Application Research of BIM Technology in Highway Reconstruction and Extension Project

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Abstract. Relying on its own technological advantages of data integration, information sharing, management cooperation and visualization, BIM technology is gradually applied to highway reconstruction and extension project construction. The applications include 4D simulation technology of construction organization scheme, traffic organization simulation technology, digital interactive virtual sand table technology and project collaborative management platform will be helpful to break through the bottleneck of highway traditional construction management and realize the leap-forward promotion of informationization and fine management level of highway reconstruction and expansion project construction.

1. Application Background
BIM technology, as a new means of information technology, has been rapidly applied in the field of highway transportation infrastructure in recent years, relying on its own technological advantages of data integration, information sharing, management cooperation and visualization. With the development of economy, the contradiction between the capacity of existing highway and the increasing traffic volume, as well as people's high standard traffic demand, has become increasingly prominent. Therefore, in the future, highway reconstruction and expansion projects will occupy a certain proportion in highway engineering construction. It is particularly urgent and necessary to realize the breakthrough of BIM technology in highway reconstruction and extension project as soon as possible, to ensure the construction progress, and to improve the level of detailed, intelligent and professional management of Engineering construction.

Combining with the advantages of BIM technology, this paper studies and establishes the application technology solution of 4D simulation of construction organization based and the solution of traffic organization simulation technology on BIM. Use three-dimensional information model richly and efficiently to find problems in highway reconstruction and expansion projects ahead of time, optimize construction technology, construction organization scheme, traffic organization scheme, etc. And perfect the application process of BIM technology. This will help break through the bottleneck of the original technical means and realize the technological innovation of expressway reconstruction and expansion project construction.

2. Application of BIM technology in highways

2.1. 4D simulation technology for construction scheme
The length of the highway engineering is too large and involves many types of projects, which relatively increases the difficulty and complexity of the construction organization. For the key control projects such as expansion of interchanges, roadbed elevation, old bridge broaden, reaming, deep road
excavation and high fill, BIM technology is used to simulate the construction scheme and construction organization in 3D, which is used to optimize analysis and configuration, find problems in advance, solve problems, reduce the impact of surplus processes on the construction process, optimize construction scheme, and ensure the high efficiency and safety of the whole construction process.

BIM virtual technology uses information model as data carrier to display the specific plan and schedule of construction, and combines the space and time information to form a 4D model, which displays the entire construction process intuitively and concretely, and also provides the effective way of sharing information resources for the construction.

(1) BIM virtual construction technology simulates the entire construction process, allowing the team technicians to familiarize the construction crafts and technical process before construction, and improve the refined management level of highway construction skills.

(2) Using 4D correlation database of BIM, virtual construction technology can quickly and accurately acquire the basic amount of data in the process, and provide timely and accurate data for formulating construction plans, and provide data support for the cost management and control.

In the construction of traditional expressway projects, it is often difficult to calculate the cost of the project expenditure, the fees already paid, the total fees payable in real time, which cannot reflect the dynamic cost of the project and the time cost of the project in a timely manner. Also, it cannot timely change the drawing, accurately obtain the project cost specified by the contract according to the specific construction schedule. But, the establishment of 4D related database in BIM virtual construction technology, virtual construction of 3D graphics, can determine the relevant parameter areas, and compare the data in the implementation process, which provides corresponding basis for data guidance in the construction.

(3) According to the BIM technical model, the construction is virtualized and optimized to reflect the construction difficulties in advance. Based on the animation rendering, a visual display of the construction process is implemented. The effective display with BIM virtual construction technology, can help the complex space standard design be displayed more intuitively, which is convenient for construction technicians to understand and use. It also effectively prevents construction technicians from making mistakes due to understanding deviations in the process of viewing drawings, and it reduces the errors in highway construction.

(4) The virtual simulation technology is used to optimize the scheme for ensuring green construction. For the installation of large and medium-sized equipment, the 3D model will display the process of lifting equipment dynamically. If a collision occurs, the program will automatically send an alarm, so that the technician can modify the parameters of the tower crane or derrick until the lifting simulation is satisfactory. The technician can improve the lifting process according to the simulation path and the lifting equipment. The selection and parameters of the lifting equipment can be adjusted until the simulation is completed successfully.

Fig. 1 Construction organization simulation

2.2. Traffic Organization Design Simulation Technology
During the construction of the highway reconstruction and extension, it is necessary to take into account the normal traffic efficiency of the existing projects and the progress of the construction, and adopt the technical principle of not closing the traffic, which puts higher requirements for the rational planning of the transportation organization.

The BIM technology is used to simulate the scheme of the traffic organization, and guide the design
and implementation of the traffic organization. According to the construction progress, the simulation of the whole traffic organization in the bidding section is pre-established. In view of the fact that the congestion traffic of the key export guides appearing likely, based on the analysis of the existing traffic flow data, traffic organization design simulation is used to predict and analyze the traffic carrying capacity of the traffic organization scheme. Optimize the traffic guidance scheme according to the simulation, and improve the feasibility and efficiency of the traffic organization scheme. During the implementation of the project, according to the adjustment of construction schedule and the situation of on-site traffic organization, adjust timely the traffic organization plan to stop construction and traffic from interfering with each other.

