

# The Application and Development of BIM Technology in Transportation Industry in Guangdong Province

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**Abstract:** In recent years, Building Information Modelling (BIM) technology has been widely used in the civil engineering industry, and the benefits of BIM technology are gradually brought out. This paper introduces the development and application of BIM technology in transportation industry in Guangdong Province. The relevant industry policies of BIM in Guangdong Province are introduced. Then, three typical BIM technology application cases, including the Nansha Bridge, the Shenzhen-Zhongshan Link, and the Huangmaohai Link, are analyzed and exhibited. Finally, the experiences of BIM technology development in the transportation industry in Guangdong Province are summarized.

## 1 INTRODUCTION

As the second revolution of the engineering construction industry under the background of the information age, BIM technology has attracted widespread attention from governments, scholars and practitioners in the engineering industry around the world (Costin, Adibfar, Hu, and Chen 2018, Zhao 2017). In recent years, China has successively introduced policies to increase the promotion of BIM technology (Lin and Zhang 2018). General Secretary Xi Jinping pointed out that it is necessary to accelerate the promotion of digital industrialization and rely on information technology innovation. The Ministry of Housing and Urban-Rural Development issued the *Guiding Opinions on Promoting the Coordinated Development of Intelligent Construction and Building Industrialization* in 2020, focusing on increasing building information Model (BIM), Internet of Things and other technology applications throughout the construction process (Liao 2020). Local provinces and cities have successively issued BIM promotion and application policies, aiming to promote the further application of BIM technology (Yang, Zhang, Yuan, and Iop 2019).

Since the reform and opening up, the Guangdong-Hong Kong-Macao Greater Bay Area has fully carried forward the opening and developing spirit,

and has gradually become one of the most open and economically vigorous regions in China (Cai 2017). It has an important strategic position in the overall situation of the country's development, and it also laid a good foundation for the development of digital transportation. The Department of Transportation of Guangdong Province follows the strategies of "Digital China" and "Building a Country with Strong Transportation Network". Important local policies such as the *Three-year implementation plan for Guangdong Province to promote the construction of new infrastructure (2020-2022)* and the *Guangdong Province Digital Transportation Strategic Plan* actively promote the application of digital technology in the transportation industry (Ren 2019). These policies point out the direction for the development of digital transportation. In addition, the rapid development of a new generation of information technology has paved the way for the application of digital transportation (Ghaffarianhoseini et al. 2017). Driven by economy, policy and technology, the transportation industry in Guangdong Province is about to usher in a wave of digital transformation. This paper focuses on three typical BIM technology application cases in Guangdong Province, including the Nansha Bridge, the Shenzhen-Zhongshan Link, and the Huangmaohai Link. Started in 2015, 2017 and 2020 respectively, these three projects represented the

development of BIM technology in the transportation industry in Guangdong Province. This article summarizes the overview and highlights of these projects, analyzes the application and promotion of BIM technology in Guangdong Province.

## 2 OVER VIEW OF TYPICAL BIM APPLICATIONS IN GUANGDONG PROVINCE

As one of the most open and developed urban clusters in China, Guangdong Province has always been in a leading position in BIM applications in the transportation industry. At the beginning of 2015, the BIM work of the Nansha Bridge was officially launched during the construction period, marking the first application of BIM technology in the industry. This project has created several key technologies such as the BIM standardized application mode of super-large highway bridges, the integration of BIM design and fabrication of steel box girder, and the management of short-term assembled segment beams through BIM and IoT. The first application of BIM technology in a mega bridge project has achieved good results.

In October 2017, the application of BIM technology for the life cycle management of the Shenzhen-Zhongshan Link was officially launched. Based on the work in Nansha Bridge, the Shenzhen-Zhongshan Link has taken a big step forward in informatization. The project has realized the business collaboration of project construction-quality

inspection-metered payment process. The project established a big data display system for real-time monitoring of key project data. Through the development of mobile APP, business management has been mobilized. Through the introduction of digital signatures, the electronic engineering documents have been realized. The application of BIM technology in this project has solved several key problems.

