Numerical modeling of rigid frame suspension composite bridge

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Abstract:

Large span continuous rigid frame bridges often suffer continuous deflection of the middle span in the service. In this paper, the rigid frame-suspension composite bridge is proposed in which main cables and hangers are adopted to support part of the beam weight at mid-span. A 70+130+80m-span bridge was selected as the case study and its finite element model was built using the software of Midas. In comparison with continuous rigid frame bridge, the rigid frame suspension composite bridge suffers significantly lower creep deflection. As the tensile force of hanger rod increases, the upper deflection value increases. The results obtained have certain reference value for the design of such composite bridges.

Keyword: rigid frame suspension composite bridge; numerical modeling; the mid-span deflection of main beam

1 Introduction

With the continuous development of bridge construction in China, the proportion of large-span continuous rigid frame bridges is gradually increasing. However, many pre-stressed continuous rigid frame bridges have appeared with mid-span sagging problems that affect the normal use and structural durability[Error! Reference source not found.].For e xample, the auxiliary channel bridge of the Humen Bridge[3] with a main span of 270m was completed in 1997. In 2003, the mid-span deflection value had accumulated to 22.2cm, which exceeded the reserved 10cm pre-arch value during construction.

The main maintenance and reinforcement methods for the problem of sustained deflection at the mid-span of large-span continuous rigid frame bridges are[4]:(1) External prestressing strengthening method: The Beijiang Bridge adopted the concept of zero-moment loading method for beam arrangement optimization, and appropriately increased longitudinal prestressed steel strands at the top of beam. The finite element calculation results show that after optimization, the mid-span deflection of the bridge can be reduced by about 70.8% in 10 years [5].(2)The method of transforming the continuous rigid frame into a cable-stayed bridge with short towers[6]. Xi Xinghua[7] conducted a verification analysis on the reinforced bridge, and the results showed that the structural system reinforcement, if designed properly, can not only enhance the main beam, but also suppress the mid-span deflection (3) Increasing section size and reinforcement method: Xiong Feng[8] summarized that the fundamental reason of continuous deflection and cracking of the beam is the insufficient resistance of the cross section.

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