Effect of SFRC Composite Deck on Negative Bending Behavior Steel Box Girder

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Abstract

To investigate the failure mode and effect on a steel girder negative bending behavior of an SFRC composite deck, eccentric tension tests and numerical simulations were conducted on C50 concrete composite deck and SFRC composite deck specimens. Furthermore, parametric analysis via girder segment finite element models was carried out for summarizing the influences of the composite deck on the steel box girder performance. The test and simulation analysis results showed that the residual contribution of SFRC slab to the axial tensile stiffness of composite deck was 36% as cracking up to 0,10 mm, while that of C50 concrete slab was only 15%. Moreover, the parametric analysis results showed that the residual contribution of SFRC slab to the bending stiffness of steel girder was twice that of C50 concrete slab. When SFRC crack width reached 0.10 mm, the bending stiffness of the main girder was reduced by 11% compared with the intact state.

Keywords: SFRC composite deck; eccentric tension test; parameter analysis; bending stiffness.

1 Introduction

Combining steel fiber reinforced concrete (SFRC) with orthotropic steel deck by shear connectors can significantly reduce cracking risk at fatigue-prone details and ameliorate pavement deteriorations. SFRC can be classified as normal steel fiber reinforced concrete, high performance concrete, and ultra high-performance concrete according to the compressive strength. Besides, excellent post-cracking behavior can be observed on the material under tension due to the strain-hardening feature. For medium span continuous municipal bridges, ordinary or high-strength SFRC can meet the engineering demands and the cost is relatively low. Therefore, making efficient use of the mechanical advantages of SFRC can improve the mechanical properties and economy of the bridge structure.

The previous studies on bridges with a composite bridge deck mainly focused on the bridge deck mechanical behavior. Shao et al.[1] conducted transverse bending tests on steel-ultra high performance concrete (UHPC) composite bridge decks and found that the local effect of transverse stress on the bridge deck is significant. Su et al.[2] proposed a crack width calculation method considering the residual stress of SFRC cracking through a static bending test of full-scale segmental composite bridge decks. Ye et al.[3]

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