INTERACTION BETWEEN LOCAL AND EULER BUCKING MODES IN THIN-WALLED COLUMNS

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Abstract

The stability of the buckling process in thin-walled columns depends on non-linear interaction between different knuckling modes. This dissertation aims at understanding these phenomena by means of relatively simple conceptual models.

The results of the 'exact' analysis for the classical buckling of a general rectangular tube, loaded in axial compression, are examined with a view to understanding them in simple, physical terms. Computer graphics are used to re-plot these results according to various hypotheses. On this basis, it is found that most of the results can be reproduced to a satisfactory first approximation by considering one set of plates as 'active' and the other as 'passive'. Some simple, rational approximate formulae are presented. These give a very good description of the exact curves.

A simple approach to predict the classical buckling stress (for a given half wavelength) of lipped channel cross-sections, loaded in axial compression, is proposed. The main idea is to consider each of the four classical buckling modes for these cross-sections as existing separately. This approach is verified against algorithm which uses an 'exact' matrix where the correlation is very good.

Two simple models for the interactive buckling in thin-walled columns are developed. The first is based on the van der Neut two-flange model and has the virtue of being capable of taking account of the initial overall and local imperfections and material plasticity. The second, which, is based on a Perry-type analysis, produces a simple post-buckling analysis for columns with general cross-sectional geometries.

The results of two series of tests conducted small-scale silicone rubber lipped channel models and aluminium thin-walled lipped channel columns are reported. In the latter series, different types of initial imperfections were identified and measured. In the main tests, the columns were loaded over a wide range of positive and negative eccentricities about the minor axis; in addition, several stub (short) columns of different lengths were also tested between rigid flat platens. The theoretical classical and interactive buckling analyses described above are used to examine these results; the theoretical predictions are presented along with the corresponding experimental observations. These analyses are also compared with the experimental results of other researchers. The results of both the present experimental investigation and those of other researchers establish the validity of the present theoretical analyses.