Application Value Analysis of BIM in Fabricated Buildings

Li Ling

School of Civil Engineering and Architecture, Southwest Petroleum University, Chengdu 610500, China

Abstract The requirements of the development of prefabricated construction and based on BIM (Building Information Modeling Chinese translation: building information model) technology at present, analysis and decision making, BIM technology in assembly building design, construction, completion acceptance and operation and maintenance of the whole life cycle of application. Virtual construction by BIM, check the design conflict, reserved design problems embedded deep prefabricated buildings, progress simulation, real-time monitoring, predict possible problems and develop solutions in advance, create favorable conditions for the control of the whole process.

Keywords BIM; assembly type building; informatization; building life cycle management

1. Introduction

As early as 1950s, China began to explore the assembly type building, and by 80s, it had a rapid development. Due to the poor mechanical performance of the fabricated components, the poor seismic resistance, the lack of materials research and development, the construction management, testing methods and installation technology lag behind, the development in 90s stagnated or even regressed. With the implementation of sustainable development and low-carbon economy, aiming at the problems of high energy consumption, high pollution and low efficiency in the construction industry, the industrialization of assembly building and building has become a hot spot in the construction industry.
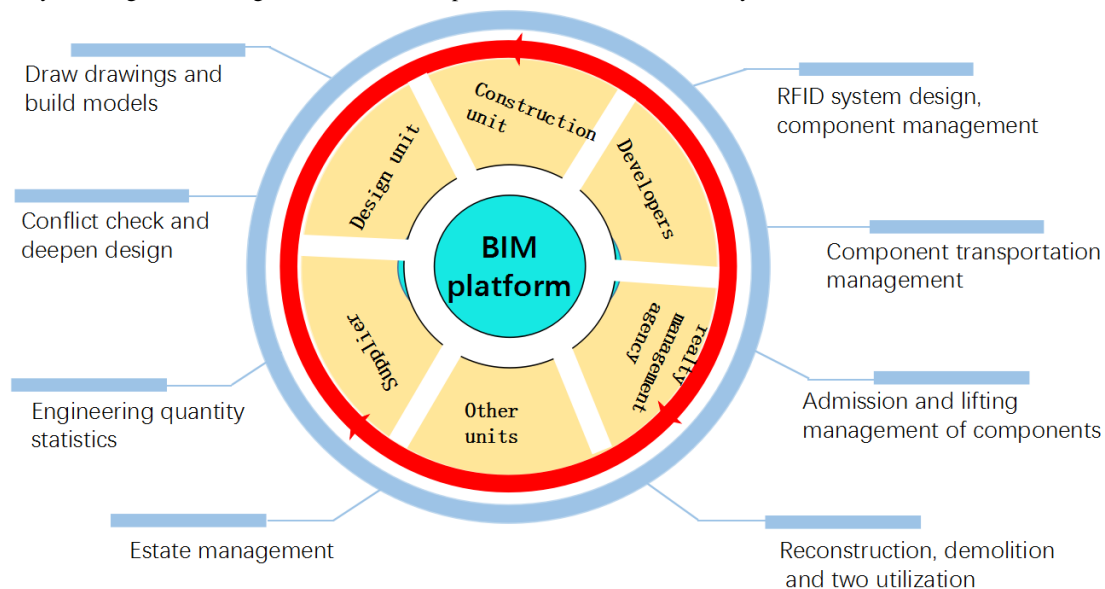

Figure 1: Application of BIM in assembly type building

March 23rd, the Ministry of housing three bursts of warning, pushing the assembly type building fully upgraded. BIM is based on the 3D digital technology, project life cycle integration project data, design and construction, suppliers and owners between the flow of information, information sharing, schedule, quality, energy consumption and other management issues.

PC (Prefabricated Construction Chinese Translation: assembly type building) is divided into two aspects in management. Is a design as the leading, design is often not fully considering the requirements of manufacturing, installation, construction and design on the collision conflict, caused by the design change, the project is ready to be expected of the state, affect the project progress and quality. The two is manufacturing as the leading, quality control, time duration and cost are often higher than the design as the leading ones, but they are slow-moving, not recognized by the market, the owners are more willing to use cast-in-situ building structure. Then BIM as an information platform in BLM (Building Lifecycle Management Chinese translation: construction project life cycle management) work well to create, manage and share of information construction, the application of BIM in prefabricated construction in figure 1.

