Research on Detection and Safety Evaluation System of Huimin Lane Bridge based on BIM

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Abstract. With the continuous improvement of the national social and economic level the size and quantity of various types of infrastructure in our country have been improved and the community has put forward higher requirements on the level and quality of the construction. In recent years the bridge collapse accidents occur frequently, but our country bridge inspection and safety assessment of the system was established late, our country bridge structure health monitoring system research and application began in the 90. of the 20th century, the implementation of large-scale infrastructure construction projects, bridge health monitoring system also will be rapid development this paper discusses the based on BIM bridge inspection and safety assessment system, and puts forward some practical measures, provides the reference for improving bridge inspection and safety assessment of the system operation level.

Keywords: BIM;bridge detection; safety assessment system.

1. Introduction

BIM is the building information model, which emphasizes the construction model based on the information data in the construction project, so as to simulate the real information of the building with digital information technology. It has the advantages of visualization, coordination, simulation, optimization and drawing, which are unparalleled in other technologies. Bridge is the life engineering of social development, and its operation safety is very important, and to ensure the safe operation of bridge is indispensable bridge inspection and safety evaluation. Therefore, it is of great practical significance to discuss the BIM based bridge inspection and safety evaluation system for bridge operation safety.

2. Overview of bridge detection and safety assessment system

2.1. Bridge inspection and safety evaluation

Evaluation emphasizes the evaluation of the value of something or whether it is good or bad, and for bridge engineering comprehensive assessment of its bearing capacity, so as to determine the strength of materials, or structural classification, with specific information to analyze the reliability of the bridge, in order to make the whole process of engineering decision. Because the bridge structure is very complex, and its design, construction and use influence is very much, then many of the specific working state of the bridge to carry out comprehensive, accurate and reasonable evaluation. Common bridge evaluation methods can be divided into two categories: one is the structural safety evaluation for small and medium Bridges and the bearing capacity evaluation as the key; Secondly, the comprehensive evaluation method of state evaluation for large Bridges is emphasized.

2.2. Research status of bridge detection and safety evaluation

In recent years, bridge construction in our country has developed rapidly, but with the rapid development of traffic also, the service life of bridge in service has been increasing, followed by a lot of bridge structure diseases, during the rapid increase of highway traffic volume, large heavy haul transport vehicles are increasing, then bridge construction should have a higher quality and level, In addition, the bridge aging, damage, original design standards, low aspects of the problems, so that the

bridge in service can not meet the needs of modern social and economic development. This chapter analyzes the status of service bridge detection and evaluation in our country.

In the middle of 1980s, many experts began to study the bridge evaluation and management system. Based on the research of Sichuan Highway Research Institute, Guangdong Highway Research Institute and the Highway Research Institute of the Ministry of Communications and other institutions, they took the experience of the bridge evaluation system developed abroad as the basis point, and then made a comprehensive analysis of our national conditions. Then the bridge database system of Sichuan Province, the bridge management system of Guangdong Province and the bridge management system of Beijing were developed. In the 1990s, the Ministry of Communications carried out a study on the bearing capacity of highway Bridges, which emphasized the study of bridge detection and reinforcement technology, and analyzed the bearing potential of in-service Bridges based on theories[1]. In 1988 and 1993, the Carrying Capacity Appraisal Method of Old Highway Bridges (Trial) and the Bridge Reliability Appraisal Procedure were also issued, which promoted the further development of bridge evaluation[2-3].

