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Experimental Study on Mechanical Behavior of T-shape Stiffened Orthotropic Steel-concrete Composite Bridge Decks

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Abstract

A new-type of orthotropic steel-concrete composite bridge deck system was developed, by casting the concrete overlay on the top of the orthotropic steel deck ribbed with T-shape steel member. To study its mechanical behavior, two new-type orthotropic steel-concrete composite bridge decks with different section dimensions were experimentally investigated and two reference decks (reinforced concrete deck and orthotropic steel deck) were also involved in the research for comparison. For the new-type orthotropic steel-concrete composite decks, the average value of the ultimate load per width is 885.7kN, which are 2.35 and 1.61 times respectively for that of the concrete and steel reference decks with almost the same section height. Experimental results proved that the composite deck can effectively control the crack initiation and propagation in the concrete and postpone the yielding of the steel bars and steel plates.

Keywords: new-type orthotropic steel-concrete composite bridge decks; T-shape steel ribs; field test; failure mode; concrete crack

1 Introduction

During the past decades, orthotropic steel bridge decks are widely used for large and medium span bridges all over the world [1]. Compared to conventional concrete decks, the advantage of orthotropic steel decks is the light self-weight, which is due to its high strength to weight ratio. However, compared to rigid concrete bridge decks, orthotropic steel decks suffer considerable local deformations caused by the wheel loads on the deck. Over the past decade, with increasing traffic volumes and higher wheel loads, fatigue cracks at welding details of orthotropic steel bridge decks were observed during the daily measurement, especially for the heavy traffic lanes [2]. Thus, a new type of bridge deck system with better fatigue performance is demanded for large and medium span bridges.

Steel-concrete composite structures are supposed to be an optimizing solution to effectively utilize the advantages of both steel and concrete materials. It has been widely used for the infrastructure applications, such as composite beams and columns. For the profiled steel-concrete composite slab, a promising application is used as building floor slabs [3]. However, in the field of bridge engineering, the utilization of steel-concrete composite slabs is quite limited. In the research of Kim et.al. [4-6], a steel-concrete composite deck slab system with profiled steel sheeting and perfobond rib shear connectors was investigated regarding to push-out tests, deck-to-girder connection tests and full-scale tests. The research results concluded that the ultimate load-carrying capacity and initial concrete cracking load of the proposed deck system is at least 220% and 230% greater than the corresponding values of an

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