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Reply by Author to W. P. Rodden

J. DeYoung*

The University of Texas at Arlington, Arlington, Texas

THE comment by Rodden is a grossly unrealistic reading of Ref. 1. The following two paragraphs are quoted from this reference.

"Comparing with thin-airfoil theory, the lift-curve slope is given exactly for any N by twice the averaged value of $\gamma_n/V\alpha$. Thus, for $N=3$, $c_{1\alpha}=\frac{2}{3}[(15\pi/8)+(3\pi/4)+(3\pi/8)]=2\pi$. Likewise the moment is given exactly for any N. Besides for the chordwise cotangent loading, the lift and moment are summed exactly for the first and second sine harmonics of chordwise loading.

The discrete chordwise loading terms γ_n/V are constant over a given incremental chord distance c/N. For plotting the chordwise loading, γ_n/V is positioned at the quarter-chord of the nth segment, that is at $\xi_n=(n-\frac{3}{4})/N$. A chordwise loading factor can be formed that relates γ/V at ξ_n with γ_n/V. This factor defined by f_n is the ratio of thin-airfoil theory value, Eq. (14), to the incremental loading theory value, Eq. (9)."

Much of the objective of Ref. 1 is to provide a simple, short, rigorous analysis to prove that the chordwise loading is integrated exactly for any N-paneled lattice. The first quoted paragraph shows that this $2N$ line theory integrates exactly as the simpler 2 line theory ($\frac{1}{4}-\frac{3}{4}$ – chord wing theory), which applies for all aspect ratios.

The second quoted paragraph concerns the problem when attempts are made to plot the chordwise loading. Although the sum of the panel elemental vortex lifts ($2\gamma_n c/N$) sum up to the exact total chord lift, the chord loading γ_n is not necessarily the exact γ at chord station ξ_n. In the second quoted paragraph a loading factor, f_n, is defined which aids in plotting the chordwise loading distribution. As repeated several times in Ref. 1, for plotting, the chordwise loading at ξ_n is defined by using the chordwise loading factor as in $\gamma/V=f_n\gamma_n/V$. Qualitatively, this f_n factor is independent of aspect ratio. Slender wing theory shows that the leading edge loading stays as high as that resulting from two-dimensional planar thin wing theory.

I do not throw babies out with the bath water, they are too precious.

Received May 4, 1972.

Index categories: Subsonic and Transonic Flow; Airplane and Component Aerodynamics.

* Adjunct Professor, Department of Aerospace and Mechanical Engineering. Member AIAA.

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