# Reader's Forum

*Brief discussion 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 "Exact and Asymptotic Expressions of the Lift Slope Coefficient of an Elliptic Wing"

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IN Ref. 1, Hauptman presents comparisons of the results obtained in papers[2,3] by himself and Miloh with those of earlier workers for the lift of wings of elliptic planform at low incidence in incompressible flow. The expressions obtained by Hauptman and Miloh, for the cases of steady flow and impulsive acceleration from rest, are in closed form. Previous solutions have been either numerical or in the form of series expansions in powers of the aspect ratio. The most extensive of the previous expansions for the wing of high aspect ratio in steady flow is given by Kida.[4] The comparisons presented in Ref. 1 are in terms of series-expansions, and agreement is reported with all but the last of the terms given by Kida.

Because the new series expansion is obtained from a closed form, the presumption is that either Ref. 2 or Ref. 4 is in error, though Hauptman does not draw this conclusion. In fact there is a third possibility, which is that the problems are not identical, and this turns out to be the case. The previous workers in the field have all treated the flat plate of elliptic planform, but a careful reading of Ref. 2 shows that the wing for which the closed form solution is obtained is actually twisted. In the Expressions (1) and (2) for $C_L/\alpha$ given in Ref. 1, $\alpha$ represents an average of the local incidence taken across the span of the wing. The problems are therefore not the same, and it is to be expected that the solutions will differ.

The analysis of Refs. 2 and 3 is substantial and not in doubt, and the twist of the wing is small compared with its mean incidence.[5] However, it is important that the nature of the solutions is recognized, and this comment is submitted in the interests of clarification.

### References

[1]Hauptman, A., "Exact and Asymptotic Expressions of the Lift Slope Coefficient of an Elliptic Wing," *AIAA Journal,* Vol. 25, Sept. 1987, pp. 1261-1262.

[2]Hauptman, A., and Miloh, T., "On the Exact Solution of the Linearized Lifting Surface Problem of an Elliptic Wing," *Quarterly Journal of Mechanics and Applied Mathematics,* Vol. 39, Pt. 1, 1986, pp. 41-66.

[3]Hauptman, A., and Miloh, T., "Aerodynamic Coefficients of a Thin Elliptic Wing in Unsteady Motion," *AIAA Journal,* Vol. 25, June 1987, pp. 769-774.

[4]Kida, T., "An Asymptotic Expression of Lift-Slope of Elliptic Wing with High Aspect Ratio," *ZAMM,* Vol. 62, 1982, pp. 491-493.

[5]Miloh, T., private communication.



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## Reply to J. H. B. Smith

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From the strictly mathematical point of view, it is true that the kinematic boundary conditions in the works mentioned by Dr. Smith are not exactly identical. However, it should be remembered that we are dealing with linearized models of the actual flow about a thin wing. It is believed that the method of satisfying the boundary conditions in Ref. 1 is consistent with the linearization assumption usually accepted in thin wing theory, since the Euler equation of motion is satisfied exactly at the wing, and the twist mentioned by Dr. Smith is indeed small and vanishes with the aspect ratio. It may also be worthwhile to quote the following observation by Jordan, who investigated very extensively the lifting problem of the circular wing: "It appears that the details of how the downwash is distributed over the wing span are of negligible importance and do not affect the outer flow, which determines the total lift."[2] Nevertheless, it is interesting that not only the total lift, but also the spanwise lift distribution resulting from the closed form solution presented in Ref. 1 is very close to the distribution resulting from Jordan's analysis for the circular wing.[3]

### References

[1]Hauptman, A., and Miloh, T., "On the Exact Solution of the Linearized Lifting Surface Problem of an Elliptic Wing" *Quarterly Journal of Mechanics and Applied Mathematics,* Vol. 39, Pt. 1, 1986, pp. 41-66.

[2]Jordan, P. F., "Exact Solutions for Lifting Surfaces," *AIAA Journal,* Vol. 11, Aug. 1973, p. 1123-1129.

[3]Guermond, J. L., private communication.