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plate span in the direction of the stiffeners to the stiffener spacing) is too small to permit use of the reduced formulas, since in this event the rigidity properties are dependent on the boundary dimensions. However, as may be seen in Fig. 1 of this closure, the range of applicability of the reduced formulas is principally governed by the degree of precision required. In this figure the variation of D_x/D is plotted against the ratio a/s using values computed from Equation [8] of the paper and compared with the asymptotic value obtained using Equation [10]. These results apply only to a plate-stiffener combination having the repeating cross section shown in the figure which is composed of isotropic materials for which Poisson's ratio $\nu = 0.3$.

Although the theory ideally requires that the number of stiffeners be large, it is believed that the number may become quite small before the validity of the theory is impaired seriously. The actual minimum number of stiffeners, as well as other restrictions on this analytical procedure, can be determined only in the laboratory. Consequently, it is hoped that support can be obtained for a systematic experimental investigation of the range of applicability and the limitations of orthotropic-plate theory in the analysis of stiffened plates.

Analysis of Short Thin Axisymmetrical Shells Under Axisymmetrical Edge Loading[1]

G. D. Galletly.[2] The authors are to be congratulated on extending Geckeler's method to axisymmetrical shells. Their method should be of interest to designers of pressure vessels.

In Section 5 of their paper the authors give limitations on the latitude angle φ, but do not explain how they arrived at these limits. Presumably they made some numerical comparisons with more accurate theories. The writer feels it would be helpful if the authors would give more detail as to how they arrived at these limits, with which theories they compared their approximate method, what criterion of accuracy they were using, how many cases they investigated, and so on.

Authors' Closure

The authors thank Dr. Galletly for his generous comments. They believe, though, that the merit of the paper is due mainly to its consolidating existing methods and ideas into a convenient technique, rather than to its novelty. (There is really little in the paper that is truly new.)

The approximations involved in arriving at Equation [6a] of the text are

$$M_\theta \cos\varphi/rQ \simeq 0, \quad u \cot\varphi/w \simeq 0, \quad \nu N_x/N_\theta \simeq 0 \qquad \text{[A1]}$$

where u is the meridional displacement. The first approximation is made in the moment-equilibrium relation, the other two in the stress-strain relation. The last expression may be shown, for conical shells, to be equivalent to

$$\nu l/\sqrt{2\lambda s} \simeq 0 \qquad \text{[A2]}$$

where s represents meridional distance from the apex, λ the meridional distance of the smaller end (of the truncated conical shell) from the apex. The approximation involved in Relations [9] of the text requires the further assumption[3] that

$$\sqrt[4]{12(1-\nu^2)}\ \sqrt{s\tan\varphi/h} \gtrsim 3 \qquad \text{[A3]}$$

This is insured by

$$\lambda \gtrsim 2.5l \qquad \text{[A4a]}$$

for the truncated cone (l refers to the smaller end), and by

$$\lambda \gtrsim 4l \qquad \text{[A4b]}$$

for the untruncated cone (λ and l now refer to the wide end).

The foregoing restrictions appear to be quite drastic, but it also appears from Hetenyi's example[4] and Galletly's[5] that some of the errors are self-canceling and that the formulas may be used safely, down to φ = 45-deg inclination.

Another question concerns the distance c from the meridional center of the virtual center of a short, cylindrical shell, with linearly varying wall thickness. Letting

$$\eta = h/h_0 = 1 + \alpha x/L \qquad \text{[A5]}$$

represent the wall-thickness variation, one obtains, by steps analogous to the case of radius variation (Equations [17], [18], [19] of the paper) that

$$c = -\alpha L/4 \qquad \text{[A6]}$$

When there is simultaneous increase of wall thickness and of radius with x, then the two effects—presumed to be small—may be superposed, and one obtains

$$c/L = -\alpha/4 - L\cos\varphi/4r_m \qquad \text{[A7]}$$

[1] By G. Horvay, C. E. Linkous, and J. S. Born, published in the March, 1956, issue of the Journal of Applied Mechanics, Trans. ASME, vol. 78, pp. 68–72.

[2] Shell Development Company, Emeryville, Calif. Assoc. Mem. ASME.

[3] See reference (8) of the Bibliography of the paper, p. 105.

[4] "Theory of Plates and Shells," by S. Timoshenko, McGraw-Hill Book Company, Inc., New York, N. Y., 1940, p. 359.

[5] "Influence Coefficients for Hemispherical Shells With Small Openings at the Vertex," by G. D. Galletly, Journal of Applied Mechanics, Trans. ASME, vol. 77, 1955, pp. 20–24.

Bending Creep and Its Application to Beam Columns[1]

Yoh-Han Pao.[2] The authors are to be commended on the refreshingly simple and interesting manner in which they have presented the method of solution of the analytical problem. The experimental method of determining the creep deflection at the free end of the beam-columns by means of an electric-indicator circuit is clever and seems to be free of the faults associated with many of the earlier experimental techniques reported in the literature. The authors are, of course, also to be congratulated on the agreement between theoretical results and experimental data, at least for three of the four cases reported.

The writer was also interested in the fact that the values of the stress indexes a and n are 1.47 and 1.82, respectively, for the magnesium alloy FS1-F investigated. They are sufficiently far from unity so that the theory of viscoelasticity could not be used for this problem. In terms of viscoelasticity, Expression [5] of the paper describes a material with three retardation times, the values being zero, $^1/_2$, and infinite. Further refinement in the direction of considering additional relaxation times was apparently sacrificed in order to take care of the nonlinearity in stress.

Authors' Closure

The authors wish to thank the discusser for his comments and encouragement.

[1] By L. W. Hu and N. H. Triner, published in the March, 1956, issue of the Journal of Applied Mechanics, Trans. ASME, vol. 78, pp. 35–42.

[2] Polychemicals Department, Research Division, E. I. du Pont de Nemours and Company, Wilmington, Del.

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