In March 2020, the BIM and informatization work of the Huangmaohai Cross-sea Link was officially launched. The project fully inherited the technical foundation of the Shenzhen-Zhongshan Link and Nansha Bridge, pushing BIM and informatization application to a new level. The project focused on optimizing the coding collaboration system in depth, and improved the application level of project construction-quality inspection-metered payment collaboration. The project has developed an integrated BIM platform, carried out in-depth mining and analysis of multi-dimensional data, and introduced mobile digital signatures to push the informatization of engineering construction and management to a new level.



Figure 1: Over view of typical BIM applications in Guangdong Province.

### 3 THE APPLICATION AND DEVELOPMENT OF BIM TECHNOLOGY

#### 3.1 First Application in Nansha Bridge

Nansha Bridge is an east-west cross-river passage project connecting Nansha District of Guangzhou and Shatian Town of Dongguan. Located in the Guangdong-Hong Kong-Macao Greater Bay Area, this project is the western end of the Guangzhou-Longchuan Expressway. The project has a total length of 12.9km and a total investment of 11.2

billion yuan, including two kilometer-class suspension bridges. At the beginning of 2015, the BIM application during the construction period of Nansha Bridge was officially launched. The project aims at digital design, digital construction and intelligent management. Five key technologies, including the BIM standard application mode for super-large highway bridges, the integration of BIM in steel girder design and fabrication, management of short-term assembly segment beams with IOT technology, BIM platform for collaborative management, and application guidelines of BIM technology in mega bridge construction projects, have been developed.



Figure 2: Over view of the Nansah Bridge Project.

However, there are still some aspects to be improved in the application of BIM technology in Nansha Bridge. The information management system of Nansha Bridge lacks a unified management platform and full life cycle planning. It needs to switch between different systems, thus the user experience is not good. Data between different technical service providers cannot be shared and transferred, which results in poor interoperability. These problems reduce the application efficiency of BIM and information systems.

#### 3.2 Development in Shenzhen-Zhongshan Link

The Shenzhen-Zhongshan Crossing Sea Channel Project (referred to as the Shenzhen-Zhongshan Link) is another world-class sea-crossing cluster project integrating bridges, islands, tunnels, and underwater intercommunication after the Hong Kong-Zhuhai-Macao Bridge. It is one of the major engineering

projects in the national 13th five-year plan. In October 2017, the full life cycle BIM technology application of the Shenzhen-Zhongshan Link was officially launched. The project is guided by the goal to improve quality, increase efficiency, and reduce costs. The project has developed several key technologies, including 3D digital design and delivery, steel shell intelligent manufacturing, smart beam factory application, collaboration management platform, and smart construction. This project achieved the unification of management systems, the integration of design-manufacture-inspection process, paperless management, key processes collaboration, and site visualization, which solves some of the key problems in construction management.



Figure 3: The BIM platform for Shenzhen-Zhongshan Link.

Based on the work of the Nansha Bridge, the Shenzhen-Zhongshan Link has taken a big step forward in BIM application. However, in the actual application process of the project, there are still insufficient user habits and insufficient information system assessment and reward mechanisms, which affects the enthusiasm of some participants in using the system. The mobile terminal has been able to achieve some basic functions, but the ability of approval management is not strong enough.

### 3.3 Improvement in Huangmaohai Link

The Huangmaohai Link Project starts in Zhuhai, which connects to the Hong Kong-Zhuhai-Macao Bridge. The project starts at Gaolangang Interchange, crosses the Huangmao Sea with a length of 14 km, and ends in Taishan, Jiangmen. The total length of the road is about 31 km, including a 700-meter-span cable-stayed bridge and a 720-meter-span double tower cable-stayed bridge. At the beginning of 2020,

the BIM application and informatization of the Huangmaohai Link was officially launched. The Huangmaohai Link Management Center optimized the division of WBS and bill of quantities. A standard mapping relationship between WBS and bill of quantities is established. Based on the unified project management code system, each business system establishes a connection with each other. A collaborative management of process inspection-progress control-quality supervision-measurement payment-file management is achieved. The current 3D graphics technology has high requirements on computers and networks, which greatly affects the value of BIM technology. The BIM platform of Huangmaohai Link was comprehensively upgraded. The operation speed was improved and the display details was enriched. New platform reduces computer performance requirements and improves the application of 3D models. Finally, the Huangmaohai Link adopts mobile KEY technology, which realizes signature approval on the mobile phone. The legality and convenience of electronic files are effectively balanced.

