

# Explore on Calibration Method of Mechanical State Parameters for Safety Evaluation of Bridge Structure

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**Abstract:** This paper mainly discusses the calibration method of mechanical state parameters in the safety evaluation of bridge structures. Firstly, the importance of safety evaluation of bridge structure is expounded, and its important role in ensuring the safe operation of bridge is pointed out. Then, the common calibration methods of mechanical state parameters are introduced, including theoretical calculation method, experimental calibration method and empirical formula method, and their advantages and disadvantages are analyzed. Then, the suggestion is put forward that the appropriate calibration method should be selected according to the specific situation in the actual evaluation. Finally, the importance of mechanical state parameter calibration method is emphasized in order to improve the accuracy and reliability of bridge structure safety evaluation.

**Keywords:** Bridge structure; Safety evaluation; Mechanical state; Parameter calibration

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As an important part of traffic engineering, the safety of bridge is directly related to the safety of people's lives and property and the stability of society. Therefore, it is very important to evaluate the safety of bridge structure. This paper mainly discusses the calibration method of mechanical state parameters in the safety evaluation of bridge structures.

## 1. The importance of safety evaluation of bridge structure

The safety evaluation of bridge structure is a comprehensive and systematic evaluation of the bearing capacity, stability and durability of bridge structure under various working conditions, which is an important link in the process of bridge design, construction and use. By evaluating the safety of bridge structure, the hidden safety hazards of bridge structure can be discovered and prevented in time to ensure the safe operation of bridge.

First of all, the safety evaluation of bridge structure can help designers understand the bearing capacity and stability of the bridge, so as to rationally choose the design scheme and ensure the structural safety of the bridge. Through the evaluation, the weak links and potential problems in the bridge structure can be found, and timely measures can be taken to improve and reinforce the bridge, so as to improve the bearing capacity and stability of the bridge.

Secondly, the safety evaluation of bridge structure is also very important for the monitoring and management of the construction process. In the construction process, through the real-time monitoring and evaluation of the bridge structure, the problem of unqualified construction quality or safety risks can be found in time, and corresponding measures can be taken to adjust and repair, so as to ensure the construction quality and structural safety.

Thirdly, the safety evaluation of bridge structure can also provide a basis for the maintenance and management of bridge. Through the regular evaluation of the bridge structure, the aging degree and damage of the bridge can be understood, timely maintenance and maintenance can be carried out to extend the service life of the bridge and ensure the safe operation of the bridge.

Fourth, the safety evaluation of bridge structure is also of great significance to the safety of public life and property. If the bridge structure has safety hazards, once an accident occurs, it may cause serious casualties and property losses. Therefore, by evaluating the safety of bridge structure, potential safety problems can be found and solved in time to ensure the safety of public life and property.

It can be seen that the safety evaluation of bridge structure plays an important role in the process of bridge design, construction, use and maintenance. Only through comprehensive and systematic evaluation can we ensure the structural safety of the bridge and

protect the safety of public life and property.

## **2. Calibration method of mechanical state parameters**

Mechanical state parameter calibration is the basis of bridge structure safety evaluation, and its accuracy directly affects the reliability of evaluation results. At present, the commonly used calibration methods for mechanical state parameters mainly include the following:

### **2.1 Theoretical calculation method**

The mechanical state parameters of the bridge structure are determined through theoretical calculation. This method is simple and intuitive, but requires accurate theoretical models and a lot of calculations. In theoretical calculation, finite element analysis, elastic theory and other methods can be used to analyze the force and deformation of the bridge structure, so as to obtain the mechanical state parameters. This method is suitable for preliminary design and conceptual design, and can quickly obtain the preliminary mechanical state parameters.

### **2.2 Test calibration method**

Determine the mechanical state parameters through the actual bridge structure test. This method is accurate and reliable, but the cost is high and the cycle is long. In the test calibration, the static test, dynamic test, fatigue test and other methods can be used to test and measure the bridge structure, so as to obtain the mechanical state parameters. This method is suitable for detailed design and construction drawing design stage, and can provide accurate mechanical state parameters.

### **2.3 Empirical formula method**

By summarizing a large number of bridge structure design and construction experience, the empirical formula of mechanical state parameters is established. This method is simple and fast, but its accuracy is limited by experience and data. In the empirical formula method, some empirical formulas can be summarized according to the existing bridge structure and engineering cases to estimate the mechanical state parameters. This method is suitable for engineering practice and can provide a rough range of mechanical state parameters.

