Advancing Prefabricated Building Design through the Synergy of Digital Art and BIM Technology in the Construction Industry

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Abstract. BIM in architecture shows universality and comprehensiveness. The technology can be effectively used in the whole process of architectural engineering design, production, transportation and assembly. This paper expounds the prefabricated building and BIM Technology. By analyzing the characteristics and advantages of prefabricated building and BIM Technology, this paper analyzes the feasibility and value of BIM Technology in prefabricated building. At the same time, this paper applies BIM Technology to prefabricated concrete buildings under EPC management mode, and analyzes its effectiveness in design stage, component production stage and construction stage. The results show that BIM Technology can provide technical support and management guarantee for the design stage, component production stage and construction stage of prefabricated concrete buildings under EPC management mode.

Keywords: BIM, EPC management mode, Prefabricated Building, Construction Effectiveness, Digital Art, Construction Industry
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1 INTRODUCTION

At present, prefabricated building is recognized by more and more people in the industry for its unique advantages [7-6]. BIM uses industrial technology and organization to make building standardized. BIM makes the architectural design from plane to form a model which makes change and move towards a new stage [4]. BIM is recognized as the inevitable trend of the construction industry. Building information model, refers to the creation, application and management process of building information model.

At present, there are many problems in the construction industry, such as the decentralization of industrial structure; Backward means of information exchange; Energy conservation, environmental protection and sustainable development are facing severe challenges [5-10].

However, the emergence of BIM Technology fundamentally solves these problems and realizes all-round engineering information integration and management. The application of BIM is the start for better development of the construction industry [3]. It has been tried out in some enterprises and achieved excellent results, but has not been fully popularized.

Prefabricated building (PB) and BIM are both emerging technologies [1-9]. BIM can realize the collaborative work of various disciplines, improve work efficiency, reduce work errors in various links, and achieve the purpose of cost saving. BIM will make the PB more perfect and reasonable. Vigorously promoting the development of PB is not only the consensus of the whole industry, but also a practical matter that must be implemented. We should follow the steps of the 13th five year plan and pay attention to BIM in PB.

2 DESCRIPTION OF BIM TECHNOLOGY AND PB

2.1 BIM Technology

BIM is both a "building information model" and a "building information modeling". BIM is no longer a narrow model or modeling technology. BIM is different from 3D model. It is a new concept and its associated methods, technologies, platforms and software. BIM is not only the innovation of design and construction, but also the improvement of production and efficiency. It consists of product model, process model and decision model. They are complementary and interactive cycle models. Figure 1 shows the composition of BIM [8].

Figure 1: BIM Composition Diagram.

BIM Technology is the catalyst to accelerate the informatization of domestic construction industry. According to the meaning of Bim and combined with engineering construction practice, it is summarized that BIM has the following characteristics.

1) Visualization. The whole process of BIM building information model is visual. On the one hand, it changes from the plane drawing drawn by CAD from "point, line and surface" to three-dimensional model, which is a three-dimensional and intuitive effect drawing; More importantly, the whole construction process such as project design, construction and operation is visual, which facilitates better communication, discussion and decision-making among all stages and participants of the project.

2) Coordination. Coordinate the inconsistency of project information among disciplines, effectively communicate with disciplines, better meet work needs and improve design quality and quality.
3) Analog. Use relevant software to conduct simulation experiments in later operation stage, so as to provide a very intuitive visual progress control management basis for each stage.
4) Optimization. At present, construction projects tend to become larger and more complex. Bim and its related optimization software can be used to improve complex projects. BIM Technology can be used to optimize project schemes and design of special projects.
5) Graphability. The following drawings can be produced by using BIM Technology: comprehensive pipeline diagram; Embedded casing diagram; Collision check debugging report and suggested improvement scheme.
6) Integration. BIM is not an "information fault" in different stages of the building life cycle. It is an integrated management throughout the whole life cycle. Its integration greatly improves the labor efficiency and shortens the construction period.
7) Parameterization. BIM parameterization can quickly solve the problem of model establishment error caused by the error of software operator. At the same time, the parametric components have data correlation with each other to ensure that the topological relationship of model components is not affected.
8) Information completeness. The completeness of BIM information is reflected in the following three points: the topological relationship of 3D geometric information of engineering objects; Complete project information description of the project object; The logical relationship between engineering objects.

