Technical Comments

Comment on "Unsteady Boundary-Layer Flow of Power Law Fluids"

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IN Ref. 1, a similarity analysis was made of the unsteady boundary-layer flow of power law fluids. The similarity transformation corresponding to a linear group of transformations was derived and numerical results were tabulated for a few values of n's and α's.

The same problem was treated in 1965[2] using both linear and spiral groups of transformations. By replacing u and $U(t)$ in Ref. 2 by $v+U$ and $-V(t)$, respectively, the transformations treated in Ref. 1 is seen to be identical to case 1 of Ref. 2.

It may also be added that the expression for m in Ref. 1, Eq. (4), should be replaced by

$$m = \{1/(n+1)\}\{(n-1)\alpha+1\}$$

This can be demonstrated by simply putting n equals to 1. Using the form in Eq. (4) of the paper, the transformation given in Eq. (6) of Ref. 1 cannot be obtained.

References

[1] Roy, S., "Unsteady Boundary-Layer Flow of Power Law Fluids," *AIAA Journal*, Vol. 11, No. 11, Nov. 1973, pp. 1581–1582.

[2] Na, T. Y., "Similarity Solutions of the Flow of Power Law Fluids Near an Accelerating Plate," *AIAA Journal*, Vol. 3, No. 2, Feb. 1965, p. 378.

Received December 18, 1973.
Index categories: Boundary Layers and Convective Heat Transfer—Laminar; Nonsteady Aerodynamics.

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Reply by Author to T. Y. Na

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I OFFER my thanks to Prof. Na for his interest in my study.[1] However, according to my copy of the manuscript, the value of m is what he says it should be, namely

$$m = \{1/(n+1)\}\{(n-1)\alpha+1\}$$

The discrepancy that appears in the paper is due to the printer's devil.

References

[1] Roy, S., "Unsteady Boundary-Layer Flow of Power-Law Fluids," *AIAA Journal*, Vol. 11, No. 11, Nov. 1973, pp. 1581–1582.

Received February 28, 1974.
Index categories: Boundary Layers and Convective Heat Transfer—Laminar; Nonsteady Aerodynamics.

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Comment on "Buckling in Segmented Shells of Revolution Subjected to Symmetric and Antisymmetric Loads"

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IN a recent paper, Sheinman and Tene[1] describe a computer program for the buckling analysis of shells of revolution under nonaxisymmetric loads. Although the authors state in the title and elsewhere in the paper than their analysis includes both symmetric and antisymmetric loads, it appears to this writer that their analysis specifically *excludes* antisymmetric loading, the simplest case of which is axisymmetric torsion. This is clear from Eqs. (12), which give only the symmetric components of prebuckling variables, and also from the buckling equation (19), in which the symmetric and antisymmetric buckling components are uncoupled. Following Eq. (19), the authors state, "Hence a shell subjected to symmetric or antisymmetric load will buckle in a symmetric or antisymmetric mode." This statement is not true, since under antisymmetric load the symmetric and antisymmetric buckling components are, in fact, coupled.

I also would like to point out the existence of a computer program which treats buckling of shells of revolution under general mechanical and/or thermal loads. This program (SRA101) is one of a series of programs for shells of revolution, which are described in Refs. 2 and 3. Buckling loads calculated by SRA101 for some conical shells under nonaxisymmetric pressure loads are presented in Ref. 4. As in the analysis presented in Ref. 1, SRA101 also makes use of Fourier decomposition of prebuckling and buckling variables but uses forward integration techniques instead of a finite difference formulation for the resulting differential equations.

References

[1] Sheinman, I. and Tene, Y., "Buckling in Segmented Shells of Revolution Subjected to Symmetric and Antisymmetric Loads," *AIAA Journal*, Vol. 12, No. 1, Jan. 1974, pp. 15–20.

[2] Cohen, G. A., "Computer Analysis of Ring-Stiffened Shells of Revolution," CR-2085, Feb. 1973, NASA.

[3] Cohen, G. A., "User Document for Computer Programs for Ring-Stiffened Shells of Revolution," CR-2086, March 1973, NASA.

[4] Cohen, G. A., "The Effect of Angle of Attack on the Buckling of Mars Entry Aeroshells," CR-2087, Feb. 1973, NASA.

Received March 11, 1974; revision received July 8, 1974.
Index categories: Structural Stability Analysis; Structural Static Analysis.

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Reply by Authors to G. A. Cohen

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OUR paper[1] actually deals with buckling analysis of shells of revolution for *nonaxisymmetric* loads. The presented derivation, confined to a symmetric load, was merely intended

Received April 30, 1974.
Index categories: Structural Stability Analysis; Structural Static Analysis.

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as an illustration of the approach, and G. A. Cohen is right in noting its limited validity. The equations for an antisymmetric load are, however, readily obtainable by the same means, using the following expressions instead of the symmetric ones in the original Eq. (12) of the paper:

$$
\begin{aligned}
e_\xi^{(0)} &= \sum_{m=1}^{L} \bar e_{\xi m}^{(0)}(\xi)\sin m\theta & N_\xi^{(0)} &= \sum_{m=1}^{L} \bar N_{\xi m}^{(0)}(\xi)\sin m\theta \\
e_\theta^{(0)} &= \sum_{m=1}^{L} \bar e_{\theta m}^{(0)}(\xi)\sin m\theta & N_\theta^{(0)} &= \sum_{m=1}^{L} \bar N_{\theta m}^{(0)}(\xi)\sin m\theta \\
e_{\xi\theta}^{(0)} &= \sum_{m=0}^{L} \bar e_{\xi\theta m}^{(0)}(\xi)\cos m\theta & N_{\xi\theta}^{(0)} &= \sum_{m=0}^{L} \bar N_{\xi\theta m}^{(0)}(\xi)\cos m\theta \\
\phi_\xi^{(0)} &= \sum_{m=1}^{L} \bar\phi_{\xi m}^{(0)}(\xi)\sin m\theta & M_\xi^{(0)} &= \sum_{m=1}^{L} \bar M_{\xi m}^{(0)}(\xi)\sin m\theta \qquad (1) \\
\phi_\theta^{(0)} &= \sum_{m=0}^{L} \bar\phi_{\theta m}^{(0)}(\xi)\cos m\theta & M_\theta^{(0)} &= \sum_{m=1}^{L} \bar M_{\theta m}^{(0)}(\xi)\sin m\theta \\
\phi^{(0)} &= \sum_{m=0}^{L} \bar\phi_{m}^{(0)}(\xi)\cos m\theta & M_{\xi\theta}^{(0)} &= \sum_{m=0}^{L} \bar M_{\xi\theta m}^{(0)}(\xi)\cos m\theta
\end{aligned}
$$

$$p = \sum_{m=1}^{L} \bar p_m(\xi)\sin m\theta$$

(where the Fourier coefficients are the antisymmetric terms of the prebuckling state); and adding them, for an arbitrary load, to the original symmetric expressions.

For a symmetric load, the quantities $t_{\xi e}^{(n)}$, $t_{\theta e}^{(n)}$, $t_{\xi\theta e}^{(n)}$, $m_{\xi e}^{(n)}$, $m_{\theta e}^{(n)}$, $m_{\xi\theta e}^{(n)}$, $c_{\pi e}^{(n)}$, $d_{\pi e}^{(n)}$ $(\pi = 1, 6)$, $g_{\pi e}^{(n)}$, $h_{\pi e}^{(n)}$ $\pi = 1, 3)$ in the original Eqs. (14–16) are a function of the symmetric buckling variables only, with $e = 1$ and of the antisymmetric variables only, with $e = 2$ (see Appendix A of the paper). For an antisymmetric load the picture is reversed, and for an arbitrary load the quantities are a function of *both* types of variables, with $e = 1$ *and* $e = 2$. For example, for an antisymmetric load we have

$$t_{\xi 1}^{(n)} = \sum_{m=0}^{k} [A_4^{(n,m)}(\bar e_\xi^{(0)})(\bar u_{m2}^{(1)\prime} \perp \omega_\xi \bar w_{m2}^{(1)}) \perp A_1^{(n,m)}(\bar e_{\xi\theta}^{(0)})\bar v_{m2}^{(1)\prime} \perp A_1^{(n,m)}(\bar\phi^{(0)})\bar v_{m2}^{(1)\prime} \perp A_4^{(n,m)}(\bar\phi_\xi^{(0)})(-\bar w_{m2}^{(1)\prime} \perp \omega_\xi \bar u_{m2}^{(1)})] \qquad (2)$$

$$c_{11}^{(n)} = \sum_{m=0}^{k} [A_4^{(n,m)}(\bar N_\xi^{(0)})\bar e_{\xi m2}^{(1)} \perp 4\omega_\xi A_4^{(n,m)}(\bar M_\xi^{(0)})\bar e_{\theta m2}^{(1)} \perp 4\omega_\theta A_4^{(n,m)}(\bar M_\theta^{(0)})\bar e_{\theta m2}^{(1)} - \omega_\theta A_4^{(n,m)}(\bar M_\theta^{(0)})\bar e_{\xi m2}^{(1)} - 2\gamma A_4^{(n,m)}(\bar M_\theta^{(0)})\bar\phi_{\xi m2}^{(1)} \perp 4n/r A_2^{(n,m)}(\bar M_{\xi\theta}^{(0)})\bar\phi_{\xi m2}^{(1)} - 4\gamma^n A_1^{(n,m)}(\bar M_{\xi\theta}^{(0)})\bar\phi_{\theta m2}^{(1)}] \qquad (3)$$

$$d_{11}^{(n)} = \sum_{m=0}^{k} [-2A_4^{(n,m)}(\bar M_\xi^{(0)})\bar\phi_{\xi m2}^{(1)}] \qquad (4)$$

$$g_{11}^{(n)} = \sum_{m=0}^{k} [A_4^{(n,m)}(\bar p)\bar w_{m2}^{(1)}] \qquad (5)$$

$$h_{11}^{(n)} = \sum_{m=0}^{k} [\omega_\xi A_4^{(n,m)}(\bar p)\bar u_{m2}^{(1)} \perp \gamma A_4^{(n,m)}(\bar p)\bar w_{m2}^{(1)} \perp A_4^{(n,m)}(\bar p')\bar w_{m2}^{(1)}] \qquad (6)$$

From the foregoing conditions of symmetric/antisymmetric, it is seen that the matrices in the original Eqs. (18) and (19) are no longer diagonal for an antisymmetric and an arbitrary load. Hence a shell under a *symmetric* load buckles in a symmetric *or* antisymmetric mode, and a shell under *antisymmetric or an arbitrary* one buckles in a symmetric *and* antisymmetric mode; separation of the two types, as is done in the original Eq. (20), is thus impossible for a nonsymmetric load.

References

[1] Sheinman, I. and Tene, Y., "Buckling in Segmented Shells of Revolution Subjected to Symmetric and Antisymmetric Loads," *AIAA Journal*, Vol. 12, No. 1, Jan. 1974, pp. 15–20.

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