



Behavior of Orthotropic Steel-UHPC Composite Bridge Deck under Cyclic Loading

Zhanchong Shi

Department of Bridge Engineering, Tongji University, Shanghai, China

Department of Engineering Structures, Delft University of Technology, Delft, The Netherlands

992364798@qq.com

Qingtian Su

Department of Bridge Engineering, Tongji University, Shanghai, China

sqt@tongji.edu.cn

Milan Veljkovic

Department of Engineering Structures, Delft University of Technology, Delft, The Netherlands

m.veljkovic@tudelft.nl

Contact: 992364798@qq.com

Abstract

In recent years, ultra-high performance concrete (UHPC) has been introduced in the design of orthotropic steel decks (OSD) to reduce the risk of fatigue cracking. To investigate the fatigue behaviour and fatigue damage process of the orthotropic steel-UHPC composite bridge deck, a full-scale specimen was designed and tested under cyclic loading. Test results show that the fatigue resistance of orthotropic steel-UHPC composite bridge deck satisfies the requirements of the designed vehicle load up to 2 million cycles with no cracks occurred in this phase. Rib-to-crossbeam weld and U-rib butt-welded connection are the two most vulnerable details to crack in OSD under cyclic loading. The fatigue resistance of U-rib bolted connection was investigated, and it is concluded that it performs better than that of U-rib butt-welded connection. The short-headed studs fractured under excessive cyclic loading and 5 types of the fatigue failure modes are identified. And the UHPC layer above the crossbeam exhibited limited number of cracks with the maximum crack width less than 0.05mm at the end of the cyclic, much beyond the requirements.

Keywords: composite deck; anchors; fatigue behaviour; short-headed studs; S-N curves.

1 Introduction

The conventional orthotropic steel bridge decks (OSD) are often used in large-span bridges, especially in cable-stay bridges and suspension

bridges, for their higher strength, lighter self-weight, and more convenient installation. In operation practice, fatigue cracks of welded details in OSD have been observed worldwide, such as the Severn Bridge in the United Kingdom (Wolchuk 1990), the Throgs Neck Bridge in the United States