

Encyclopedia of Physics. S. Flügge, Chief Editor, Volume VIa/4- **Mechanics of Solids.** C. Truesdell, Editor. Springer/Verlag, Berlin, Heidelberg, and New York 1974. 332 Pages. Cloth DM 185, U.S. \$75.90.

REVIEWED BY J. D. ACHENBACH¹

This volume of the *Encyclopedia of Physics* contains two articles: "Wave Propagation in Nonlinear Viscoelastic Solids," by J. W. Nunziato, E. K. Walsh, K. W. Schuler, and L. M. Barker, and "Waves in Solids," by R. N. Thurston. The articles are quite different in character. The article by Nunziato, et al. is limited to a well-defined and specific topic. It is a unified presentation of theoretical and experimental results in one-dimensional nonlinear viscoelastic wave propagation. Many of the most interesting results on waves in viscoelastic solids have been obtained during the last 20 years. The article is well written. One can read through the work, and be informed in a painless manner of the state of knowledge.

"Waves in Solids" by R. N. Thurston is a much more ambitious piece of work. The article is mainly concerned with the theoretical basis for understanding the propagation of mechanical waves in solids. The larger part of the article deals with general concepts in continuum physics. There are lengthy sections on thermodynamics, electromechanical interactions, material symmetry, etc. The work testifies to the scholarship of the author but this reviewer would have liked to see more discussion of typical wave propagation effects. There is, however, much interesting material in this article. It is authoritative on the influence of various physical effects on the propagation of harmonic waves.

Aeroelasticity of Plates and Shells. By E. H. Dowell. Noordhoff International Publishing, Leyden. 1975. 139 Pages. Cost \$16.92 or Dfl. 45.

REVIEWED BY HOLT ASHLEY²

This little book represents the first systematic, comprehensive treatment of its subject which is more than just a review of the literature. Since its author is right that most of the early difficulties in resolving differences between theory and wind-tunnel observations have been overcome, its appearance is timely. The reader is entitled to high hopes, because the author participated personally in much of the significant progress since 1960. Of all those currently active, his name is connected with the outstanding list of contributions to theoretical developments in the field and its associated aerodynamic tools. By and large, these hopes have been realized.

The first chapter contains a brief but illuminating discussion of the physical nature of the problem and the requirements of successful testing. Section 2.1 complements this review with a linearized theoretical treatment of the two-dimensional plate exposed on one side to an airstream, wherein various aerodynamic approximations underly an explanation of the known types of aeroelastic instabilities. Section 2.2 and Chapter 3 then go into more exact analytical models of the linear and nonlinear situations, respectively. A few carefully selected

results from the literature display the effects of Mach number, support conditions, geometry, and the several other parameters which govern the various phenomena.

Chapter 4 discusses the potential-flow aerodynamic theory which is needed for plate and shell stability and response prediction. Particular emphasis is given to the author's integral-transform scheme for calculating generalized forces, as well as to an inviscid shear-flow approximation which simulates the important effects on stability of the boundary layer. The acoustics of a cavity behind the plate or shell are touched upon. The Chapter 5 discussion of structural response to turbulence is mainly descriptive, relying on the literature for background on power-spectral methods and for the subject of acoustic excitation. Chapter 6 returns to wind-tunnel testing, starting with a dimensional-analysis presentation of the governing parameters. Then follows a selection and critique of the correlation between theory and experiment, which is a highlight of the book.

There are two appendices. The first summarizes key results from theory of elasticity, leading to useful plate and shell equations of motion. The second—an interesting note on the effects of boundary conditions—curiously receives little mention in the body of the text.

Perhaps the outstanding characteristic of this book is the way in which it combines a synthesis of recent knowledge on its subject with key literature citations. There are only four or five "significant" references which the reviewer missed. The unified manner wherein the linear stability boundary is integrated with subcritical and supercritical response is also praiseworthy. The young researcher will appreciate the way in which opportunities for useful future work are identified, both in the concluding chapter and throughout the text.

There are a few reasons for dissatisfaction, and most of these are associated with an almost obsessive desire on the part of the author (or the publisher!) to keep the book as short as possible. Although the primary objective was to expose fundamentals, yet the needs of engineers in industry could have been served with a few more pages on panels *in flight* and a critique of the criteria (some overly conservative) that have been proposed for their design. Quantities are left undefined or unexplained, as with the cryptic notes on Fig. 2.2 or the missing discussions on how various data were obtained. Power spectral methods deserve a few pages in Chapter 5, as do shell-response measurements in Chapter 6.

In Section 5.2, since the author chooses to mention a couple of papers on one particular approach to turbulent flow as "a laminar flow becoming unstable," he owes his readers something on the vast classical literature of turbulence and boundary layers. Finally, when a book is referenced, it is customary to mention the section or pages where particular material will be found.

No one is perfect, and a few errors have crept in. Thus, on page 104, $\bar{w}(x)$ must everywhere be a real quantity before traveling waves are eliminated completely from the first equation. In the page 18 discussion of transfer functions, it is perhaps misleading to associate "aeroelastic eigenvalues" with nonexistence of the transfer function. The transfer function being discussed relates to simple harmonic inputs, and it is perfectly well behaved for all frequencies except when its denominator has a purely imaginary or unstable root.

Also, there is the usual collection of misprints that bedevil every first printing of a technical book. The reviewer counted 43 "typos," minor errors, and omitted definitions during one careful reading. Fortunately none of these detracts severely from the overall high quality of this valuable addition to the literature of aeronautics and applied mechanics.

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