Vol. 43, No. 3 DUKE MATHEMATICAL JOURNAL© September 1976

SUPERSONIC FLOW PAST A NEARLY STRAIGHT WEDGE

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One of the best known of the special solutions of the gas dynamical equations for steady state planar flow consists of two constant states of the gas separated by a straight shock $\mathcal{S}$: see Figure 1. The flow velocity $\mathbf{q}^{(0)}$ upstream of $\mathcal{S}$ must of course be supersonic, while the flow downstream, which is uniquely determined by the angle β between $\mathbf{q}^{(0)}$ and $\mathcal{S}$, may be either subsonic or supersonic, depending on the value of β. As β varies one obtains a 1-parameter family of states that may be connected to a given upstream state by a single shock. As is shown in Chapter 4 of Courant–Friedrichs [1], these solutions may be used to construct the two dimensional flow past a straight wedge inserted into a uniform supersonic flow, provided the opening angle of the wedge is not too great. We assume the reader is familiar with this reference, and we follow the notation of this book, apart from certain exceptions noted below.

In this paper we study the flow past a nearly straight wedge when the flow upstream is uniform supersonic. As it happens, the flow past one side of the wedge is entirely independent of the flow past the other, and we consider only flow past the top side. We use a perturbation method to show that, provided the curvature (and several of its derivatives) of the wedge is sufficiently small, we may obtain a solution in a bounded region downstream of the vertex which consists of a single, slightly curved shock with smooth flow downstream of the shock. The position of the shock is determined by the requirement that the flow at the surface of the wedge must be tangential. Our analysis only applies

Received February 21, 1976. Research supported in part under NSF contract GP 22927. The author is an Alfred P. Sloan fellow.