Many experts and scholars have also put forward various evaluation and detection methods. Wang Yongping et al proposed to measure the damage of bridge structure or the damage degree of component, and built the fuzzy comprehensive evaluation system and bridge evaluation expert system based on the fuzzy mathematics principle. The corresponding knowledge base has been analyzed and sorted out by several experts, and has the corresponding machine learning function[4-5]. Liu Muyu et al. built a sound safety evaluation model of long-span concrete-filled steel tube arch bridge based on analytic hierarchy process (AHP), and proposed the corresponding index system. The fuzzy theory is introduced to construct a fuzzy comprehensive evaluation method for the safety of long-span concrete-filled steel tube arch Bridges[6-7]. Based on the characteristics of bridge structure and defects, Lu Yaxing et al. proposed the monitoring content of the defect condition of bridge components, and pointed out the corresponding five-level evaluation standard of the components. Based on the bridge defect condition index, the corresponding calculation model was constructed, which effectively combined the subjective and objective factors. Thus, the parameters of the model are calibrated, and the BCI and the bridge maintenance and repair countermeasures are discussed, and the corresponding relationship between them is analyzed in detail. Pan Liming used analytic hierarchy process (AHP), fuzzy mathematics theory and artificial neural network method to evaluate the safety and durability of cable-stayed Bridges[8-9]. For this purpose, he developed a neural network expert system for the safety and durability evaluation of large Bridges. The final comprehensive evaluation result is the overall state of the bridge, which corresponds to the five levels of fuzzy membership vector: excellent, good, medium, poor and inferior.

3. Shortcomings of traditional bridge detection and safety assessment techniques

Traditional bridge inspection technology emphasizes that experienced engineers can visually inspect or use portable inspection instruments to measure, and finally obtain the information to carry out strict monitoring and testing and structural safety evaluation of the bridge to be inspected. This kind of artificial bridge inspection is carried out according to the time, which can be divided into regular inspection, regular inspection and special inspection. After that, the artificial bridge inspection method in the specific project has great limitations, and there are many shortcomings in it. This chapter analyzes the following aspects:

3.1. Poor integrity

Specific detection is carried out for a single component, can provide local detection and diagnosis information, and can not provide structural detection and safety evaluation information systematically.

3.2. Inflexible professional assistance

Traditional bridge technology needs many professional cooperation, and this work time and regional relationship is limited and departments or cities, can not actively mobilize technical talents.

3.3. Technical communication depends on drawings

The sensor layout scheme of the drawings is developed through the media, which should be able to humanly use the spatial imagination, so as to transform the two-dimensional drawings into three-dimensional spatial entities, but there are easy to exist potential misunderstandings in terms of communication. And the visibility is not strong.

3.4. Long cycle and poor timeliness

The information connection between each major is fluid. Only after the previous major is completed, the next major can be expanded, and the information between them cannot be shared. Bridges can take years to inspect, and many major accidents or severe natural disasters do not provide real-time information to policymakers and the public.

4. BIM based bridge health detection and safety evaluation technology

BIM is the building information model, which originated from the United States and has been gradually recognized and applied by many countries. This kind of technology is different from the traditional bridge health detection technology[10]. The BIM based bridge health detection technology is the bridge project information model data, which can provide more professional collaborative detection, evaluation and management. The main technical core is the bridge structure model information system, and the bridge detection information collection system and the bridge structure safety evaluation and early warning information system, which are analyzed as follows in this chapter.

4.1. Bridge structure model information system

All the bridge information data systems are BIM based modeling software, whose construction is mainly the structural data information of bridge structure and construction and operation environment project. Most of the bridge construction, structure and mechanical and electrical information is based on Revit modeling software, which provides visual communication and management basis for the optimization of the bridge health detection program, data collection and bridge reinforcement. Prior to the implementation of inspection and reinforcement programs, sensors and quantity and sensitivity indicators should be arranged in detail for prospective simulation and optimization, so as to provide very accurate and accurate data information, but also to accelerate the efficiency of communication and collaboration among various professionals. There is no intelligent detection and evaluation of Bridges, especially in the detection of blind spots of different types of Bridges. The brief view of the Huimin Lane bridge building information model is shown in Figure 1.

