

2012/13 Undergraduate Research Grant Scheme

Project title: Experimental Determination of the Buckling Behaviour of Steel Web Tapered Tee Section Cantilevers

University: Plymouth University

Supervisor: Boksun Kim

Student: tba

Aims of research:

The buckling behaviour of steel web tapered tee cantilevers is not well known and neither Eurocode 3 nor BS 5950 provides guidance on how to design such beams. The aim of this project is to investigate their buckling behaviour experimentally. To achieve the aim the following objectives are set:

- 1) Carry out physical lab tests in order to determine the failure modes and buckling capacities of such beams.
- 2) Validate the buckling capacities determined from the energy method and finite element analyses.
- 3) Provide a design method for buckling checks.

Description of method:

Inspired by a practicing structural engineer, Dr Kim has recently researched the stress patterns of steel web tapered tee cantilevers (Kim and Oliver, 2011; Kim et al, to be submitted.). Dr Kim's research into tapered tee cantilevers has been extended to buckling aspects. The progress made so far is as follows:

- 1) A method for predicting the lateral torsional buckling capacities of web tapered tee cantilevers has been developed using the energy method in collaboration with Dr Mansel Davies from the School of Computing and Mathematics at Plymouth University.
- 2) A parametric study is currently being carried out in order to determine the local and lateral torsional buckling capacities of tapered tee cantilevers. Various cases distinguished by the degree of taper and slenderness have been analysed using the LUSAS finite element software.

A total of ten tapered tee cantilevers subject to a point load at the free end will be tested in the Heavy Structures Laboratory at Plymouth University. Five cases distinguished by the degree of taper will be tested experimentally. The buckling modes and capacities of the beams will be obtained. The buckling capacities obtained from methods 1) and 2) will be validated. After thorough validation, a design method for determining the buckling modes and capacities of such beams will be developed. A worked example will be produced.

References [1] Kim, B. and Oliver, A. (2011), A study of web tapered tee section cantilevers. IABSE-IASS Symposium, London
September 2011.

[2] Kim, B., Oliver, A. and Vyse, J., Bending stresses of steel web tapered tee cantilevers, to be submitted to the
Journal of Constructional Steel Research.

Benefits to structural engineering:

This project was inspired by a practicing structural engineer. He sought guidance on the design of tapered tee cantilevers, but after spending hours searching he found no guidance in BS 5950 and Eurocode 3 and as a result he over-designed the beam. This was wasteful of time and resources.

The outcome of this project will be to improve the understanding of the buckling behaviour and performance of steel web tapered tee cantilevers. The resulting decision matrix and spreadsheet will speed up the decision process and manufacturing, and therefore lead to a safe and cost effective option.

Proposed finish date: May 13