2. The application value of BIM in the planning and design stage of assembly building
2.1 Improve design efficiency and applicability
In order to improve the efficiency and the component in the construction phase of the prefabricated construction can be utilized, design all kinds of embedded and reserved prefabricated needs very accurate, it is necessary to design the professional personnel in the planning and design stage of assembly building closely. Now use the design units of traditional two-dimensional CAD drawings are difficult to achieve using the professional interaction effect, and the use of BIM technology to build the design information platform, design the professional design personnel can quickly transfer their professional, synchronous modification of design scheme. BIM is the core idea that this design platform can achieve. BIM technology will construct a single component or object in a project as a basic element. This element model contains various information about the components, such as geometric dimensions, spatial topological relations, material properties and price, construction requirements, etc., to form a parametric architectural model, as the entire construction project data database or information collection. Using BIM technology and "cloud" technology, the professional design personnel can contain their professional design information of BIM model unified uploading BIM design platform, through the collision check and automatic error correction function, automatically select the professional's own design conflict and conflict between various professional design, help the professional design personnel to find out the problems existing in the professional design; Prefabricated construction of prefabricated type and the type is various, the large amount of figure, with BIM technology "synergy" design features, a professional design personnel to modify the design parameters of can synchronization, and correct by other design professionals call, it is convenient for supporting the professional design personnel to adjust design scheme, to save all the professional design personnel due to the design scheme to adjust the amount of time and energy.

2.2. Creating a standardized build set
In the process of building the model, the standardized design of component is realized step by step, and the component family library is built. As is known to all, the components of an assembled building are different, and laminated beams, laminated plates, doors, windows and so on are all parts of assembly building which need a great deal of use. We can make use of BIM technology to realize the opening and sharing of design information. The designers can upload the new prefabricated component model to the project cloud to share it. The size, style, and other categories of information integration in the cloud into all kinds of prefabricated and convenient library, other designers or the next time in the process of modeling can be called directly, save time, improve efficiency, reduce the error rate. With the cloud server in the family are continuously enriched, continuous supply of various types of family, the designer can be compared to similar family made optimization, parametric family, prefabricated standard size and shape to form a fabricated building. And a parametric family, but also greatly improve the use of precast prefabricated construction in flexibility, enrich the design of assembled prefabricated buildings, can be more conducive to meet the requirements of different apartment layout and style building, improve assembly building beautiful degree, to meet the diverse needs of different residents.

2.3. Improve design accuracy
Prefabricated construction in the construction process is prone to assembly deviation problem, which is a large part of the reason lies in the design process without considering the connection problems and different professional fight interface connections between different problems, set aside. In the 3D view of the BIM model, the designer can see the visual assembly between the prefabricated parts fit in prefabricated construction deepening design, can see the visual component geometry, internal structure, reinforcement spacing, the thickness of the protective layer of some important parameters such as the reserved embedded into prospective location, design. Collision check using BIM technology, analysis of assembly conflict between the various professional, again confirm the reliability of prefabricated joints, in order to improve the accuracy of precast installation status, reduce the delay due to the error caused by the design period, reduce the waste of materials, truly green building.

3. The application value of BIM in assembly building manufacturing stage
3.1. Convenient for statistical engineering quantity

Prefabricated construction is different from the cast member, masonry components such as it is not only to the statistics of the total quantity, but also the need for a number of statistics on each stage of each assembled component, in order to back in the factory production. Using traditional CAD or measurement software, cost personnel need a lot of time to calculate the amount of engineering, and the number of different components of assembly should be re counted. The need to acquire the cost information project cost personnel under the traditional mode provided from the designer's drawings, according to relevant provisions, the professional and professional knowledge of cost management, in this case, with or without the use of a design provided by the information completely by the cost of personnel according to their professional judgment, and designers do design methods and results submitted design style influence cost results not. BIM model is a rich information project component and component database, can provide cost management to project components and parts information costers, thus greatly reducing the tedious work of traditional statistical quantities and potential errors caused by this.

