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Joint Iteration Method of unloaded Cable Shape and Pre-displacement of Main Cable Saddle for Long-span Suspension Bridges

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ABSTRACT

In this paper, a new method for calculating the unloaded cable shape and main cable saddle pre-displacement in the construction of long-span suspension bridges is proposed, which is called the joint iterative method (JIM). In this method, the first iteration does not require presupposing the saddle pre-displacement, and the results of the unloaded cable shape obtained in each subsequent iteration cycle will be mined to guide the saddle pre- displacement correction in the next iteration. This method uses simplified cable models and convergence conditions different from classical methods. In the simplified model of main cable mechanics, equal horizontal component of suspension bridge on both sides of main tower is taken as implicit condition, and equal unstressed cable length of each span of main cable is taken as convergence condition in iteration. Using this method, the pre-displacement of the main saddle and the unloaded cable shape of the Yingwuzhou Yangtze River Bridge is calculated by MATLAB program and compared with its designed value. The results show that this method requires few iterations and has high speed and accuracy.

Keywords: long-span suspension bridge; unloaded cable shape; pre- displacement of cable saddle; joint iterative; the Yingwuzhou Yangtze River Bridge

1 INTRODUCTION

At present, there are many studies on the calculation of the unloaded cable shape of suspension bridges. [1-3] There is also some research on the solution of cable saddle pre-displacement. [4,5] However, the results of these studies on the unloaded cable shape have little guiding effect on the calculation of the pre-displacement of the cable saddle. The calculation of cable saddle displacement is not well guided by the calculation of the unloaded cable shape.

In this paper, the tension-only bar element is used to simulate the main cable, and a novel simplified mechanical analysis model is proposed for the simulation method of the bar element. The new mechanical model is used to iteratively solve the unloaded cable shape, and the relationship between the unloaded cable shape and the saddle pre-displacement is deeply explored. The new iterative convergence criterion is adopted to avoid the initial saddle pre-displacement, and the calculation result of the unloaded cable shape can guide the update and adjustment of the saddle pre-displacement.

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