Engineering Intelligent Construction Technology Based on BIM Technology

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Abstract. Intelligent building technology is a term used to describe the use of sensors and other technologies that allow remote monitoring and control of buildings. Intelligent building system is also known as smart home automation or smart home control. The goal of these systems is to provide automated solutions for controlling the lighting, heating, ventilation, safety and energy management of buildings. "Intelligent construction" is a new construction concept, which requires the development of the construction industry to take the road of low consumption, low pollution and sustainable development. At the same time, it can apply information technology to reform the traditional production mode of the construction industry. The core technology of "intelligent construction" concept is building information modeling (BIM). BIM Technology can change the phenomenon of low efficiency of information transmission and sharing among various departments and participants of engineering projects. It is the direct application of information means in the construction industry and the technical support for the construction industry to change the traditional construction concept.

Keywords: BIM Technology · Engineering · Intelligent construction technology

1 Introduction

The construction industry is still an important industry in China's national economy, but the characteristics of labor-intensive and on-site production make it difficult to improve the productivity of the construction industry; With the current requirements of economic and social development, the profits of the construction industry are getting thinner and thinner, and the employment management is becoming more and more difficult. The runaway investment, construction period, quality and management of engineering projects will be exacerbated.

It can be seen from this that the dilemma faced in the construction of engineering projects precisely needs to be solved intelligently [1]. The construction of smart city provides a very favorable opportunity for the intelligent construction of engineering projects. Whether it is application system, facility construction or information platform, it can provide a solid foundation for the intelligent construction; On the other hand,

the important economic status, high energy consumption and low productivity of the construction industry also means that smart cities that are not smart construction will have obvious shortcomings, that is, smart cities are inseparable from smart construction [2]. The "smart house" in the UK and the "smart building" in Amsterdam mentioned above need intelligent construction means. For example, the Internet of things technology is used to monitor the construction process, making the whole construction process efficient, low-carbon and intelligent.

Intellectualization is transformed from data and informatization. The intellectualization of construction mode, namely "intelligent construction", as an emerging construction concept, was proposed by Dr. Yang Baoming. It mainly expounds the two meanings of intelligent construction [3]. One is that the whole construction industry can take the road of sustainable development, ensure the efficient use of various resources in the whole construction process, realize the requirements of low-carbon and energy conservation, and save resources to the greatest extent Protect the environment and reduce pollution; The second is to use advanced information technology to realize the intellectualization of the whole construction process, so that all parties can work together, information and data can be effectively shared, and a win-win situation can be truly realized [4].

The realization of smart construction has the following significance and functions for the whole construction industry: first, the refined construction management requirements of smart construction can change the extensive production mode on the construction site, so as to save 5%–10% of the invested capital; Secondly, the requirements of intelligent construction on project quality can prolong the life cycle of the whole project, reduce unnecessary resource loss and realize the requirements of low-carbon construction [5]; Thirdly, the concept of smart construction requires all participants of the project to work together, so as to improve the information management level of enterprises, promote the management level of construction enterprises, and realize the economies of scale of the whole construction industry.

2   Related Work

2.1   Origin and Definition of BIM

(1)   Origin of BIM

BIM (building information modeling) was developed by Georgia in 1975 Dr. Chuck Eastman of the Institute of Technology University, the "father of BIM", proposed that in the whole life cycle of an engineering project, the function of integrating all information, including the geometric characteristics of the building, functional requirements and the performance of building components, into the same building model can be called the building information model. The single building information model can also contain the progress, cost, resources and other information in the construction process [6].

In 2002, Autodesk officially put forward the concept of building information modeling. Since then, BIM has been widely spread. Major software companies such as Autodesk, graphisoft and Bently have successively put forward the definition of Bim and launched BIM design, analysis, simulation and construction software.

(2) Definition of BIM

The definition of Bim in the national building information modeling standards (nbims) is as follows: BIM is a digital model, which contains physical geometric information and functional characteristics. In the whole life cycle of engineering project, it can provide reliable basis from conceptual design to demolition stage. At the same time, each project participant can create, extract and update project information in the BIM model according to their own permissions. BIM is also a shared digital model based on specific standards, which can meet the collaborative work of all project participants [7].

