Journal of Architectural Research and Development

Review Article

Analysis of Key Issues in Design Codes for Long-Span Highway Bridges

Meng Wan

China Merchants Chongqing Communications Technology Research & Design Institute Co., Ltd., Chongqing 400067, China

Abstract: In recent years, with the continuous expansion of China's infrastructure construction, related construction work, including highway and bridge construction, has been steadily progressing. Among them, bridges are an important component of infrastructure construction, and their safety and stability are related to the travel of the masses and even the safety of their lives. China has a strict management system for bridge design specifications. This article mainly takes long-span highway bridges as an example to study the key issues of its design specifications and proposes countermeasures for related work.

Keywords: Long-span highway bridge; Design code; Key issues; Response

Publication date: April 30, 2020

Publication online: April 30, 2020

Corresponding author: Meng Wan, qq191478917@163.com

1 Introduction

Bridge design specifications can fully reflect a country's professional design level and industry standards. China's control of the highway bridge industry work includes a series of relevant national policy requirements and industry professional standards. Relevant industry professional codes generally summarize mature construction work experience, and there is still much room for development in the ability to innovate related codes. For long-span highway bridges, because of their difficulties in design and construction, and with a certain degree of originality, some key issues in the design specifications of this type of bridge need to be further clarified, so as to facilitate the related work better.

2 Overview of Design Specifications for Long-Span Highway Bridges

At present, the code content related to the design of long-span highway bridges includes the "Uniform Standard for Reliability Design of Highway Engineering Structures" and the "Uniform Standard for Reliability Design of Engineering Structures". These two international standards regulate the work related to bridge design, such as stipulating that the partial coefficient method and limit state method must be used for analysis. At the same time, as far as the content of existing bridge codes in China is concerned, there are three main aspects.

The first is the basis for the development of highway engineering technical work. Relevant departments in our country have combined the original standards of highway engineering technology and introduced new ones to form a comprehensive and meticulous new specification content. In addition, the relevant technical indicators of highway design have been incorporated into the technical standard specifications. When designing long-span highway bridges, it is necessary to abide by the relevant specifications. The second is the seismic design code for highway bridge engineering. For example, for various construction difficulties and key issues in tunnel construction, the relevant regulations point out that the designer should explain the design situation in detail and make relevant work recommendations. At the same time, specific and clear stipulations are made on the relevant load capacity of the bridge, so as to effectively guarantee the implementation of highway bridge engineering. Third, the relevant specifications in the selection and design of the foundation of the bridge have also been specifically explained. [1] For example, technicians should follow

the principle of limit state to select and design the foundation of the bridge, use advanced scientific and technical means to carry out technical design work, and continuously optimize and innovate existing plans.

3 Key Issues in Design Specifications for Long-Span Highway Bridges

3.1 Service life of long-span highway bridges

In general, the standard service life of highway bridges in China is 100 years, but many highway bridges cannot meet this standard. After the relevant work is completed, an important reason for the actual service life of some long-span highway bridges and the predicted service life is not up to standard is that many vehicles will overload operations in order to earn more revenue, and other problems and conditions will also occur. One reason is that the bridge also lacks the supervision and inspection of relevant units and departments, and it also has problems.

3.2 Fatigue loads of highway bridge vehicles

A key issue in the design of long-span highway bridges is vehicle fatigue loading. At present, the relevant regulations in China are very different from those in other countries. With the emergence of vehicle fatigue load problems in recent years, relevant research work has been initiated in the professional field to try to make breakthroughs in vehicle carrying capacity, etc., and will be successfully applied in practical work to standardize highway bridge design and other related work.

3.3 Vehicle load design reduction method

The calculation of the vertical and horizontal load reduction of a vehicle is a commonly used calculation method for bridge design in the world. In this way, the main consideration is that the load of the vehicle occurs less frequently in the case of full load in the verticall and horizontal directions, and a reduction calculation is required in the bridge design process. This calculation method is not wrong in itself, but the value of the reduction factor is questionable. The reason is that in the face of large-span highway bridges of different lengths and standards, consideration should be given to using different reduction factors instead of using the same coefficient standards for calculation and design work[2]. Another influencing factor that requires the application of different reduction factors is that there are still problems such as overloading in vehicle transportation in China, which leads to the congestion of overloaded vehicles on the bridge. Therefore, the use of span size to determine the vertical and horizontal reduction coefficient needs further discussion.

