THE FINITE DEFORAMTION OF THIN PLATES AND SHELLS

Derek George Ashwell M.A.

Trinity College, Cambridge

Abstract

A number of fundamental large-deflexion problems in the elastic bending, compression, and torsion of thin plates and thin-walled members are investigated in detail.

From the general equations for the extensional bending of thin plates an equation is obtained governing the bending of rectangular plates into certain types of surfaces of revolution. This equation is applied in turn to the pure bending about one axis of initially curved and corrugated plates, to flat-square, or rectangular plates loaded by distributed bending moments applied to all four edges, and to plates with initial curvature loaded by compressive forces parallel to the axis of curvature. All these problems exhibit the type of instability characteristics of thin-walled structures which depend in curvature of their stiffness. Curves are drawn showing the deformation suffered by the plates, the critical loads are found, and the post-bucking behaviour is described.

The final chapter considers the finite torsion of a twisted elastic cantilever. It is well known that the displacement of such a cantilever relative to its support is a rotation about its flexural axis, to so-called axis of twist. It is here shown that, by considering the distortion of the cantilever without reference to its support, an axis of *distortion* can be found that is, in general, quite different from the accepted axis of *displacement*. General expressions are derived for the determination of the axis of distortion, and it is fond that the finite deformation of thin-walled sections depends on the position of both axes, in a manner which is described.

Various experiments are described which were designed to test the analyses of all types of problem considered in the dissertation and their results are found to confirm them satisfactorily.