THE PLASTIC BEHAVIOUR OF TUBULAR BEAMS

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Abstract

The application of plastic theory methods to steel framed structures provides a reliable and simple method of structural analysis provided such factors as stanchion, lateral and local instability can be ignored. The present dissertation is concerned solely with local instability, in particular, in tubular beams where stanchion and lateral instability will not occur.

In the determination of the collapse load for a structure by the Simple Plastic Theory of Design a member is required, at a plastic ‘hinge’ to rotate whilst retaining its resistance moment until equalisation of moments has taken place. It is possible that local instability may cause a significant reduction in the resistance moment of a tube; and knowledge of the post yielding behaviour of tubes is desirable if these are to be used in structures designed by the Simple Plastic Theory.

There is at the time of apparent disagreement between the various solutions of the inelastic buckling problem and very little information on the post buckling behaviour of plates and tubes. Using the conception of a rigid perfectly plastic material and the assumption of a ‘Tresca’ yield criterion an analysis is developed that does explain the plastic buckling of plates and tubes and is in reasonable agreement with test results. The work is mainly concerned with rectangular tubes but has been extended to the case of circular tubes.

As the effect of local instability in rectangular tubes is small and therefore difficult to measure, the first part of the experimental programme was designed to isolate and study the compression plate behaviour. Further experimental work was designed to simulate the behaviour of a tube at the plastic hinge in a structure.