Tracking management of box steel structure building components using building information modeling technology

Hu Sun[1], Chuqi Shi[2,] *, Hengbao Jiang[1], Qian Zhao[2]

[1] Guangzhou Research Institute of Construction Industry Co., Ltd., Guangzhou, China

[2] Guangzhou Construction Engineering Co., Ltd.

* Corresponding Author Email: 201610102881@mail.scut.edu.cn

Abstract. Based on the reconstruction of an office building in Guangzhou and the actual application, the tracking management methods of prefabricated box steel structure building components are summarized and the corresponding management methods suitable for prefabricated box building are found. Through the application of building information modeling (BIM) technology, the standardization of the implementation of the scheme is made, and implementation process, component tracking management methods are further validated and improved. In this way, the prefabricated component design, production, transportation, approach, information transmission problems in installation process can be solved, and the management efficiency of prefabricated box component tracking can be improved, material waste can be reduced. Using BIM technology can effectively guarantee the progress of the project, and provides examples for similar projects.

Keywords: prefabricated box building, building information modeling technology, component tracking, the project management.

1. Introduction

In recent years, box steel structure buildings have developed vigorously and are widely used in offices, schools, dormitories and other buildings[1]. It has a series of advantages, such as high degree of standardization, fast construction speed, high degree of industrial production, high assembly rate, reusable and so on[2]. At present, it is necessary to better control the dynamics of components, avoid the delay of construction progress caused by production delay, insufficient stacking space on site and slow mobilization of components, and solve the problems of difficult component information transmission, difficult component positioning and long time for manual verification one by one according to the drawings[3]. Drawing on the more mature material tracking technology in other industries and the advantages of informatization, visualization, coordination and omni-directional of building information modeling (BIM) technology, component tracking and system management of steel structure components can provide scientific and feasible technical support for construction projects, effectively reduce the time spent in information transmission and further realize the fine management of the project.

The construction of prefabricated buildings is characterized by a large number of components, a large number of information management data and dynamic changes[4]. However, in the actual construction process, it is difficult to transfer the component status information and locate the components, so it takes a long time to check one by one manually according to the drawings. BIM technology provides scientific and feasible technical support for prefabricated building construction with its characteristics of dynamic informatization, visualization, simulation and coordination[5,6].

This paper systematically and reasonably combs the information tracking construction management of building components in an office building reconstruction project in Guangzhou, hoping to provide a method reference for the tracking management of fabricated components.

2. Project overview

2.1. Box type steel structure building

Box type steel structure building is a kind of building similar to container type (Fig. 1). The main structure is steel structure, which integrates interior decoration such as doors and windows, wallboard, ground, ceiling and electromechanical pipeline. Finally, the building is formed through the superposition of boxes. It has the characteristics of fast construction, flexible box splicing, and can be used immediately after completion.

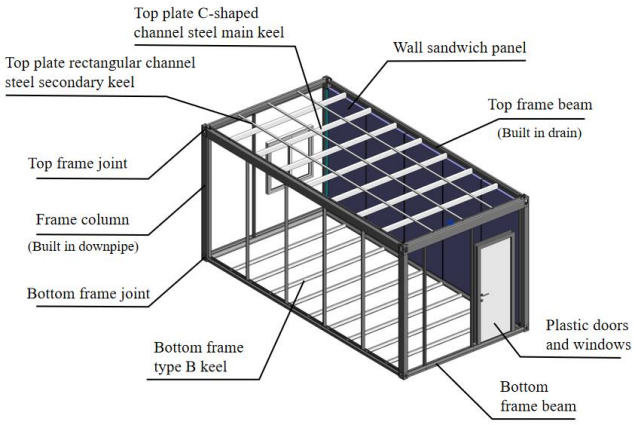

Fig.1 Schematic diagram of box steel structure building

2.2. Building overview

The office building reconstruction project is located in Tianhe District, Guangzhou. It is an expansion project of a multi-storey office building. On the basis of the original three storey office building, a three storey office building is expanded, which is constructed in the form of box steel structure building. A total of 40 standard boxes and 10 customized boxes are used (Fig. 2).

Fig.2 Schematic diagram of box structure model (A), and effect drawing after reconstruction (B)

3. difficult points of construction technology

(1) The transmission of existing technical information is difficult. There are many kinds and quantities of prefabricated building components, with a large amount of information. It is difficult to

rework the box building on site and requires high accuracy; At the same time, the production, transportation, mobilization and installation of components are difficult to control in real time, the information transmission stays on paper. It is difficult to store real-time data, the data is easy to be lost, and the transmission of component information in each process is difficult and difficult to control.

(2) According to the actual situation of the project site, the construction site is small, and the situation that office personnel need to enter and leave the site during the construction process should be taken into account, so the site layout is difficult.

