Numerical Simulation of Longitudinal Shear Behavior of High Strength Steel and Concrete Composite Girders

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Abstract

Longitudinal shear failure is a typical failure mode for composite girders. Based on experimental study, the finite element model was calibrated and numerical studies were carried out to analysis the longitudinal shear behaviour of high strength steel and concrete composite girders. It was analysed the effect of transverse reinforcement ratio, concrete strength, and steel grade on the longitudinal shear behaviour of high strength steel and concrete composite girders. Based on the current specifications, the transverse reinforcement area and longitudinal shear strength of the test girder were verified. Learn from the analysis results, the concrete strength grade no less than C60 was suggested with priority for concrete slab, for composite girders using steel with nominal yielding strengthen above 420 MPa. To prevent the longitudinal shear failure for the high strength steel and concrete composite girders, the transverse reinforcement ratio no less than 1,18% was suggested.

Keywords: high strength steel and concrete composite girders; longitudinal shear behaviour; numerical simulation; design criteria.

1 Introduction

The longitudinal shear failure is a typical failure mode for steel and concrete composite girder, which will result in the reduction of loading capacity. The longitudinal shear failure would occur when adopting improper design, like insufficient transverse reinforcement, inadequate arrangement of shear connector, etc. High performance composite girder is encouraged nowadays to acquire superior structural performance, including high strength, high toughness and improved durability. Thus, the longitudinal shear resistance for high strength composite girder needs to be focused. In order to make full use of the material properties of high strength materials, the requirements for the resistance of longitudinal shear failure need to be stricter for high strength composite girders.

Mattock proposed the theory of shear transfer in concrete slab in 1972, and found that transverse reinforcement was the main part of the longitudinal shear resistance of concrete slabs [1]. Oehlers conducted experiments and finite element analysis for composite girder, which revealed that the cracks in the concrete slabs with double-row studs would extend forward in a herringbone pattern or along the centre of the stud as

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