

## Application of BIM technology in project management

Yu-Ying Hong<sup>i</sup>, SHI-Kai Lin<sup>ii</sup>, Wei-Wei Mao<sup>iii</sup>, Lu-Wang Yuan<sup>iv</sup>, Xiu-Qin Cui<sup>v</sup>, Qi-Yun Wu<sup>vi</sup>,  
Jia-Wen Xie<sup>vii</sup>, Sheng-Wei Wang<sup>viii</sup>, Chu Liu<sup>ix</sup>, Zi-Xuan Liao<sup>x</sup>

<sup>i</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 1107062217@qq.com )

<sup>ii</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 2911324381@qq.com )

<sup>iii</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 1759224672@qq.com )

<sup>iv</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 1312426482@qq.com )

<sup>v</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 260548187@qq.com )

<sup>vi</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 1273531045@qq.com )

<sup>vii</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 1347460360@qq.com )

<sup>viii</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 464230594@qq.com )

<sup>ix</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 542115664@qq.com )

<sup>x</sup> (Engineering Cost Major, School of Architecture and Engineering, Sanming University, China  
Email: 2483749833@qq.com )

### ABSTRACT

BIM technology is a major innovative technology in the construction industry, and the informationization of engineering projects based on BIM technology will certainly serve as one of the effective ways to improve the efficiency and profit of the construction industry. Taking the plant of Sanming Agricultural Mechanization Development Center as an example, the article analyzes the application of BIM technology in project management, dissects the advantages and characteristics of BIM technology, and provides ideas to further improve the reliability of BIM technology applied in project management.

**Keywords-** Application; BIM technology; construction industry; Informatization; Project Management.

Date of Submission: 02-06-2023

Date of acceptance: 13-06-2023

### I. The concept of BIM technology

BIM technology is an applied technology for building data modeling, which simulates the actual state of the building mainly through data and information related to the construction project. BIM technology is crucial to the whole project, not only to create 3D building models, but also to control the changes of construction indicators, data and dynamic cycles, thus improving construction efficiency and

providing clear and simple construction data and target forecasts for the whole project, and effectively reduce risks. <sup>[1]</sup>

### II. Application of BIM technology in project management

#### 2.1 Civil engineering modeling

Quanta GTJ is a civil calculation software, which helps engineering costing companies and practitioners to solve professional estimation, bidding budget, construction progress change and completion

settlement by recognizing dwg drawings, importing BIM design model, cloud collaboration and other functions for BIM civil measurement model establishment.

Only the foundation of this steel structure plant project is modeled by GTJ for calculation, and the rest of the modeling is done by other software of Quanta. Independent foundation is used for single column or towering structure and self-contained foundation, whose type can be selected according to material performance and stress state. The plane shape is usually circular or polygonal. However, in addition to self-weight and vertical live load, wind load is the main design load of the towering structure, in order to make the foundation in all directions with approximately the same overturning stability factor, the use of circular foundation is more appropriate. In view of the high center of gravity of such structures. A slight tilt of the foundation will increase the eccentricity of the load, thus causing a development toward a greater slope. Therefore this type of foundation deformation is controlled with allowable tilt. The concrete strength of the independent foundation is C30, and the concrete strength of the mat is C15. When modeling in this software, first of all, a new project should be created, select the corresponding list of quotas, and then set the floor settings for the floor height and concrete strength of different floor elements, protective layer thickness, and reinforcement specific gravity, and then you can draw, insert the foundation drawing, extract the axis and independent foundation and ground beam information for automatic identification. In addition, it can change the extraction error message, that is, GTJ part to complete the calculation and modeling of the foundation components.

