Stability Analysis on Middle Steel Pylon of Taizhou Yangtze River Bridge

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Summary

Stability of the steel middle pylon is a significant issue to be discussed for Taizhou Yangtze River Bridge. With consideration to the middle pylon initial deficiency and integration-region related bucking, a finite element analysis is performed to simulate the stability of the middle pylon. Firstly, a total bridge frame model is established for elastic and elastic-plastic analysis. Secondly, shell element is introduced for detailed simulation of the pylon and combined with beam element to establish the total bridge model. According to the analysis results, the initial deficiency has no significant impact on the analysis results. Elastic-plastic stability analysis of frame model shows the stability safety factor of middle pylon is 2.417 in the most unfavourable situation, much less than the result of elastic analysis. Analysis adopting hybrid model presents result consistent with the frame model, and demonstrates both the local and entire instability process clearly.

Keywords: Three-pylon suspension bridge, Steel middle pylon, Stability safety factor, Shell element, Initial deficiency, Local instability.

1. Introduction

With the increasingly longer bridge span, bridge pylons become higher and relatively the high strength materials and thin-wall structure are adopted in the construction, introducing the stability issue as a most important topic to discuss. Taizhou Yangtze River Bridge, which is currently under construction and located in Jiangsu Province, China, is a three-pylon two-span suspension bridge with a main span of 390 +1080 +1080 +390 m, as shown in figure 1, demonstrating enormous progress in suspension bridge system research. For the multi-pylon suspension bridge, the structure performance and security performance of middle pylon play a vital role in the whole security system. The main cable of Taizhou Yangtze River Bridge has to cross a side span and a main span before it arrives at the middle pylon from the anchorage. Thus, the main cable has relatively weak constraints on the top of middle pylon. The stability of the middle pylon is one of the key issues to be well solved for this bridge [1].

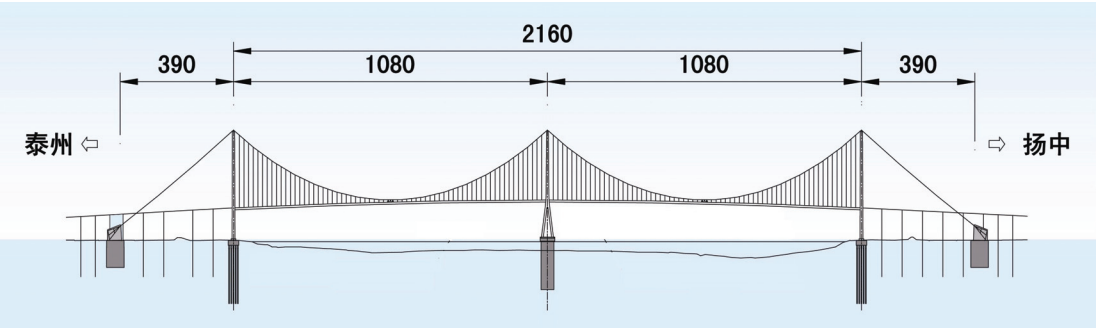

Fig. 1: General layout of the three-pylon suspension bridge

An innovative structural configuration was applied in the steel box middle pylon of Taizhou

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