Wind-resistant study on the steel middle pylon of Taizhou Yangtze River Bridge

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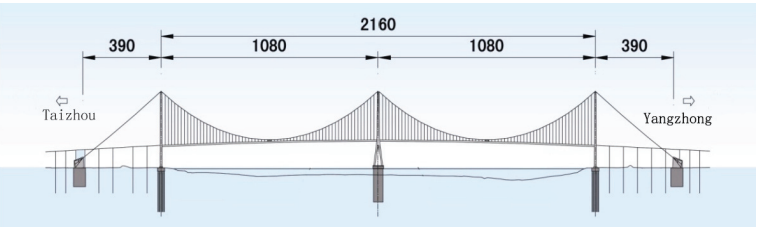
Summary

The type of three-pylon suspension bridge is applied to more and more large-span bridges. Wind-resistance in design and construction of middle pylon is of great concern for this type of bridge. In this paper, both wind tunnel test and CFD (computational fluid dynamics) are introduced to the wind-resistant study on middle steel pylon of Taizhou Yangtze River Bridge. Through segment sectional model testing and CFD analyzing, more accurate aerodynamic force coefficients are suggested for the pylon's structure design. Through full aero-elastic model testing, wind-induced vibration is checked, which includes vortex resonance, buffeting and galloping. All these results obtained play an important part in middle pylon's actual design and construction. In the meantime, they are also meaningful references for other similar middle pylons.

Keywords: wind tunnel test; CFD; aerodynamic force coefficient; wind-induced vibration; middle pylon.

1. Introduction

The middle pylon is the key structure of three-pylon suspension bridge. In order to adapt to the unbalanced force of the two main spans, middle pylon should have enough flexibility and sufficient stiffness. Taizhou Yangtze River Bridge, with span arrangement of (390+1080+1080+390) m, as seen in Fig.1, adopts longitudinal herringbone shape steel middle pylon for the first time in the world.[1]



However, static and dynamic wind effects on the middle pylon are complicated. In this paper, the middle pylon of Taizhou Bridge under construction is investigated by means of wind tunnel test and CFD analysis.

Fig. 1: Elevation arrangement of Taizhou Bridge (Unit: m)

Through segment sectional model force-measuring test and CFD analyzing, the wind loading on different segments with different yaw angles are obtained. Aerodynamic loading coefficients are suggested, compared with Wind-resistant Design Specification for Highway Bridges[2].

After that, full aero-elastic model test of middle pylon is carried out to study wind-induced vibration, including vortex resonance, buffeting and galloping.[3] According to construction process, there are totally three key status of pylon model tested. Based on wind tunnel test results, wind-resistance of middle pylon is evaluated and some suggestion is given on the wind risk management during its construction.

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