

Research on bridge detection and safety evaluation system based on BIM

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Abstract. With the improvement of social and economic level, the scale of different types of infrastructure is constantly widening, the social from all walks of life put forward more stringent requirements for the level and quality of construction in our country. At present, many construction accidents occur frequently, and bridge collapses occur from time to time. The development of bridge detection and safety assessment structure system is in the initial stage. The research of bridge structural health detection system started in 1990, and the capital construction project has been slowly developed, and bridge detection has been gradually taken seriously. From a practical point of view, this paper analyzes and expounds the construction of bridge detection and safety assessment system based on BIM in detail.

Keywords: BIM technology; Bridge detection; Security evaluation system.

1. Introduction

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

2. Overview of BIM technology for bridge monitoring system

In recent years, the development of bridge engineering construction in our country is rapid, but the traffic pressure is increasing year by year, and the bridge "is increased by years" is increasing. Therefore, the relevant units need to detect and evaluate the safety of the bridge. The safety assessment of bridge emphasizes the comprehensive assessment and judgment of the safety problems of bridge engineering, including the bearing capacity of bridge, the strength of bridge materials and other aspects, and the use of specific information to comprehensively analyze the reliability of bridge [1]. Due to the complexity of bridge engineering construction and the variety of factors affecting the construction, it requires the evaluation of the specific working state of bridge. Generally, bridge evaluation methods are divided into two categories. The first category is to evaluate the beam bearing capacity and structural safety of small Bridges [2]. The other category is the evaluation of large Bridges, and at this time, the emphasis is on the comprehensive evaluation of the operating state of the bridge. According to the research results of many highway research institutes in our country and the foreign studies on bridge evaluation system, and combining our national conditions, our country has established the regulations on bridge testing and safety evaluation [3]. Many relevant experts and scholars have proposed various evaluation and detection methods for bridge detection, and have discussed the BIM bridge detection and safety assessment, analyzed the relationship in detail, and finally determined the overall state of the bridge is divided into five levels of fuzzy membership vector for evaluation.

3. Defect analysis of old bridge inspection and safety assessment technology

Poor integrity is the main problem. In the traditional bridge detection process, the detection is generally carried out on a single component, and the local detection information and the corresponding diagnostic information are provided as far as possible, and the structural detection information and safety assessment information cannot be provided systematically [4]. Lack of professional assistance, the operation of traditional bridge detection technology requires full cooperation between many professionals. There are many restrictions on working time and working place, and it is difficult to introduce technical talents. In addition, the technical communication is mainly based on drawings, which is very dependent on drawings. The layout scheme of drawings sensors is generally carried out with the help of media. The artificial use of space imagination converts two-dimensional drawings into three-dimensional space, but communication misunderstandings still exist, and the visibility is still not up to standard. The cycle is relatively long and the timeliness is not high. The professional information connection presents the characteristics of flow. After the end of the last program, the next professional work can be carried out, and information sharing cannot be achieved. Bridge inspection takes a long time, many accidents occur frequently, and when natural disasters occur, it is difficult to provide effective information content for decision makers and the general public, its' imaginary figure shows as figure 1.

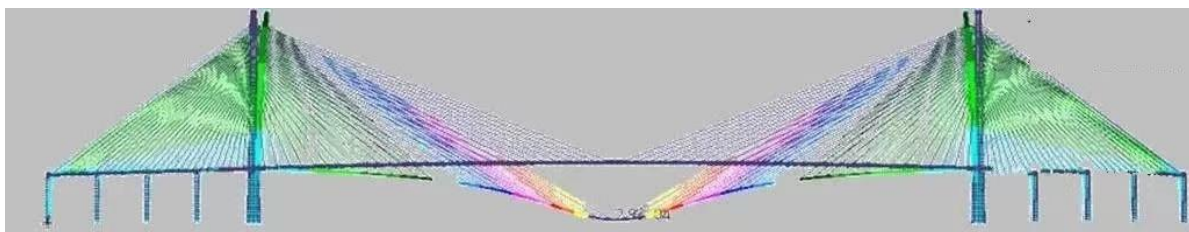


Fig 1. BIM technology display of imaginary figure monitoring data.

4. Bridge health testing and safety assessment technology based on BIM

BIM technology is a building information modeling technology originating from the United States. It has been gradually recognized and applied in many countries. This technology is different from the traditional bridge health detection technology, the BIM-based Bridge operating condition detection technology is the data of the bridge project information model, which can provide more professional services for systematic detection, evaluation and management. BIM core technologies are mainly bridge structure model information system, bridge detection information collection system and bridge structure safety early warning system.

4.1. Information acquisition system for bridge structural model

The bridge information and data system is based on BIM modeling software. The construction of the information acquisition system is mainly based on the structure of the bridge and the structural information of the construction and operation environmental projects. BIM technologies are all based on Revit modeling software for future Bridges, which optimizes the bridge safety condition inspection plan, provides data collection and bridge reinforcement functions, and provides visual communication and management basis for this. Before executing the inspection and reinforcement plan, technicians should prospectively simulate and optimize the sensors as well as the quantity and sensitivity metrics to provide precise data and information that can improve the efficiency of communication and collaboration. In terms of the evaluation and other detection of Bridges, the application of BIM technology can target the blind areas of different types of bridge detection.

