DYNAMIC THERMAL BUCKLING OF A THIN CYLINDRICAL SHELL

SANTIAGO,J.M.;MATISZIK,C.R.;WISNIEWSKI,H.L.

The dynamic buckling of a thin walled cylinder subjected to a combined thermal/blast pulse is analyzed with the ADINA finite element program. The calculations model an experiment conducted in a shock tube simulating a nuclear event. The cylinder, clamped at both ends and made of 6061-T6 aluminum, is first exposed to radiation from a thermal source and then enveloped by a side-on shock wave. The analysis employed the ADINA 16-noded rectangular curved shell element and the isotropic thermo-elastic-plastic material model.

Prior to modeling the experimental situation, calculations were performed to evaluate thermal buckling parameters for the cylinder under a uniform temperature increase. Two types of analysis were performed: a "linearized" buckling analysis to determine buckling modes and a incremental nonlinear buckling analysis to determine the critical buckling temperature.

The thermal/blast calculation employed the same finite element model as the preliminary buckling analysis, proceeding with the same method of analysis and using the initial imperfections previously obtained, but used the nonuniform experimental thermal pulse. After a controlled interval, the shock wave loading was impressed on the model and the calculations proceeded dynamically, using the Newmark implicit time integration method. Comparisons of the finite element results and the experimentally recorded data will be presented, in terms of displacement contours and displacement and strain histories. The paper will discuss the synergistic relationship between thermal buckling and dynamic buckling due to the shock wave, and will evaluate the sensitivity of the nonlinear calculations to initial imperfections.