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Research on Information Management of Prefabricated Buildings Under EPC Mode

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Abstract. With the development of modern society, labor cost becomes more and more expensive, and the issue of green intelligence is crucial. Therefore, buildings like prefabricated buildings, which consume less energy, are green and less dependent on labor, have attracted widespread attention. However, due to the construction characteristics, it is difficult for the traditional management mode to meet its information management requirements [1]. This paper discusses the establishment of an information management platform based on the EPC general contracting management model, which interacts and shares information with all participants, and integrates information technology such as BIM (Building Information Modeling), RFID (Radio Frequency Identification), IOT (Internet of Things), and establishes corresponding models according to their characteristics. These models provide efficient information management means in four stages: design, production, construction, and operation and maintenance, and improve the management efficiency of the whole process of prefabricated buildings.

Keywords. EPC general contracting model, prefabricated building, BIM technology, RFID technology, information management

1. Introduction

Prefabricated building is a building that is constructed by a "building block" construction method. The building is designed and divided into several components or selected from a library of existing prefabricated components, and then transported and installed according to the process. The change from cast-in-place to hoisting is the main operation on site, which can reduce the waste of resources, protect the environment, save costs, and ensure the construction period better than cast-in-place buildings, which is why the national construction department is vigorously promoting prefabricated buildings. Since the standardization and industrialization of prefabricated buildings also determine the necessity of information transfer and utilization, as well as the importance of the integration of industrialization and informatization, the information management of prefabricated buildings is particularly important for its future development. This paper takes the EPC general contracting mode as the background and the BIM technology as the basis to promote the development of information management of prefabricated buildings and solve some problems in information processing by building an information platform.

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2. EPC Organization and Management Mode of Prefabricated Building

2.1. Construction Features of Prefabricated Buildings

Prefabricated construction is not only a change from cast-in-place to prefabricated components, but also a change in construction methods and sites. First of all, it is fast and can guarantee high precision, which can greatly accelerate the schedule, and is less constrained by the climate conditions, saving labor and improving the quality of the project; secondly, compared with cast-in-place buildings, both safety and fire prevention, and durability are outstanding; the last is its social benefits, the construction method of prefabricated buildings can be conducive to civilized construction and safety management, as well as play a role in environmental protection and resource conservation [2]. But in the construction, it needs to do good protection measures at its node connection, so the comprehensive cost of the project will be very high, and it is low intensive degree, design, procurement and construction stage management is easy to disconnect and conflict, and transportation is more difficult.

2.2. Characteristics of EPC Management Mode of Prefabricated Buildings

Based on the characteristics of prefabricated buildings, the EPC contracting mode covering engineering, procurement and construction can be well matched. The general contractor of EPC mode can well coordinate and guide the designer, constructor, supplier and other units, make overall work deployment for all parties of the project, clarify the work functions and requirements of each post, and manage them in a centralized manner to eliminate possible disconnection and constraints in the design procurement construction phase. Moreover, this can make the responsibilities of the project subject more clear, which is conducive to the implementation of the duties to the people, the implementation of the problems to a specific stage, and the implementation of the responsibility retroactive mechanism [3]. In view of the advantages of EPC management mode and its adaptability to prefabricated buildings, corresponding systems shall be established, and information management platforms shall be established by applying information technology, so that the participants at all stages can play their roles better, more accurately and more effectively. The traditional EPC project management mode and main work contents are shown in figure 1 below.

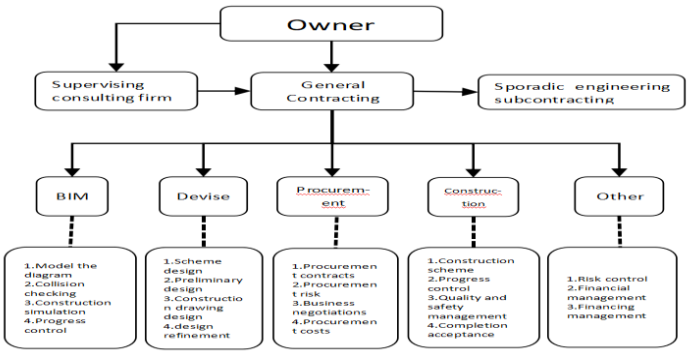

Figure 1. EPC model and main work content.

