Analysis on Segmental Deck Replacement Plan for Large-Span Network Arch Bridge

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Abstract

As a long-span network suspender arch bridge, the main girder of Qilu Yellow River Bridge was designed as steel-concrete composite structure, and the concrete deck was designed as replaceable components due to the possible severe local damage caused by the direct vehicle load. In this paper, different segmental replacement plans were put forward according to the structural characteristics, and an integral mixed finite element (FE) model was established based on the 420m main span in order to study the mechanical performance of this bridge in the process of deck replacement. The effect of variable replacement lengths and positions on the structural response, in both longitudinal and transverse directions was figured out. The analysis results show that all the deck replacement plans discussed in this paper are feasible, and different demolition methods affect the stress change amplitude of the structure in different way, of which the lateral change of replacement methods has a more obvious impact on the structure.

Keywords: large-span network arch bridge; steel-concrete composite beam; segmental deck replacement; FE.

1 Introduction

For the steel-concrete composite structure, cracks are inevitable to occur on the concrete deck caused by directly vehicle load, especially for the negative bending moment area[1-3]. In contrast, the damage degree of steel beam which is not directly subjected to external force is lighter. So it is necessary to adopt appropriate repair strategies to prolong the service life of deck to be consistent with the life of steel beam. Compared with overhaul, replacement repair strategy has greater advantages in carbon emissions, energy consumption and cost at all stages of the bridge deck life cycle[4]. Therefore, it is a wise choice to design the concrete bridge deck as a replaceable structure in the composite beam considering the life-cycle economy of the bridge and the benefit of environmental protection[5].

Segmental replacement and whole-span replacement are two main forms of deck replacement according to the specific damage location and degree of concrete, of which segmental replacement is a more appropriate

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