ASPECTS OF THE ELASTIC BUCKLING OF THIN CYLINDRICAL SHELLS

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Abstract

Whilst working in the aerospace industry, the author realised that the structural use of thin cylindrical shells was hampered by a lack of understanding of their buckling behaviour. This dissertation embodies research which examines this behaviour in physical, as opposed to mathematical terms.

The work proceeds from a simplified re-working of classical methods of analysis. The physical behaviour of the perfect shell is discussed in terms of the interaction of stretching and bending effects, and the details of the interaction are investigated for a variety of buckling modes. The simplified method also gives a more immediate derivation of standard classical results and suggest the adoption of a second dimensionless geometric parameter for long cylindrical shells under radial (and hydrostatic) pressure, in addition to the well-known parameter of Batdrof, and hence a common load ordinate for a unified plot of theoretical curves and experimental values. Imperfection sensitivity of short cylindrical shells under hydrostatic pressure is discussed, and a theoretical curve devised to allow for it. Finally, conclusions are drawn concerning the differing roles played by longitudinal and circumferential shell stiffeners.

Two loading cases of practical importance are examined experimentally using cylindrical shell specimens moulded in Silicone RTV rubber by a centrifugal casting technique which is described.