4 Performance issues such as risk accidents and seismic resistance

On the one hand, in terms of risk accidents, because risk accidents are unpredictable, in the process of designing long-span highway bridges, design work can only be carried out in combination with previous work experience and existing design specifications. In this process, conventional design work needs to be carried out in accordance with the design specifications of highway bridges, but this may cause inadequate risk response, and does not combine the probability of risk occurrence and the damage of highway bridges to reasonably carry out design work such as bridge structures. The problems related to highway bridges cannot be clarified, and design specifications cannot be ensured to ensure the stability of bridge structures[3].

On the other hand, in terms of seismic resistance performance design, this work is related to the safety performance of long-span highway bridges. In the design process, it is necessary to consider the issue of action strength and other issues. In other words, it is still not possible to fully guarantee that the relevant design requirements are applicable in various situations. In the design of bridges, it is still necessary to continuously apply new equipment and new technologies and adopt different design methods to improve the seismic performance of the bridge.

5 Responses to Key Issues in Design Specifications for Long-Span Highway Bridges

5.1 Properly increase the useful life of the bridge

Aiming at the problem of bridge service life in the design, the relevant provisions of bridge service life should be further increased. The "Uniform Standard for Reliability Design of Engineering Structures" (2008 edition) currently formulated in China provides the definition of service life. The service life of highway bridges mainly refers to the predetermined service life of highway bridges without major repairs. However, in the face of the conflict between the design life and the service life, it is necessary to further standardize the related work from multiple aspects. For example, it

should be mentioned in the relevant specifications that the actual bearing capacity of the bridge is improved, and the stability of the bridge structure is further enhanced. At the same time, the design and construction of bridges should also be strictly regulated to avoid problems such as bridge cut-offs, material overloading, and overloading operation of transport vehicles.

5.2 Improve the bridge regulation system

Facing the key problems existing in the design specifications of long-span highway bridges, in addition to the specifications related to the years of work, it is necessary to improve the bridge specification system. On the one hand, we should pay attention to the work of international bridge standards. Bridge construction is a worldwide problem, and many countries are conducting research and construction of industry-related work. In contrast, bridge construction in China is still inadequate. Therefore, it is necessary to draw on the essence of relevant bridge regulations in developed countries such as Europe and the United States. Introduce the local application of bridge specifications in China and continuously improve the standardization of bridge design. On the other hand, we should pay attention to the construction of China's mature norms, and we must constantly summarize domestic industry innovation attempts, industry-related regulations, and international regulations and research results. Progress to enrich existing norms and regulations should focus on professional talents. Introduce and improve writing team capabilities.

5.3 Further standardize bridge design standards

In the process of standardizing bridge design standards, for long-span highway bridges, standardization work needs to be carried out in accordance with actual conditions. For example, China has a vast area, and there are great differences between different regions. In the design work of highway bridges, if the same design standards are applied, it is obviously not possible to adapt to local conditions. Therefore, we must further refine the bridge design standards and distinguish the actual design of the bridge according to division and the same situation, such a standard is more conducive to standardize the design work, and solve key problems in the design.

In fact, China also mentioned in the relevant regulations that enterprises and regions can formulate a standardized system based on their own standards. This indicates the direction for the construction of highway bridges to a certain extent. If various regions and enterprises can further refine the related common problem solving strategies, it will be like an icing on the cake, and it will be more conducive to the development of the entire transportation industry in a standardized direction.

6 Conclusion

In short, there are still some problems that need to be improved in the design specifications of long-span highway bridges in China, such as load reduction, risk, earthquake resistance and other issues. The emergence of these problems has a lot to do with the immaturity of the current relevant normative system. Therefore, the problems should be constantly identified to improve the pertinence of solving the problems. At the same time, relevant departments and units should be innovative and improve the construction of similar highway bridges, focus on experience summarization, subject research, focus on introducing advanced practices, and finally build a mature and complete standardized bridge construction system.

References

[1] Xu K. Discussion on Key Issues of Design Code for Long-Span Highway Bridges in China [J]. Engineering Technology Research, 2017 (9): 252-253.

[2] Lu JQ, Song YZ. Research on Key Issues in Standardization of Long-Span Highway Bridge Designs [J]. China Standardization, 2017 (20): 169-170.

[3] Cao W. Discussion on the key issues of design codes for long-span highway bridges in China [J]. Sichuan Cement, 2016 (02): 86.