Research on the Application of BIM Technology in Bridge Engineering

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Abstract. In recent years, BIM technology has developed rapidly in the field of housing construction, and has been well applied in many housing construction projects. However, the application of BIM technology on bridges is less. This article takes Hongjiazhong Bridge as an example to research and explore the application of BIM technology in bridges. Conduct application research on accountability, program simulation, quality and safety management, BIM platform management, etc., and explain the innovative applications of BIM technology in GIS, VR, AR, operation and maintenance.

1. Introduction
At present, there are many problems in the current construction industry, such as management problems: the responsibilities of managers, the management of materials, and the management of construction sites. Problems with drawings: changes in design drawings, the effectiveness of drawing information transmission, and the transition from two-dimensional to three-dimensional. The problem of cost: reduce the waste caused by changes, real-time control of costs, and cost calculation. At this time, the introduction of BIM technology can largely solve the above problems. BIM (Building Information Modeling) technology was first proposed by Autodesk in 2002 and has been widely recognized by the industry worldwide. It can help achieve the integration of building information from the design, construction and operation of the building to the life cycle of the building. At the end, all kinds of information are always integrated into a three-dimensional model information database. The design team, construction unit, facility operation department and owner and other parties can work collaboratively based on BIM, effectively improving work efficiency, saving resources, reducing costs, and achieving sustainable development [1].

2. Project overview
Hongjiazhong Bridge (bridge length K7+993, length 99m, width 40m, span 3×30). The bridge is designed as a double-width bridge. The superstructure of the bridge is designed as prefabricated prestressed concrete simply supported small box girder, the pier adopts column type pier pile foundation, the abutment adopts gravity U-shaped abutment, earth retaining abutment, piled abutment, pier and abutment pile foundation are all in accordance with The design of rock-embedded pile adopts bored pile construction. In the bridge, the EM80 and EM120 expansion joints are treated separately at the front wall of the abutment and the beam body, and the bridge deck is continuous at the remaining positions (see Fig.1).
3. Basic application of BIM technology

3.1 Review of auxiliary drawings
Through the establishment of various professional BIM models, find drawing problems, summarize and organize them, and form written documents as the basis for drawing review. In the process of multi-party review, use the 3D model as the communication medium for multi-party review. Mark the problems in the drawings in the 3D model before the multi-party review. During the review, review the problems one by one and propose amendments, which can greatly improve communication efficiency.

3.2 Collision check
The main tower concrete, the main tower reinforcement, the steel anchor box, the ring prestress and the stiffness skeleton can be checked for collision, and the pipeline layout can be reasonably arranged to reduce rework and reduce costs. Using BIM Works or Navisworks software, set the corresponding collision check rules, the software can quickly find the collision point that meets the collision conditions, and generate a collision report. Each collision information includes the collision type, collision depth, and the specific three-dimensional situation. Identify the collision point in advance, and adjust the plan in a timely and reasonable manner to avoid delay or rework [2] (see Fig. 2).
3.3 Animation simulation of construction technology
The three-dimensional model of Hongjiazhong Bridge is established according to the drawings, which satisfies the imagination of the architects more. With the help of the BIM visualization model, designers can improve the accuracy and work efficiency, and better serve the project quality.

(1) Confession of complex nodes. For complex nodes, three-dimensional animation demonstrations and visual technical explanations to the construction personnel have effectively improved the intuitiveness and accuracy of the content. The construction team can also quickly understand the design intent and construction plan to ensure the smooth realization of the construction goals. The earth improves the efficiency of clarification, the construction process is executed more thoroughly, the rework is reduced, and the quality of the project is improved (see Fig. 3).

![Figure 3. bim5d roaming.](image)

(2) Simulation and optimization of special construction plan
Through the BIM technical guidance to prepare a special construction plan, you can intuitively analyze complex processes, simplify and transparent complex parts, and simulate the construction status of the site after the plan is prepared in advance, which may cause potential hazards, safety hazards, and fire hazards on the site. Waiting for investigation in advance, and rationally arranging the construction procedures of the special plan, is conducive to the speciality and rationality of the plan [3].

3.4. Precise calculation
Quickly and accurately build a BIM model, statistically analyze engineering data, and provide accurate data for engineering calculation. Part of the project has a large volume of concrete, and a member needs to be poured in sections, but the design drawings do not give the amount of each section, but only give a total amount, but this is not conducive to project cost management. Now the BIM model can be used to divide the segments according to the construction technology on the spot to give the engineering quantity, and the engineering quantity data of each segment is entered into the BIM platform. When pouring on the site, the mobile phone can be used to conveniently view the design quantity and put the actual usage on site is entered into the BIM platform in real time, which plays a role of comparison [4] (see Fig. 4).
3.5 5D construction progress simulation

The BIM three-dimensional model is associated with the progress and funds to dynamically control the project progress and funds, so that project managers and company leaders can see the project implementation at a glance.

The model is divided according to the bridge construction process, and the BIM model is associated with the construction schedule and construction log, and the spatial information and time information are integrated into a visual 4D (three-dimensional model + time dimension) model, which is intuitive and accurate. It reflects the construction process of the whole building and realizes dynamic monitoring and early warning of progress [5] (see Fig. 5).

