Experimental Study on Tension Mechanisms of UHPC Link Slab

Bruno Briseghella, Jianhui Lin, Junqing Xue, Xiangfeng Pan

Fuzhou University, Fuzhou, Fujian, China

Camillo Nuti

Department of Architecture, Roma Tre University, Roma, Italy

Contact: junqing.xue@fzu.edu.cn

Abstract

The ultra-high performance concrete (UHPC) link slab has been proposed to provide a suitable solution to the cracking problem of conventional reinforced concrete (RC) link slab. This paper presents an experimental study on the tension mechanisms of UHPC link slab under monotonic tension loads. The experimental results of load-displacement curves, crack development and strains of UHPC link slab were investigated and compared with those of RC link slab. It can be found that in the elastic phase, the tension stiffness and ultimate loads of the UHPC link slab were respectively 2.6 and 2.4 times those of the RC link slab. Compared with the RC link slab, the number of cracks on the top surface of the UHPC link slab was larger, but the average crack width was significantly smaller. The concrete and reinforcement strains of UHPC link slab were smaller than those of RC link slab.

Keywords: jointless bridge decks; link slab; ultra-high performance concrete; tension mechanisms; load-deflection response; tension stiffness; crack development.

1 Introduction

Deck joints are installed at each end of simple-supported girders to accommodate the cyclic longitudinal thermal movements of the superstructure [1, 2]. However, a large number of investigation data showed that the deck joints are expensive to maintain and easy to be damaged due to the influences of unconservative set of design temperature parameters and overloaded vehicles [3-7]. In order to resolve the problems caused by deck joints, the concept of jointless bridges have been widely studied and used [1, 3-6, 8]. Link slab, i.e. a continuous slab installed between adjacent simply supported girders, is one solution to eliminate deck joints over the piers to form a jointless bridge deck [9-12].

However, the conventional reinforced concrete (RC) link slab is subjected to a complex stress state due to the combination of: a) the girders longitudinal deformation induced by the average effective bridge temperature variation; b) the concrete creep and shrinkage; c) the rotational deformation of the girder ends caused by vertical traffic load. Due to the previous reasons and to the low tensile strength of the concrete material, it is easy to be cracked causing deterioration [11-14].

Compared with RC material, the ultra-high performance concrete (UHPC) has larger tensile strain, higher compressive strength and better

https://doi.org/10.2749/nanjing.2022.0600
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