The Institution of Structural Engineers

International HQ
11 Upper Belgrave Street
London SW1X 8BH
United Kingdom
tel: +44 (0)20 7235 4535
fax: +44 (0)20 7235 4294
mail@istructe.org
www.istructe.org

2013/14 Undergraduate Research Grant Scheme

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

University: University of Sheffield

Supervisor: Jurgen Becque

Student: tba

Aims of research:
Rectangular Hollow Section (RHS) trusses are enjoying an increasing popularity due to their ability to combine structural efficiency with aesthetics. However, the truss connections (which are typically welded) require particular attention in design since they can be subject to a number of particular failure modes. In the case were equal width members are connected (resulting in an even outside surface of the truss) the governing failure mode is buckling of the RHS side wall. Current design rules are based on considering a strip in the side wall as a column and result in unnecessary conservative predictions of the connection capacity, especially for slender side walls. The aim of the research is to develop new, more accurate design equations where (more realistically) the side wall is treated as a plate under biaxial stress.

Description of method:
The following methodology will be used:

• Laboratory tests will be carried out on a limited number of equal width RHS X- and T-shaped connections loaded in compression using the testing facilities at the University of Sheffield. The focus will thereby lie on RHS members with a high wall slenderness, for which currently little or no experimental data is available.

• The new test data will be combined with existing data, obtained through a literature search, to provide a database covering a sufficient range of wall slenderness values, geometries and steel grades.

• A model based on classical plate buckling theory will be developed as the basis for new design equations. In particular, the option of an energy approach (Rayleigh-Ritz) with a realistic displacement field will be investigated.

• A reliability analysis will be carried out using the available data to ensure the proposed design equations are accurate and safe.

Benefits to structural engineering:
Seen their popularity and consequently the volume of RHS trusses being constructed, more accurate design guidelines for RHS truss joints would result in significant cost savings, as well as in a more efficient use of the material. The latter has obvious environmental benefits, not in the least in terms of greenhouse gasses. Reduced costs would benefit contractors and clients, while increased competitiveness of RHS products would also benefit RHS manufacturers. On the whole, the field of structural engineering (and designers in particular) would benefit from a more thorough understanding of the behaviour of RHS connections.

Proposed finish date: June 2014