The Application of Computer Bim Assisted Secondary Development Technology in The Structural Design of Prefabricated Subway Station

Wenjun Liu¹*
¹China Railway Siyuan Survey and Design Group Co., Ltd., Wuhan, China, 430063
*Corresponding author e-mail: postmaster@crfsdi.com

Abstract. In view of the demand for collaborative management in subway station engineering construction, this paper, by referring to the experience of manufacturing industry development, attempts to introduce the synergic and virtual manufacturing concepts that have been successfully used in manufacturing industry into subway station construction engineering, and discusses the integrated collaborative design mode and implementation path of BIM based railway station construction from macro to micro. The concept of prefabricated building and the characteristics of BIM technology can complement each other in comprehensive coordination and many other aspects. The deep integration of the two is conducive to the rapid development of industrialization, information technology and intelligence in the field of subway construction[1].

Keywords: Bim Technology, Subway Stations, Prefabricated Buildings, Application

1. Introduction
Technology is known as the second revolution of the construction industry. In the context of a new round of scientific and technological innovation and industrial reform, BIM technology is integrated into the whole process of prefab construction projects to provide guarantee for the industrialization, informatization and intelligent development of the construction industry, which will lead the construction industry to a new height. As the scale of subway construction expands day by day, urgent demands are put forward for specific methods to improve efficiency and quality by using BIM technology and to fully apply BIM to subway scheme design, construction management and other links[2].

2. Project summary
In recent years, national, provincial and municipal levels have successively issued relevant policies and guidelines on the vigorous development of prefab building and BIM application[3]. In order to promote the continuous innovation of the subway industry, a subway station in Guangzhou combines the concept of prefabricated design with BIM technology to explore the application of BIM technology in the design of prefabricated subway stations. Guangzhou a subway station project belongs to the underground three - storey island - type platform. The station. The station has a length
of 221.7m, a width of 22.30 to 2620m and a depth of 24.48 to 25.27m. The main building area is 15,234.21m. The station has 4 entrances and 2 sets of wind booths.

3. Design of subway station based on BIM technology

Due to the characteristics of prefabricated buildings, new challenges to the design and construction are presented, such as fully professional collaborative design, to meet the fine design of component processing, and the diversified demands of independent customization. In order to better meet the above challenges, BIM technology has been applied throughout the whole process of design and construction in the design process of this fabricated subway station, and a series of new explorations have been completed.

3.1. Full professional integration of collaborative design

Based on the collaborative design platform, various majors can realize real-time sharing of working files in the cloud server, and data exchange between local files and platform central files can be achieved through synchronization, which leads to seamless understanding of each other's latest design scheme, thus achieving efficient and integrated collaborative design. Taking structural specialty as an example, the design tasks of the main structure, internal structure and auxiliary structure of the station are disassembled. For example, the main structure of the station can be disassembled according to the floor to the roof layer, the station hall layer, the floor layer, etc., among which the building escalator is modeled independently[4].

Compared with traditional professional fund raising and return, the change of collaborative form makes professional cooperation not limited to room layout, equipment layout and management. In terms of line space coordination, it can realize the deep collaborative design of material selection, process equipment information, installation sequence and embedded parts integration, so as to meet the requirements of prefabricated design depth.

3.2. It satisfies the fine design of component processing

In the design stage, Autodesk Revit is adopted to establish BIM model of the prefabricated subway station structure and optimize the model. Then, the analysis model is imported into Autodesk Robot Structure analysis software. Robot can automatically read the geometric section, material and other information of rod and plate and shell units to ensure that the calculation model is completely consistent with the design model. After applying load and boundary conditions under various working conditions in the Robot, the structure analysis is carried out, and the information such as structure deformation and internal force is calculated. At the same time, through the secondary development of Robot, a plug-in which can automatically read the internal forces of structural units under various working conditions and carry out the design and calculation of reinforcement is developed, which greatly improves the efficiency of structural reinforcement design. The internal force data and design reinforcement data read by the plug-in can be exported to the structural analysis database, which can be associated with the BIM model's component reinforcement and directly guide the on-site steel cage processing. See Figure.1 for the related design process and effect[5].
3.3. Standardization information management of prefabricated parts
The basic characteristic of prefabricated structures is that they are assembled efficiently at the construction site after being processed in a factory that produces standardized prefabricated components. Due to the standardization of information of BIM technology characteristics and selection from the BIM component library of prefabricated components can be assembled and process information in prefabricated may at any time, in the process of prefabricated construction BIM applications, through the establishment of BIM component library implements the unified administration of standardization components, but also realized the information processing of artifacts.

3.4. Construction simulation of prefabricated components and critical nodes
Continuous wall construction simulation, as shown in Figure 2. Three-dimensional geological, concrete, steel cage, equipment and other models were established to simulate the process of double wheel milling into grooves, steel cage welding and lifting, and concrete pouring and pouring. Accurately statistics the amount of rock and soil excavation, steel, concrete cast, project cost and schedule[6].

3.5. The diversified needs of independent customization
Based on the design mode, it is no longer limited to the function of the software to some extent, and can be opened by independent customization. To meet the diverse design needs. In the design of this prefabricated subway station, the 3d geological model can be generated by developing the geological modeling plug-in and importing the geological information database obtained from the previous
investigation with one click (Figure3). The model can be compatible with formation jumping, inversion and so on. Meanwhile, based on the 3D geological model, the foundation pit excavation simulation can also be carried out, and the program can automatically count the earthwork excavation quantity of different strata.

Figure 3. D geological model plug-in.

4. Application effect analysis
The application of BIM technology in the design of prefabricated subway station shows that the 3d model of prefabricated subway station can not only intuitively present the 3D effect of the station, but also contain powerful parameters and data information, laying a foundation for the data sharing of all stages of the whole life cycle of the project. Of course, in this prefabricated subway station design, the technology is mainly applied to the advance simulation of station design and assembly construction. If the application field is extended to operation, maintenance and other links, the full life cycle management can be truly realized and the advantages of BIM technology visualization can be maximized.

5. Conclusion
This paper takes an prefabricated subway station project in Guangzhou as an example to apply BIM technology to scheme design, 3D modeling and structural analysis in the design and construction simulation, and through the secondary development to meet the different design needs, for the future technology in the design of subway station provides a reliable technical route. Through the in-depth practice of the project, the concept and technical characteristics of prefab architecture are comprehensively coordinated, fine design, standardized information management, construction simulation, and diversified demands. Many aspects such as customization can complement each other. The deep integration of the two is conducive to the development of the construction industry, especially the industrialization, informatization and intelligence of subway construction.

References
[1] Ding Liyun. BIM Application: from 3D to nD [R]. Shandong: Shandong Jianzhu University, 2012.
[2] Geng Ming Bao, 2016, 33 Research on intelligent collaborative design system based on data platform [J]. Railway Engineering (04): 16.21.
[3] Tang Long. Discussion on construction technology and quality control of subway station project [J]. Ding]. Science and Technology Plaza, 2017 (08): 161-164.
[4] Tu Yingfei. Analysis and suggestions on urban rail transit Station operation management Characteristics [J]. Urban Rail Transit Research, 2014, 17 (10):22-24.
[5] Sun Xiaomeng. Research on optimal design of subway station bearing structure [D]. Xi ’an University of Science and Technology, 2016.
[6] Zhang Yan, LU Ye. Comparative analysis of collaborative design and traditional architectural design [J]. Engineering Economics, 2018, 28:68-71.