2.2 Analysis on BIM in PB

At present, BIM Technology is the catalyst for the development of China's construction industry (CI). Compared with traditional technology, it has many outstanding advantages, which can promote the rapid development of IT in the CI, so as to promote the development of CI industrialization. BIM is relatively mature. It promotes each other with PB to achieve the purpose of mutual benefit and win-win results. The core of PB is industrial production, and the key to industrial production is standardization, that is, standardized design, standardized component production and standardized construction. The standardization of each link determines that all links of design, component production and construction should follow the same standard, coordinate and correct each other, so as to maintain the optimal coordination and consistency. Through the integration of BIM Technology, the same standard in all links of design, component production and construction can be coordinated, modified and consistent, so as to truly solve the problem of PB.

PB have short production cycle and strong structural performance, and can achieve good economic and social benefits. However, with continuous improvement of social level, it has achieved some results, many factors restrict its development. Applying BIM Technology to PB can provide a new perspective for the improvement of other relevant laws and regulations; BIM Technology can not only present the appearance and structure of the building in a three-dimensional way, but also carry out the in-depth design of prefabricated components and nodes. The detailed display of three-dimensional angles greatly reduces the error of in-depth design. The important value of BIM Technology is reflected in the information sharing among all levels, disciplines and participants in the project. The problem of untimely information transmission is also self-defeating. BIM can provide new ideas for the scientific and effective management system of the project. BIM in PB can not only promote the development of information technology of PB, but also efficiently promote the green and sustainable development of CI.

The traditional CI is a linear process, from the owner to the design unit, to the construction unit, decoration unit, and finally to the operation and maintenance unit for management and maintenance. The linear process from beginning to end is quite lengthy, and there will be loss of

information in the middle, which cannot be completely and accurately transmitted to the next unit, as shown in Figure 2.

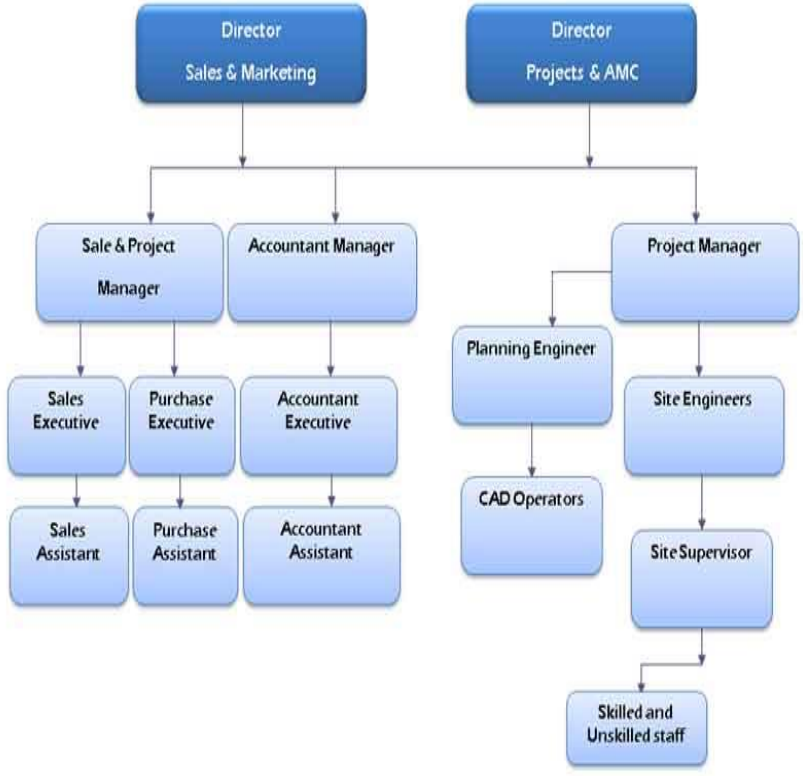

Figure 2: Traditional Ci Process.