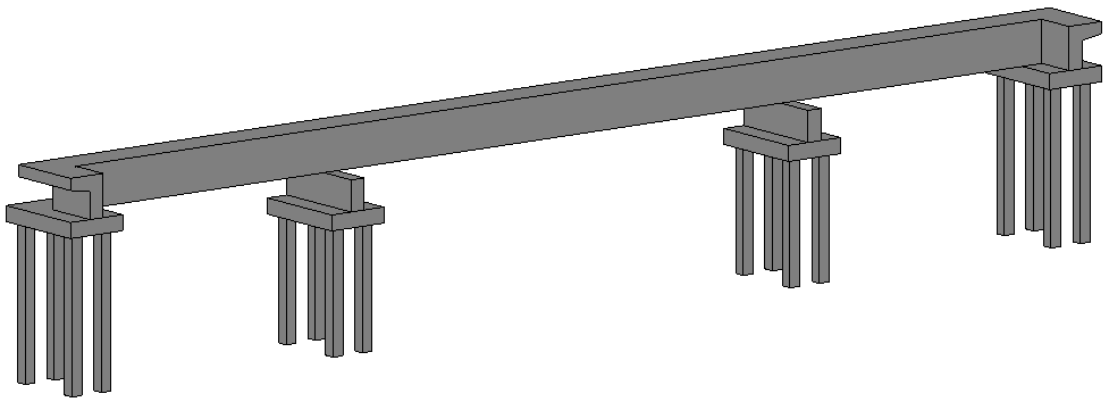

Fig.1 Simple view of bridge building information model

4.2. Bridge detection information data acquisition system

The bridge health monitoring system combines the structure monitoring, system identification and structure evaluation to form a comprehensive monitoring system. Most of them use a variety of advanced testing instruments and equipment to stimulate the outside world of the bridge, including traffic load and environmental load, so as to monitor the response of all aspects. Building information data acquisition system mainly focuses on all parts of the bridge, and then uses the corresponding instruments to check all aspects of stress and displacement and load information, and then connects it with the computer. The network interface can realize remote data transmission and data processing. The stress-strain sensor is based on the collected data and the different data of the installation position. For example, the data information of bridge structure includes stress and displacement and disturbance, then prestress and structural key point stress and beam disturbance, as well as vibration and support reaction and pile stress; The data information of load and action of bridge structure includes earthquake action, wind, rain and snow load, collision of vehicles and ships, river scour, displacement and settlement of pile foundation and cap, etc. The data information of the external environment of the bridge structure includes temperature and humidity and concrete, and then the corrosion degree of the steel bar and the corrosion gas concentration. In the meantime, the sensor layout should emphasize the principle of economic and reasonable, but also should comprehensively analyze the stress characteristics of the bridge, and should be analyzed and reasonably optimized for monitoring items and layout points. It should be emphasized that its particularity and its key parts, its monitoring equipment capacity and the number of sensors are highly redundant, so as to effectively ensure the safe operation of the whole system. It should meet the requirements as far as possible for the rapid upgrade of the subsequent modules of the system, and the sensor construction should reduce the damage to the whole bridge structure as far as possible.

4.3. Bridge structure safety assessment and early warning information system

The bridge structure safety evaluation system is based on the established bridge structure damage identification mechanism and cloud database. After the data collected by the bridge detection system is preliminarily screened, the bridge structure characteristic information is obtained, and then the BIM model is constructed for simulation analysis. Only in this way can the bridge structure safety evaluation be better carried out. The intelligent early warning information system is constructed according to different bridge types and geographical locations. The system should include: first, the evaluation of structural geometry parameters; Identification of structural deformation damage; Thirdly, recognition of structural internal force and stress damage; Fourth, damage identification of structural vibration characteristic parameters; The fifth bridge structure working state evaluation; Sixth, bridge bearing capacity identification; The main body of BIM based bridge structure safety assessment and early warning information system is very key, among which BIM model is the most important subject. All professional departments can realize information intercommunication through the network and mobile communication terminal, so that the engineers distributed in different geographical locations and different professions can work together through the network, and the linear mode can be avoided between departments as far as possible. In order to actively leverage the resources and talents of various departments. Secondly, based on BIM bridge detection visualization, the effective optimization of sensor layout, construction and detection system is realized. FIG. 2 shows the brief view of BIM based bridge structure safety assessment and early warning system.

