitor the progress management and cost management in real time. It can be expressed intuitively by graph, as shown in Figure 1.

2.2. The development of BIM5D technology

The construction industry has always been the pillar enterprise of China's economic development. However, due to the rapid upgrading of the construction industry, and most of the construction enterprises still rely on the experience and inertia thinking learned in the past, so that the development of the industry is subject to many restrictions, and the limitations of management technology can not be broken. In addition, the application of traditional manual measurement and calculation software has been far behind the development needs of the current era\(^1\).

In recent years, BIM Technology has been widely concerned and applied in the construction field, and the application scope of BIM Technology is not limited to three-dimensional simulation. The new five-dimensional technology of 3D (entity) + 1D (Progress) + 1D (cost) has gradually come into people's vision, and is widely recognized, more and more in the project application operation.

The development of BIM5D technology has also undergone several important developments, as shown in Figure 2 below.
Fig. 2. Developments in BIM5D technology

3. Application of BIM5D Technology in Fine Management

3.1. Application of BIM5D Technology in Progress Management

The preparation of progress plan is one of the contents of construction schedule management. Because of the influence of various factors on the construction site, the preparation of schedule plan will change, which is a spiral process. For the designer, the problems encountered in the construction stage can not be fully considered. Therefore, even if the project enters the construction stage, design changes often occur. In the traditional modeling method, it may even be necessary to redraw the drawing. However, under the application of BIM5D technology, it is only necessary to modify the content on the original basis, and then some situations can be changed accordingly, which greatly improves the work efficiency of designers.

In BIM5D platform, after importing the model, the previous construction plan files are associated, combined with the labor, materials, machinery and other resources used in the construction, the construction schedule is predicted, and the construction simulation is realized, so that the data
management becomes more convenient, the construction period is shown in advance, the situation is prepared and solved in advance, and the real dynamic management of project progress is realized. In the process of construction, by comparing the plan with the actual situation, we can observe whether the target is completed or not, and the construction progress of the project can be lagging behind or ahead of schedule [3]. If there is a lag, it can be adjusted as soon as possible to avoid delaying the completion of engineering tasks. At the same time, BIM5D technology can focus on the key points and difficulties in the project, preview them in advance, reduce the problems that may appear in the process, and prepare measures as soon as possible to solve the problems, so as to ensure that the construction tasks can be completed on schedule.

The progress management process is shown in Figure 3:

![Figure 3. Schedule management process](image)

3.2. Application of BIM5D Technology in Cost Management

The application of BIM5D technology in cost management can improve the collaborative efficiency. Different participants, different departments and different professionals need to cooperate with each other to ensure smooth communication, effective information transmission, and avoid subsequent accountability and rework. Using BIM5D technology, we can find and deal with the possible problems in the drawings in time to realize the transparency of cost information [4].

In the process of construction, the specific quantities are not only the basis of project budget, material procurement and project settlement, but also the important reference data of project cost management. BIM5D technology makes the information of construction enterprises and their project departments transparent. The company can supervise the real-time situation of project construction, avoid false report of output value, solve the problem that the cost of project construction stage cannot be transparent, and it is convenient to trace the root of the problem in the process.

The project cost control based on BIM5D Technology (flow chart is shown in Figure 4) is an improvement on the traditional cost control method and management. The combination of BIM5D technology and cost control can solve many problems encountered by traditional methods [5].
In the BIM5D of Glodon, you can input the bid price, budget cost and actual cost of the contract, compare the three calculations, query the comparison between the planned budget and the actual cost in the construction stage at any time, and predict the real-time profit and loss of the construction project.

3.3. Application of BIM5D Technology in Quality Management

BIM5D platform is a comprehensive management platform that can integrate various professional models. With BIM5D technology, you can view engineering drawings before construction, and predict and solve engineering problems after construction.

When BIM5D technology is used to design the construction organization, the construction schedule and 3D model components are associated. These components can be independent of each other or can be edited into the selection tree to facilitate process simulation and virtual construction at any construction node. 4D model can generate daily construction organization arrangement, and put forward potential problems and optimization suggestions. Temporary facilities (such as scaffolding, tower cranes, etc.) are added to the virtual model and associated with the schedule, which makes the construction management team more convenient.

With BIM5D technology, as long as there is a network, the quality problems in the project can be inquired and marked at any time, and the rectification can be carried out timely after the repair scheme is provided. After finding the problem, the safety management personnel and quality inspection personnel on the site can mark and record the corresponding position of the problem on the BIM5D platform, and conduct data synchronization, so that the construction personnel can know the existing problems at the first time, study and solve the problem, and upload it to the platform for the relevant personnel to check again. Reduce the occurrence of problems in the actual construction process, avoid the situation of delay and waste of resources, and ensure that the construction progress can be completed on schedule.

