Mechanical Performance of Stud Connector in Lightweight Concrete

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Summary

Shear connector is quite important to steel and concrete composite bridge which benefits the material advantages. In this study, static and fatigue performance of typically used stud shear connector in lightweight concrete was investigated experimentally. Compared with normal concrete, lightweight concrete has the feature of reducing self-weight of bridge superstructure. It has been applied in some composite bridge deck constructions and repair works because of the strength improvement and water absorption amelioration nowadays. However, the lower modulus and other drawbacks of lightweight concrete still exist. The effect of lightweight concrete on stud shear connector remains unclear. In this sense, we carried out related push-out tests, including static and cyclic ones. The stud shank diameter and height were 19 and 150mm, respectively. The lightweight concrete compressive strength was designed above 40MPa, and its density was 1900kg/m^3. The test results generally indicated that lightweight concrete tended to lower stud mechanical performance but still applicable for composite bridge. Moreover, it was suggested that fatigue strength evaluation of stud in lightweight concrete based on Euro code 4 is safe but appears underestimation, and that based on JSCE(Japan Society of Civil engineers) standard can be acceptable as well but may cause overestimation.

Keywords: lightweight concrete; stud shear connector; shear stiffness; shear strength; fatigue strength.

1. Introduction

Shear connector is quite important to steel and concrete composite bridge which benefits the material advantages. The steel concrete interlayer interactions are actually governed by shear connector's mechanical performance represented by shear stiffness, shear strength and cyclic response. The studies concerning shear connector originated from 1950s. In 1954, Viest firstly carried out research on shear studs [1], and Chapman and Balakrishnan carried out study on studs with consideration to steel and concrete interlayer slip and splitting [2, 3]. Moreover, Oehellers and Johnson systematically investigate the steel concrete interlayer slip development. At present, stud shear connector under multi-axial load actions has also been investigated because of the design development of composite bridges[4,5].On the other hand, cyclic performance of stud shear connector was also investigated by many researchers[6, 7]. Based on the cyclic push-out tests, fatigue S-N curves has been provided in civil specifications which basically satisfy engineering practices.

Compared with normal concrete, lightweight concrete has the feature of reducing self-weight of bridge superstructure. Hence mechanical status of substructures can be ameliorated, especially for seismic performance. Traditionally, lightweight concrete was hardly considered being applied as a material for structural members due to the low strength and high water absorption. Ollgaard and Slutter et al studied the static effect of lightweight concrete on stud in 1971[8]. They proposed the empirical strength evaluation equation based on push-out tests, but the corresponding compressive strength was almost lower than 35MPa, and the cyclic behavior of stud in lightweight concrete was

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