2013/14 Undergraduate Research Grant Scheme – Executive Summary

Project title:
New design equations for RHS joints subject to side wall buckling

University:
University of Sheffield

Supervisor:
Jurgen Becque

Contact details:
Sir Frederick Mappin Building, Mappin Street, Sheffield, S1 3JD
Telephone: 0114 222 0252
Email: j.becque@sheffield.ac.uk

Student: Na Zhang

Project summary:
Buckling of the side wall is the governing failure mode for equal-width Rectangular Hollow Section (RHS) connections. However, the current CIDECT design rules are suspected of leading to overly conservative strength predictions, especially for RHS with fairly slender walls. The aim of the project was therefore to propose a new, more accurate design equation. While the current CIDECT equation is based on the column design curves, considering a strip of material in the side wall to behave as a column, the new equation accounts for the two-dimensional character of the side wall buckling as a plate.

In a first step, five laboratory tests were carried out. The test specimens consisted of 100x100RHS cruciform joints with variable thicknesses (3mm, 4mm, 5mm, 6mm and 8mm) and thus variable wall slenderness. All specimens were subjected to a compressive load on the brace members while the end shortening and the side wall displacements were recorded with transducers.

A literature review revealed a further 19 relevant test results which were added to the database. In a next step, the non-dimensional capacities (i.e. the measured capacities divided by the yield strength of the connections) were plotted versus a slenderness parameter. This slenderness parameter is based on the elastic critical buckling stress of the side wall, with the plate buckling coefficient determined from a Rayleigh-Ritz approximation. A regression analysis was then performed to reveal the new design equation. The proposed equation exhibits an average ratio of the predicted to the experimental capacity of 0.94 with a coefficient of variation of 0.13 and thus far outperforms the current CIDECT design equation or an alternative equation proposed by Packer.