TOPICS IN THE ELASTIC BUCKLING OF PLATES AND COLUMNS

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Abstract

The thesis is divided into two parts, the first of which considers the buckling of anisotropic plates, and the second is concerned with a problem in the buckling of an elastic box column.

Anisotropic materials are manufactured by incorporating layers of stiff glass of carbon fibres in flexible matrices of epoxy or other polymeric resins. Plates made from such materials have bending and stretching rigidities much greater than their transverse shearing rigidities, which are determined by the low shearing moduli of the resin matrices. Because of this it has been suggested that a “thick-plate” analysis of their behaviour is necessary, as conventional “thin-plate” theory neglects the transverse shearing strains. This thesis examines the small deflection buckling of anisotropic thick plates, the eigen-values being found by a novel numerical method derived from the technique known as Dynamic Relaxation. It is found that the buckling-loads may be considerably over estimated by a thin-plate analysis, and that the magnitude of the error is strongly dependant upon the boundary conditions.

An elastic box column may either buckle locally or by overall flexure. It has been shown that a small “local” imperfection can substantially reduce the load-carrying capacity of the column, particularly when the buckling-loads for the two modes acting separately are nearly the same. In the second part of the thesis the effects of both local and overall (column-axis) imperfections behaviour is characterised by the value of a single, combined imperfection parameter. The analysis has been performed by considering the finite-deflection behaviour of a simplified model system but the results agree well with the results of a number of tests on small-scale rubber box columns.