Application of BIM Technology in Bridge Engineering and Obstacle Research

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Abstract: with the development of economy and the reform of cities, the bridge engineering in China has entered a period of rapid development. By 2009, the number of highway bridges in China has exceeded that of the rest of the world. According to the statistics of 2014, the number of roads and bridges in China is 757100, and its extension meters reach 42.5789 million. The emergence of BIM technology has brought a new experience to China's construction industry. Compared with the traditional CAD, the most significant change in BIM technology is to change building information from two-dimensional to three-dimensional. At the same time, BIM visualization, synergy and automation help building participants to do a lot of work better and more conveniently. Because of the continuous expansion of bridge engineering in China, bridge engineering has gradually become more complex and diverse, which has also brought problems to many industries. The research on BIM in our country is still in some surface stages. There are deeper things worth digging into.

1. BIM background

In the world, China has become a worthy industrial country [1]. The gross output value of the national construction industry reached 21.4 trillion yuan in 2017, accounting for 25.87% of the GDP, and the added value of the construction industry accounted for more than 6% of the total GDP for many years [2]. The rapid development of the construction industry makes the traditional construction technology appear to be much behind. In May 2011, the 2011~2015 Construction Informatization Development Program issued by the Ministry of Housing and Construction showed that the application of BIM in the domestic construction industry should be vigorously promoted.

BIM (Building Information Modeling), is architecture, and Building is understood as all architectural fields, including civil engineering, traffic engineering, historical building protection, landscape design, etc. Information is information, information not only contains some building information, such as column parameters, it can also be all stages of the life cycle, environmental parameters, simulation parameters, is a kind of information thinking. Modeling is a model, Professor Xie Shangxian, director of the National Taiwan University BIM Research Center, suggested translating Modeling into plastic models. So BIM is the integration and application of digital information based on 3D model, including the whole process of building life cycle. By using BIM visualization, coordination and simulation, time and cost can be greatly saved [3].

BIM technology plays an important role in the construction industry in design, construction, operation and maintenance, from early project design, quality control, cost control, schedule control, data management, collision inspection, and later operation simulation, maintenance and BIM. It enables people to break the constraints of environment and geographical location, thus more efficient
communication, and provides a platform for information sharing for staff, so that all parties can timely feedback on changes and BIM the convenience of the construction industry, BIM also entered a period of rapid development in China [4].

2. Current status of bridge construction

With the rapid development of our country, various infrastructure industries also need to reform, bridge engineering as an important part of China's infrastructure has entered a period of rapid development, as our demand for construction is higher and higher, China's demand for bridges is also increasing, such as multi-level interchange, these needs tend to be more functional, intelligent, information, building forms become more cumbersome, bridge design gradually tend to span, structural difficulties, design changes become difficult to solve, these have increased the cost of bridge engineering, brought more security risks, delayed progress, We now need to look at the existing problems and development of bridges from a higher perspective. The traditional CAD model has been difficult to meet the current construction technology, and the two-dimensional drawings are somewhat difficult in the current bridge engineering [5]. The bridge dilemma is mainly reflected in the following three stages:

1) Design stage: The design of the bridge is directly related to the quality of the bridge. In the design stage, the designer needs to analyze and design from the mechanical performance, practical performance, appearance performance and other aspects, and also need to consider the construction process. Process flow, planned construction period, project cost and other issues. For these designs, if only two-dimensional drawings are used to show them, the drawings and documents produced will be very cumbersome and complicated. Because there are too many drawings and documents, and the communication of information is not in place, problems such as material waste, labor waste, and extension of construction period may occur during construction.

2) Construction stage: Due to the current economic growth and population increase, the number of vehicles has also increased rapidly. On limited land, people's demand for bridges has become more complex, with larger spans, multi-functionality, complex structures, and construction difficulties. Increasingly, these problems have been difficult to solve with traditional construction methods. In terms of bridges, we urgently need some new materials, new processes, and new technologies to solve the current dilemma.

3) Operation and maintenance stage: After the bridge is put into use, the later operation and maintenance stage of the bridge cannot be ignored. The information of the participants, the registration of materials, the design drawings and other documents need to be completely preserved, and the quality of the latter must be Monitoring, because these data can be used to trace the responsible party in the later stage, and can also be used as reference materials for similar projects, so the storage of data files should be more standardized, refined and scientific [6].

