AIAA JOURNAL
Vol. 31, No. 5, May 1993

Book Review

Shock Wave Reflection Phenomena

Gabi Ben-Dor, Springer-Verlag, Berlin, 1992, 307 pp., $69.50.

The reflection of a moving shock wave by a rigid surface depends on the angle between the shock wave and the surface. When this angle is small, a regular reflection occurs. The latter consists of the incident wave and a reflected wave. With increase in angle, a critical value is reached beyond which the shock reflection is irregular. For weak incident shocks, the irregular reflection is termed a simple Mach reflection (SMR), which consists of the incident wave, a reflected wave, and a Mach stem, all joined at a triple point. For strong incident shocks, the first departure from a regular reflection is in the form of a double Mach reflection (DMR). The latter contains two triple points. Further increase in angle leads first to a transitional Mach reflection (TMR)—an SMR with a kink in the reflected wave—and then to an SMR. The first experimental observations of SMR, TMR, and DMR were made by E. Mach (1878), L. G. Smith (1945), and D. R. White (1951), respectively.

Concern about the effects of thermonuclear blast waves on ground facilities has led, in recent years, to a renewed interest in shock reflection phenomena. Topics of current interest include transition criteria, flowfield properties and effects of viscosity, wall roughness, and dust pickup. Emphasis is also being placed on the development of numerical codes. Professor Ben-Dor has been an active participant in shock reflection research for the past 15 years. As such, he is well qualified to author a review of the current status of this field.

The present book consists of four chapters and an extensive list of references. Chapter 1 provides an introduction to the subject and includes a historical background, a description of regular and irregular reflections, and a discussion of transition criteria. Chapter 2 is the largest chapter in the book and deals with self-similar unsteady flows. The interaction of a moving shock with a wedge is an example of such flows. Ben-Dor provides detailed descriptions of the various types of Mach reflections. Transition criteria are further discussed and extensive comparisons between analytical transition estimates and experiment are provided. Effects of nonideal gas behavior, viscosity, and surface roughness are also discussed. Chapter 3 treats the interaction between a steady oblique shock and a rigid surface. Chapter 4 treats non-self-similar unsteady shock reflection. The latter includes shock propagation over concave and convex cylinders and over double wedges. The interaction of a spherical blast wave with the ground is also discussed.

The emphasis of the book is on reflected shock structure and transition criteria. A great deal of related experimental data are presented. However, other than a reference to Colella and Henderson, regarding triple-point structure, the author has omitted discussion of results from the numerical codes that have been developed in recent years to describe shock reflection flowfields. For example, further details on the flow associated with a DMR would be of interest to those concerned with the effects of blast waves on ground structures.

Overall, the book contains much useful information and is recommended to those with an interest in shock reflection phenomena.

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