Challenges of Long-span Bridge Construction and Maintenance in China

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Summary

This paper reports the recent development and challenges of long-span bridge construction and maintenance in China. Following a review on the construction experience of long-span bridge projects in recent three decades, the paper enumerates the technical challenging issues faced for long bridge construction and maintenance in this country, and the R&D in progress and the prospection in the near future are introduced.

Keywords: long-span bridges; construction; maintenance; development in China, technical challenges.

1. Development of Chinese modern bridges

In the past thirty years, China has made great achievements in the bridge construction. The total mileage of highway has increased from 0 to 100,000 km compared to 30 years ago, and the total mileage of high-speed railway from 0 to 16000 km in the past 10 years. Up to date, there are about 730,000 bridges all around China, outnumbering that of 600,000 bridges in the United States. A total 85 long-span bridges were erected across the Yangtze River (Figs. 1) and more than 240 large and medium-sized highway/railway bridges over Yellow River. All these achievements undoubtedly and greatly enhance the international status of China in bridge engineering.

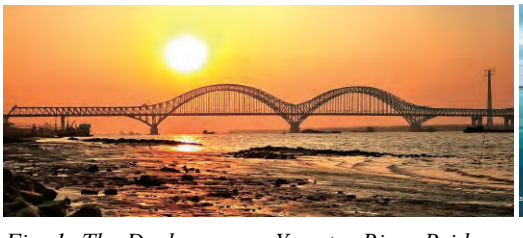

Fig. 1: The Dashengguan Yangtze River Bridge

Fig. 2: The Hong Kong-Zhuhai-Macau Project

2. Progress of bridge technologies in China

The progress of modern bridge technologies is embodied in the following aspects: (i) Bridge designs not only focuses on solving the traffic problems, but also fully considering the aesthetics and durability; (ii) Continuous innovation on conceptual design leads to the evolution of structural analysis; (iii) Bridge design firms are gradually restructured from single format of design business to modern enterprises with comprehensive professional qualifications including design, consulting, and R&D; and (iv) Construction technologies toward maturity.

China has experienced a process of learning, following and catching-up developed countries in bridge engineering in recent 3 decades. Fortunately, the rapid economic growth and the great demand on infrastructure constructions gave us the opportunity to master pioneering bridge technologies.

3. New technical challenges for long-span bridges

There are many challenging issues for future long span bridge constructions in China, including: (i) tough construction conditions, such as strong wind, strong earthquake, deep water, and severe environment; (ii) rigorous requirements in functions, such as combined highway and railway bridges, all-weather open traffic, and high-speed railway transportation; and (iii) super long span bridge structures, such as bridges over Qiongzhou Straits, Bohai Straits and Taiwan Straits.

4. Health monitoring and maintenance of long span bridges in China

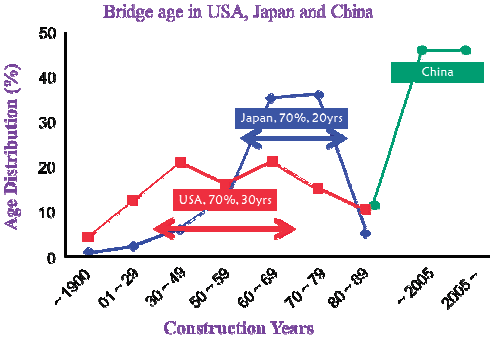

Fig. 3: Bridge age distribution in USA, Japan and China

Similar as developed countries like US and Japan, about 70% bridges in China were constructed in recent 30 years with rapid economic growth (Fig. 3). Bridge construction area gradually shifts from the coastal developed area to the inland and the western undeveloped area. Even though it is expected that the boom of bridge construction will continue for quite a period of time, the main tasks of bridge engineering in China are gradually transiting from construction to construction/ maintenance. In this circumstance, the structural health monitoring (SHM) technology for bridges are deeply expected and implemented in practice. Since 1999, more than 200 bridges, including over 160 long span bridges, have installed SHM system in China.

5. Concluding remarks

Bridge engineering technology in China has made significant progress in recent 30 years. However, there are still many challenging technical issues, especially for the constructions and maintenances of super long-span bridges in the sea-cross projects under planning, and of bridges in the central and western regions in China. Rapid economic development has brought the severe environmental and ecological problems; the philosophy of sustainable development brings new tasks to bridge engineering technologies. Meanwhile the bridge maintenance technologies are becoming more and more important. Structural health monitoring, as a new technology for maintenance, is very much expected, however the current states, both in theoretical and technical levels, still cannot meet the demands in practise. On the other hand, the new generation of industrial revolution, represented by the Internet, Big Data and so on, is also bring new opportunities for the bridge construction and maintenance technology development. Chinese bridge engineers need to make greater efforts in technology innovation in the future.

Acknowledgements

The author would like to thank Dr. Ye Xia and Mr. Yi Zhou from Tongji University, for their helps on data survey, figures preparation and grammar checking. The related researches by the author are supported by the National Basic Research Program of China (973 Program) (2013CB036305) and the National Science and technology support program of China (2012BAJ11B01).