(1) Based on traffic simulation analysis software and BIM model, microsimulation is established for important nodes of highway guidance and transformation. By synthetically considering geometric model and vehicle behavior model, the influence of traffic control, unhealthy climate, vehicle characteristics and other factors on traffic simulation is reflected as truly as possible. A dynamic traffic organization model is established, which conforms to the actual traffic situation, and the traffic situation is analyzed traffic conditions statistically. Large area traffic flow simulation can demonstrate the feasibility of reconstruction and expansion scheme at macro level quickly and intuitively.

(2) Traffic organization simulation can dynamically and vividly simulate various traffic phenomena such as traffic flow and traffic accidents, reproduce the time and space changes of traffic flow, deeply analyze the characteristics of vehicles, drivers, pedestrians, roads and traffic, effectively carry out traffic planning, traffic organization and management, traffic energy conservation and research on rationalization of transportation flow

(3) Traffic organization simulates the operation of vehicles in the road network intuitively and scientifically predicts whether the traffic is congested or not and whether the road is unobstructed at a certain location, so that corresponding traffic diversion measures can be put forward accordingly, so as to optimize the traffic organization scheme in time and enhance the scientificity and operability of the traffic organization.

(4) In view of the construction section traffic management department will formulate the corresponding vehicle diversion measures, conduct vehicle guidance in the upstream of the construction section, divert part of the traffic volume to other alternative routes, and ensure smooth traffic in the construction section so as to avoid the phenomenon of vehicle queuing. Large area traffic flow simulation can also reflect the rationality of the diversion measure quickly and intuitively.

(5) Describing the dynamic traffic system by means of figures, words or graphics, issuing evaluation reports, allowing the builders to better grasp and control the traffic situation and reflect the rationality of the traffic organization scheme from the micro level, so as to facilitate communication and communication among the project participants.

![Fig. 2 Traffic organization simulation](image)

3. Construction of BIM Collaborative Management Platform

BIM collaborative management in construction period refers to the use of information technology means, establishing information ecosphere for construction projects with interconnection and collaboration, intelligent production and scientific management based on construction process management. In order to realize visual intelligent management of engineering construction and improve the information level of engineering management, the data in virtual reality environment and engineering information collected by the internet of things are deeply analysed, providing process trend prediction and expert
During the construction period, BIM collaborative management implants more high-tech technologies such as artificial intelligence, sensing technology and virtual reality into all kinds of production links, and is generally interconnected to form the "Internet of Things", which is then integrated with the "Internet" to realize the integration of project management stakeholders and construction site. The core of BIM collaborative management during the construction period is to improve the interaction between the engineering stakeholder organizations and staffs in a "more intelligent" way, so as to improve the clarity, efficiency, flexibility and response speed of the interaction.

The technical support of BIM collaborative management during construction period mainly includes data exchange standard technology, BIM technology, visualization technology, 3S technology, virtual reality technology, Internet of Things technology, information management technology, database technology, network communication technology, etc.

In general, BIM collaborative management during construction period can be divided into two levels: project collaborative management and dynamic management of project resources. Among them, project collaborative management is mainly oriented to macro-business, realizing the overall management and control of project progress, quality, safety, measurement, documentation, etc. It is the exhibition end of project management, which can be realized by pc, web or app. The dynamic management of project resources is mainly oriented to the management of production factors, including personnel, materials, facilities and equipment, monitoring and monitoring, which reflects the optimization of organization and resource allocation, and provides the underlying elements for project collaborative management.

4. Technological trends
With the deepening understanding of BIM concept, BIM application shows the characteristics of BIM+, under the new internet era of “big data” and “cloud computing”. Actively carrying out the application research of BIM technology in expressway reconstruction and expansion project is also actively exploring the feasibility of applying "BIM+" in expressway reconstruction and expansion project. Form mature standardized products according to project construction requirements at project management level to meet the requirements of engineering informatization construction. Realize the "multi-stage application", "integrated application", "multi-angle application", "collaborative application" and "universal application" of BIM technology in expressway reconstruction and extension project, and to build the core quality of Engineering construction.

5. Concluding remarks
As an effective means of informatization and project management, BIM technology exerts its advantages in information completeness, information relevance, visualization, coordination and simulation. On the one hand, the construction organization and traffic organization of expressway reconstruction and expansion project is optimized to provide technical support for lean construction of engineering. On the other hand, through BIM collaborative management platform, integrate data and compress the whole line management chain to achieve the goal of information sharing, management
coordination, quality improvement and efficiency, which is helpful to greatly improve the progress, quality and safety management and control level of expressway reconstruction and expansion projects.

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