Application Research of BIM Technology in Bridge Reconstruction and Extension Engineering

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Abstract. Regarding the characteristics, engineering needs and technical difficulties of the Chuhu Bridge of the Hening Expressway Project, relying on the four-to-eight expansion project of the Hening Expressway, combined with modern information technologies such as BIM, big data, cloud computing, mobile Internet, etc. Virtual simulation and other technologies can solve the technical problems in the construction of expressway expansion projects, and directly serve the expansion project of Hening Expressway.

1. Introduction
BIM technology is one of the most popular researches in the field of domestic construction engineering. Architectural design units, construction units, management units, and even relevant government departments are vigorously promoting the development of BIM technology, and vigorously promoting the application of BIM in bridge engineering projects. BIM application technologies mainly include: collision inspection, project quantity estimation, 4D model-based visual simulation of construction process, construction progress management, safety risk management, etc. The use of BIM technology to solve the technical problems in the construction of Chuyao Expressway is conducive to the improvement of the construction quality of expressway engineering and the level of refined management of the entire process of construction projects. This article takes a highway in China as an example to specifically analyze the Application value in the bridge.

2. Project Overview
The Hening Expressway Reconstruction and Expansion Project is part of the original Hening Expressway. The project spans three counties of Chuzhou and Hefei. The starting point is located at Chuhu Bridge of the Hening Expressway where Zhouzhuang in Anhui Province and Pukou in Jiangsu Province meet. It extends from east to west, passing Quanjiao County and Hefei City in the middle, with a total length of 89.323km.

3. Application of BIM technology

3.1 Checking drawings
The three-dimensional visual representation is more accurate and easier to observe and understand than the traditional two-dimensional drawings. According to the established BIM three-dimensional model,
the design is preliminarily inspected, and collision checks between various professions are performed

The implementation plan is as follows:

(1) Draw the BIM model according to the finalized design drawings.

(2) Use the collision inspection software to carry out the collision inspection of the model to solve the

(3) Cut the two-dimensional drawings of complex key parts and compare with the design drawings.

(4) Modify the drawings based on the collision inspection report and design drawings.

3.2 Engineering calculation

Engineering quantity review is an important part of cost management. The cost management report of

In the design stage, the quantity and price of the project are input into the component unit of BIM, which

In the bidding stage, the owner unit can quickly calculate the amount of works required for bidding

During the construction settlement process, the model containing quantity and price data is linked to the

The BIM model automatically summarizes the budget data, tender list, and measurement and payment
data at the design stage to provide a basis for completion settlement.

3.3 Construction organization plan 4D simulation technology

For key control projects such as inter-tunnels, BIM technology is used to perform three-dimensional
visual simulation of construction plans and construction organizations, and to optimize analysis and
configuration of construction resources (materials, labor, mechanical equipment), find problems in
advance, solve problems, and reduce redundancy. The impact of the process on the construction process,
optimize the construction organization plan, and ensure the efficiency and safety of the entire
construction process.

Construction organization process:

(1) The establishment of the overall organization

Based on the 4D simulation analysis function of BIM technology, when the construction schedule is not
compiled, the construction phases are quickly divided by simple process editing, etc., to determine the
starting position of each unit project and a reasonable construction sequence. At this time, it is possible
to disregard parallel, cross and other process operations, simulate and analyze whether the division of
the construction section is reasonable, whether the construction starting flow direction and construction sequence are reasonable and feasible, and so on.

(2) Special construction program simulation, process simulation, multi-program comparison simulation

After the construction section, construction start flow, construction procedures and construction sequence are determined, the parallel and cross operations in the construction are considered, the construction time of each unit is rearranged according to the overall project progress target, the key construction process is determined, and the software is used for simulation Analyze and prepare material process plans, etc., and establish corresponding quality control measures and safe and civilized measures for the five factors that affect the quality of the project during the construction phase, namely people, materials machinery, methods and environment.

