Mechanical Performance of Composite Truss Bridge with Double Decks

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Summary

A new structure form of composite truss bridge which composed of upper and lower concrete decks and truss member is proposed to resolve the traffic jam in cities in this paper. Based on one engineering example of a composite truss bridge with main span of 96.0m，the mechanical behavior including deflection, stress distribution of concrete slab, concrete chord and steel web under different load conditions are investigated. In addition, the joint parts which connect steel truss and concrete slabs are the most important components in structure system. Different joints in terms of structure type and thickness of steel gusset plate are analyzed and determined by finite element analysis to prevent the local stress concentration of the steel gusset plate. All the results of static behavior for composite truss bridge with double decks in this study provide reference for the design and construction of such type bridges.

Keywords: composite truss bridge, double decks, mechanical behavior, joint part

1. Introduction

As the needs of more traffic space, multiline highways and new transportation infrastructures should be constructed to solve the traffic jam in cities. Therefore, based on viaducts system, to enlarge urban space in height direction, building urban viaduct with double decks is an effective measure to increase traffic volume of viaducts in central urban areas. Also, Composite truss bridge with double decks provides wide vision for drivers.

Compared with concrete box girder, the composite truss bridge has lighter dead weight, can give fewer burdens on the substructure and be long-span. As for the mechanical performance, it transforms bending moment of the bridge into axial forces on upper and lower concrete decks, which fully use the good compression performance of concrete. At the same time, the shear force is changed into axial force on steel truss web members.

In recent years， several composite truss bridges have been built. Sarutagawa Bridge and Tomoegawa Bridge, which adopt composite structures with steel-pipes, are the first multiple continuous rigid frame bridges [1]. The main spans for Sarutagawa and Tomoegawa Bridge are 110m and 119m respectively. With concrete upper and lower slabs and steel pipe webs, Shitsumi Ohashi Bridge is a 5-span continuous composite truss bridge which locates on the Kawamoto-Hata prefectural highway and passes through the Kando Gawa River [2]. The span arrangement is (64.0 + 75.0 + 60.0 + 45.0 + 34.0) m and the width of deck is 10.75m (effective width: roadway 7.25m + walkway 2.50m). Minpu Bridge in Shanghai is the first composite truss cable-stayed bridge in China, the main span is steel truss structure and the side spans are composite truss structures [3]. With a main span of 708 m and side spans of 63 m, the total span is 1212m. It has eight lanes on the upper deck and six lanes on the lower deck.

In terms of studies on composite truss bridge, researchers mainly focus on joint structures. Xue [3] presented a model test and numerical finite element analysis on the mechanical behavior of a

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