# Innovative Design of Railway Steel-Concrete Mixed Box Girder Cable-Stayed Bridge

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## Summary

The Yongjiang Railway Bridge carrying 2-lines heavy-load railways is a steel-concrete mixed box girder cable-stayed bridge with the span arrangement of （53＋50+50+66+468＋66+50+50+53）m. The stiffening girder is a closed and streamlined box girder with two materials longitudinally: the center 419m of main span is steel box girder installed by deck cranes and the rest of the girder is site-cast concrete box girder.

Considering that the railway bridge possesses characteristics of carrying heavy railway live load, high requirements for the stiffness of the whole structure, fixed railway tracks, an innovative concept of the structural system for long-span railway bridges is carried out, and three Innovative Technologies is obtained including orthotropic steel deck stiffened by V-shaped ribs, steel-concrete joint with ladder-shaped concrete filled in and frontal/ posterior compression-bearing plates, bilateral–bearing-load cable-girder steel anchorage box. The experimental research proves that orthotropic steel deck stiffened by V-shaped is superior in fatigue behaviour, the proposed new types of steel cable-girder anchorage box and steel-concrete joint both have good performance in the force transferring and fatigue properties. And also vehicle-bridge coupling vibration analysis also shows that the steel-concrete joint achieves smooth transition of stiffness and the trains run smoothly.

**Keywords:** steel-concrete mixed box girder; railway cable-stayed bridge; design ideas;Innovative Design; steel-concrete joint; V-shaped stiffener; steel anchorage box

## 1. Introduction

The Yongjiang Railway Bridge crossing the Yongjiang River is located in Ningbo City, Hubei Province. This bridge carrying 2-lines heavy-load railways is the key component of the North Link of the Ningbo Railway Hub in China. The main channel width of the river segment at the bridge site is approximately 180m with water depth of above 18m. The both side benches where the water depth is less than 1.5m is flat and shallow. The site geological condition is soft soil ground covered by weak layers with depth of 25～45m. The weak layers are mucky soil and flowing～soft plastic clays which have high moisture content and poor physical and mechanical properties. The bedrock is weakly weathered argillaceous sandstone with average embedded depth of 126m.

As the Yongjiang River is a bed-shifting river, the navigation and flood protection both require that main span can cross the river and is aligned to nearby highway cable-stayed bridge. Meanwhile, the towers cannot be arranged between the both levees. In consideration of topographical characteristics, technical and economic conditions and harmony of landscape, the Yongjiang Railway Bridge is a steel-concrete mixed box girder cable-stayed bridge with the span arrangement of （53＋50+50+66+468＋66+50+50+53）m and the main span of 468m crosses the river[1], Fig.1 shows the perspective view of the bridge.

The stiffening girder is a closed and streamlined box girder with two materials longitudinally: The stiffening girder of side spans and main span of 24.5m extending from each side span are concrete box girder and the rest of main span is steel box girder. The concrete box girder is site-casted on

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