THREE-DIMENSIONAL SHOCK WAVE REFLECTION TRANSITION

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ABSTRACT: It has been established that the shock wave reflection pattern on a plane surface below a supersonic body can comprise of regular reflection immediately below the body, which then transits to Mach reflection in the lateral direction [1]. In two-dimensional studies of wave reflection between two finite width wedges placed symmetrically in a supersonic wind tunnel it became important to examine the aspect ratio of the wedges and the consequent possible influence of a finite width wedge causing the intrusion of three-dimensional flows [2]. By choosing a low aspect ratio wedge and yawing and rolling the optical axis the nature of the transition could be examined in more detail as shown in Fig. 1. These flows will be discussed.

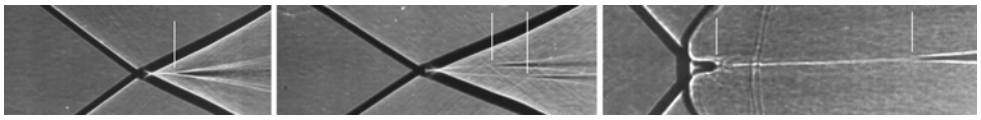

Figure 1. The regular reflection of incident waves from wedges. Left image is a conventional shadow image; centre image is with the optical axis slightly rolled and yawed and the right image with significant yaw. The vertical white lines indicate the transition point.

It is found that the transition point fluctuates and that the above geometry is not ideal for a transition investigation. The alternative utilised is to cap the edge of one side of the pair of wedges with a conical surface so as to force a stable Mach reflection as shown in Fig. 2a. Since direct visualisation is impractical because of the blockage caused by the cap, the laser vapour screen technique, LVS, was employed. Typical results are given in Fig. 2 together with the corresponding result from numerical simulation. What develops is an interesting and even more complex flow which is analysed using a series of transverse LVS images and the corresponding CFD cross-sections. A three-dimensional surface model is constructed to illustrate this complex flow field.

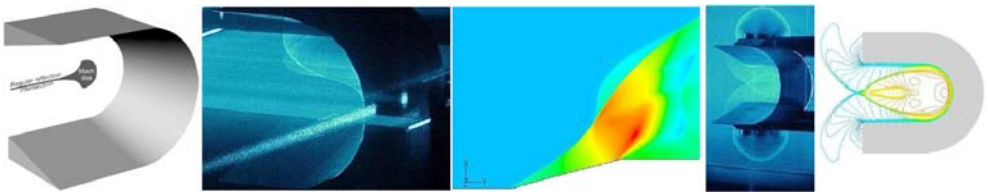

Figure 2. Capped model geometry and LVS and numerical results in the symmetry plane and in the trailing edge transverse plane.

References

1. Marconi, F. *Shock reflection transition in three-dimensional steady flow about interfering bodies.* AIAA J. 1983, 1, 707-713
2. Skews, B.W. *Three-dimensional effects in wind tunnel studies of shock wave reflection.* J. Fluid Mech. 2000, **407,** 85-104