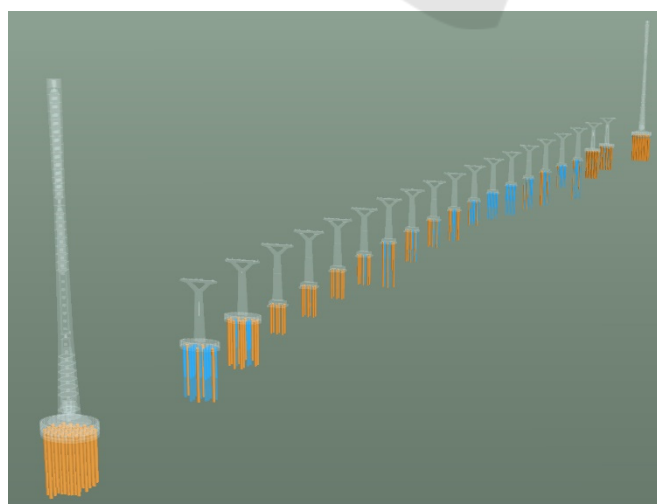


Figure 4: Improved BIM platform in Huangmaohai Link.



## 4 CONCLUSION

Informatization is an inevitable demand for the development of the transportation industry. In recent years, with the support of national and local policies, the digitization level of the highway industry in Guangdong Province has gradually improved. The Nansha Bridge Project introduced BIM technology in transportation construction industry in 2015. Several key technologies were developed in Nansha Bridge. The Shenzhen-Zhongshan Link Project has taken a big step forward in informatization in 2017. This project has established a unified project management platform, which solves some of the key problems in construction management. The Huangmaohai Link Project focused on optimizing the coding collaboration system in depth, and improved the application level of project construction-quality inspection-metered payment collaboration. Huangmaohai Link pushed the informatization of engineering construction and management to a new level. Guangdong Province has made bold attempts in the digitalization of highway projects. By actively establishing demonstration projects and continuously iterating and upgrading, the scale benefits of digitalization have gradually emerged. Nowadays, there are many applications of BIM and informatization in highway engineering. In order to ensure the unity and compatibility of the application of BIM technology, an application standard for BIM in highway engineering projects should be established in the future.

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## REFERENCES

- A. Costin, A. Adibfar, H. Hu, and S. S. Chen, "Building Information Modeling (BIM) for transportation infrastructure—Literature review, applications, challenges, and recommendations," *Automation in Construction*, vol. 94, pp. 257-281, 2018.
- A. Ghaffarianhoseini et al., "Building Information Modelling (BIM) uptake: Clear benefits, understanding its implementation, risks and challenges," *Renewable and Sustainable Energy Reviews*, vol. 75, pp. 1046-1053, 2017.
- Cai. Chimeng, "The Strategic Significance and Realistic Challenges of the Urban Agglomeration Construction in the Guangdong-Hong Kong-Macao Greater Bay Area," *Social Sciences in Guangdong*, no. 04, pp. 5-14+254, 2017.
- Lin. Jiarui and Zhang. Jianping, "Review and Exploratory Text Mining of Building Information Modeling Policies in China," *Construction Technology*, vol. 47, no. 06, pp. 73-78, 2018.
- Liao. Yuping, "Accelerate the transformation of the construction industry and promote high-quality development-interpretation of the 'Guiding Opinions on Promoting the Coordinated Development of Intelligent Construction and Construction Industrialization'," *China Engineering and Consulting*, no. 09, pp. 20-21, 2020.
- Ren. Zhihong, "The Significance and Value of the Development of the Digital Bay Area in the Guangdong-Hong Kong-Macao Greater Bay Area," *New Economy*, no. 10, pp. 8-14, 2019.
- X. Zhao, "A scientometric review of global BIM research: Analysis and visualization," *Automation in Construction*, vol. 80, pp. 37-47, Aug 2017, doi: 10.1016/j.autcon.2017.04.002.
- Y. Yang, Y. Zhang, L. Yuan, and Iop, "Development of Building Information Modelling in China: A Review of Policy Trends," in *5th International Conference on Advances in Energy, Environment and Chemical Engineering*, vol. 358, IOP Conference Series-Earth and Environmental Science, 2019.