Linear Analysis of Uniformly Stressed, Orthotropic Cylindrical Shells

C. W. Bert. The authors are to be congratulated for presenting some interesting quantitative results on the linear behavior of thin-walled orthotropic cylindrical shells of infinite length. I have used the term *membrane* behavior since the geometry was assumed to be thin-walled and the loadings considered produce only membrane stretching and shearing action as opposed to bending and transverse shearing action. Also, I have used the term *anisotropic*, since the net effect of orthotropic material at an arbitrary orientation with respect to the cylindrical coordinate system is anisotropic material relative to the latter. Such material is sometimes called planar anisotropic (in the thin-walled case) or monoclinic in the general case. Unfortunately there is no uniformity in terminology for anisotropic materials. For instance, the present authors used the term orthotropic, while Reissner and Tsai (1972) used the term anisotropic. In contrast, Pipes and Whitney (1979) have used the term anisotropic and yet gave numerical results only for the "specially orthotropic" case. One solution to this terminology dilemma would be to use the term "generally orthotropic" for the present class of material, as opposed to "specially orthotropic."

In the introductory paragraph, the authors refer to fire hoses as being helically reinforced. This is somewhat misleading, since fire hoses, as well all commercially available reinforced hoses, are bihelically reinforced, i.e., there are two families of reinforcements, one at +θ and the other at −θ with respect to the cylinder axis. This ±θ configuration results in what is known as balanced construction in which there is no shear-normal coupling, i.e., in the tangential plane the material behaves orthotropically not anisotropically. This bihelical situation also occurs in filament-wound products such as pressure vessels, rocket motor casings, piping, etc.

Also in the introductory paragraph are mentioned axially corrugated (fluted) and helically corrugated (bellows) shells. Although it is a first approximation to "smear" the corrugations, as was done by Fedoslov (1945), Andreeva (1955), and Akasaka and Takagishi (1958) for circumferentially corrugated diaphragms, extreme care must be exercised in obtaining the equivalent orthotropic elastic constants, since the nature of corrugations include excessive local bending action. A previous analysis of such a shell structure was presented by Franklin (1967).

Previous work on static loading of helically reinforced cylindrical shells was done by Padovan and Lastingi (1972) using the anisotropic version of Flügge's thin-shell theory. The discussor (Vanderpool and Bert, 1981) has conducted analytical and experimental investigations of helically (not bihelically) reinforced thick-walled cylinders. The analysis was based on the monoclinic version of Mirsky's thick-shell theory with exact solution for a finite-length, free-free cylinder using the Flügge-Forsberg method. The experimental specimen was specially made by hand-wrapping unidirectional S-glass/epoxy tape at 30 deg to the cylinder axis.

Finally the discussor would like to point out that there are typographical errors in equations (44) and (45) in that \( \sigma_y \) and \( \sigma_x \) should be interchanged.

References


Laminar Start-Up Flow in a Pipe

G. S. Patience and A. K. Mehlrotra. In his interesting paper on start-up flow, the author has introduced a parameter, \( M \), which accounts for the head that must be devoted to the acceleration of the flow. The expression for \( M \), equation (14), is incorrectly reported in his paper. Instead it should read as follows,

\[
M = (G_\rho D^4 / 2048 \mu p L)
\]