3. Construction of Information Management System for Prefabricated Buildings under EPC Mode

The information management system constructed in this paper is based on BIM Technology and the overall management of EPC general contractor. First, build a unified information management platform, collect and integrate information about design, production, transportation, construction and operation and maintenance stages through this platform, and then exchange and share information with the owner, design unit, manufacturer, transportation unit, construction unit and other participants. In combination with BIM Technology, Internet of things technology, RFID technology and two-dimensional code technology, Mutual non-interference and mutual coordination can not only ensure the unity and comprehensiveness of model data, but also make the personnel exchange of all participants timely and accurate. At the same time, through the temporary control of the government and the internal maintenance of the project, together with the supervision of public opinion, the management efficiency is improved to realize the all-round informatization application of prefabricated buildings.

Figure 2 shows the information management system under the EPC mode. This system transforms the point-to-point, single direction and low efficiency information transmission among stakeholders under the traditional information management mode into a unified, multi-directional and high-efficiency information sharing, and provides an efficient management means for prefabricated buildings.

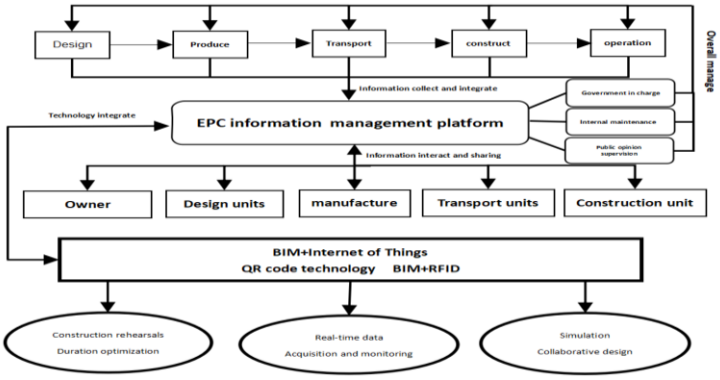

Figure 2. Information management system under EPC mode.

4. Application of Information Management System of Prefabricated Building in Design and Production Stage

4.1. Design Stage

With design as the main line throughout, through EPC mode management, we can understand the scale and structure of the building, as well as the required components and materials in the design stage. The EPC information management platform can clearly give the owner's requirements to the design unit, and the design unit will make overall planning for the comprehensive scheme of the building, structure,

electromechanical and decoration system, so as to achieve the overall unity, clear and reasonable purpose without conflict, follow the principles of standardization and integration, and ensure the coordination between the project quality and various disciplines. Then, the model established by BIM Technology is used to cooperate with the preliminary design, the detailed design of construction drawings and the design of prefabricated component processing drawings [4].

(1) Preliminary design. According to the technical points, the preconditions of the design are clarified, the splitting and decoration scheme is determined, the component type is optimized, the unified technical measures for the construction drawing design are formulated, and the process nodes are determined.

(2) Construction drawing design. Through the three-dimensional solid model established by BIM, the defects, omissions and collision problems between various disciplines can be found intuitively and accurately in the design [5], and then the prefabricated components can be deepened, and the two-dimensional plane construction drawings and detailed drawings can be drawn through the three-dimensional model, as shown in figure 3.

(3) Processing drawing design of prefabricated components. Collect all the requirements for prefabricated components of various disciplines and links on the production details of components, design lifting points, stacking support points, embedded parts to be embedded in the component lifting link, etc.

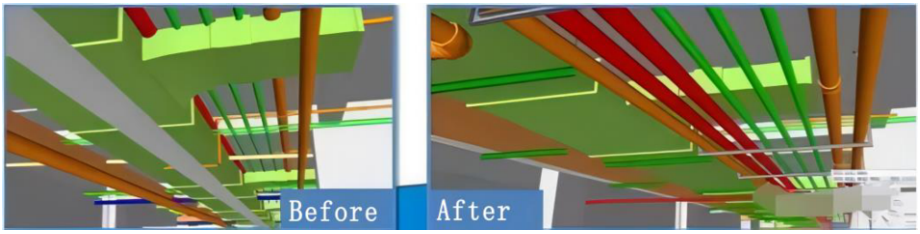

Figure 3. Collision check and optimization of BIM.

