Analysis on the Application of BIM Key Technology in Road and Bridge Construction Management

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Abstract: With the rapid development of science and technology, BIM technology is widely used in many fields. The application of BIM technology in road and bridge construction management can provide a strong basis for the management decision of the whole process of road and bridge construction, improve the level of road and bridge construction management, and ensure the quality and service life of road construction. In addition, the application of BIM technology can not only shorten the construction period but also save the cost of roads and bridges. BIM technology plays an important role in the construction process of road and bridge engineering.

1 Introduction
At present, the domestic economic development trend is good, per capita car ownership continues to increase, the requirements for roads and bridges continue to improve. In this context, the current road and bridge construction has become more complex, which is not only affected by the built environment, but also closely related to various professional technologies. Most of the current road and bridge projects are still at the level of two-dimensional engineering drawings. And it is difficult to find problems in the project at the first time with this inefficient method of information transmission, which not only affects the construction progress, but also destroys the overall appearance of the project. In this regard, it is necessary to introduce BIM technology to achieve effective management and control of road and bridge projects. This paper takes the expressway construction project of YC-YX2 in Jiangsu section of Yixing to changxing expressway as an example, and mainly explores the application and implementation process of BIM model [1].

2. Application of BIM technology

2.1 BIM model application
(1) Drawing problem report: Exam design drawing, check drawing problem, and summarize problem reports to assist drawing examination.
(2) Collision detection: Use the created BIM model to detect the main body of the project and analyze the collision, and generate a collision analysis report;
(3) Three-dimensional layout of the construction site: Combine drawings, site layout and surrounding environment to create a BIM model of the three-dimensional layout of the construction site, and simulate the site layout and surrounding environment to ensure that the layout of the construction site is reasonable [2];
(4) Construction scheme simulation: For important construction technical schemes, BIM
technology is used to produce 3D visual animation, simulate the construction process, demonstrate the feasibility of the scheme, and use simulation animation to illustrate to the technicians and workers, so as to improve the efficiency and quality of disclosure [3].

2.2 Building a BIM collaborative management platform "Construction Site of Intelligentization"
The board diagram of the Construction site of intelligentization is shown in figure 1.

(1) Safety and environmental protection management: establish safety inspection, hazardous project management, hazard source management, video surveillance, environmental monitoring and other modules to conduct comprehensive safety and environmental management [2].

(2) Schedule management: Establish zebra crossing entry, co-construction, personnel placement and other modules, and conduct schedule management in combination with BM system.

(3) Quality refers to the management of building quality inspection and actual measurement, and on-site intelligent management.

(4) Cost management: Establish a material acceptance system combined with BIM system for cost management.

![Figure 1: The board diagram of the Construction Site of Intelligentization](image)

3. Application of BIM technology in road and bridge construction management

3.1 Road and bridge construction safety management
In the construction of roads and bridges, a lot of manpower, material and financial resources are required, and there are some potential safety hazards. In order to avoid the occurrence of safety accidents, safety management at the construction site must be strengthened. The use of BIM technology can simulate the construction process and construction links, timely identify potential safety hazards on site, re-examine the construction plan through detailed simulation, understand the unsafe factors at the construction site, take preventive measures in advance to eliminate potential safety hazards and accidents from the source[4]. On the other hand, the use of BIM technology can accurately locate on-site personnel, strengthen construction supervision, realize visual construction management, conduct in-process operations during construction, and in-depth control of potential safety hazards, timely feedback information, and effectively solve various difficulties in construction.
What’s more, it can predict the construction effect in advance for systematic adjustment [1].

3.2 Statistics of road and bridge engineering volume
The accuracy of road and bridge engineering volume statistics and engineering cost budgets must be high, but the traditional working methods in the past were mainly manual calculations, which not only required a lot of time, but also had low accuracy. In addition, if different professionals participate together, it will be difficult to share data and information. Through the application of BIM technology, the engineering quantity and cost of each construction link can be calculated in a timely and accurate manner, and the data information can not only be stored on the information platform to provide information support for the next construction link, but also be proofread and consulted at any time [4]. The engineering quantity data collected by BIM technology can not only calculate the cost of the bridge, but also provide a scientific and reasonable basis for making construction plans.

3.3 Coordinating road and bridge construction projects
Road and bridge engineering involves many projects, and an important part of the management is the organization and coordination of various construction projects, which can speed up the construction progress of the project. The construction sites of roads and bridges are narrow and long, and there are often multiple projects working at the same time, which will affect the construction quality of the bridge, and also have certain safety hazards. By applying BIM technology, the construction process can be simulated. According to analysis, completing the coordination of various projects before project construction can not only ensure the construction quality of the project, but also effectively improve the construction schedule and reduce the possibility of safety accidents at the construction site.