(3) The construction personnel lack experience in assembly construction. Managers and workers lack experience in assembly construction, and errors are easy to occur in the construction process. Building construction requires multi-party participation, and coordination is difficult.

4. Project solution strategy

Considering the characteristics and difficulties of the project, this paper focuses on solving the problem of difficult information transmission of box steel structure building, and uses the application of BIM technology to digitize the component information and assist the engineering construction. The electronic tag is used to transmit the digital information of steel structure components, and the component QR code, bar code (hereinafter referred to as electronic tag) and basic information of some steel structure components are added on the label surface to ensure that the information can be transmitted through various ways. Data editing and uploading through mobile phone or electronic tag reader can greatly improve the degree of automation and greatly reduce the error rate, so as to significantly improve the management of dynamic information of building components.

The specific application process is: design and processing drawings→ BIM model generation of electronic labels→ processing in the factory→ exit factory transportation→ on-site warehousing→ construction→ acceptance.

4.1. Component production

BIM working group will generate the corresponding electronic label information from the design and processing drawings, including the type, name, axis position, size, direction of components, corresponding design and processing drawings, relevant personnel and other information. The technicians of the factory correspond to the design drawings and the electronic labels generated by BIM, produce one by one, and paste no less than 2 electronic labels on each produced component. The quality inspection personnel input relevant quality inspection information and data according to the inspection and acceptance of components (Fig. 3).

Fig.3 Reading and writing electronic labels and installation information of electronic equipment

4.2. Transportation management

After the steel structure members pass the delivery, affix electronic labels on the transport vehicles, input the vehicle related information, specific vehicle quantity, actual loaded member information, etc., and upload the acceptance photos. GPS equipment is used to locate the vehicle to achieve the application of real-time tracking.

4.3. Site receiving

After the steel structure members arrive at the site, the technicians responsible for receiving the materials will check and accept the steel structure members one by one by scanning the vehicle labels. The system will automatically check the delivery and warehousing information and check the omission of the members, and summarize the unqualified and omitted member information to the technology department.

The components that pass the acceptance shall be placed according to the position determined in advance, and the component information shall be input one by one, and the electronic label of component installation shall be pasted. At the same time, the positioning GPS shall be placed and the relevant information shall be input according to the construction organization scheme.

4.4. Component installation

The construction personnel locate the corresponding storage yard through GPS through the pre-determined construction organization scheme, find the corresponding steel structure components, use the electronic tag reading and writing tool to confirm the installation position of the components, then hoist them, and use the BIM model information on the tag to organize relevant personnel to install them. After the installation is completed, enter them into the information platform.

4.5. Acceptance of each stage

After the installation of steel structure components is completed, the technology department will push the acceptance work items to the quality inspection department, which will organize personnel of relevant departments to accept the components after installation one by one. After passing the acceptance, scan the electronic labels of components and update the information. The dynamic information of its steel structure components is updated through the platform information and uploaded to the BIM model components for association to form a process flow. And feed back to the design, factory, finance and other departments through the platform network at the same time.

5. Application of BIM technology

The design department or BIM department uploads the model and drawings to the platform and enters the component processing information. The information of component tracking is collected through GPS and mobile terminal. The project leader sends the corresponding task list through the daily platform feedback information. The technical department is responsible for managing the work and the specific implementation arrangement of the schedule. At the same time, the technical department is also responsible for the completion statistics of the daily work plan and forming the construction log according to the platform information.

6. Tracking management based on electronic tag and GPS

The project uses 20 GPS and hundreds of electronic labels for component tracking management. The electronic labels are mainly pasted on each steel structure component. GPS is applied to vehicle tracking and positioning, yard positioning of corresponding components, etc. By deploying data receivers and mobile electronic device readers and writers to replace manual recording work, we can realize the intellectualization of component positioning, reduce manual operation, reduce the staff

burden of management work, increase the portability of management and ensure the real-time and effective data.

7. Project data analysis

Different colors are used to distinguish component states, which can intuitively show the current progress and give corresponding early warning. At the same time, the statistical analysis of component status can be carried out through BIM model to assist the regional leaders of the project to control the project progress as a whole, coordinate and allocate human and material resources, and ensure the realization of the overall progress goal of the project.

8. Conclusion

Combined with the specific construction situation of an office building reconstruction project in Guangzhou, this paper summarizes the application of component information tracking. In this project, BIM technology is used for component information tracking and management, which solves the problem of uncontrollable dynamic information change of fabricated box steel structure building components, improves the construction efficiency, shortens the construction period, reduces the material loss and rework on site, reduces the construction cost, realizes the fine and organized management of engineering mode, and provides a reference for similar projects. There are still many possibilities for the application of BIM technology in box steel structure buildings, which is worthy of further exploration.

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