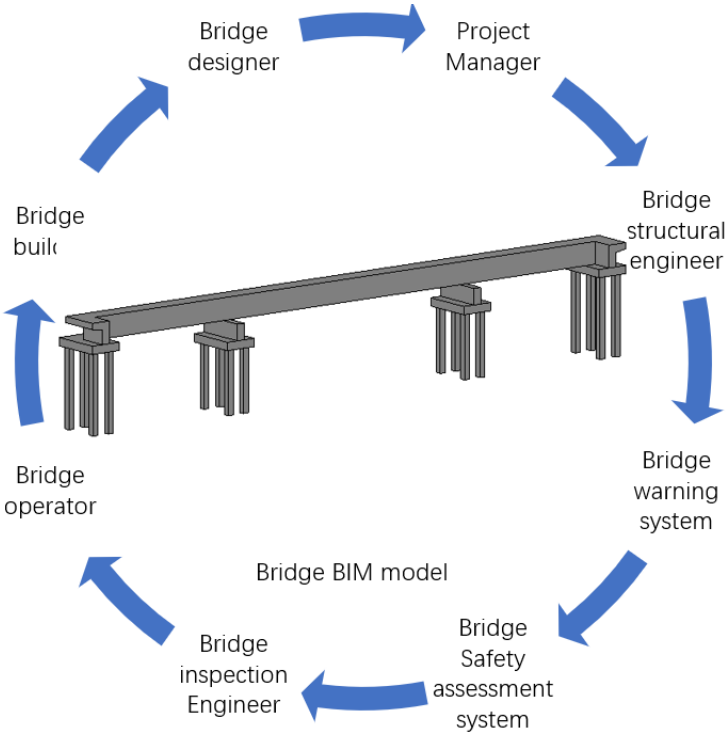

Fig.2 Brief view of BIM based bridge structure safety assessment and early warning system

5. Closing Remarks

Bridge maintenance monitoring in our country is very backward, and lacks very advanced technology, most of which is stranded in the artificial bridge detection and security checking technology, then it needs to consume more manpower, the material resources, financial resources, and time. The construction of bridge project information model is explored as an important basis, and then network technology and wireless optical fiber are used to collect information data in bridge operation, so as to carry out the new technology of BIM bridge safety detection and monitoring for data analysis. This technology is also an important trend of the development of bridge detection and monitoring management technology in the future. However, despite the rapid development of bridge detection and safety evaluation system, there are still many shortcomings, it also shows that the discussion of BIM based bridge detection and safety evaluation system, has a great practical significance for the safety of bridge operation. This paper discusses the overview of bridge inspection and safety assessment system, and analyzes the shortcomings of traditional bridge inspection and safety assessment technology.

6. Conclusion

This paper takes outdoor scene 3D reconstruction technology as the research object, proposes a 3D reconstruction method based on P3P algorithm and triangular mesh through the indoor scene real image, proves the effectiveness of this method, solves the laser data lack of target color and texture information. However, this study also has certain limitations. For example, the method of 3D scene reconstruction uses a single image to map the texture of each triangular mesh surface, which requires a lot of computing time. In the next step, we can consider the stitching of multiple images to generate the texture map of the whole scene, and then use the corresponding relationship between laser and image to realize the 3D scene reconstruction of the whole large-scale scene.

Acknowledgments

This work was financially supported by the key scientific research project of Chongqing education commission: Research on bridge operation safety evaluation of health monitoring System based on BIM Model time history Analysis(Contract no. KJZD-K202005201).

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