Analysis of local compressive behaviour of concrete bed under an embedded cast iron cable saddle

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Abstract

The cable saddle on top of pylon not only helps the main cable pass through the summit of design form, but also transmits the tremendous force to the pylons. An imbedded cast iron cable saddle is proposed for a single pylon and two spans cable stayed bridge. Due to the arched shape of the cable saddle, the local compressive pressure on concrete bed may not be uniform. A plain strain FE model and A solid FE model is adopted to investigate the stress distribution in concrete foundation. The reduce factor for nonuniform local compression is about 0.73. This cable saddle structure can meet the local bearing capacity via theoretical verification, which could provide an example for the similar type of structures.

Keywords: concrete local compressive behaviour; embedded cable saddle; nonuniform local compression; finite element method

1 Introduction

The main cable saddle is a specific structural member installed on top of pylons for suspension bridges. It not only helps the main cable pass through the peak of design cable form, but also transmits the tremendous vertical force to the pylons. In order to reduce the bending stress in the main cable in the cable saddle, the radius of the groove casted in the cable saddle is usually at the range from 8 to 12 times of main cable's diameter. Moreover, the cable saddle structure should guarantee that bundles of wires are fixed in it, where there is enough friction between main cable and cable saddle.

For the suspension bridges with two or more pylons, the cable saddles usually are offset to the side span a certain amount of distance before the girder segments are lifted. This approach has advantage of cutting down the bending moment at the root of pylons, generated by the unbalanced forces on both sides of the cable saddles during construction. Then the cable saddles will be propelled step by step towards the main span direction in accordant with the girder segments lifted and installed. These cable saddles would eventually arrive at the centre of top section of pylons just when the girders are totally installed in right place under the main cable. In this research the background involves a single pylon suspension bridge that is a symmetric hybrid of suspension and cable stayed structure. However, comparing with the common suspension bridges just mentioned, the bending moment in pylon is not going to be influenced by the unbalanced forces of main cable, thus the cable saddle needs to be offset no longer.

With respect to saving material and keeping simple for the structure, an imbedded cast iron cable saddle is proposed in this paper. Compared with the common cable saddle structure, the amount of material for the alternative can be reduced by approximately 40%. It should be noted that the imbedded cable saddle is not an original innovation around the countries, the Hardanger bridge in Norway has adopted the similar

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