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Multilayered Anisotropic Shells of Revolution with Complicated Shapes (1981)

Abstract

In this work, for the first time the theory and numerical methods for the nonlinear analysis of multilayered anisotropic (not only orthotropic) shells have been developed. The particular attention is paid to the simplicity of realization of computational procedures for multilayered composite shells that permits their direct use in engineering.

It has been developed a geometrically nonlinear theory of multilayered anisotropic shells based on the independent assumptions concerning distributions of displacements and transverse shear stresses as well through the thickness of the shell. The governing differential equations have been obtained by applying the three-field Reissner mixed variational principle. The feature of this approach is that the equations of Hooke's law for the transverse shear stresses and strains are satisfied *integrally* over the thickness of the shell.

A new method for describing geometry of shells of revolution with complicated forms has been proposed. The reference surfaces of such shells are formed by revolution of arbitrary curves given on a plane by a discrete number of points whose coordinates are defined with random errors of measurement. The solution of this problem is obtained with the help of the effective procedure based on smoothing the data by spline functions.

The analysis of the effect of anisotropy in axisymmetric angle-ply shells of revolution has been presented. It has been shown that neglecting the effect of anisotropy can lead to an incorrect description of the stress-strain fields in angle-ply shells. The tire modeling and computational models for tires are discussed in detail. The truck and passenger car tires of bias-ply and radial configurations are investigated by using the proposed Timoshenko-Mindlin theory of multilayered anisotropic shells.