According to the definitions of Bim in various versions at home and abroad, although they will have their own advantages in understanding, they all have the following common points:

① The information contained in BIM contains not only the functional attributes and physical characteristics of building components or equipment, but also all the information of all participants, serving the information management of the whole life cycle of engineering projects;

② BIM is a digital expression, which is parametric and computable;

③ Information sharing based on open standards.

2.2 Main Features of BIM

According to the previous description of the origin, definition and comparison with CAD of BIM, it is concluded that BIM has the following characteristics:

(1) Parametric representation of building components

Parameterization is an important idea in architectural design. It mainly includes two parts: parameterized element and parameterized modification engine. Parametric elements are expressed in the form of components. The differences between components are mainly reflected in the adjustment of parameters. Parameters save all the information as element components [8]. The parametric modification engine mainly provides the modification technology of modifying elements. The modification of any element by designers can automatically associate with other elements, and even the parameter changes caused by the deletion, movement or size change of components will change the parameters of relevant elements and associate them, without modifying the associated elements and views one by one.

(2) Dynamic display and adjustment of 2D, 3D and parametric models

The dynamic display and adjustment of two-dimensional, three-dimensional and parametric models is one of the important features of BIM. It can not only express elements in the traditional two-dimensional plane form, but also real-time building components in three-dimensional form, but also carry out analysis and calculation in a specific case.

(3) Diversification of information output forms

In addition to the model represented by BIM, the most important thing is the database that stores project information. BIM database can export information in corresponding format according to customer needs. Including planar 2D drawings, text, tables, 3D models, etc. The forms of information output can be roughly divided into two categories [9]. One is graphic data, such as plan, section, three-dimensional effect, elevation, etc.; The other is non graphic data, which will be output in the form of documents, such as Bill of quantities statistics, door and window class table, equipment information table, etc. BIM can also be dynamically modified during information output, that is, if the parametric information of a component element in the model is modified or changed, it can be dynamically reflected in the corresponding report in time. If the size of a beam changes, the size, length and volume of the beam will be automatically adjusted in the engineering quantity statistics [10]. The table does not need to be modified manually, which greatly improves the work efficiency.

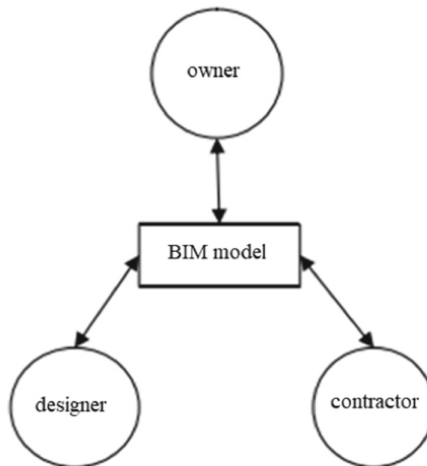The information sharing and communication mode of BIM is shown in Fig. 1 below:

Fig. 1. Comparison diagram of BIM information exchange methods

3 Engineering Intelligent Construction Technology Based on BIM Technology

3.1 Intelligent Construction Architecture Based on BIM

According to the research significance of the framework system of intelligent construction, and combined with the horizontal relationship of the function realization of each subsystem of the intelligent construction system, build the intelligent construction system based on BIM as shown in Fig. 2. The construction system is based on the BIM

