



## General Design of Airport Road Yaojiang Bridge in Ningbo

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### Summary

Ningbo has grown into one of the four international deepwater harbours in China. For its continued development and to provide a link between the main town and the north of the city, also enhance the regional economic development by connecting to the northern coastal link with Shanghai, a plan was developed for the construction of a vehicular bridge across Yao Jiang River along the Airport Road. This Airport Road Yaojiang Bridge has dual four lanes and side pedestrian walkways and spans the river at a location where it is approximately 250m wide.

Bridge design has become an art, moving out of the traditional framework of common bridge forms to reflect the client's desire for landmark structures. By working closely with an Architectural team, a bridge of striking appearance and simplicity has been achieved. To achieve this, the design team proposed a modified fan cable-stayed bridge with twin off-set pylons of 128m high. Its appearance reflects the City's culture and history but also ties in with the City's new international image. This asymmetric structure has also provided an exciting challenge to the Design Engineers. This paper describes the bridge design from conceptual design to the detailed design, including major technical standard, physical conditions of the bridge site, overall design of the Project Bridge in particular for the consideration of aesthetics, buildability and structural stability.

**Keywords:** Ningbo Airport Road Yaojiang Bridge, General Design.

### 1. Description

In compliance with the "Ningbo Master Plan (2004-2020)" approved by the State Council, Ningbo is to undergo continued development and has a variety infrastructures projects in planning, one of which is the project involving the new Airport Road Bridge.

The planned Airport Road Bridge will have dual four lanes and side pedestrian walkways. Major technical criterions of the Project Bridge are listed in the following:

- (1) Design Traffic Speed: 80km/h;
- (2) Design Traffic Lane: Dual four lanes;
- (3) Load Standard: City-A Class;
- (4) Maximum Longitudinal Slope:  $\leq 3.0\%$ ;
- (5) Cross Slope: 1.5%;
- (6) Design Reference Life: 100 years;
- (7) Navigation Standard: Inland river 500 tonnes.

### 2. Development of Scheme Design – Concept and Aesthetics

The bridge is designed as a very modern and visually attractive structure that would hopefully attract the attention of the media and of different architectural organizations, due to its unique

design and therefore promote China and Ningbo city worldwide. By working closely with the architectural team, the general arrangement of this Ningbo Airport Road, Yao Jiang River Bridge was proposed as a modified fan cable-stayed bridge with twin off-set pylons of 128m height. The main bridge between the approach road structures consists of a five-span structure of 380m length with a main span of 180m and four side spans of 50m (Fig. 1, Fig. 2).

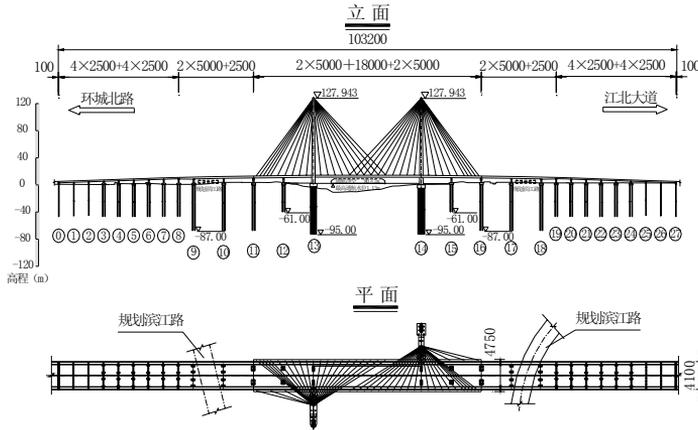


Figure 1 Elevation and Plan



Figure 2 Perspective

When the general arrangement of the bridge structure had been established from the aesthetic point of view, the detailed engineering design was started to check the bridge stability and establish the number and size of the main structural elements including stays, pylons, bridge deck, and foundations. The main idea of design and analysis for such asymmetrical cable-stayed bridge is to reduce the cable force to the minimum and hence reducing the force transferred to the pylons and ease the design of pylons as a result. This can be achieved through utilizing fully self load-carrying capacity of steel box girder by means of pre-settling the main girder before stressing the stayed-cables. In view of maintaining safe control of the bridge structure during construction, it was envisaged that the deck would be erected on falsework supported in the river.

With this design we consider that the bridge along with its landscaped island and surroundings has achieved the intention of developing a striking and signature structure to match the intentions of the bridge status.