## 2.2 Installation modeling

The construction and installation calculation part of the project is carried out by GQI, the first step: understanding the drawings, the important thing is the design instructions, different drawings design instructions will be somewhat different, in the software in accordance with the design instructions for engineering settings; second step: after setting the engineering information, and then import CAD drawings, more important is to set the proportion, drawing positioning, and the division of the drawings; third step: Use the equipment lifting function to identify and draw the components; Step 4: Draw pipes, lines, etc. according to the drawings; Step 5: Based on the externally imported bill of quantities, summarize the calculation and then set the method to export the bill of quantities and the price list.

GQI calculation software has a more convenient automatic identification function, the use of this function will greatly improve our modeling

efficiency, because different CAD drawings because they are drawn by different people, in the identification process may be due to the drawing of the drawing is not standardized resulting in errors, then we need to manually modify. For example, the software draws pipes and lines with the function of automatic connection of equipment, but sometimes the automatic identification is not satisfactory, and then it is necessary to make manual changes.

GQI modeling image intuitively expresses the system design intent, which greatly improves the accuracy of the installation project calculation. GQI calculation software can directly visualize the installation models of water supply and drainage, electrical and HVAC in three-dimensional space, which provides technical support for the project calculation and improves the accuracy of the calculation. <sup>[iii]</sup>

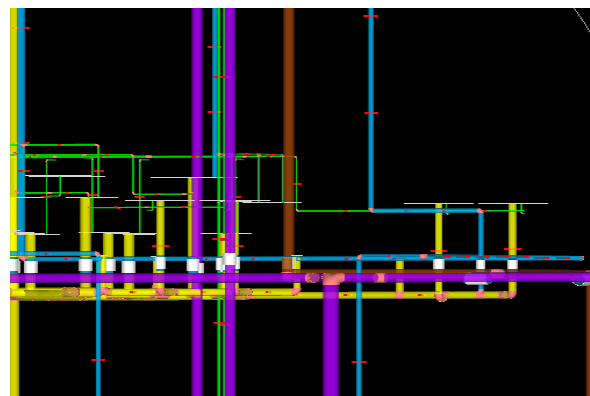


Fig. 1.1 Installation project model

## 2.3 Construction Organization Design

Construction organization design is used to guide the construction organization and management, construction preparation and implementation, construction control and coordination, allocation and use of resources and other comprehensive technical and economic documents, to the entire construction project as the object of the preparation of construction organization design, the entire project construction process plays a comprehensive planning, key control role. <sup>[iiii]</sup> In project management, the BIM technology that scientifically achieves the construction organization design can achieve good management of the whole process of civil construction, which has important significance for ensuring the construction quality and the final economic benefits of the construction project. The main preparation includes general design of construction organization, project overview, general deployment of construction, general construction schedule, main construction machinery and equipment and facilities allocation plan, general layout of construction.

The preparation of this project schedule is a key part of construction organization design, which will have an impact on the effect of project management of engineering construction. In the process of construction schedule preparation, we should use the quantity calculation results exported by Quanta GTJ and GQI software to calculate the quantity of works, apply the corresponding labor quota to calculate the labor quantity of corresponding works, and consider the characteristics of each construction process, construction sequence, construction organization relationship, time required for each process and resource demand, arrange the appropriate number of construction sections, construction teams and staffing quantity. The number of construction sections, construction teams and staffing quantity, etc. are arranged appropriately, and the construction step and beat are obtained, and finally the schedule network diagram is drawn using Quanta Zebra Monon software, which results in the time scale network diagram of the project.

Of course, the schedule generally needs to be checked, adjusted and optimized repeatedly before forming the official version, thus ensuring the construction plan is scientific and reasonable. When the actual construction progress lags behind the schedule, the duration of the process and the organization between the processes can be adjusted. If the actual construction progress is delayed due to the construction process, you can use Quanta Zebra Monon software to adjust the construction process, construction organization relationship and resource deployment plan in the planned progress, and then simulate the construction according to the new progress plan to find the progress conflict points that are easy to be ignored, and make adjustments and optimization, so as to improve the control of the construction progress planning process. The BIM technology of construction organization design prepared by Quanta Zebra Monolong software is widely used in the process of project schedule control management, which helps to ensure that the project is carried out in an orderly manner and according to the plan.