system platform design, which can be divided into data layer, model layer and application layer. Through IFC data conversion processor, the construction party can obtain the 3D building information model provided by the designer and serve as the basis for the operation of the system platform. At the same time, the 4D building information model generated by linking the 3D building information model with the construction progress is used to realize the construction optimization control, dynamic construction management and dynamic construction simulation, and meet the progress objectives, cost objectives, quality objectives and safety objectives in the construction stage. At the same time, all participants of the project can also set different access rights through the network platform for project negotiation and coordination.
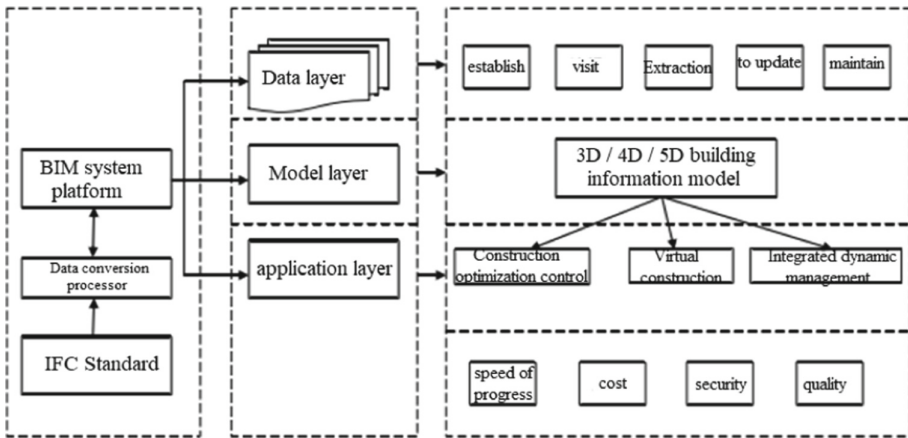

Fig. 2. Intelligent construction architecture based on BIM

3.2 Implementation Steps of Intelligent Construction Based on BIM

From the perspective of the globalization of construction industry, the development of BIM Technology has become a global hotspot. The value of BIM is not only reflected in collaborative design, but also plays an important role in the whole life cycle of engineering projects. In terms of housing industry research, BIM provides strong technical support for automation and large-scale housing industrialization. Its main role is reflected in the creation of three-dimensional information model, component assembly simulation and the whole process tracking and supervision of large-scale component procurement, manufacturing, transportation and installation. At the same time, BIM Technology can meet the green and low-carbon construction concept required by smart construction, mainly including sunshine calculation, energy consumption analysis, carbon emission index calculation and analysis of BIM Technology.

　　The wisdom based on BIM is of great application value, and some cities have taken positive action. For example, Shenzhen has done a lot of exploratory work to promote the application of BIM Technology. The Shenzhen Public Works Department has established a BIM work leading group and research group, established strategic cooperation

with relevant BIM software providers, and actively studied the establishment of BIM standards of the public works department under the current conditions. In order to promote the promotion and application of BIM Technology in the industry, enhance the core competitiveness of enterprises and promote the healthy and sustainable development of the industry, Shenzhen housing and Construction Bureau organized the BIM Committee of Shenzhen engineering design industry to formulate the 2012 work plan for BIM promotion in Shenzhen design industry. The main work includes: organizing the preparation of the guidelines for BIM application research and development in Shenzhen engineering design industry; Carry out BIM application demonstration in the project; Hold BIM training lectures, etc.

Ningbo should actively learn from Shenzhen and other cities, take early action, make comprehensive planning, overall coordination, and formulate implementation steps and measures to promote smart construction in Ningbo. For example, set up Ningbo smart building leadership and promotion organization, formulate BIM application guidelines, issue incentive policies and incentives to promote BIM based smart building application, carry out BIM application demonstration in the project, carry out BIM application in the whole life cycle and whole process, and formulate the overall promotion and application plan and scheme of BIM based smart building.

4   Conclusion

"Smart city" is a new model of global urban development, and the construction of global smart city is inseparable from the comprehensive intellectualization of the construction field, in which smart construction is an indispensable and important part. "Smart construction" is a new construction concept. It requires the development of the construction industry to take the road of low consumption, low pollution and sustainable development. At the same time, it can apply information technology to reform the production mode of the construction industry. Combined with the concept of life cycle management and lean construction, this paper obtains the connotation of intelligent construction, improves resource utilization and realizes the requirements of low-carbon and energy saving; Take BIM as the technical core.

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