3. Application of BIM in bridge

The information technology can improve the efficiency of bridge engineering, solve some technical problems, and play an important role in cost, time and safety quality. Therefore, the application of BIM technology in bridge engineering has been paid attention to by many people at different levels. Because BIM is an information integrated management based on three-dimensional model and a dynamic process, BIM application in bridge engineering is as follows:

The feasibility study phase, as the most important work in the early stage of the project, should take into account the feasibility and necessity of the project. When carrying out the feasibility study, the indicators should be carefully completed in the light of the actual situation of the project and the surrounding environment and background conditions. This involves the need for participants to work together, BIM can provide an information-sharing platform where changes or indicators can be processed in a timely manner, thus improving work efficiency, solving communication problems, and BIM can also use its visualization to build a simple project model during the feasibility phase, render, simulate, and then provide to the owner or builder for some later design work, such as pipeline simulation, surrounding greening and building orientation [7].
The design stage can be based on the simple 3D model provided by the BIM for precision design, which solves the traditional CAD 2D model, and the 3D model can also add some design inspiration to the designer. When design changes occur, they can also be changed directly on the model, thus improving efficiency. BIM can also provide pipeline collision inspection and correct some collisions before construction, which can not only reduce rework, speed up the construction period, but also save costs. Bridge is different from general building structure. When carrying out bridge engineering, it is necessary not only to design the shape of bridge, but also to analyze and calculate some structure of bridge. This may affect the shape of the bridge. BIM the three-dimensional model can be optimized and corrected to obtain the optimal solution [8].

Construction stage is the key process in engineering. The BIM 3D field layout software can plan and design the construction site, avoid the unreasonable place found in the later stage of construction, and help the construction process to be completed smoothly. BIM5D can also be used to simulate the construction progress of the project before construction, organize the construction progress, avoid the situation of nest workers and waste of resources. In the project construction, BIM provides a dynamic construction process to save cost, speed up the construction period and improve quality [9] (see Fig. 1).
Figure 1. Tree Diagram of BIM application in bridge engineering.

After the first few stages, a large number of data files have been stored in the later stage. Too many documents may lead to some lack of information. Because the service life of bridge engineering is decades or even hundreds of years, information is particularly important. BIM can provide information management platform for bridge engineering, database operation and maintenance, and bridge risk prediction and analysis. It provides scientific data for bridge maintenance [10].

4. Obstacles to the application of BIM technology in bridges

BIM introduction plays a vital role in bridge construction, but there are still some problems. First, Since the introduction of BIM technology is not particularly long, it is widely used in civil buildings, but it is relatively few in bridge engineering. At present, most of the applications are only in the stage of mold turning, and most of them are local and fragmented information. BIM value is not fully reflected, its research depth is still shallow.

Second, China’s theoretical research on the combination of bridge engineering and BIM is still relatively small, but also belongs to some pioneering, basic research, how to better combine bridges and BIM, fully tap the potential of BIM is a problem we need to solve at present. Third, BIM technology does not have a clear standard and criterion in bridge application, including some component libraries and some technical specifications. The lack of this information will encounter many obstacles in bridge engineering communication.

Fourth, most of the BIM technology in our country depends on foreign software, especially in bridge engineering. The software in our country is too few in bridge, without its own software, it will often encounter many difficulties and obstacles in learning, and be subject to others in the authority of software use.

Fifth, Since China is still relatively backward in the informationization and intelligence of bridge engineering, there is still a shortage of talents in the combination of bridge and BIM, most of which are the mode of building +BIM, so that bridge projects in many places still use very traditional methods, only a small number of bridge projects have applied BIM. This makes many projects inefficient, quality is not guaranteed, innovation is not enough, which is very unfavorable to the bridge construction in China.

Through the above analysis, we should reflect on and revise the current situation. Bridge engineering has an important economic position in our country, so we should go out of an innovative and developmental road to fully explore the potential of BIM. Further study how to combine BIM with bridge efficiently, train more excellent bridge talents and formulate their own standards and norms for bridge engineering. And more research and development of related software for bridge engineering to open a new world.

5. References

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