Numerical analyses on flexural performance of UHPC link slab-abutment backwall system in jointless bridges

Bruno Briseghella, Zhen-guo Yang, Jun-qing Xue*, Jian-hui Lin, Fu-yun Huang

College of Civil Engineering, Fuzhou University, Fuzhou, China

Contact: junqing.xue@fzu.edu.cn

Abstract

The link slab could be applied to the abutment-superstructure connections to eliminate deck joints to form a link slab-abutment backwall (LS-AB) system in jointless bridges. However, due to the rotation and longitudinal deformation of girder ends, the reinforced concrete LS-AB system may crack. In order to improve the crack resistance of the LS-AB system, the ultra-high performance concrete (UHPC) could be used. The finite element model was built by ABAQUS to investigate the flexural performance of the UHPC LS-AB system. The results indicated that UHPC could improve the ultimate load, bending stiffness and crack resistance of the LS-AB system. The cracks mainly appeared on the link slab under bending. With an increase in the ratio of rubber sheet length to span, the displacement corresponding to initial concrete cracks increase. The bending stiffness of the UHPC LS-AB system is mainly influenced by the material and rubber sheet length.

Keywords: jointless bridge; link slab-abutment backwall system; ultra-high performance concrete; finite element model; parametric analyses; ultimate load; bending stiffness; crack resistance.

1 Introduction

It is widely acknowledged that the deck joints are the most vulnerable elements in existing multi-span simply supported girder bridges due to improper design and fatigue failure under heavy traffic loads [1]. In order to fundamentally resolve the problems induced by deck joints, the concept of jointless bridges has been widely used [2]-[8]. The link slabs can be used to connect the adjacent girders on the piers to eliminate deck joints and remain the adjacent girders as simply supported [9]-[10]. The debonding layer was set between the link slabs and girders [10]-[11].

The link slabs may be also applied to eliminate deck joints between the girders and abutment backwalls to form jointless bridges [12]-[13], which can be named as link slab-abutment backwall (LS-AB) system. In LS-AB system, as illustrated in Figure 1, the girder and abutment backwall is integrally connected by the link slab and the gap exists between the girder and abutment backwall. The debonding layer, such as rubber sheet, can be set between the girder and link slab.

However, due to the rotation and longitudinal deformation of the girder end induced by thermal variation, traffic load and the soil pressure behind the abutment backwall, the LS-AB system constructed by the reinforced concrete (RC) may

https://doi.org/10.2749/christchurch.2021.0866
Distributed by structurae