FE Modeling of the Interfacial Behaviour of Precast Multi-box Girder

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Abstract

To facilitate the reuse of the internal mold of precast multi-box girder and accelerate bridge construction, the torsional crossbeam at the end of precast simply supported multi-box girder needs to be changed to post-cast in-situ. Finite Element Modelling package ABAQUS 2021 was used to model the interfacial shear behaviour of the three-dimensional Z-shaped straight shear specimens. The models took into account the bond-slip relationship between the old and new concrete interfaces and the interaction between the concrete and the shear key. The models were validated and calibrated based on the experimental results. The study shows that the rigid shear key can improve the shear load capacity of the specimen at the new and old concrete interface. The difference between the model and experimental results is relatively small and therefore it shows the capability of the finite element modelling to carry out parametric analysis.

Keywords: precast multi-box girder; concrete interface; shear performance; new-to-old concrete; anchors; shear key.

1 Introduction

Simple-supported continuous small box girder bridge is a typical medium-span bridge which is very economical and applicable, and is favored by the engineering construction and construction parties[1]. Because the two ends of the small box girder need to set a diaphragm to ensure the torsional performance, the internal model uses a disposable wooden template, which is time-consuming and expensive[2]. The integral pull-out steel internal formwork technology is introduced into Shanghai Jiamin Viaduct. However, this construction technology requires that the precast part of the small box girder cannot contain the end diaphragm, and the joints of the precast-cast-in-situ structure need to be moved in to the support span. Because the shear force near the fulcrum of the small box girder is the largest, it results in precast - cast-in-place joint shear problems.

Numerous scholars have carried out studies on the shear resistance of new-to-old concrete interfaces. The results show that without reinforcement, the main factors affecting the interface shear capacity are the direction of the bond surface, the roughness of the interface, the type of interface agent, the concrete strength, the curing age and the dimensional effect[3–8]. The joints in the precast-cast sections form a natural weak surface and there are no prestressed steels passing through, which is not conducive to shear resistance (see Figure 1). However, the anchoring of prestressed steel bars at the interface constitutes a rigid shear key that is beneficial to the shear resistance of the interface.

Therefore, in this paper, numerical models are established to analyse the factors affecting the interface shear load capacity, based on Z-type direct shear experiments in conjunction with the

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