3.4. Advantage Analysis of BIM5D in Fine Management

BIM Technology reduces the uncertain factors in the construction management, provides effective information for the construction project, and timely updates the information, and derives the calculation model. The project parameters and quantities in the model are combined with each other to calculate the more accurate price[6].

BIM5D technology realizes the integration of entity model + schedule + cost, achieves the purpose of optimizing cycle and saving cost. BIM5D technology has great advantages in the control plan of construction project. Through the integration of costs and resources, it is easier to explain the rationality of the plan and to optimize and adjust the unreasonable configuration. At the same time,
through the construction dynamic simulation, the dynamic loop control method is adopted to optimize and adjust the schedule and shorten the construction period. The application of BIM5D technology ensures the supply of construction materials and the application of project progress payment, improves the efficiency of collaborative work and makes all links work normally.

The automatic calculation of BIM5D technology not only improves the work efficiency of the engineering cost industry, but also obtains more accurate data, avoiding the error caused by human factors. Through the combination of physical simulation and schedule and cost, the cost personnel can display the results more quickly and intuitively, and can quickly understand the impact of scheme changes on cost, cost and schedule control. BIM5D technology through dynamic observation, more accurate statistics and analysis of data.

4. Case analysis

4.1. Project Overview

The name of this project is Municipal Library. The project land is located in the core area of the urban area. The proposed library is to solve the problem of insufficient area and public storage of the original municipal library. It is mainly composed of document collection and storage functions, public library use functions and corresponding supporting service functions.

In this construction project, the design service life is 50 years, and the structural safety level is set at Grade II, with an above-ground construction area of 35,888 square meters and an underground construction area of 9,444 square meters, with a total construction area of 45,332 square meters, including one underground floor, six above-ground floors and a building height of 34.350 meters (to the building roof); 36.8 m (counting to parapet), the project is a concrete frame shear wall structure.

4.2. Project model establishment

The project involves civil engineering, mechanical and electrical, steel structure and other disciplines. In the early preparation of the project, we first applied BIM Technology to establish three-dimensional model according to the given drawings, deepen the drawing and collision detection, which is beneficial to enhance the understanding of the construction project and save the BIM5D applicable software format. Then we need to do the layout of the construction site. We use the Glodon construction site layout software to generate three stages: the site layout of the foundation stage, the main stage and the decoration stage, and save them in the IgMs format, so as to facilitate the application of Glodon BIM5D software. Finally, we use the software zebra to compile the project schedule, and export the prepared software to the project format, It is convenient to import Association later.

4.2.1.3D modeling.

This project is a frame shear wall structure, so revit2017 modeling is applied at the beginning. As a result of the construction of multiple models, the model was divided into several parts, including the building contents. After the completion of the civil model, we carry out collision detection to find out the conflicts in the components, summarize the problems, and change the conflicts, so as to avoid the delay of construction period and the increase of cost caused by the conflicts[7].

The overall 3D model established and optimized by the Revit modeling software is shown in Figure 5.
4.2.2. Construction site layout.
In the Glodon construction site layout software, the construction site of the project construction is arranged, and the construction site is simulated and visualized, so as to plan the later construction site. We divide the construction site into two areas: construction area and living area. In the construction area, there are all kinds of material storage yard and various machinery. In the living area, it is the temporary facilities such as sports field, accommodation and kitchen that various construction personnel may need in the process of project construction, figure 6 shows the decoration stage.

4.2.3. Schedule preparation.
In the preliminary preparation, the software we applied is zebra schedule. In this software, we compile the construction schedule, and we can also export it to excel form for observation. At the same time, we also need to export it to project format, which will be applied in Glodon BIM5D software later.

4.2.4. Establishment of gmsd BIM5D model.
In the previous preparation, we mainly completed the professional solid model (Revit 3D model), site model (foundation stage, main body stage, decoration stage) and construction schedule which need to be imported from Glodon BIM5D. Import the three-dimensional modeling, site layout and construction progress of the above three stages into Glodon BIM5D[8]. In the integration of entity professional modeling and construction site layout model, we need to pay attention to whether the import base points are consistent. If not, manual adjustment is required. The integrated model is shown in Figure 7.
4.3. The application value of BIM5D technology in this case

The application value of BIM5D technology in this case is described from the following three aspects.

4.3.1. The application value of BIM5D technology in the progress control of this case.

Before the start of the project, BIM5D technology is applied to plan and forecast the progress of the project, so as to reduce construction emergencies and avoid unnecessary waste of construction period. The Library covers a large area and has a large amount of engineering work. Of course, the engineering data is also huge. In this project, the BIM5D technology can be used to integrate the data of the project. The start and end of the process can be set in the BIM5D system of Glodon. If there is any change, it can also be set in the platform to change the final plan without recalculating the construction period.