In the actual safety evaluation of bridge structure, the appropriate calibration method of mechanical state parameters can be selected according to the specific situation. Generally speaking, for newly built Bridges, test calibration method or theoretical calculation method can be used to ensure the accuracy of evaluation results. For existing Bridges, empirical formula method can be used to simplify the evaluation process. In addition, a variety of methods can be combined to carry out comprehensive evaluation to improve the reliability of evaluation results. It should be noted that no matter what kind of mechanical state parameter calibration method is adopted, it is necessary to fully consider the structural characteristics, load characteristics, environmental conditions and other factors of the bridge to ensure that the evaluation results are targeted and practical. At the same time, it is also necessary to update and modify the mechanical state parameters regularly to adapt to the use and aging of the bridge.

It can be seen from the above that the calibration of mechanical state parameters is the basis of the safety evaluation of bridge structures, and the selection of an appropriate calibration method is crucial to the accuracy and reliability of the evaluation results. In practical application, the appropriate calibration method should be selected according to the specific situation, and the characteristics and influencing factors of the bridge should be fully considered to improve the reliability and practicability of the evaluation results.

## **3. Selection and application of calibration methods for mechanical state parameters**

In the actual safety evaluation of bridge structure, the appropriate calibration method of mechanical state parameters should be selected according to the specific situation. Generally speaking, for newly built Bridges, the test calibration method should be preferred to ensure the accuracy of the evaluation results. For existing Bridges, theoretical calculation method or empirical formula method can be used to simplify the evaluation process.

For the newly built bridge, because there is no historical data and operating experience for reference, the test calibration method is the first choice. Through the actual bridge structure test, the mechanical parameters of the bridge, such as load capacity, stiffness and deflection, can be accurately measured and evaluated. The test calibration method can provide reliable data support to ensure the accuracy of the evaluation results. In the process of test and calibration, it is necessary to fully consider the bridge design parameters, construction technology, material properties and other factors, as well as the type, size and distribution of loads. Through reasonable test design and data analysis, accurate mechanical state parameters can be obtained, which provides a basis for the safety evaluation of Bridges.

For existing Bridges, due to the lack of test conditions and cost constraints, theoretical calculation method or empirical formula method can be used to calibrate the mechanical state parameters. The theoretical calculation method is based on the accurate theoretical model and a lot of calculation, and the preliminary mechanical state parameters can be obtained quickly. This method is suitable for preliminary design and conceptual design, and can provide a rough range of mechanical state parameters. Empirical formula rule is based on the existing bridge structure and engineering cases, summed up some empirical formulas for estimating the mechanical state parameters. This method is suitable for engineering practice and can provide a fast estimation of mechanical state parameters.

When selecting the calibration method of mechanical state parameters, it is also necessary to consider the structural characteristics, load characteristics and environmental conditions of the bridge. Different bridge types and structural forms may require different calibration methods. For example, Bridges with special structures, such as suspension Bridges and cable-stayed Bridges, may require special test methods and calibration techniques. In addition, it is also necessary to consider the service life and maintenance of the bridge, and regularly update and revise the mechanical state parameters.

The selection and application of calibration methods for mechanical state parameters should be carried out according to specific conditions. For newly built Bridges, the test calibration method should be preferred; For existing Bridges, theoretical calculation method or empirical formula method can be used. No matter which method is adopted, it is necessary to fully consider the characteristics and influencing factors of the bridge to ensure the accuracy and reliability of the evaluation results.

#### **4. Conclusion**

The safety evaluation of bridge structure is an important means to ensure the safe operation of bridge, and the calibration of mechanical state parameters is the basis of the evaluation. Therefore, attention should be paid to the research of calibration method of mechanical state parameters to improve the accuracy and reliability of safety evaluation of bridge structures. In this paper, the calibration method of mechanical state parameters in the safety evaluation of bridge structure is preliminarily discussed, hoping to provide some references for the safety evaluation of bridge structure.

#### **References:**

- [1] Wang J. Discussion on the design of Bridge Structure Safety and Durability [J]. Encyclopedia Forum Electronic Magazine,2021(2):439-440.
- [2] Gou Hongye, Liu Chang, Ban Xinlin, Meng Xin, Pu Qianhui. Research progress of bridge-track system monitoring and Traffic safety in high-speed railway [J]. Journal of Traffic and Transportation Engineering,2022,22(1):1-23
- [3] Yuan Xingtong, Guo Wenlong. Safety analysis of bridge structure across Subway tunnel [J]. Heilongjiang Transportation Science and Technology,2022,45(5):95-98
- [4] WANG Haihua, Guo Long, Wang Longlin, Jiang Guofu. Research on Design Method of Bridge Structure Safety Evaluation and Temporary Reinforcement [J]. Bonding,2021,47(9):193-196.