3.4 Road and bridge construction schedule management
The past experience of road and bridge construction schedule management shows that there is a big difference between the actual schedule and the construction plan of road and bridge construction. This is mainly due to the unreasonable schedule management plan formulated by the management personnel, and the insufficient disclosure of the data information of the construction schedule management [5]. The application of BIM technology in road and bridge construction management can build a 4D virtual model, and formulate targeted solutions and management measures by analyzing the virtual construction conflicts in the 4D model. At the construction site, the entry time of construction personnel, materials and equipment should be accurately controlled, as well as the starting and ending time of each project [3]. The construction process of the project needs to be strictly monitored and controlled to avoid rework of the projects, and it is strictly forbidden to delay and wasting time during the construction process.

3.5 Construction equipment, materials and personnel management
In the construction of roads and bridges, the construction projects are very complicated, and a lot of equipment, construction personnel and building materials are used. If there are problems in some aspects, such as equipment failure, lack of construction personnel, insufficient building materials, etc., it will increase the difficulty of on-site management personnel and affect the smooth progress of road and bridge projects. By applying BIM technology to the construction management of roads and bridges, managers can use the 4D model and information platform to understand the specific conditions of the equipment, materials and personnel required at the construction site in advance, and formulate effective solutions.

4. Implementation process

4.1 Model creation
(1) To establish a 3D topographic map, the UAV aerial images is used to record the terrain of the project, the lidar is used to scan the terrain data to create a 3D terrain surface, and then the real 3D
terrain environment is combined with satellite remote sensing images. As shown in figure 2.

![Figure 2: Model diagram of 3D topographic map](image)

(2) The establishment of the geological model

① Using the geological section to construct the geological surface: In Civil3D, the geological section is used as the longitudinal curve of the path, and the flat curve of the geological section is used as the flat curve of the path to create a road route and convert it into a three-dimensional characteristic line.

② Correction of the geological surface of borehole pile data. The borehole data is processed into a set of points corresponding to each geological surface. The geological surface is created by extracting the 3D characteristic line and corresponding dot group file of each layer and extracting the two adjacent elements. The middle part of the curved surface is a three-dimensional geological model [5].

(3) The application of geological model is based on the grade of surrounding rock and other geological conditions as the judgment basis to automatically identify the risk level, and different colors are used in the model to identify the risk level of the construction interval [5]. In the BIM model, the step value is preset, the distance between the prelithology change is within the range of the preset step value, and the prelithology change data is sent to the person in charge in the form of icons to achieve the warning effect of geological changes.

5. Software configuration

The modeling process mainly uses software such as Revit and Civil3D, and the implementation process is mainly based on the BIM5D platform [6]. As shown in Table 1.

| Number | Software Brand | Software Version | Function & Application |
|--------|----------------|------------------|------------------------|
| 1      | Revit          | 2018             | Construction and maintenance of civil engineering, site layout, electromechanical models, data entry and export, etc. |
| 2      | Navisworks     | 2018             | Used for the summary and examination of various professional models, pipeline collision detection, three-dimensional roaming, disclosure, etc. |
| 3      | Civil 3D       | 2018             | Construction of terrain and geological models, export of spatial coordinates and other data, etc. |
Dynamo 2.0.1
Graphical platform for secondary development, script development for improving workflow, and construction of tunnel and pipeline relocation models

Rebar calculation and formwork support of Glodon
Glodon series software can carry out three-dimensional modeling of rebar and formwork brackets, and export detailed list tables

Lumion 6
Video rendering and production

BIM5D
The latest edition of the 2017
Application of quality, safety, schedule and cost after integrating the model

XZglodon
The latest edition of the 2017
Data storage and cloud-based applications

Construction Site of Intelligentization
Refined, informatized, and scientifically managed first-line production on construction site

6. Conclusion
It can be seen that the application of BIM technology in road and bridge engineering construction management plays an important role in road bridge construction, which can promote roads and bridges to obtain good economic and social benefits. BIM technology can make correct decisions for managers, provide a true and reliable foundation, scientifically manage the entire construction process of roads and bridges, avoid quality and safety accidents during the construction process, reduce the construction cost, and ensure construction period [6]. Based on this, BIM technology should be widely used in future road and bridge construction management to promote the rapid development of transportation networks.

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