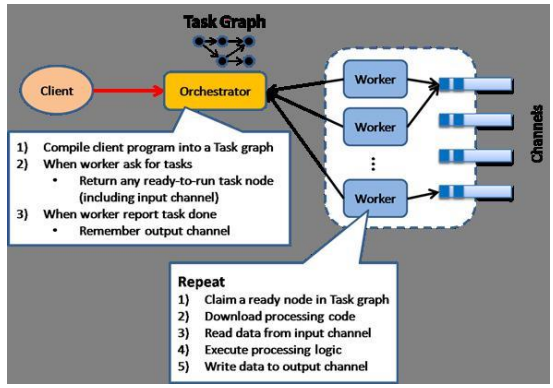

Figure 3: CI Process with BIM Technology as the Core.

The introduction of BIM Technology has brought great changes to the process of the CI, as shown in Figure 3. It can strengthen the communication between the owner, design unit, component manufacturer, construction unit and operation unit, and establish a two-way communication channel between BIM database and all parties. All participants can share information and work together among disciplines, which can improve work efficiency, reduce errors between links, and achieve the purpose of shortening construction period and saving cost.

BIM Technology not only has application value in information sharing among participants, but also has important application value in the design stage, component production stage, construction stage and operation stage of PB.

3 CASE ANALYSIS

This paper takes Baiziwan prefabricated concrete public rental housing project as an example. It is a pilot indemnificatory housing project in Beijing developed by Beijing indemnificatory housing construction investment center, designed by Beijing ZhuZong Group Co., Ltd. and undertaken by Beijing ZhuZong Group Co., Ltd. in the general contracting management mode (EPC). The maximum number of floors of the project is 27, the standard floor height is 2.8m, the maximum total height of the building is 80m, the total construction area is 222800 m2, and the construction area of underground rigid steel structure sunken courtyard and overall garage is 88100 m2; The construction area of aboveground and steel structure overhead corridors and prefabricated houses is 134700 m2.

BIM Technology provides the general contracting industrial chain of China housing and Urban Rural Development Corporation with: design production construction multi discipline collaborative deepening design; Organization optimization of prefabricated concrete components for production + construction; Multi participant comprehensive management of general construction coordination based on BIM Technology. The reasons why BIM Technology is adopted in the project are as follows: (1) High requirements for EPC project management: the core element of the project is to comprehensively coordinate and manage the design, component production and construction unit as the EPC project general contractor to realize lean construction in the whole life cycle. (2) Complex engineering structure form: the main structure of the project is complex, the top floor fluctuates, and the single drop is large. The joint review of drawings and the deepening of construction drawings are the difficulties in the early planning of the project. (3) Shortage of prefabricated construction talents: the training of management talents and the transformation of migrant workers into industrial chemical workers are the key guarantee of the project. (4) The standard rate of prefabricated components is low: the prefabricated residential units of the project are diverse, and the multi-stage collaborative management of prefabricated components is the guarantee of the project duration goal.

BIM provides an information sharing platform. BIM can quickly find out the required information and reduce the time to read the drawings. It can not only guide the component production more reasonably and accurately, but also help to realize the information management in the component production stage. Import BIM model into bim5d, integrate all professional models, and update the latest model at any time to ensure the accuracy and unity of the model. The bim5d platform can extract the information of each prefabricated component, automatically complete the reinforcement setting out, and generate the bill of materials. Bim5d platform can also export material purchase plan, material site demand plan and material mobilization plan at all stages. These material plans are the premise of coordinating component procurement, production, transportation and on-site installation. They are not only an indispensable data source for the production management platform in the production stage, but also the data basis for the construction of the production platform. The

data plans in the platform can be extracted at any time and on demand, which can meet the needs of docking with the production management platform in the future.

