AN ABSTRACT OF A THESIS

THE FREE VIBRATION OF A CYLINDER-CONE-CYLINDER SHELL COMBINATION

James Matthew Baker

Master of Science in Civil Engineering

The purpose of this study was to analyze the free vibration of a cylinder-cone-cylinder shell combination through the use of the user written FORTRAN code 'axirzvibdp1' [1]. The method of analysis was a numerical method based upon the three-dimensional theory of elasticity. The strain-displacement equations and the stress equations of motion were derived in cylindrical coordinates. The displacement functions were given in terms of the circular frequency. These equations, along with the stress-strain equations, were combined to produce the displacement equations of motion, which were assumed to be axisymmetric for simplification. The nine-node Lagranian finite element was formulated based on the cylindrical coordinate system and the standard eigenvalue problem for vibration was solved to determine the natural frequencies and mode shapes of various boundary conditions, shell configurations, and material properties.

The two boundary conditions considered in this study were free-free and fixed-free. The free-free boundary condition case varied multiple geometric parameters including: the small inside radius, a_1, the lengths of both cylindrical shells, L_1 and L_2, the conical shell length in the z-direction, *HC*, and the angle of the conical shell, α. All the geometric parameters, except the angle, were nondimensional with respect to the small outside radius, b_1. The material properties for the free-free boundary condition case were isotropic with a Poisson ratio of 0.3. The fixed-free boundary condition case varied the two geometric parameters: the ratio of the small inside radius to the small outside radius and the conical shell angle. The material properties studied in the fixed-free boundary condition case included an isotropic case with a Poisson ratio of 0.3 and a reinforced concrete modeled as a transversely isotropic composite. In this study the first fifteen frequencies for the circumferential wave numbers, m = 0,1,2,3,4,5, were generated. Mode shapes were plotted for the first twelve natural frequencies, for free-free boundary conditions, and for the first eight natural frequencies, for fixed-free boundary conditions. Some results of the 'axirzvibdp1' program were validated with close agreement by the results of the commercial software ANSYS.