
REVIEWED BY C. W. BERT1

As the field of composite materials and structures continues to mature, there is a continuing need for both text and reference books. As for the mechanics aspects of the subject, most of the classic texts, such as those of R. M. Jones (Mechanics of Composite Materials, Scripta, 1975) and R. M. Christensen (Mechanics of Composite Materials), Wiley, 1979) do not go into the structural aspects in very much depth. An exception in The Behavior of Structures Composed of Composite Materials by J. R. Vinson and R. L. Sierakowski (Martinus Nijhoff, 1986). The present book may serve as a text for a graduate-level course or as a reference for practicing design engineers and researchers. It is unique in that it covers for the first time in an English-language composites text, the subjects of ring structures and thin-walled beams.

Chapter 1 is an introduction to the structural properties of composite materials including anisotropic elastic behavior. Chapter 2 presents a very general development of the equations of an orthotropic elastic medium and their specialization to thin-walled structures. Special mention is made of stiffened structures, varying thickness, hygrothermal effects, material and geometric nonlinearity, buckling, and dynamic response. The material nonlinearities considered include both elastic-plastic and nonlinear elastic behavior.

Composite beams, columns, and circular rings are treated in Chapter 3. This work is distinct from other texts in that it includes postbuckling behavior of columns, vibrational behavior of shear deformable beams, and bending and deflection of rings. Chapter 4 deals with thin-walled beams, including those with open cross-sections, and single and double-cell closed cross-sections, including bending, twisting, and warping.

Chapter 4 covers composite plates, including unstiffened and stiffened rectangular plates and circular plates. Deflection, buckling, and post-buckling are all treated. The importance of transverse shear deformation is included via first-order shear deformation theory. Many of the numerical results are compared with experimental results for validation.

Circular cylindrical shells are analyzed in Chapter 6 for deflection, buckling, and free vibration. Both complete cylinders and cylindrically curved panels are treated. In addition to first-order shear deformable theory, classical thin-shell, membrane, and semi-membrane theories are discussed. Both linear and geometrically nonlinear behavior is analyzed. The final chapter (7) is devoted to axiymmetric deformation of shells of revolution, including both linear and geometrically nonlinear analysis, and design of membranes of revolution.

The book is very clearly written and illustrated. The only criticism, a very minor one, is the limited number of references (48), some of which refer to Russian editions of journal articles, even in cases in which English translation editions exist.

This book is highly recommended to all engineers, designers, and researchers concerned with composite structures.


REVIEWED BY YI-CHAO CHEN2

Classical thermodynamics was developed primarily for systems composed of gases and liquids, with minimum consideration given to mechanical aspects, such as motion, deformation, and stresses. Such considerations are of great importance in the study of solids. While there has been a large number of works in thermoelasticity, thermoplasticity, etc., many of them routinely apply basic principles of thermodynamics to solids without questioning the validity of these principles in the specific context. Most modern treatments of these theories require mathematics at advanced levels, and may not be readily accessible to those who are just beginning research in these areas.

Professor Ericksen has devoted his career to research in theoretical physics, including thermodynamics. His expertise in virtually every area of mechanics enables him, in the present volume, to illustrate the use of fundamental ideas of thermodynamics to analyze nonlinear phenomena in solids, and to pinpoint the difficulties involved as well as possible solutions. Considering the depth of thought shown in this work, it is quite remarkable that it was developed from a series of lecture notes for seniors and beginning graduate students, and uses elementary mathematics.

Some general notions and basic principles of thermodynamics are stated in Chapter 1, that exposes, as do the following chapters, the reader to various controversial ideas. Constitutive theory of heat transfer is discussed in Chapter 2 with the aid of Clausius-Duhem inequality, reflecting the author’s view that energy and entropy are well defined for many nonequilibrium processes.

Equilibrium theories for solids of simple geometries, i.e., bars and plates, are discussed in Chapters 3 and 4. Clearly demonstrated is the application of thermodynamics to examining stability and phase transitions in solids subject to various loading conditions and thermal settings. The essentially one-dimensional analyses allow for an exposition with a high concentration of ideas for the amount of mathematics required. Similar practices are exercised in Chapters 5 and 6.

1Benjamin H. Perkinson Chair and Director, School of Aerospace and Mechanical Engineering, The University of Oklahoma, Norman, OK 73019-0601. Fellow ASME.

2Professor, Department of Mechanical Engineering, University of Houston, Houston, TX 77204-4792.