4.2. Production Stage

In the production stage, the quality of prefabricated components determines the quality of prefabricated buildings, and only accurate and efficient management can improve the quality of components. The information management system studied in this paper can well assist the manufacturer in internal management: first, according to the principle of integration, a collaborative mechanism of production and design and a perfect production management system are established. Through the cooperation between the manufacturer and the designer, the manufacturer can cooperate with the designer in the component splitting work, and both parties have a certain understanding of the components. Then, the manufacturer extracts the component parameters input by the design unit from the information platform, expresses the components through the BIM Technology, and combines the BIM information with the component information processing CAM (Computer Aided Manufacturing) and the manufacturing information management system (MES) to realize the automation and industrialization of the component production. Since the re-entry of the factory is avoided and the error of information input is prevented from the root, So as to meet the requirements of high accuracy in the production of components. The information platform can also record

the production process of standardized prefabricated components according to the relevant process information. When a new prefabrication plant is established in the future, these information can be entered into the database of the new plant to assist the new plant in the targeted site selection and purchase of materials, so as to achieve high standards, high requirements and high efficiency production.

5. Application of Prefabricated Building Information Management System in Construction Stage

The information management in the construction stage runs through the whole project. In the construction stage, the system integrates information technology such as BIM, RFID, Internet of things and two-dimensional code technology to assist the management of progress, safety, quality and construction environment on the site.

5.1. Schedule Management

Progress is the main line of project implementation, the focus of all parties in the project, and the comprehensive embodiment of project management ability. Progress management is generally divided into three stages: planning, implementation and control. Through EPC information management system, BIM, RFID and other technical means are integrated to realize the coordination of construction tasks of multi disciplines and multi participants of the project, and through the rapid information feedback mechanism, the production status of the construction site and the real-time situation of the project progress are dynamically presented in the form of data and graphics to provide multi-dimensional information for the management, Assist in project management and control and efficient decision-making.

Prepare the overall progress plan and milestone plan through the information management platform, integrate the BIM model and associate with it, conduct 4D rehearsal, coordinate the management arrangement of the whole progress, distribute tasks, and designate relevant production leaders or subcontractors to track the tasks. The responsible person gives information feedback on the on-site tracking plan. Timely discover possible conflicts in work arrangement between personnel and key and difficult points in relevant links, conduct dynamic comparison of existing progress, planned construction period and advanced and delayed construction period, and improve the overall plan prepared by the platform [6]. Figure 4 shows the 4D simulation of BIM Technology Progress of a prefabricated building.

The integrated application of BIM and RFID can effectively improve the inconsistent progress in the construction process. The progress data of component construction process is collected by RFID, and the collected information is input into BIM model timely and completely. The BIM model is used to generate the difference between the plan and the actual progress. In this way, the information management of risk prevention and real-time tracking in the construction process can be effectively realized [7]. The time and cost dimensions can also be included in the construction stage to simulate the project construction process, which has a positive effect on improving the construction scheme, and the construction progress and cost can be significantly improved.

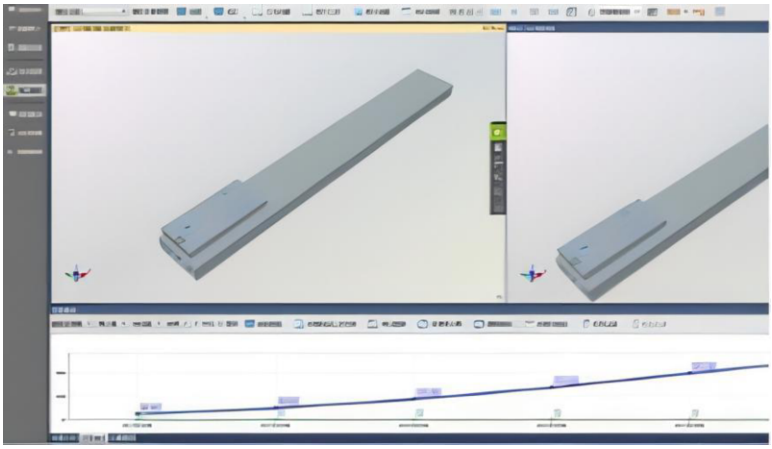

Figure 4. 4D simulation of construction progress.

5.2. Security Management

Construction safety has always been the most important issue in the construction industry. Based on the overall management of EPC, this paper integrates BIM and RFID technology through the EPC information management system to realize the updating of the construction site environment of prefabricated buildings, the positioning of construction participation and the division of construction dangerous areas.