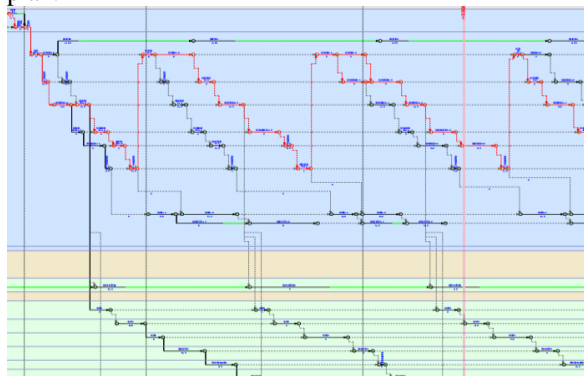


Fig. 1.2 Time scale network diagram

#### 2.4 Construction site simulation

Construction site layout is one of the important parts of the whole process management of the project and a very important aspect of the construction unit in the project management. Scientific and reasonable site layout can reduce safety risks to improve efficiency, reduce project costs while ensuring the construction period, and ensure that the project develops quickly and well within the specified time. The most prominent feature of the application of BIM technology in the construction of engineering projects is the simulation nature, which helps this technology to be better implemented into each construction link<sup>[iv]</sup>, and the establishment of 3D drawings through Quanta construction site layout software can fully simulate.

Foundation stage, main stage and decoration stage are the three major processes that engineering projects go through, and each stage has its own characteristics.

The project's construction site set up two gates, width and height to meet the needs of vehicle transportation, the introduction of off-site roads and on-site transport roads, the main one-way road 4m, two-way road 6m, to consider the turning radius and slope restrictions, as far as possible and warehouse, processing shed effective connection to reduce secondary handling; layout of large machinery and equipment such as tower cranes, placed to cover the location of the transport components of the site, surrounded by the establishment of fences and Independent power distribution boxes; layout of warehouses, yards generally close to the use of the site, longitudinal and parallel to the traffic lines; erection of temporary activity board room, with offices (set in the relative concentration of personnel within the plant), dormitories (10 people each), canteens, bathrooms, etc., should meet the needs of different stages, a variety of professional work teams on the dormitory, office space and material storage and processing sites, the temporary construction area every other distance to put a Fire extinguisher box; temporary water and electricity are essential, attention should be paid to avoid high-voltage power lines through the site, and at the same time, mark the ground well, and try to avoid mutual interference of various construction majors such as civil construction and installation.

The application of BIM technology innovates more possibilities for construction projects through simulation, arranges multiple construction solutions in the software, and selects the most suitable and economical site arrangement.

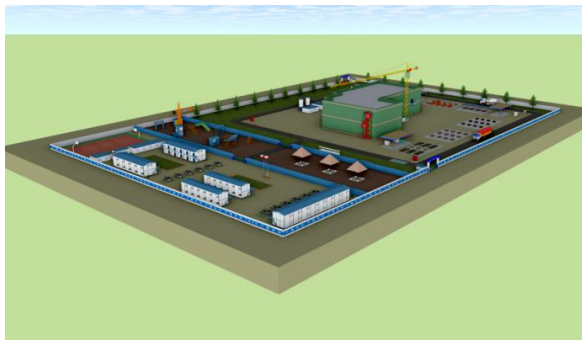


Fig. 1.3 Construction site layout

## 2.5 BIM5D application

BIM5D is a new concept of construction dynamic simulation technology, a new model of schedule and cost management as well as engineering technology, which is based on 3D model with additional time axis and cost axis, so it is called BIM5D.<sup>[v]</sup> BIM5D also plays a vital role in engineering construction and is widely used in the construction of engineering projects, not only for effective data integration, but also for optimized business management.