4.2. Data acquisition system of bridge detection information

Bridge health monitoring system combines structure monitoring with system identification and structure evaluation to form an integrated monitoring system. Most of them use a variety of advanced

testing instruments and equipment for all kinds of stimuli outside the bridge, including traffic load and environmental load, so as to monitor the response of all aspects. Building information data acquisition system is mostly focused on various parts of the bridge, show as figure 2, and then use the corresponding instruments to check all aspects of stress and displacement and load and other information, and then connect it with the computer, the network interface can realize data remote transmission and data processing. The stress-strain sensor is based on the collection data and different data of the installation site. For example, the bridge structure data information includes stress and displacement and disturbance, and then the prestress and structure key point stress and beam disturbance, there is vibration and support reaction force and pile foundation stress; The load and action data of bridge structure include earthquake action, wind, rain and snow load, collision of vehicles and ships, river scour and displacement settlement of pile foundation and cap, etc. The external environmental data information of bridge structure includes temperature and humidity and concrete, and then the degree of steel corrosion and the concentration of corrosion gas; In the meantime, the sensor arrangement should emphasize the principle of economy and rationality, and the stress characteristics of the bridge should be comprehensively analyzed, and the monitoring items and deployment points should be analyzed and optimized reasonably. It is necessary to emphasize its particularity and key parts, and its testing equipment capacity and the number of sensors are extremely redundant, so as to effectively ensure the safe operation of the whole system. It is necessary to meet the rapid upgrade of the subsequent module system of the system as much as possible, and the damage to the whole bridge structure brought by the sensor construction should be reduced as much as possible.

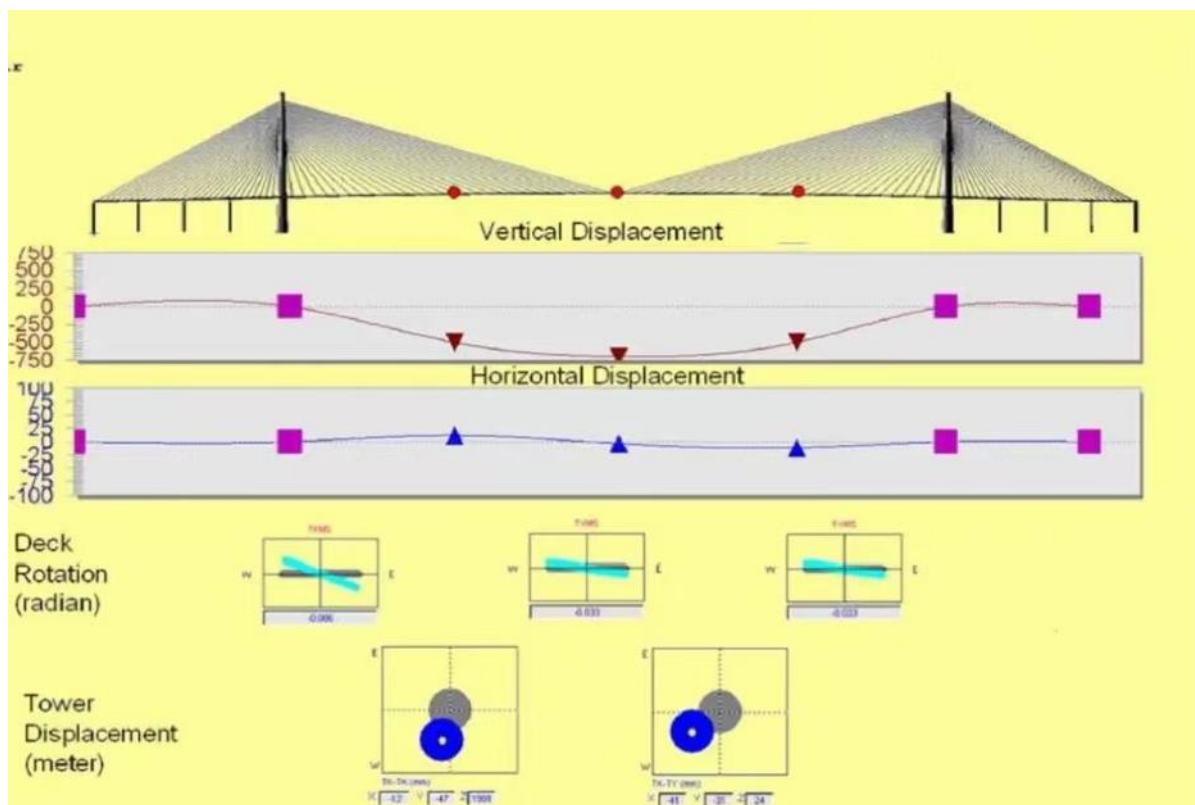


Fig 2. Example of monitoring system data display.