(1) Update of construction environment

Through the integration of BIM and RFID technology, the danger situation can be warned in real time according to the construction site information in advance. The BIM module can realize the effective collection and processing of site information, and can update the dangerous situation in the site area in real time. After integrating the content of safety inspection, it can achieve the purpose of early warning. The RFID tag is a tool for BIM model to collect field information. The RFID chip embedded in the prefabricated components can make the prefabricated assembly in the construction site reflect in the BIM model in real time [8]. In order to realize the positioning of personnel, it is necessary to equip the on-site operators with RFID tags, which are generally embedded in the safety protection devices to supervise the safety protection status of the operators.

(2) Construction participation positioning

All kinds of mechanical equipment and components on the prefabricated building site are the main sources of the first type of hazard sources. The positioning of mechanical equipment and prefabricated components is to master their location and to calculate and delimit the corresponding hazard areas. Through the integrated management of the platform, the designer can identify the less mobile or fixed hazard sources through the BIM model and monitor them by the RFID reader. If non operators enter the designated area, they will automatically alarm to improve the overall safety.

(3) Hazardous area classification

After the construction dynamic simulation and hazard source identification of the operation site are completed, the hazard levels of different professional areas can be divided by visual models in different construction stages according to the model

identification, and different safety levels can be implemented according to the divided areas to provide corresponding evaluation results. With the cooperation of BIM platform, the management personnel of all disciplines can simulate the construction space and materials required for this operation in advance, and strive to reduce the intersection of space and time in combination with the proposed risk level. If it is unavoidable, they can also perform rehearsal and allocation of various resources to improve the construction efficiency.

5.3. Quality Management

On the basis of EPC mode information management system, a globally unified quality management system and model are formulated from the overall level by means of cloud two-dimensional code technology, cloud computing, BIM Technology, Internet of things technology, etc., to assist on-site personnel in comprehensive quality control.

Bim4d schedule model and 5D cost control model are established by BIM Technology to conduct integrated management on the quality, schedule and cost of prefabricated construction projects. On the basis of the established EPC mode information management platform, combined with PDCA (i.e. plan- implementation- inspection- Implementation) management cycle, the construction quality can be best controlled. The integration of BIM Technology and two-dimensional code technology is applied to the detection of construction quality. Before the hoisting of prefabricated components, the quality management personnel scan the built-in two-dimensional code information of prefabricated components through handheld devices to have an accurate understanding of component information, installation location and quality requirements [9]. Avoid possible installation errors. Realize informatization and intelligent management, reduce the intervention of human factors, and achieve real-time control over the quality of on-site construction. Provide reliable basis for possible follow-up quality responsibility tracking.

With the rapid processing of big data cloud computing in the background of EPC mode information management system, it can flexibly provide multi-dimensional statistical analysis and reports, and reduce the time spent in sorting out work process records. Help project decision-makers and enterprise managers quickly understand the project quality control.

5.4. Construction Environment Management

The EPC mode information management platform is used to integrate and manage various construction environment management related systems such as the dust monitoring subsystem, the building solid waste monitoring system, the construction site layout system based on BIM Technology, and the on-site water saving and water resource utilization monitoring system. Collect environmental information such as site wind speed, dust, noise and waste, integrate the information with the management platform, adjust the construction environment according to the weather and site conditions, and greatly improve the construction environment management level of the construction site.

6. Application of Modular Building Information Management System in Operation and Maintenance Stage

The operation and maintenance stage of the project is at the end of the industrial chain. The operation unit uses the Internet of things terminal equipment for data analysis and processing according to the standard library of parts and components established by the design unit, the digital tag information embedded by the manufacturer, the simulation model and construction information established by the construction party, etc., to grasp the operation of all components and various equipment in the building in real time, and find and deal with damaged building components. During the operation and maintenance, the operating unit detects the use and maintenance of buildings through the property management system, and transmits the above information to the shared database through the Internet to provide necessary information for the later reconstruction and expansion of buildings [10].

7. Summary

With the development of information technology, information-based engineering management has become an emerging research trend in this field. This paper establishes a unified information management platform for EPC mode with information interaction and sharing. It integrates BIM, RFID, Internet of Things and other information technology to provide efficient information management means in the four stages of design, production, construction and operation and maintenance, in order to improve the management efficiency of the whole process of prefabricated buildings and to provide reference for future related research.

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