

The Introduction of High-Speed Railway Bridges in Wuhan-Guangzhou Passenger Dedicated Line, China

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Summary

Due to its longest mileage under construction as well as the highest technical standards, Wuhan-Guangzhou passenger railway line, with full length of 968 km as well as the speed of 350 km/h, is one of most significant high-speed railway project in China now. Began in June 2005, the Wuhan-Guangzhou passenger line is expected to operation in 2009, since several large bridges projects are near to completion. The sustainability of bridge cannot be neglected in this great railway project. Compared to general railway bridge, high-speed railway bridge will cover the majority mileage of line. Based on the analysis of these bridges in Wuhan-Guangzhou passenger line, the paper gives general condition of the high-speed railway bridges in China. Moreover, numerous technical features of these bridges has been introduced at the same time, such as design standards, building material, design loads, type selection, deck layout, etc.

Keywords: Chinese High-Speed Railway; Railway Bridge; Bridge Design.

Wuhan-Guangzhou passenger line is the one of significant sections of Beijing-Shenzhen passenger railway line, which has the longest mileage as well as highest technical standards among all the passenger dedicated line under construction now. The established Beijing-Guangzhou railway is one of the busiest lines, particularly overloading in the section of Wuhan to Guangzhou. In order to maintain substantial additional passenger trains, freight trains were forced to close during the holidays. Faced with the need for economic growth as well as higher quality transportation in this area, the new Wuhan-Guangzhou dedicated passenger line is a radical solution to this problem. Launched in June 23, 2005, the whole project is expected to be completed by the end of 2009. By then, the time cost between Wuhan and Guangzhou is just four hours and more than six hours will be saved.

The sustainability of bridge cannot be neglected in this great railway project. Compared to general railway bridge, high-speed railway bridge will cover the majority mileage of line. Nowadays, the construction of bridge almost reaches 50% of all passenger dedicated line projects. For instance, the proportion of bridge is nearly 88% in Beijing-Tianjin express railway and almost 80% with 1060km out of 1318km in total length in Beijing-Shanghai high-speed railway. The total length of Wuhan-Guangzhou dedicated passenger line is about 968 km, laying ballastless track at one time within the section of seamless lines. 15 new terminals as well as 3 overtaking stations will be built, including three larger stations of Wuhan, Changsha and Guangzhou. The average distance between stations is about 561769 km. It is estimated that 411 km length of 662 bridges will cover 42% of the total length and 169 km length of 236 tunnels (including uncovered tunnels) 17%, together 59%. The entire length ratio of bridge and tunnels reached 67% after the decision of an 80 km bridges increase in May 2006 in order to meet the requirements for laying ballastless track in some section with weak settlement.

Based on the experience from high-speed railway bridge projects all over the world, China's design corporation made a breakthrough in design of high-speed railway bridge. In this paper, the representative bridge has been introduced from the design to construction. The simply-supported beam or a continuous beam with standard span and cross-section is widely used in Wuhan-Guangzhou passenger lines. Except from special need, the box girder is most commonly used in

Wuhan-Guangzhou passenger line. All the superstructure and substructure directly use of standard reference drawing. According to geological conditions, Wuhan-Guangzhou passenger dedicated line across a number of major rivers and highways. In order to meet the clearance restrictions or avoid difficult construction condition, a series of bridge with special span has been designed, including continuous rigid frame, variable cross-section continuous beam, continuous rigid frame, basket handle arch (X-arch), tied-arch bridge and cable-stayed bridge.

Continuous beam with variable cross-section is a common bridge type when across the river and the existing road. The design parameters of Chencun Waterway Bridge has been introduced as a representative one.

The tied arch bridge contain with ribs, tie bar, walers as well as deck system. The deck systems located under the arch rib, connecting by hangers. In static mechanics, this structure possesses an external static system with internal hyperstatic system. This type is equipped with several merits, including elegant appearance, high span capacity, effortless making method and superior durability. A number of tied arch bridges with a main span of 140m have been designed for the first time in Wuhan-Guangzhou passenger line. The Tingsi River Bridge has been introduced as an example of such bridge type.

There are two kinds of railway steel arch bridge used in China. One is flexible arch with steel truss girder, the other steel truss arch. Compared to flexible arch, steel truss arch has great stiffness as well as span capacity. Hence, it has been widely used in passenger dedicated line. In the practice of this type, the representative ones are Dashengguan Bridge on the Beijing-Shanghai passenger line as well as Dongping Waterway Bridge on Wuhan-Guangzhou passenger line.

Tianxingzhou Bridge is not only the sixth bridge across the Yangtze River in Wuhan city, but the landmark project of Wuhan-Guangzhou passenger line. Tianxingzhou Bridge, mixture for highway and railway, is cable-stayed bridge with 1092m total length, steel truss girder, double pylons and three cable planes of fan shape, bridge design speed 200km/h. The arrangement of main bridge is 98 +196 +504 +196 +98 m. As a milestone project, Tianxingzhou Bridge has numerous breakthroughs in the design and construction:

Through the introduction of Wuhan-Guangzhou dedicated passenger line, the great progress of high-speed railway bridge now has been shown. In spite of this improvement, engineers today are still confronted with the issue of sustainability. Although China has vast territory, it faces a serious shortage of resources. Hence, how to design and implement is not this only thing that the engineers cared, how to make best use of the limited resources are questions that must be taken into account. Wuhan-Guangzhou passenger dedicated line as the pioneer of Chinese highway construction, will provide with valuable design and construction experience. On the one hand, the bridge design has been optimized. For example, the width of girder has reduced from 13.2m to 12.6m in Beijing-Shanghai high-speed railway. In this way, enormous material would be saved, since there is many thousand kilometers along the line. By studying the problem encountered in Wuhan-Guangzhou line, on the other hand, a more reasonable construction technology has been improved in follow-up projects. Therefore, the finished projects all over the world brought the experience to China's highway projects, and the China's highways as well as bridge in its turn added experience other projects in the future. Only more information exchanges all over the world can we build more sustainable bridges and the limited resource on the earth will be protected.

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