Application of BIM Technology in Subway Station Construction

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Abstract - *In order to study the application of building information modeling (BIM) technology in subway station construction based on the Shijiazhuang subway station, this paper studies the typical application of BIM technology in station construction, such as three-dimensional visualization, collision detection, construction schedule, engineering quantity calculation and so on. The practice shows that the BIM technology can improve the construction efficiency and quality, reduce the cost, realize the dynamic control of the construction process, and improve the construction management level of the project. At the same time, this paper summarizes its problems in construction application and gives reasonable suggestions.*

Key Words: BIM, Subway station, Simulation, Construction.

1. INTRODUCTION

Presented by Dr. Chuck Eastman of architecture and computer science, Georgia Tech College in 1976, BIM (building information modeling) has the characteristics of visualization, coordination, simulation, optimization and graphics. BIM is the second revolution after the engineering construction industry has gone through the "drawing board", whose impact on the construction industry is obvious. The evolution process can be summarized as: manual drawing ->CAD->BIM. At present, the application of BIM technology in construction, machinery and other industries is relatively mature, bring about innovations in the field. In comparison, although the research on BIM technology in railway industry started late, progress is fast. The railway design institutes and construction units have gradually carried out some BIM technology application research and pilot work. BIM technology is widely used in tunnel construction, but its application in underground subway station is few. Therefore, in order to improve the level of project construction management, the benefits of BIM will be maximized. It is of far-reaching significance for the development and exploration of BIM construction stage to carry out this research, providing reference for the application of BIM technology in construction enterprises.

2. BIM SURVEY

1.1The necessity of applying BIM technology

Compared with other construction industries, the construction of urban subway industry is characterized by many stations, long lines, wide coverage, large scale, high investment, long construction cycle, and large amount of data and information. The main problems in the construction process are: information communication between different professions is not timely and smooth, forming "information isolated island", resulting in construction conflicts; The constructor is biased in understanding the design intent; The loss of design and construction results makes information incapable of sharing and inefficient, which can not be effectively used for later operation and maintenance management. Delay or mistake in any link will cause delays, quality problems and even safety accidents.

Using BIM technology can solve these problems perfectly, whose core is to solve the problem of information isolated island and realize the information sharing circle, so as to make the project information fully shared and transmitted nondestructively in the whole process of planning, design, construction and operation and maintenance, and enable technicians to make effective and correct response to engineering information, which changes the mode of construction management and improves the level of project management. In addition, before the project starts, according to the two-dimensional drawings, the three-dimensional model is constructed to realize "what you see is what you get" and eliminate the misunderstanding between design and construction, so as to find the problems in the design ahead of time and optimize the construction plan, which makes the construction site management more standardized, the construction process more controllable, and ensures the reasonable and orderly development of the project.

1.2Application value of BIM Technology

In the case of the gradual application of BIM technology in the construction stage, the technical plan and construction process involved in the construction process are digitalized, informationized and parameterized, which makes on-site lean construction possible, and enables fine management to be implemented.

The recent value of BIM technology in construction stage is mainly reflected in: the work efficiency can be improved and the quality of work can be improved; before commencement, the virtual construction technology can be used for comparison and selection of construction plans, and the best construction plan can be obtained; through following up the progress, cost, safety and quality of construction site, it makes site construction more standardized and controllable, so as to facilitate project managers to make decisions.

Long term application of BIM technology in construction stage can bring significant economic and

social benefits to construction enterprises, mainly in the following aspects.

The improvement of the technological level and external image of enterprises: The application of BIM technology in the construction stage makes the construction technology of the enterprise stride forward to the fine construction technology, and enhances the core competitiveness of the enterprise. At the same time, enhancing the external image of the company is conducive to the expansion and operation of the enterprise market. The improvement of the management level and profitability level of enterprises: By using BIM's 4D, 5D (3D+ progress + cost) dynamic management technology, it can greatly improve the comprehensive management level of the construction process, so as to achieve effective use of existing resources and improve profitability. Green construction and achieving good environmental benefits: Using BIM comprehensive construction technology can reduce the waste of manpower and building materials, and contribute to the green economy of our society.

3. PROJET OVERVIEW

Shijiazhuang Rail Transit Line 1 Zhongshan Square Station - Liberation Square Station starts from Zhongshan Square Station of Zhonghua Avenue and goes east along Zhongshan East Road to Jiefang Square Station of Qianqian Street. The mileage of the starting point is K8+854.560, the mileage of the end is K9+388.850, and the length is 534.29 m. The interval wiring is 377.6 m long, and is a separate boarded tunnel with double caves for left and right lines. The thickness of the covering soil is about 8-10 m, which mainly passes through fine sand layer, medium coarse sand layer, silty clay layer and silt layer, while the dome is mostly located in medium coarse sand. There are 10 types of A-J sections, and there are frequent transitions between the sections. The maximum section width is 14.3 m, the height is 10.75 m, and the section area is 123m2, and the minimum thickness of the soil between the left and right lines is 0.5 m. The tunnel is located directly below the main commercial street between New Town Plaza and railway station. There are more pipelines and structures under interval wiring. Construction environment is complex, construction risk is high, and on-site organization is difficult, and it is listed as a first level risk tunnel by Shijiazhuang urban rail transit Company Limited.

