

Key Technology of Middle Pylon Design in Three-Pylon Multi-span Suspension Bridge

Mengya ZHU
Civil Engineer
J.P.C.D.
Taizhou, China
zhumengya_1980@163.com

ZHU Mengya, born 1980, received her civil engineering degree from Xuzhou Normal University.

Lin JI
Senior Civil Engineer
J.P.C.D.
Taizhou, China
tzbridge@qq.com

JI Lin, born 1962, received his civil engineering degree from Tongji University.

Jing RUAN
Senior Civil Engineer
Hohai University, J.P.C.D.
Nanjing, China
tzbridge@163.com

RUAN Jing, born 1975, received her civil engineering degree from Southeast University.

Summary

The three-pylon multi-span suspension structure is one of the proper structure types for continuous large spans crossing rivers and straits. Based on the design of Taizhou Bridge, stiffness selection for the middle pylon is introduced in this paper. In order to solve the design difficulty of three-pylon multi-span suspension bridge, the multi-scale elastic-plasticity stability analysis and the study on the anti-slippage safety between the cable saddle on the middle steel pylon and the main cable are carried out, which have been presented in this paper. The key design technology for the middle pylon of three-pylon multi-span suspension bridges would provide the powerful support to the design of the middle steel pylon structure.

Keywords: Three-pylon multi-span suspension bridge, stiffness selection, elastic-plasticity stability analysis, anti-slippage safety

1. Introduction

Driven by the need in construction of river and strait crossing transport facilities, some ultra-large span bridge structures emerge rapidly. Among them, the three-pylon multi-span suspension bridge is one of the appropriate structures of multi-span bridges crossing rivers and straits, which has been utilized by Taizhou Bridge and Ma'anshan Bridge in China. The three-pylon suspension bridge is a brand-new structure type, in which a main pylon is erected at the middle of two-pylon suspension bridge's main span to reduce the load of the main cable and the anchors on both ends.

Longitudinally, the middle main pylon is only a vertical fulcrum supporting the main cable with saddle. Compared to the traditional two-pylon suspension bridges, the main cable of the three-pylon suspension bridge has weak constraints on the middle pylon, so the stiffness of the middle pylon directly affects the structural performance of the whole bridge. How to select an appropriate stiffness of the middle pylon to ensure the sound structural stability and anti-fatigue performance, as well as considering the deflection span ratio of stiff girders, the middle pylon and foundation load carrying capability and saddle anti-slippage safety are key technical matters to be resolved in the design of the middle pylon.



Fig. 1: Overview of Taizhou Bridge

Taizhou Bridge (Fig. 1) is the first three-pylon suspension bridge in China and the first one with the main span exceeding 1,000 meters in the world. The bridge, crossing the main channel with two continuous main spans, is located in the middle section of the Yangtze River in Jiangsu. The span layout of the three-pylon suspension bridge is (390+1 080+1 080+390) m. According to the research on structural behaviour of three-pylon suspension bridge, the middle pylon of Taizhou Bridge adopts the