In Glodon BIM5D, the progress can be set as the comparison between the planned progress and the actual progress in the construction simulation module, and the model made before can be imported and associated with the construction plan file. The BIM 3D project image in each stage of construction can be displayed in the software. By comparing the planned progress with the actual progress, we can know whether the project has been completed on schedule; if the project is completed before, it is the completion of construction or ahead of schedule; if it is completed later, there may be delay in construction period. In the construction process, the actual progress response zone of Glodon BIM5D shows the comparison between the current progress and the planned progress. If the construction progress is shown in red, it means delay; if it is green, it means completion ahead of time or on schedule. Moreover, in the construction simulation module, it can be set as planned or actual progress.

4.3.2. Application value of BIM5D technology in cost control of this case.

In this project, the application of BIM5D technology to the cost prediction is helpful to improve the work efficiency of the staff. Compared with BIM5D technology, the traditional pricing method has the problem that the information is not updated in time. The BIM5D technology is applied to accurately input the information requirements in the drawings, effectively convey them, find the missing problems and optimize them in time, so as to realize the visualized management of the cost information of the project.

In the BIM5D software of Glodon, the data of labor, materials and machinery of the project can be integrated, which can quickly query and output the quantity, and can forecast the utilization data of labor, materials and machinery in advance, and generate relevant material reports. After associated with the schedule, according to its requirements, the material use plan of different stages is formed and provided to the site personnel to help them make relevant preparations in advance, so as to avoid the construction period delay caused by the lack of labor, materials, machinery and other resources. It can
also avoid the waste of labor, materials, machinery and other resources. According to the planned time, different component quantities are generated.

Under the premise of the previous operation, the fund curve and resource curve can be generated. Through the expression of the curve, the fund plan and resource plan can directly reflect the change and use of the project's capital resources, and export them to excel table format and convert them into line chart.

In addition, Glodon BIM5D software has the function of three calculation comparison, that is, the bid winning contract price, budget cost and actual cost. The comparison between planned funds and actual funds in different stages can be queried at any time to predict the profit and loss of the project.

In the early stage, according to the quick output function of BIM5D technology software and the construction schedule of the project, the labor, materials, machinery and other resources required in each time period are listed and prepared in advance, and analyzed, so as to reduce the delay of construction period caused by uneven resource allocation and increase the cost of the project. In the later stage of the project, we get the income, project cost, actual cost and other data of the project, compare and analyze them, find the existing problems, summarize and analyze, and try to avoid them in the future construction projects.

4.3.3. The application value of BIM5D technology in the quality control of this case.

Glodon BIM5D software supports the integration of three terminals, that is, the PC terminal, the external webpage end and the mobile terminal. The three terminals are seamlessly connected, and the data are processed collectively. PC terminal is the gathering point of project information. All BIM information is collected and integrated here, including the establishment of model, the comparison of schedule and actual, material query, and the generation of capital resource curve. We can get rid of the shackles of the external web pages, and provide the construction side with different modes of information management.

When the quality and safety problems are found, the project quality and safety management personnel shall submit them to the quality management or safety management module of the software, and the software will timely notify the person in charge of this stage for timely rectification. Compared with the traditional quality and safety problem notification process, it is more rapid in BIM5D. The quality and safety management problems are carried out on the external web page of Glodon BIM5D software. After the quality and safety management personnel find problems in the construction, they will mark the software, and inform the relevant personnel immediately and deal with them. After solving the problem, change its status in the software and submit it to the quality and safety management personnel for verification and judgment again.

In this problem-solving process, we gather the information and do not repeat it again and again. We can improve our work efficiency, reduce the project cost, and ensure the progress and safety of the construction project.

Glodon BIM5D software is a platform for integrating information, which can reflect multiple problems. We can also supervise the quality management of the project at any time through the three terminals provided by it, and analyze and optimize the project, which greatly improves the work efficiency of the staff.

5. Conclusions

At present, the construction industry is still in the development, but in the traditional project, the participants lack of effective and timely communication, and it is difficult to achieve dynamic supervision. Based on BIM5D technology, project managers can make effective analysis and decision in the face of complex construction project management.

For now, the application of BIM Technology in China is still in the initial stage. However, from a series of policies proposed by the Chinese government for the development of BIM Technology in the construction industry, the country also pays more and more attention to the application of BIM5D technology in the engineering construction industry. More and more enterprises will find the
 advantages of BIM5D technology and attach importance to it and apply it. In this paper, BIM5D technology is associated with the fine management of construction projects, hoping to be helpful to the progress management, cost management and quality management of the project.

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