3.2. Easy component management

RFID system can be used to manage prefabricated parts, RFID (Radio Frequency Identification): radio frequency identification (RFID) is unique, scalable, operational, simple and so on. The use of prefabricated RFID system, the manufacturing stage in component production, will save the RFID label into various components in the component information, to ensure the production, transportation, installation information, centralized management for all kinds of components, more operation after the renovation to prepare, can accurately find every component location, shape, nature, change, visa and other detailed information. BIM technology is used to optimize the production process, speed up the trial production process, save the time limit and improve the quality. The interactive design of the RFID and BIM systems is shown in figure 2.
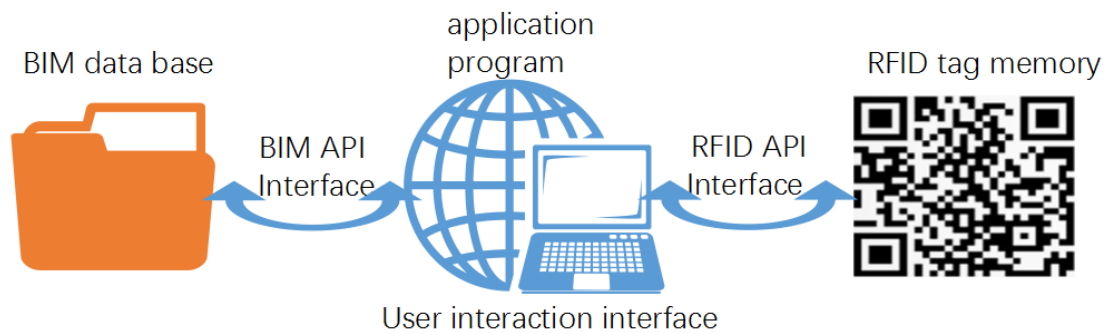

Figure 2: Interactive Design of RFID and BIM systems

3.2. Component transportation management

The use of BIM technology helps to achieve the ideal goal of zero inventory and zero defects in lean construction. According to the actual site construction progress, quickly to component manufacturing factory information feedback, adjust the component production plan, reduce the probability of occurrence of work to be expected. The train number can be planned according to the size of the component, and the transportation route is planned according to the storage area of the component, and the component production and transportation plan is formulated according to the construction sequence. The combination of BIM and RFID can determine the needs of components earlier, and reduce the delays caused by poor information. At the same time, the timely feedback of construction site information can also guide the production of components, and further realize the goal of lean construction.

4. The application value of BIM in the construction stage of assembly type building

4.1. Improve the efficiency of admission and lifting of components

In the actual construction site, the storage component is often limited by the scope of the site. It is necessary to use the effective space as much as possible to find the exact location of a prefabricated component accurately, and the work is difficult. General site, fill in the report are made by artificial way, prone to error, slow speed, low efficiency, especially in large quantities of prefabricated components acceptance, improper placement of the staff member is difficult to judge the real situation, leading to a variety of problems, affecting the overall efficiency. At this stage, the use of BIM combined with RFID technology can track the actual process of monitoring component storage and lifting, and the wireless network real-time transmission of information, reduce manual input information may have caused the error, even without manual intervention, set a fixed RFID reader directly, as long as the vehicle speed to meet the conditions, you can collect data, timely and effective for tracking control of prefabricated components, improve inventory and on-site management, improve the construction efficiency, optimize the cost control.

4.2. Better control of engineering progress

In the aspect of process control, can effectively collect the construction process data by BIM and RFID combined with the progress of related software, such as Project, to analyze the data and, for the 5D simulation of the construction. The actual progress data analysis results are compared with the original schedule, the progress deviation is obtained, and the progress adjustment system is adopted, and measures are taken to adjust the actual construction schedule to ensure that the total construction period is not affected. At the construction site, management personnel can timely access to components using a hand-held or fixed RFID reader collection label component information storage and lifting condition information, and through the wireless sensor network timely delivery schedule information. The acquired progress information can be imported into the BIM5D software to simulate the progress and compare it with the schedule, so as to control the actual progress of the project. Shorten the construction period, control the cost and optimize the construction.

