The Eleventh Pacific Structural Steel Conference, 29-31 October 2016
Shanghai, P.R. China

Shear lag effect on ultimate tensile capacity of high strength steel angles

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A b s t r a c t

This research investigates the shear lag effect on the behaviour and ultimate tensile capacity of high strength steel (HSS) tension angles with bolted and welded connections. Eighteen full-scale tests were conducted, including fourteen specimens with HSS tension angles and four specimens with normal steel (NS) tension angles. For these specimens, single tension angles were connected to the gusset plates either by bolted or welded connec-tions. The main test parameters included steel grade, connection length and out-of-plane eccentricity. In general, the test observations showed that the shear lag effect was significant for the bolted HSS angle specimens connected by the short leg. The effectiveness of the design equation in the current design specifications for quan-tifying the shear lag ($1-x/L$rule, where$x$ = out-of-plane eccentricity and L = connection length) was evaluated using the test results. The comparison of the test results and the predictions by the design equations showed that the latter gave un-conservative estimates of the ultimate tensile capacity of the specimens with bolted HSS angles connected by the short leg. Based on the finite element models validated by the test results, a parametric study was carried out, and the results also indicated that the current design equation would lead to unsafe estimates of the ultimate tensile capacities of bolted HSS angles connected by the short leg. Finally, a modified design guide-line was proposed based on the results of the numerical study.

Keywords: Shear lag, High strength steel, Tension angle, Experiment, Design method