First, enter the Quanta BIM5D software to establish the single unit information and floor information, and import the model file of this project for model integration; then, according to the schedule plan of the construction organization design to create a new flow section and associated; next, import the completed schedule plan and associated; fourth, to set the work conditions, and then you can compare the simulation of multi-view port; finally, import the cost budget book will be budget list for Finally, we can import the cost budget to match and correlate the budget list, and then realize the multi-dimensional control of project site technology, schedule, cost, quality and safety.

The use of BIM5D technology can reduce the cycle time and cost of construction, improve the quality of the project, and dynamically simulate the changes in the construction process, thus enabling real-time monitoring of construction management and greatly improving the efficiency and quality of construction management.<sup>[vi]</sup>

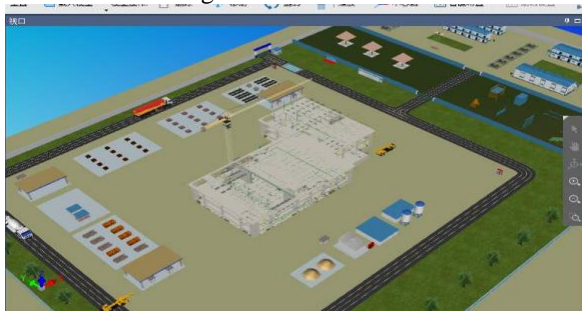


Fig. 1.4 BIM5D model

## III. Summary

BIM uses digital technology to manage construction projects, significantly improving the efficiency of the construction process and greatly reducing the waste caused by errors and omissions. Using BIM technology to complete the civil model of the building and the three-dimensional model of water, heating and electricity, etc., in the modeling process, we can find out the problems of errors and omissions in the drawings of various professions, and analyze and optimize them in time, basically solving the contradictions in the drawings, optimizing the architectural design, greatly reducing the negotiation changes in the construction phase later, and controlling the project cost at the source. The use of BIM technology in the project construction process to prepare the construction schedule can effectively avoid unnecessary construction errors and reduce the appearance of rework in construction, thus improving the construction speed, reducing construction costs and ensuring the orderly development of construction. The application of BIM5D in project management is reflected in the five aspects of schedule, quality, cost, safety and material, which can guarantee the diversification and refinement of the whole project management process to the maximum extent and further control the construction cost, improve the quality and efficiency of the whole building construction, so that the effective control of the whole process of building construction from the beginning to the end is fully reflected.<sup>[vii]</sup>

Note: This paper is the research results of the following projects : College Students' innovation and entrepreneurship training program S2021111311067X, the "14th Five Year Plan" of Fujian Education Science 2021 Annual Project FJKBK21-020, the Higher Education Research Project SHE2103 of Sanming University 2021.

- [1]. Kong W. Application of BIM technology in the project management of construction engineering [J]. *Jiangsu Building Materials*,2023,No.192(01):152-153.
- [2]. Xing Liying, Shi Jing, Ding Yongguang, Liang Yihan.Application of GQI in construction water supply and drainage calculation [D]. Henan Shenyang:Nanyang Normal College,2021.
- [3]. Han Yulong. Analysis of the preparation of construction organization design (scheme) [J]. *Construction Technology*,2015,44(S1):742-745.
- [4]. Feng Chao. Application of BIM technology in construction of building engineering [J]. *Small*

and medium-sized enterprise management and technology (upper journal), 2015, (4)

- [5]. Xiao Qiju. Discussion on the application of BIM-5D technology in construction of building engineering [J]. *Construction Machinery and Maintenance*, 2022, No. 306(05): 108-110.
- [6]. Chen Zhuo. Analysis of the application of BIM5D technology in large-scale construction project management [J]. *Bulk cement*, 2020, No. 204(01): 38-40.
- [7]. Liu Xiaoyi, Miao Fengmin. Research on the application of BIM5D technology in construction project management [J]. *Value Engineering*, 2019, 38(3): 142-144.