FINITE ELASTIC-PLASTIC DISPLACEMENTS OF SHELLS

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Abstract

A detailed theoretical and experimental study is presented for large deflection elastic and elastic-plastic behaviour of thin spherical shells subjected to uniform external pressure, and concentrated inward load applied at the apex through a rigid boss.

The theoretical study is carried out using the rate problem, This is a boundary value problem for the rates of stress velocities and rates of surface tractions which takes geometry changes into account. The rate problem is first derived for a general continuum in terms of Cartesian tensors. The corresponding rate equations for an axisymmetric shell are then derived in terms of generalised stress rates, and strain rates. In the elastic region the governing differential equations are linear in the rates are solved numerically by expressing it in finite difference form. By solving a sequence of such rate problems the entire load-deflection characteristic of the shell is determined to any desired stage.

In the plastic region the governing equations are non-linear, and are solved using the strain-bound iteration technique. The experimental study was carried out on aluminium and P.V.C. hemispherical shells. The theoretical results are in fair agreement with previous and present experimental results. Further the results show that the boss size does influence the buckling behaviour of spherical shells under point load. Also an initial external pressure is shown to cause dramatic collapse under point load.

Finally in the sixth chapter the rate equations are derived for a general shell.