Book Review

Cascade Aerodynamics, by J. P. Gostelow
Pergamon Press, Elmsford, New York, 1984, 270 pp., $22.50.

Cascade Aerodynamics by J. P. Gostelow, is a welcome addition to the professional field of turbomachinery aerodynamics, since the last book on this topic was published nearly 20 years ago (N. Scholz, *Aerodynamik der Schaufelgitter*, Verlag G. Braun, 1965, translated into English by A. Kline, *Aerodynamics of Cascades*, AGARDograph No. 220). During the last 20 years, a great deal of research has been carried out in the fields of low- and high-speed cascade testing, three-dimensional flows in the endwall region, analysis and computation of compressible and shocked flows, and viscous and turbulent effects.

The author has spent most of his professional life working in the area of cascade aerodynamics and, hence, has the vantage point necessary to write a book in this area. This is primarily a reference book for turbomachinery aerodynamicists and designers in industry, academic, and research laboratories. It gives an up-to-date account of the state-of-the-art in the field. There are more than 750 references in this area; this and an overview of the entire field makes the book a very valuable addition to the professional field.

The author deals with the cascade model and the equations of motion, nomenclature, and the cascade equations in the first chapter. The second chapter is on low-speed cascade testing. Here, he brings in American as well as European practice in this area, and he even has a listing of various cascade tunnels around the world. The material on cascade testing covers only overall performance measurement, and no attempt has been made to correlate the large amount of data generated using these cascade tunnels.

The third chapter is on three-dimensional flows and nonrectilinear cascades. It includes the effects of axial velocity ratios, secondary flows, and losses in endwalls, and endwall boundary-layer development. This is a very difficult topic and has been the subject of extensive investigation over the last 20 years. He has brought together an extensive bibliography that provides a coherent review of the literature in this area and has kept the analytical treatment of the subject fairly simple.

The author deals with high-speed cascade testing in the next chapter and provides an overall view of the various cascades available in various parts of the world, including their features. The emphasis is on facilities and typical results, not on data correlation. He has spent a great deal of time building such facilities at Cambridge University himself; hence, he is on firmer ground with regard to high-speed cascade testing. From the point of view of students and newcomers, it would have been useful if the author had covered, in detail, flow visualization and measurement techniques used in high-speed cascade testing.

The next two chapters cover incompressible and compressible potential flows, and are comprehensive and up-to-date, even though incompressible potential flow has been covered in earlier texts (J. H. Horlock: *Axial Flow Turbines, Axial Flow Compressors*). The material on compressible theories is an extremely useful compilation and review of the state-of-the-art in the calculation of subsonic, supersonic, and transonic flows through cascades. The author has done an excellent job in presenting the difficult material in this area.

The next three chapters cover somewhat specialized areas. The one on viscous flows is well written and easy to follow, as it deals mainly with two-dimensional boundary-layer growth and loss correlation, but no attempt was made to describe methods of solving the partial differential equations governing the flowfield. Most of the techniques described are integral methods, which are extremely useful in the design process. The chapter on stall and unsteady flows has been the subject of a great deal of investigation in recent years, and most of the material in the chapter is descriptive, providing a brief overview of various phenomena including unsteady flow, flutter and stall, as well as the trailing-edge phenomena. The chapter on special applications includes boundary-layer and circulation control methods, tandem cascades, jet flap, blade cooling techniques, and the effects of sweep and dihedral. Here again, the material, is mostly descriptive and provides an overview of the various special effects.

The chapter on evaluations of prediction accuracy deals with the prediction of pressure distribution and boundary-layer growth in a cascade and comparison with experimental data. The last chapter is written with the designer in mind. Included are the effects of various special parameters on the performance of cascades, such as the thickness-chord ratio, the leading- and trailing-edge thicknesses, stagger angle, space-chord ratio, shape of camber line, incidence angle, Reynolds number, freestream turbulence, tip clearance, etc.

The strength of the book lies in its simplicity and breadth of coverage. Most of the material available on cascade flows is included, and the author has kept the mathematics and fluid mechanics as simple as possible. An introductory knowledge in these areas should be sufficient to follow this book. One of the shortcomings is the omission of computational techniques, which are now proven to be powerful tools for the prediction of the flowfield through these passages. The inclusion of modern measurement techniques, including the laser Doppler velocimeter and hot-wire techniques, would have enhanced the usefulness of the book.

The book is well written and should be valuable for all practicing turbomachinery engineers and researchers. It provides an overview of the field, and the author has performed a valuable service to the professional field.

Budugur Lakshminarayana
The Pennsylvania State University