5. The application value of BIM in the operation and maintenance stage of assembly building
5.1. Improve property management level
The modern information construction industry has been the existence of two-dimensional drawings (including the various electronic documents and wood) of various electrical and mechanical equipment operation manual, 2D drawing is abstract, incomplete and non related defects, when used by professionals to find their own information, understand the information, make the corresponding decision according to their own judgment understand the information and then, which often spend a lot of time and error prone, often when there is the decoration of the drill broken cable, pipe burst cannot find the nearest valve lift, no time to replace the parts caused by falling, the fire evacuation is not timely casualties happen etc.. On the basis of BIM in combination with other relevant technologies, implementation of property management and the BIM models, drawings, data, information, change of integrated management, the establishment of the property operation of health indicators, it can be very convenient for the operation and maintenance of property equipment to guide and record, remind repair, maintenance and management level, improve equipment components.

5.2. Reconstruction, demolition and two utilization
The operation and maintenance phase, BIM in the design stage of the various properties of various units, such as the name, shape, location, size, area, use, floor practice set in the model, combined with the application of networking technology in building security monitoring, equipment management and other aspects can be very good for the construction of a full range of management. In the process of rebuilding, expanding, dismantling and utilizing two buildings, the information of prefabricated parts in the model can be called directly. Although the electronic tag life is not enough to meet the civil building design requirements for a period of 50 years (active electronic tag generally 3-5 years of life, passive electronic label the longest 40 years of life), but the future technology will be more mature, label longer life, our management can extend to the demolition of buildings. Will meet the reliability requirements of building component reuse, reduce material and energy consumption, to meet the requirements of sustainable development.

6. Conclusion and Prospect
This paper makes a simple analysis on the application of BIM in the assembly building, can be seen by BIM technology in prefabricated construction decision-making, design and construction, the completion acceptance and operation and maintenance play a good role in control of life cycle. It provides powerful technical support for the promotion of energy saving, water saving, land saving, material saving, green, environmental protection, recycling and sustainable development in our country's assembly type building. But the analysis of this article lacks of demonstration, so it is necessary for us to make joint efforts.

Reference
[1]. Li Xinwei, Tiandong, Ma Tao. BIM assembly design system concrete analysis and Research on [J]. architecture based on 2016,46 (17): 58-62. [2017-08-31].
[2]. Zhang Chao. Research on key technology of assembly structure design and construction based on [D]. BIM Southeast University, 2016.
[3]. In Longfei, Zhang Chun. Journal of building BIM [J]. civil engineering and construction management integration system based on 2015,32 (04): 73-78+89. [2017-08-31]. DOI:10.13579/j.cnki.2095-0985.2015.04.012
[4]. Bai Shu, Zhang Yankun, Han Feng, Zhang Dehai, Li Wei. Application of BIM technology in assembling building analysis in [J]. construction economy, 2015,36 (11): 106-109. [2017-08-31]. DOI:10.14181/j.cnki.1002-851x.201511106
[5]. Chang Chun, Wu Feifei. Management of assembly building construction process based on BIM and RFID technology [J]. Journal of Shenyang Construction University (SOCIAL SCIENCE EDITION), 2015,17 (02): 170-174. [2017-08-31].

[6]. Li Tingting, Yang Xuehui, Zhang Dehai, Zhang Tao. BIM technology in prefabricated engineering application of [J]. information technology in building and civil engineering, 2014,6 (04): 62-65+69. [2017-08-31]. DOI:10.16670/j.cnki.cn11-5823/tu.2014.04.012

[7]. Qi treasure house, Li Changfu. Research on life cycle management of assembly building based on BIM. [J]. construction technology, 2014,43 (15): 25-29. [2017-08-31].

[8]. Li Li, Liu Lu. Information management of the whole life cycle of the assembled residential building [J]. residential technology, 2014,34 (06): 53-56. [2017-08-31]. DOI:10.13626/j.cnki.hs.2014.06.013. BIM

[9]. Ji Limiao. BIM technology of prefabricated concrete structure design [D]. based on Shenyang Construction University, 2014.

[10]. Zhou Wenbo, Jiang Jian, Xiong Cheng. Research on Application of BIM technology in prefabricated residential building [J]. construction technology, 2012,41 (22): 72-74. [2017-08-31].