A Comparison Study of Reinforcement Design Methods of Concrete Box Girder Bridges Considering Spatial Effects

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Abstract

At present, typical reinforcement methods of box girders able to consider spatial effects are known as the amplification factor method, "panel element model" method, and the "spatial grid model" method. However, the differences between these methods have not been investigated.

In this paper, these methods are compared in terms of the full spatial resistances of box-girders, by evaluating the reinforcement results in an example. A surplus indicator in different directions in terms of the ultimate bearing capacity and normal section crack resistance is defined. The results show that in the mid-span section, the amplification factor method is prone to over-limiting the principal tensile stresses at the bottom panel near the web, and the other two methods have the good load-bearing capacity and crack resistance in all directions, but the reinforcement (especially for the spatial grid model method) is too conservative at the web and bottom panel.

Keywords: box girder; design method; spatial effect.

1 Introduction

Concrete box-girders possess the merits of high availability and strong bending, and torsion resistance, and are thus comprehensively applied in the bridges of span lengths of more than 40m [1]. Meanwhile, the mechanical features of box-girder bridges are also more sophisticated than any other structures with an open section, such as the T beam bridges. The spatial effects in the top, bottom, and web slabs of a box-girder, as well as the connections between them, are so remarkable that a very precise design is difficult to implement. Then inappropriate consideration of these spatial effects in the reinforcement design analysis happens, which might introduce cracks and structural risk [2,3].

To solve this issue, the codes worldwide started to use an amplification factor approach for the

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