Characteristicsof Slipbetween Cable and Saddle in Suspension Bridges

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Summary

For multi-pylon suspension bridges, the anti-slip ability of main cable in saddle is critical for structural security, and the understanding of cable slip characteristics is particularly significant for assessing that ability. An attempt was made in this paper to consider the cable as a discrete body and take the strand as the basic research object, which is different from previous conventional methods. Based on that concept, a series of model tests were conducted under varying the boundary contact conditions and the number of strands. The test results illustrated the mechanical change of each strand with the slip force increasing. An effective approach was proposed to judge the slip points of strands, on this basis ,the corresponding overall frictional coefficients were calculated. It is clear that the strands under different contact conditions successively start to slip, which can be regarded as the 'layered-slipping 'phenomenon. Comparing the results in different testing cases shows that the boundary contact condition and the number of strands have relatively larger effects than expected.

Keywords: Suspension bridges; saddle; strands; model test; slip.

1. Introduction

As the major load-bearing structure of suspension bridges, main cable is supported by saddle placed in the top of pylon. The stability of relative location between cable and pylon is vital for structural security, which means the main cable is not allowed to slip in the saddle. Generally, the anti-slip problem of main cable is not serious in traditional two-pylon suspension bridges, as long as the ratio of side span and main span is appropriate.

With the rapid development of the transportation infrastructure ,the structural system of multi-pylon multi-span suspension bridge was proposed and applied into practice. Comparing with the traditional two-span suspension bridges, it increases the number of pylons in main span, which can not only optimize the structural mechanical properties but also greatly improve the whole bridge spanning ability [1]. However, it is difficult to choose a suitable rigidity of middle pylon, owing to the existence of 'middle pylon effect' [2].Considering the stiffness of whole structure, a relatively rigid middle pylon tends to be adopted. This tendency, at the same time, makes the anti-slip stability of the main cable become one of the key issues, which is urgent to be settled.

Some researchers have carried out experiments in attempts to study the cable slip behaviour. Through the model test, the influence of contact surfaces treatments on overall frictional coefficient was studied, and one strand composed of 132 wires was taken as the test cable to study its slip behaviour [3]. In the case of saddle equipped with a horizontal friction plate, the frictional resistance of cable was tested, and a simplified calculation formula was derived without considering the effect of lateral friction [4]. With the Taizhou Yangtze River Bridge and Yingwuzhou Yangtze River Bridge as the engineering background, two model tests were conducted respectively [5, 6]. In both of those two tests, the cable composed of 10 strands was considered as a whole, and the frictional coefficients were obtained. Additionally, the latter one also tested the improvement effects by adding two cast steel plates in saddle notch.

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