not a jump, at $(p/p_0) = 0$ For example, with $\nu = 0\ 3$ and $(l/R) = 4$, one obtains the following:

1) For $(R/t) = 500$ at $(\sigma/\sigma_0) = 0\ 01$, the minimum φ_L occurs at $m = 3$ and not at $m = 1$

2) For $(R/t) = 200$ at $(\sigma/\sigma_0) = 0\ 02$, the minimum φ_L occurs at $m = 2$ and not at $m = 1$

Experimental evidence (although not directly applicable, since it refers to actual shells whose buckling behavior deviates from that predicted by linear theory) also confirms that $m > 1$ for some cases of combined axial compression and lateral pressure (see, for example, Ref 2)

References

[1] Sharman, P W , "A theoretical interaction equation for the buckling of circular shells under axial compression and external pressure " J Aerospace Sci **29**, 878–879 (1962)

[2] Weingarten, V I , Morgan, E J and Seide P , ' Final re port on the development of design criteria for elastic stability of thin shell structures Space Technology Labs , Los Angeles, TR 60 0000-1945, p 175 (December 1960)

Reply by Author to J Singer

P W Sharman*

Loughborough College of Technology, Leicestershire, England

THE author is grateful to Dr Singer for pointing out the slight error in his statement

The main utility of an interaction equation is, of course, to provide a rapid means of design rather than an exact analysis An advantage of formulating such an equation in terms of "reserve factors" is that the denominators may be calculated from theoretical or empirical formulas, although such a mixture of theory and experiment is not really satisfactory However, in the absence of close agreement with theory and experiment, the procedure may be acceptable for design estimates

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* Senior Lecturer, Department of Aeronautical Engineering

Comments on "Mach Number Independence of the Conical Shock Pressure Coefficient"

Wayne E Simon*

Martin Company, Denver, Colo

THE results presented in this note[1] may be compared with those of a recent technical note[2] which also presented an approximate equation for shock wave angle as a function of cone angle and Mach number In addition, the effect of specific heat ratio was included, and an equation for the surface pressure coefficient was developed Comparisons with exact results were shown for Mach number from 1 05 to 20 0, cone angle from 0 to the detachment value, and specific heat ratio from 1 1 to 1 8

Simpler equations were also presented [Eqs (12) and (13)][2] for the case when the sine of the cone angle was less than 85% of the detachment value In the nomenclature of the present note,[1] these equations would be

$$\sin\theta_w = \left[\frac{\gamma+1}{2}\sin^2\theta + \frac{1}{M_\infty^2}\right]^{1/2} \tag{1}$$

$$C_P = \left[\frac{\gamma+7}{4} - \left(\frac{\gamma-1}{4}\right)^2 + \frac{6}{M_\infty^6} + \frac{M_\infty^2 - 1}{M_\infty^4 \sin\theta}\right]\sin^2\theta \tag{2}$$

Equation (10) of the present note, with θ in radians, is

$$\sin\theta_w = \left[\theta^{1\ 87} + \frac{1}{M_\infty^2}\right]^{1/2} \tag{3}$$

In the limit of Newtonian flow ($M_\infty \to \infty$, $\gamma \to 1$), Eq (3) becomes

$$\sin\theta_w = \theta_c^{0\ 935} \tag{4}$$

In the same limit, Eq (1) becomes

$$\sin\theta_w = \sin\theta \tag{5}$$

Since in Newtonian flow $\theta_w = \theta$, it is clear that the form of the approximation in the present note is not valid in the limit, even though the numerical values for air are reasonable In addition, the effect of specific heat ratio on shock angle is not considered

References

[1] Zumwalt, G W and Tang, H H , Mach number independence of the conical shock pressure coefficient," AIAA J **1**, 2389–2391 (1963)

[2] Simon, W E and Walter, L A , 'Approximations for supersonic flow over cones,' AIAA J **1**, 1696–1697 (1963)

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* Associate Research Scientist, Aerospace Division of Martin-Marietta Corporation Member AIAA

Reply by Author to W E Simon

Glen W Zumwalt*

Oklahoma State University, Stillwater, Okla

THE technical note of Simon and Walter[1] was published just after the final form of the paper being discussed[2] was submitted, so there was no opportunity for prepublication comparison of the two works As Simon points out, they have indeed succeeded in including the effect of the specific heat ratio in their conical shock approximations, and their curves then draw attention to the insensitivity of conical shock angle and surface pressure coefficient to γ values for the range applicable to perfect gas analysis They have obtained very good agreement for the $\gamma = 1\ 405$ value and for other γ values at the one cone angle of 20° No doubt they experienced the same difficulty as we in checking results for other γ values because of the lack of available published cone-flow solutions

In answer to Simon's criticism, it should be pointed out that our principal purpose was to call attention to the conical shock-wave pressure coefficient's strange behavior Secondarily, as a suggested use of this fact, an approximation for the conical wave angle was developed The resulting equation was similar in form to that of Simon and Walter, and it is not obvious to me that their equation is more simple Our equation fails to agree with the Newtonian limit, it is true However, Simon and Walter's equation (13) fails in exactly the same way, giving values almost identical to ours, unless the γ value is arbitrarily changed to unity The

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* Associate Professor of Mechanical and Aerospace Engineering Member AIAA