Effects of Clustering and Flange Surface Friction on Headed Shear Stud Demands

Hillhouse, B.[1], and Prinz, G.S.[2]

Abstract

This paper presents a novel approach to measuring shear stresses within embedded studs and investigates the effects of stud clustering and steel flange surface friction on resulting stud demands during fatigue loading. In this study, thin flexible transverse pressure gauges are attached to the studs of composite beam specimens to measure the peak contact pressure and allow calculation of stud shear demands from existing elasticity theory. A total of three large-scale composite girders are fatigue tested, representing both uniform and clustered stud configurations and two levels of flange surface friction. One non-composite beam test is also performed to better understand friction contributions to composite action. Results from the fatigue testing and instrumentation suggest that stud demands estimated by the AASHTO provisions are conservative. All composite specimens survived over 4,500,000 fatigue cycles at an applied stress range of 67.6MPa (9.8ksi) while maintaining full composite action and experiencing negligible increases in slab slip. Stud shear stress measurements for specimens having a Class A flange friction surface (cleaned mill scale surface) experienced stud demands that were nearly 66% lower than those estimated by the AASHTO provisions which neglect friction effects. When PTFE sheeting was added to reduce friction at the steel-concrete interface, AASHTO stud demand estimations were within 10% of measurements. Modifications to the current AASHTO stud fatigue demand provisions are proposed.

[1] Graduate research assistant, University of Arkansas, Fayetteville AR
[2] Assistant Professor, University of Arkansas, Fayetteville AR