Readers' Forum

Brief discussions of previous investigations in the aerospace sciences and technical comments on papers published in the AIAA Journal *are presented in this special department. Entries must be restricted to a maximum of 1000 words, or the equivalent of one* Journal *page including formulas and figures. A Discussion will be published as quickly as possible after receipt of the manuscript. Neither the AIAA nor its editors are responsible for the opinions expressed by the correspondents. Authors will be invited to reply promptly.*

Comment on "Separation Model for Two-Dimensional Airfoils in Transonic Flow"

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THE authors of the above paper[1] have used the experimental pressure-distribution of the NASA GA(W)-1 airfoil at 20 deg angle of attack, with turbulent separation at 50% chord, to verify quite successfully their predicted theoretical pressure distribution (Fig. 6 of Ref. 1).

In our 1976 work,[2] which has been totally ignored by the authors, the same GA(W)-1 airfoil test data were also used to verify successfully our theoretical predictions, but we chose the much more challenging 21 deg test with separation at 15% chord, as shown in Figs. 6 and 7 of Ref. 2. We also verified quite well the predicted pressure-distribution for the NACA 63-018 at 18 deg with separation at 30% chord and for the NACA 65, 2-421 at 20 deg with separation at 35% chord.

We used the simple Goldschmied pressure-recovery criterion[3] to determine the turbulent separation pressure, while the authors have some flexibility in the separation point location by monitoring both the skin-friction coefficient C_f and the boundary-layer shape factor H, as computed with the most sophisticated Green[4] "lag-entrainment" integral method.

As a minimum, the authors should display in their reply their GA(W)-1 computation for the 21 deg case, together with the experimental data points, so that it may be compared to ours. If full credibility is desired, then the NACA 63-018 and 65, 2-421 calculations should also be carried out and displayed.

References

[1]Dvorak, F. A. and Choi, D. H., "Separation Model for Two-Dimensional Airfoils in Transonic Flow," *AIAA Journal*, Vol. 22, Aug. 1984, pp. 1064-1070.

[2]Farn, C.L.S., Goldschmied, F. R., and Whirlow, D. K., "Pressure Distribution Prediction for Two-Dimesnional Hydrofoils with Massive Turbulent Separation," *Journal of Hydronautics*, Vol. 10, July-Aug. 1976, pp. 95-101.

[3]Goldschmied, F. R., "An Approach to Turbulent Incompressible Separation Under Adverse Pressure Gradients," *Journal of Aircraft*, Vol. 2, March-April 1965, pp. 108-115.

[4]Green, J. E., Weeks, D. J., and Brooman, J.W.F., "Prediction of Turbulent Boundary-Layers and Wakes in Compressible Flow by a Lag-Entrainment Method," RAE TR-72231, Dec. 1972.

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Reply by Author to F. R. Goldschmied

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IT is unfortunate that the research community involved in separated flow studies appears to have been totally unaware of the work by Goldschmied et al.[1] A recent review of separated flow models by Blascovich[2] of Grumman refers only to the author's 1965 publication.[3] We can only surmise that the *Journal of Hydronautics* was not distributed widely to aerodynamics groups; certainly that was true in our case. In comparing Goldschmied's work with ours, two points must be made. First, in our present work and in the earlier CLMAX study by Maskew and Dvorak[4] a wake model (vorticity sheets) was employed to account for the separated flow region. The pressure in the separated flow region is calculated directly in the method based on the amount of vorticity shed into the wake. Particularly in the CLMAX method the wake shape and location, determined by iteration, influence quite strongly the final predicted separated flow pressures. In Goldschmied's approach the final pressure level in the separated region is determined from a correlation of experimental data taken from the very same airfoils for which pressure distributions are being computed. This would not seem to be a fair test of the approach. In all of this, we should not lose sight of the fact that the present work was primarily directed to transonic flows.

References

[1]Farn, C.L.S., Goldschmied, F. R., and Whirlow, D. K., "Pressure Distribution Prediction for Two-Dimensional Hydrofoils with Massive Turbulent Separation," *Journal of Hydronautics*, Vol. 10, July-Aug. 1976, pp. 95-101.

[2]Blascovich, J. D., "Characteristics of Separated Flow Airfoil Analysis Methods," Grumman Aerospace Corp., Bethpage, N.Y., Jan. 1983; also AIAA Paper 84-0048, Jan. 1984.

[3]Goldschmied, F. R., "An Approach to Turbulent Incompressible Separation Under Adverse Pressure Gradients," *Journal of Aircraft*, Vol. 2, March-April 1965, pp. 108-115.

[4]Maskew, B. and Dvorak, F. A., "The Prediction of $C_{\ell_{max}}$ Using a Separated Flow Model," *Journal of the American Helicopter Society*, April 1978.

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