

Innovative Design of Tuanbo Bridge In An Urban Environment

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Summary

In 2006, Tianjin Municipality invited international firms to take part in a design competition for a new bridge over the 1,020 metres wide Duliujianhe River in Tianjin. The bridge location was unusual in that two navigation channels existed close to the river banks, separated by a shallow central portion. The winning scheme presented the concept of a pair of striking cable-stayed bridges each with a single needle-shaped pylon inclined towards one another, connected by a low level viaduct over the shallow portion of the river. The span arrangement of each cable-stayed bridge is 45+138+30+30m. The most spectacular part of the structure is the pair of 120m-long steel pylons inclined at an angle of 72° to the main girder, hinged at the bottom and supported by the bridge's main piers. This paper will firstly introduce the general layout of the main bridge, and the design of the main steel and concrete girder, stayed cables and the leaning pylon. Secondly, the paper will discuss innovative structural design points which presented challenges to the designers for this longer-than-usual span for the concept selected. Finally, the construction method of this bridge will be also introduced in brief.

Keywords: cable-stayed bridge; needle-shaped pylon; hinged connection; design innovation; construction methods.

1. Project Background and Overview

The Tianjing Tuanbo New Bridge is located at the entrance of the Tuanbo new town which is the south pivot point of the Tianjing 'triangle'. In 2006, the Halcrow China Ltd won the International Conceptual Design Competition of Tuanbo New Bridge, the result of which was announced in Tianjin. In the selected design scheme, the Tuanbo New Bridge's main bridge adopts the innovative shape of a soaring flying 'crowned crane', as shown in Figure 1.



Figure 1 Bridge Facade Rendering

2. General Layout of Bridge

The main bridges of Tuanbo New Bridge are supported by needle-shaped single pylon cable-stayed bridge with the bridge pylon inclined towards the center of the river. These pylons are hinged at the base connection with the pier column, but with a rigid connection provided between the deck girder and pier column. The elevation is shown in Figure 2.

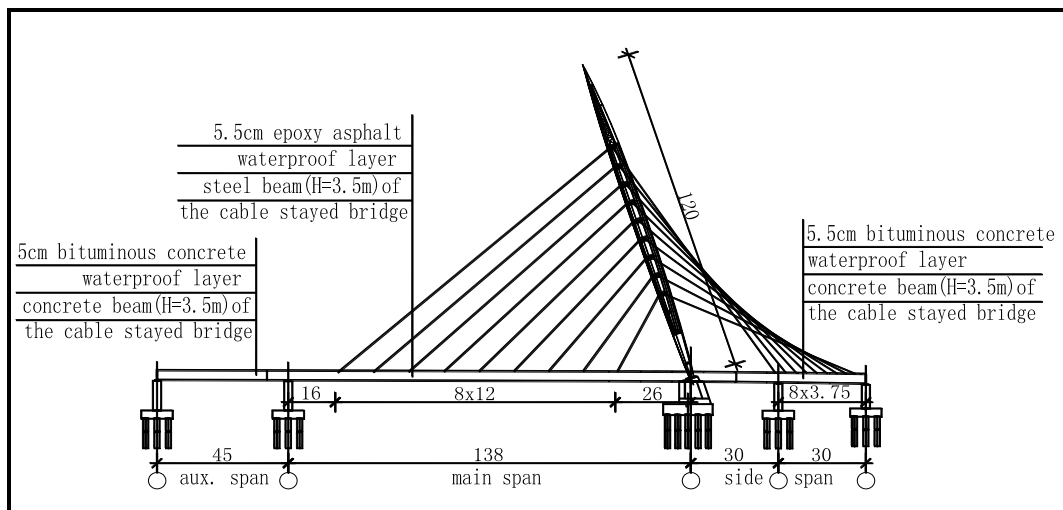


Figure 2 Main Bridge Elevation

2.1 Main Girder

The main girder is a hybrid of steel and concrete box structures. The steel box girder segment length is 160m, which includes main span 138m, auxiliary span 7.5m, and side span 14.5m; the rest is pre-stressed concrete box girder.

2.2 Main Pylon

The lower part of the 120m high pylon is a mono-block cast steel structure 16m in length with an arc-sided triangular cross section tapering out from bottom to top. The mid-pylon column is made of three main pylon steel pipes with 1200mm outer diameter, 50mm wall thickness, and 77m high. The upper, decorative part is made of spliced seamless steel pipes.

3. Conclusion

Along with the rapid development of China's economy, in addition to the safety and functional requirements on the bridge during construction, there is ever greater emphasis on bridge aesthetics. The bridge in this article is one of such developments in bridges in the country. The design concept, overall layout, structural innovation points and construction methods of the bridge introduced in this article, and especially the structural innovation of the pylon hinge structure and auxiliary span arrangement, contribute to this development and can inspire future design engineers to ever better quality in bridge design.