BIM Technology and bim5d platform change manual production into automatic production, so that mold design, reinforcement processing and component testing are all automatic production, effectively improve component quality and accelerate component production efficiency. Combined with RFID technology and scientific identification, a traceability quality management system of components is formed. In the whole life cycle of the component, the RFID electronic tag is used as the identification, and the basic information (floor number, size, material, etc.) of the component, the traceability record of production quality and the life cycle status (production stage, storage yard location, installation, operation and maintenance status) are viewed on the mobile device by scanning the tag.

Through RFID coding technology, the prefabricated components are uniformly coded. In the whole prefabrication process, the handheld mobile equipment is used to read the corresponding data in each link of production, so as to achieve the whole process quality detection. It can also monitor the production of the construction by monitoring the component production line, use the mobile terminal to realize the production inspection record of the component, and feed back to the daily production. Through the application of QR code and RFID, the whole process management and tracking of components from production, stacking, transportation and assembly are realized, and finally a traceable quality management system of components is formed.

4 BENEFIT ANALYSIS

In this paper, BIM information technology is introduced in the process of PB construction, and all links of design, component production and construction are integrated on the same visual service platform to realize mutual transmission and timely correction of information. During the design process, the construction simulation technology is used to solve the possible problems in component production and construction installation in advance, simulate the construction organization in the construction stage, optimize the site layout, component mobilization time and stacking, optimize the alternation of construction processes, simulate the construction of key parts, and scientifically prepare the construction schedule. Accurately determine the construction period, guide the formulation of scientific production and construction organization scheme, realize the coordination of component design, factory prefabrication production and on-site installation, and achieve the purpose of scientific control over project planning, quality, construction period and cost. Finally, the fine construction is realized, the project cost is reduced, the construction cycle is shortened, and good economic benefits are produced.

The project selects interdisciplinary disciplines in the field of construction technology and information technology to promote the combination of information technology and industrialization technology, so as to make modern information technology an innovative driving force for industrialization.

The project applies BIM Technology, changes the original management concept, changes the traditional "construction according to drawings" into "drawing construction", adapts to the current development of EPC and prefabricated construction market, and changes from passive to active. In the practice of the whole industrial chain of PB of Zhuzong group, the deep integration of the information integration and transmission advantages of BIM Technology and the complete set advantages of PB technology will better integrate the industrial chain and optimize resource allocation. To maximize energy saving and emission reduction, to achieve a more thorough green construction goal, to help the rapid progress and continuous improvement of assembly building technology, and to promote the development of assembly type buildings, has a strong exemplary, advanced and innovative features in the assembly building construction projects.

The project can provide strong technical support for building the whole industrial chain of PB of Zhuzong group, improve the control ability and core competitiveness of Zhuzong group in the field of PB, set an industry benchmark for the in-depth application of BIM information technology in construction, and enable BIM Technology to help the deepening reform and system innovation of construction enterprises.

Under the current situation, it is necessary to improve the ability of general contracting management, take the construction period as the main line, cost as the core, assessment as the means and BIM Technology as the starting point, carry out a series of activities to promote the improvement of general contracting management ability, and implement the whole process, all-round and all-round professional management. Focus on the improvement of "five capabilities" of design management, plan management, procurement management, professional management and resource integration.

In short, in the long run, BIM information technology can better improve the overall level of PB and even the whole CI, has broad development space, and its economic and social benefits have good predictability and durability. BIM technology to create detailed 3D models of prefabricated building components and assemblies. Digital artists can then enhance these models with textures, materials, and lighting to make them visually appealing and true-to-life.

5 CONCLUSIONS

With the rapid development of industrialization and informatization of CI, with the strong support of national policy, government and CI, PB has become an inevitable development trend. The core of PB is industrial production, and the key to industrial production is standardization, that is, standardized design, standardized component production and standardized construction. The standardization of each link determines that all links of design, component production and construction should follow the same standard, coordinate and correct each other, so as to maintain the optimal coordination and consistency. Through the integration of BIM Technology, the same standard in all links of design, component production and construction can be coordinated, modified and consistent, so as to truly solve the problem of PB.

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