Sutong Bridge, China

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Introduction

Sutong Bridge is located in the southeast of Jiangsu Province, China, which is in the lower reaches of the Yangtze River. The visionary project was motivated by the need for a highway route crossing the Yangtze River and linking Suzhou and Nantong at the opposite banks. The total length of the Bridge project is 32.4km, consisting of three main parts, the viaducts on both banks of the river and the central part over the water, which is about 6km long. The central part composes of the main cable-stayed bridge with the world record 1088m span as main navigational channel, a continuous rigid frame bridge with a main span of 268m as secondary navigational channel, and approach bridges.

Fig.1: General View of Sutong Bridge

Design Concept

Sutong Bridge crosses Yangtze River in the lower reaches, one of the busiest national waterways. The long-span length is required by high navigational standard accommodating for 50,000 DWT with the net clearance of 891m in width and 62m in height. The bridge should have a main span over 1000m with considering substructural dimensions, and traditionally only suspension bridge can be chosen as a feasible bridge type.

If suspension bridge scheme had been selected, two anchor blocks should have had to be laid in the river bed under deep water, which could be costly and moreover have great impact on river morphology and ecologic environment of Yangtze River, since the river width at the bridge site is about 6km. Cable-stayed bridge, however, is a self-anchored structure with fewer water blockage in substructures. After comprehensive comparison, the design scheme of cable-stayed bridge was finally adopted with the span arrangement of 100m + 100m +

300m + 1088m + 300m + 100m + 100m = 2088m, which resulted in a new world record of the span length for cable-stayed bridge.

The bridge substructure was designed and constructed with the emphasis on sustainable development or environmental protection in the mother river of China, Yangtze River. This aim was achieved through selecting group pile foundation instead of caisson to alleviate the impact on the river flow, installing various scour protection to minimize the erosion in the river bed, and adopting partially hydrolyzed polyacrylamide (PHP) system for clay mud treatment to reduce the disposal of bored pile construction.

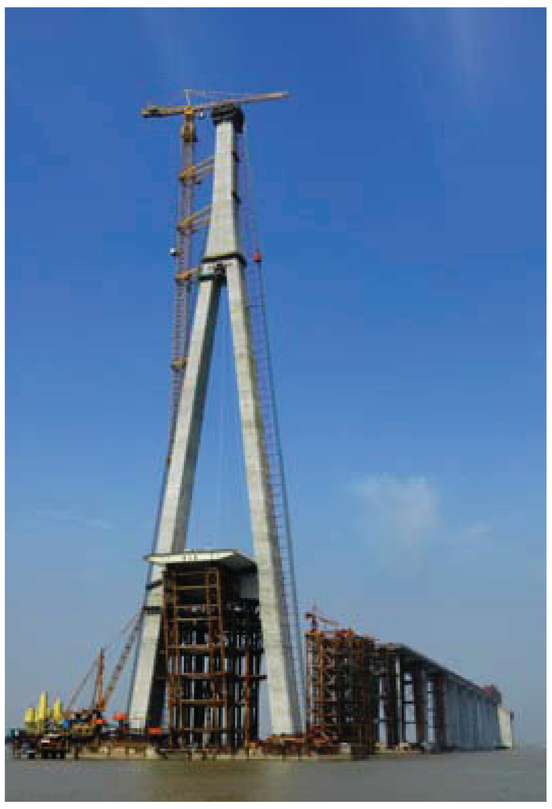
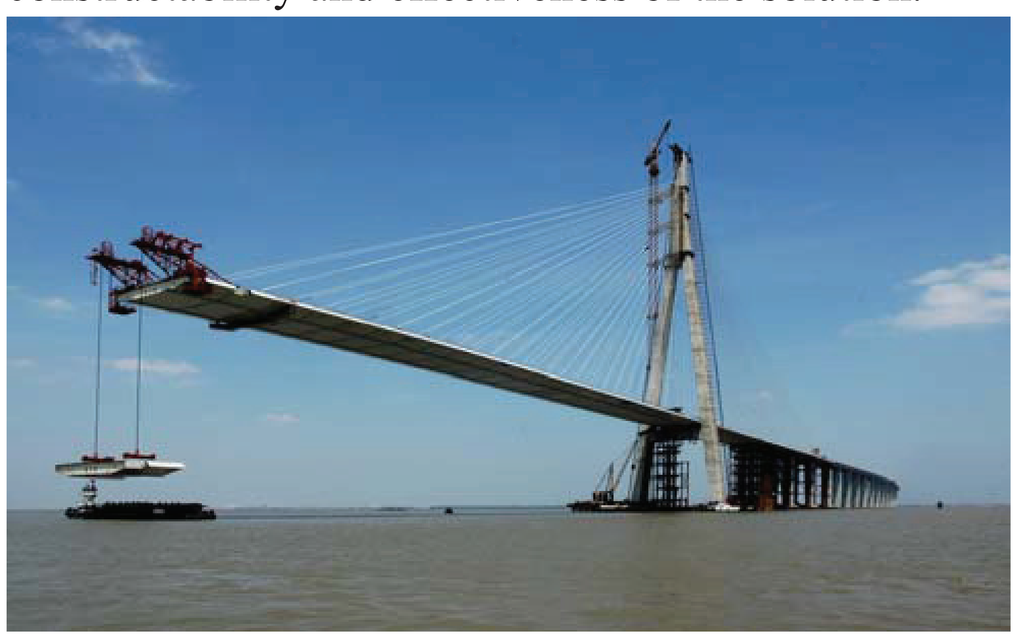


Fig.2: Casting of Pylon

Special Design Considerations

The bridge system, especially the connection between pylon and the bridge deck in longitudinal direction is critical to the structure's safety and stability. Hydraulic buffer with stop, dampers with stops and elastic restrains were studied and compared very carefully in the design stage. The results revealed that the viscous damper system with a displacement stop provide the optimal restriction for the bridge among these three choices.

Two major types of stay anchor in the pylon were studied: steel anchor box solution and post tensioned concrete solutions. Detailed comparison of the two solutions regarding safety of force transferring, durability in operation stage, detailing and construction methods etc. have been performed. Considering the above factors, the steel anchor box solution was finally selected as the preferred solution. A full-scale mock-up test was carried out to prove the constructability and effectiveness of the solution.



Comprehensive investigation and tests concerning wind induced phenomena were carried out for Sutong Bridge. The main concern was the vortex shedding of girder and pylon, parametric vibration and linear resonance of stays, wind/rain induced vibration of stays, and wind loads on stays etc.

Fig.3: Erection of Box Girder

One of the most significant challenges in the construction of this super-long cable stayed bridge is geometry control. The unique complexity of Sutong Bridge requires specially developed methods and procedures to control the geometry profile and safety of the bridge during the construction period.