4.3. Bridge structure safety assessment and early warning information System

The bridge structure safety assessment system is to use the established bridge structure damage identification mechanism and cloud database to preliminarily screen the data collected by the bridge detection system to obtain the required feature information of the bridge structure, and then carry out simulation analysis through the established BIM model, so as to realize the bridge structure safety assessment. At the same time, a more intelligent early warning information system is established for

Bridges of different types and geographical locations. At present, the system should include the following contents: (1) evaluation of structural geometric shape parameters; (2) Damage identification based on structural deformation; (3) Damage identification based on internal force or stress of the structure; (4) Damage identification based on structural vibration characteristic parameters; (5) bridge structure working condition assessment; (6) Bridge bearing capacity identification.

The bridge structure safety assessment and early warning information system based on BIM takes the bridge BIM model as the main body, and various professional departments can communicate with each other directly through the network and mobile communication terminal, show as figure 3. It can make engineers of different majors distributed in different geographical locations cooperate to carry out work through the network, avoiding the linear mode that each department must be completed after the upper department. It helps to give full play to the resources and talents of various departments. At the same time, with the help of the visualization of BIM bridge detection, the sensor placement, construction and later maintenance scheme optimization of the detection system can be realized.

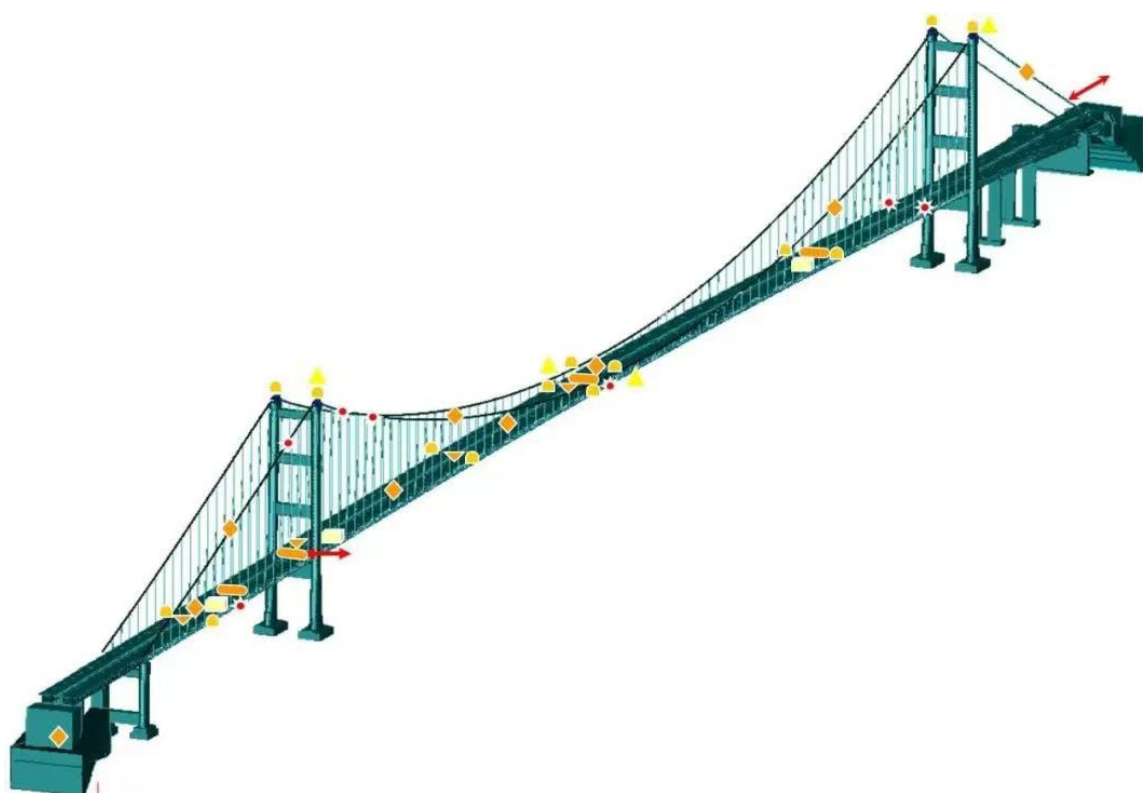


Fig 3. Schematic diagram of the BIM model of the monitoring system.

5. Conclusion:

Bridge maintenance and monitoring level in our country is very backward, and the lack of very advanced technology, most of which are stranded in the artificial bridge detection and safety checking technical level, then it will cost more manpower, material resources, financial resources and time. And explore the construction of bridge project information model as an important basis, and then use network technology and wireless fiber to collect information data in bridge operation, so as to carry out data analysis of BIM bridge safety detection and monitoring of new technology, this technology is also an important trend in the development of bridge detection and monitoring management technology in the future. However, despite the rapid development of bridge detection and safety assessment system in China, there are still many shortcomings, which also shows that the discussion of bridge detection and safety assessment system based on BIM has great practical significance for the safety of bridge operation.

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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