Through the BIM5D smart construction platform, the engineering quantity and cost information of the extracted components are specified, combined with the planned start time and planned completion time, the platform quickly obtains the funding demand plan according to the schedule. Combined with
the three-dimensional model, the system can display the progress of the project and capital requirements through the three-dimensional model at different stages. Send all cost information and BIM model data to the system server, the system automatically analyzes, organizes and collects the cost data of the project to form a multi-dimensional and multi-level cost database, realizes dynamic project cost management, realizes accurate prediction of capital plans and Dynamic Adjustment. Through the BIM5D smart construction platform, quickly and accurately analyze the total demand data of the project and generate a bill of materials; combined with the corresponding schedule and capital plan, you can reasonably formulate a material purchase plan, and calculate the material usage of each region on the BIM5D platform. Carry out precise transportation and positioning of materials, and finally achieve dynamic and refined management of materials.

3.6 beam field information management
The production process of each prefabricated beam: steel bar tying-pouring concrete-transfer beam storage-hoisting assembly, the whole process of engineering information and construction data are dynamically tracked and archived, which is convenient for project management personnel to understand the production progress of prefabricated beams in real time and realize prefabricated beams Production efficiency information management [6].

3.7 QR code application
In daily project management work, project personnel need to understand the dynamic information of the personnel, the progress of the project, the quality control of the production process of key components, and the maintenance and management of field equipment. All these traditional methods are time-consuming and laborious. Difficult to query and count. A set of effective tools are urgently needed to help him complete these tasks easily. Two-dimensional code combined with BIM technology provides engineering management solutions for construction enterprises. Record the information by scanning the QR code on the mobile phone to solve the needs of personnel management, equipment management, construction process management, engineering information display and so on during the construction process. Following the management concept of traceability in the entire process of information, all the machines in the platform are fully covered by a unique "two-dimensional code electronic ID card" to achieve one machine and one certificate. The maintenance records of all machines can be inquired on the platform, and the regular maintenance time is automatically reminded.

3.8 Quality and safety management
During the construction process, the project site technicians and safety personnel took photos and uploaded the quality and safety issues of the project site, copied to the relevant person in charge, and made real-time rectification of the area. After the rectification, the photos were uploaded to form a closed loop; the collaboration was checked through the BIM platform Situation, and grasp the development trend of various problems of the project, so that the site management is more targeted [7].

4 Innovative application of BIM technology
4.1 BIM+GIS underground data measurement
Terrain data is the foundation for the establishment of three-dimensional models. According to the model accuracy required for the above different needs, the geometric information and texture attributes of terrain are collected in the following ways (the accuracy is sequentially improved): high-resolution satellite survey, aerial photogrammetry, three-dimensional laser measuring. Through the above methods, the terrain and feature information are collected, and finally these different precision and different types of data are integrated to form a BIM basic model. Use Infraworks 360 to quickly select lines on 3D terrain and image models, and set up bridges, tunnels and other structures. And can be imported into Civil 3D for optimized design. After the plan was optimized by Civil 3D,
the results were imported into Infraworks 360. Based on the real terrain, route, roadbed, bridge and tunnel models, multiple plans were visually compared and selected to shorten the plan decision time.

4.2 Application of BIM in bridge operation and maintenance
By monitoring the safety data of the bridge and analyzing the maintenance status, we can accurately understand the service status and service life of the bridge, and distinguish the more damaged parts intuitively by color, and make timely and correct treatment. The monitoring data collected by the system is transferred to the operation and maintenance management system in real time to identify underwater mud, foreign objects and major structural damage, and respond in a timely manner [8].

4.3 UAV applications
By setting the drone shooting route and fixed shooting points, you can obtain the layout of people, materials, machines and image progress on site at each time period. In this way, you can guide the general plane management, strengthen the control of labor, and ensure the implementation of progress management goals. The comparison and analysis of the UAV shooting images and BIM construction simulations are convenient for the project department to control and adjust the construction deployment in real time, forming image data, saving a lot of manpower and material resources, and improving work efficiency.

4.4 3D laser scanning and completion model
Using the panoramic scanning technology, the entire working surface is scanned at different time nodes on site to generate a staged panoramic graphic, and the point cloud model is generated through software processing, which is compared with the BIM model and the measured data of the total station on site. Get the accuracy difference between the three to check the construction quality [9].

4.5 BIM+VR application
The general idea of the application of virtual reality technology in BIM is based on the virtual reality engine technology to carry the BIM model and its data, and use the characteristics of the virtual reality engine to implement BIM applications and present BIM results. The BIM model is seamlessly and quickly integrated into the VR platform, so that the display effect of the model, the browsing mode becomes the VR mode (similar to the game mode), and can be connected to the VR helmet; at the same time, because it is a VR platform, it is complete in this environment Retain the attribute information of the BIM model, not only get a good visualization effect but also retain the complete BIM information.

Use BIM+VR technology to form a computer-based simulation system with certain functions, make the models in the system have dynamic performance, and virtually assemble the models in the system. According to the results of the virtual assembly, in the visual environment of human-computer interaction Modify the construction plan.

4.6 BIM+AR application
AR (Augmented Reality) is augmented reality. It is an emerging computer application and human-computer interaction technology developed on the basis of virtual reality technology. Unlike VR, AR is real-time real-time virtual objects or information generated by the computer and real environment. They are superimposed together to present a new environment with real sensory effects and rich scene information [10] (see Fig. 6).
5. Conclusion
The bridge construction environment is complex, the construction is difficult, the requirements are high, the construction period is tight, the coordination relationship is many, and the amount of information is huge. The application of BIM technology in bridges can solve these problems well. The application of BIM technology in the bridge construction stage is still in its infancy However, BIM technology has unparalleled advantages over traditional management models in finding drawing errors, technical disclosure, engineering quantity statistics, collision detection, and information integration. The BIM cloud platform can realize the information management of the whole process of bridge engineering from design to construction to operation and maintenance, so as to achieve refined project management and ensure the realization of the goals of project quality, safety, schedule, cost, and environmental protection.

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