

Experimental Performance of Composite Box Girder Bridges Decked with Full-Depth Precast Panels

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Abstract

Box-girder composite bridges using prefabricated full-depth deck panels allow modular construction, greatly minimizing traffic impacts as well as providing longer span capability and better aesthetics when comparing with conventional plate girder systems. Shear stud clusters embedded in shear pockets are usually used to create composite action between concrete deck slabs and steel box girders. For accelerated bridge construction, it is advantageous to extend the spacing between the stud clusters. As a result, concerns have been raised about the effectiveness of composite action between the precast panels and the supporting girders. In this study, four composite box girders with a length of 5400-mm and a height of 380-mm were fabricated. The slab and the steel box were made composite by using closely-spaced studs over the full span length of beam. The arrangement of stud clusters of beams is respectively 2×3@400mm, 2×3@600mm, 2×2@800mm and 2×3@800mm, resulting in different degree of shear connection between 0.65 and 1.22. The specimen beams were tested to failure under two-point concentrated loads. It can be concluded from the experimental study that: (1) Shear stud clusters in the composite girder design can provide the necessary shear connection at the interface of steel box-girders and precast concrete slab bridge construction to achieve full composite action; (2) The degree of shear connection has little influence on the elastic behavior of composite box girders, and it has limited influence on the ultimate bending capacity; and (3) The testing has proven that full composite action between precast concrete panels and steel box girders can be achieved when the degree of shear connection is not less than 0.7.

Keywords: composite box girder bridge; precast deck panel; accelerated bridge construction; shear connection degree; partial shear connection