PLATE BUCKLING IN STEEL AND ALUMINIUM

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Abstract

Consideration is given to the ultimate strength in compression of both stiffened and unstiffened plates, as well as to plate assemblages. The work is primarily concerned with local buckling, although overall and interactive buckling has also been studied. The effects of a rounded material stress-strain curve have been examined, in particular the behaviour of aluminium alloys. Attention is given to the effects of initial out of flatness and residual stresses.

Tests are reported on 76 aluminium plates with controlled initial out of flatness and residual stress. Two alloys were studies, namely 5083-M and 6082-TF. Some specimens were transversely welded. Their sizes ranged from $20 < b/t < 85$, corresponding to a non-dimensional slenderness range of $0.58 < \beta < 2.85$. Comparison is made with theoretical predictions and design rules. The results indicate the importance of the roundness of the stress-strain curve on the ultimate strength of non-welded plates.

A simple method is described for predicting the complete load-shortening curve of simply supported rectangular plates in uniaxial compression. The method is developed by considering the plate to be comprised of two non-buckling edge zones and a buckling centre zone. It is applicable to either steel or aluminium type materials. Results are in close agreement with other theories and experiments.

A full analysis Finite Strip program has been developed to analyse the buckling behaviour of both plates and plate assemblages. The method takes proper account of large deflection theory, elasto-plastic behaviour, residual stresses, HAZ softening and initial out-of-flatness. Different material types can be considered. The method is applicable to local, overall, and interactive buckling problems, loaded in either uniaxial compression or bending. The predicted results compare closely with experiments.