4. APPLICATION OF BIM TECHNOLOGY TECHNOLOGY IN CONSTRUCTION OF SHIJIAZHUANG SUBWAY STATION

4.1Three dimensional model construction

The 3D design model is built on the basis of two-dimensional design drawings. Firstly, the design model is further split into a construction model by combining with site construction methods and procedures; secondly, according to the actual situation of the construction organization at the scene, construction resources (personnel, machinery and equipment) are allocated rationally, guaranteeing the accuracy of the model to meet the follow-up program simulation, construction schedule, engineering calculation and other applications. In addition, the BIM model also plays a good role in 3D rendering, realizing "What you see is what you get." and gives people a sense of reality and visual impact, which enables project managers, technicians and workers to better understand the key and difficult points of the project, and constantly optimize construction, reduce rework and reduce costs.

4.2 Pipeline collision detection

Because the subway station involves many professions, the pipeline is complex, and the space is relatively narrow, conflicts between professions are common. The most intuitive feature of BIM technology is 3D visualization, whose coordination can solve this problem. Conventional collision detection mainly includes 3 aspects: Collision between civil engineering majors; collision between pipelines and civil engineering; collision between pipelines.

Making full use of BIM technology advantage, Shijiazhuang station inspected the various specialties of the station. The initial collision point is more than 800, and each collision point can directly show the problems existing among various professional designs, which avoids "mistakes, leaks, collisions and deficiencies" in the station construction, reduces the possible error losses and the possibility of rework in the construction stage, and improves the construction quality.

4.3 Simulation of construction scheme

Before the project starts, BIM software based on Glodon company connects 3D construction model with construction schedule, integrates construction resources and other information, and then establishes 4D construction information model, which simulates and analyzes two construction organization schemes (three-step method and both side drift method) of Shijiazhuang station in this virtual environment. One the one hand, it vividly expresses two different construction states and methods, and compares and analyzes the constructability of the two construction methods. On the other hand, in the simulation process, it identifies unreasonable and problematic construction methods in design, verifies interference and conflict in construction, and is conducive to timely adjustment of construction methods before construction. An optimal construction plan (both side drift method) has been obtained, which optimizes the allocation of construction resources (personnel, machinery, materials, etc.), shortens the construction period, saves costs, and achieves the purpose of fine construction. Simulation of excavation and secondary lining construction process in the construction of both side drift method at station.

4.4Construction project time management

Through building BIM construction management platform, BIM software based on Goldon company can meet the needs of site construction progress, quantity calculation, equipment shift, monitoring and measurement integration. Firstly, before commencement, according to project implementation organization plan, it pre-arranged the construction plan. In the process of construction, by combining the actual situation of the project, it will refine the construction process so as to facilitate the on-site construction management and operation. Secondly, in the course of construction, it tracks the progress of every construction task, and timely update to the construction progress management platform. By looking at the update status of project WBS, project leaders timely grasp the status of the project construction progress, compare the actual construction progress with the design, analyze the deviation quickly, and take corresponding measures in time, realizing dynamic management of project construction. In other words, BIM technology enables schedule control to be controlled according to availability and availability, while project management is able to control every job accurately, which provides protection for normal performance of project progress.

4.5 Measurement of quantities

For project management, the most important part of cost management is the calculation of quantities, while the most effective way to calculate the quantities is to carry out multiple comparisons. And the 3 dimension is the dimension of time, procedure and region (spatial location). Control material consumption at construction site and inspect project management problems need to carry out statistical analysis of quantities from these 3 dimensions, while it is far from enough to calculate the amount of engineering from the time dimension.

5 EXISTING PROBLEMS AND SUGGESTIONS

5.1Existing problems

BIM technology has made some achievements in the construction and application of Shijiazhuang station. But there are still some problems in its application, which leads to difficulties in carrying out the work. The details are as follows: at present, construction industry is still changing from extensive to meticulous management, and construction management mainly depends on experience, whose industry development inertia, thinking mode is difficult to change at the moment, with lack of understanding of the benefits and advantages of BIM technology and insufficient application power. Software and interface problems: in the early days of BIM application, because of the high cost of software and hardware acquisition and data training, and long investment return cycle, the economic benefits are not obvious. Due to the lack of compatibility and compatibility among software, the secondary development technology is very difficult.

5.2 Suggestions

Change cognition and team building: in the process of follow-up BIM promotion and application, it should be gradually strengthened the understanding of the importance of BIM technology to enterprises, strengthen the training of BIM application talents to form BIM teams in different levels and specialties to form BIM productivity, and should be popularized gradually from the point to the surface. The application of BIM technology in tunnel and underground engineering is still in its infancy. Therefore, in the course of construction application, the strategy and mode of BIM technology application should be actively explored and constantly accumulated experience, so as to establish suitable standards for our enterprises gradually, and the application of BIM in tunnel and underground engineering construction will be gradually promoted from point to surface.

6. CONCLUSIONS

BIM, a digitalized expression of engineering project information, is a new direction of information construction. This paper applies 3D visualization, collision detection, construction schedule, engineering quantity calculation, equipment shift and monitoring measurement in the construction of Shijiazhuang station, so as to avoid problems such as poor communication and misunderstanding in design and construction, which improves the work efficiency, reduces the possible error loss and the possibility of rework in the construction stage, and improves the construction quality. At the same time, it realizes statistical analysis and real-time inquiry of project completion, resource and material planning and actual consumption, making the construction process management more refined and making the construction process more controllable and reliable.

At present, domestic construction industry is still changing from extensive to meticulous management, while construction management mainly depends on experience. As a new technology, BIM technology's application in tunnel and underground engineering is a new direction, and is still in its infancy. How to excavate its potential application value in construction stage still needs our continuous exploration and practice.

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