(3) Optimization schedule, model and iterative change of schedule

Complete the construction simulation, analyze and demonstrate, after calculating the time parameters of each project task, find out the key route and key tasks, optimize the key tasks in a targeted manner, adjust the schedule, and ensure the construction on the key line without affecting the total duration Sequential construction time, by adjusting the construction time of construction procedures on non-critical lines, to achieve the optimization of the overall construction plan of the material, to ensure the rationality of the construction sequence of the project, the proper connection rhythm of the proper connection of each procedure

(4) On-site tracking and iterative update

By defining the resource appearance configuration for the 3D information model, the traditional schedule plan prepared by the schedule department and the 3D model established by the BIM model department are visually combined, and the model is re-divided and processed in the early stage of the simulation, and the supplementary 3D model or schedule is created, Continuously add new construction information, such as logistics and transportation, field layout model, etc., and export the simulation results with construction simulation animation. During the continuous construction of the project and the continuous review by other management personnel, iterative iterations were carried out many times, and finally the construction simulation plan was derived to complete the construction simulation.

(5) Progress optimization

Under the premise of ensuring the total construction period requirements, using 4D simulation technology, continue to optimize key tasks, adjust the construction schedule, optimize the construction plan of the Beijing-Shanghai Expressway renovation and expansion project, reduce redundant links, and improve the rationality and logic of the construction sequence Sex and efficiency.

3.4 BIM-based collaborative management platform

With the help of new technologies such as BIM, mobile Internet, cloud computing, and Internet of Things, a collaborative management platform is developed during the construction period to achieve progress display and file collaboration. It is a multi-terminal collaborative management platform that integrates mobile terminal APP, PC, and Web terminals. Including: three-dimensional image progress display; quality and safety monthly report query; design model information query; drawing query; quality inspection data query; engineering attribute query; technical data collaboration, etc. To meet the needs of all parties involved in the construction of the query and analysis of full business data, give full play to the convenience of mobile terminals, users can query data in a timely manner through mobile phone terminals anytime, anywhere.

4. The engineering value of BIM technology

(1) Use the visibility of the BIM model to complete the check of the tunnel design drawings, find the "wrong", "leak", "touch" and "missing" problems in the drawings, and use the BIM calculation analysis function to realize the engineering amount Automatic accounting, accounting for the amount of work in key construction stages according to the construction schedule, and controlling construction costs.
Using BIM model, this paper simulates the special construction plan of bridge 4D, optimizes the construction process and construction organization plan, and reasonably controls the construction period. Based on the mobile terminal highway construction progress, quality and safety refined management platform. With the help of new technologies such as BIM, mobile Internet, cloud computing, Internet of Things, etc., we developed a BIM management platform based on the mobile terminal during the tunnel construction period, to solve the problems of relying on the construction progress, quality, and safety management of the project, and realize the refined management of the entire bridge during the construction.

References
[1] Zhang Y.C., Wang W.H. (2019) Establishment of 3D Digital Terrain of Highway Based on BIM. J. Science and Technology Innovation Herald, 13: 37-38.
[2] Xu T.X. (2011) Study on Landform in Domestic Landscape-style Park Based on BIM. D. Beijing Forestry University, Beijing, China.
[3] Sun S.N., Zhang R., Yu J.B., et al. (2018) Research on UAV Slope Photography and BIM Technology in Topographic Processing of Hydraulic Engineering. J. Journal of Zhongzhou University, 35: 100-105, 127.
[4] Yu S.F., Lv F.H., Liu B.H., et al. (2018) Establish a 3D Geological Model Based on BIM Technology. J. Geotechnical Investigation & Surveying, 8: 37-40, 50.
[5] Sun S.N., Zhang R., Yu J.B., et al. (2018) Research on UAV Slope Photography and BIM Technology in Topographic Processing of Hydraulic Engineering. J. Journal of Zhongzhou University, 35: 100-105, 127.