SOME PROBLEMS IN STATIC AND DYNAMIC BUCKLING

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Abstract

Four topics are treated.

In Chapter I, buckling loads are given for a flat and infinitely long elastic plate compressed in its own plane by thrusts which act parallel to two opposite edges, and which vary linearly between them. One of these edges is free, and the other is fixed in position but elastically clamped. The calculations were done by the Rayleigh-Ritz method, checked by the Schwarz method, and verified by experiments in the flange buckling of an I-section beam under pure bending.

Chapter II treats an initially curved, pin-ended strut having one end fixed in position, the other end being struck once, via a spring, by a mass, giving an impulsive axial load. Calculations suggest that, in practice, stress wave lateral bending effects are never simultaneously important. Numerical solutions of the governing equations, verified by experiment, suggest that, in practice strut shortening due to curvature does not affect strut load. Final design curves give an allowable dynamic strut load never much less that the safe static load.

Chapter III gives vibration theory for an initially curved, pin-ended bar carrying an end-mass, with verification by laboratory experiments. This theory is used to analyse the behaviour of a Losenhausen fatigue-testing machine mounted on buckled struts when the base receives a large impulse owing to the failure of a tensile specimen. Results show that the strut mass causes the transmission of loads greatly exceeding the Euler value. A simple formula giving maximum strut movement for a given specimen load is in reasonable agreement with measurements.

Chapter IV deals with the vibration of a beam bent by moments acting in a vertical plane, also the plane of maximum stiffness. The moments couple the lateral and torsional modes, giving instead two independent modes involving torsion and flexure.