presentation of its subject which, by having collected in one place a comprehensive assortment of methods and techniques of measurement, will be of value to any person interested in comparing the possibilities and limitations of each. It is most certainly recommended to the audience for which it is written.

Mechanics of Composite Materials. By Robert M. Jones. McGraw-Hill Book Company, New York. 1975. xiv + 355 Pages. Cost $21.00.

REVIEWED BY C. W. BERT[2]

With the rapid development of high-performance fibers and their increasing use in critical structural applications, there is a great need for a text which covers the topics peculiar to the mechanics of such structures: micromechanics, macroscopic anisotropy, and flexural-extensional coupling. Professor Jones has drawn from his extensive industrial and pedagogical experience in the relatively new field of composite material mechanics to write a textbook which serves this need very well.

The introductory chapter gives an up-to-date overview of the types, terminology, manufacture, current applications, and future potential of composites. Chapter 2 is devoted to macroscopic stiffness and strength behavior of a single layer. Chapter 3 is concerned with micromechanics, i.e., prediction of the composite stiffness and strength behavior from known properties and geometric configuration of its constituent materials (the fibers or other reinforcements and the matrix). Chapter 4 covers laminate mechanics, i.e., prediction of laminate behavior from known properties, arrangement, and orientation of the individual layers. Problems of stable static deflection, static buckling under in-plane loads, and free vibration of laminated, composite-material plates are presented in Chapter 5. Chapter 6 treats briefly the following miscellaneous topics: fatigue, fracture mechanics, effects of holes, transverse shear effects, and environmental effects.

This book distinguishes itself from other earlier books in this field in the following respects:

1 Well illustrated.
2 Clear presentation of fundamentals, with very thorough documentation for those who wish to dig deeper.
3 Copious comparison between theoretical and experimental results to give the reader a feel for the accuracy and for applicability of the theory.
4 Nearly free of printing errors.
5 Inclusion of problem sets (exercises).

This well-written book should be available for ready reference by all serious researchers in the field of composite material mechanics. Although Professor Jones wrote the book primarily as a graduate text, it is so clearly written, yet well documented, that it will be of great value to practicing design engineers as well as mechanicians concerned with composites.

Elastodynamics, Volume 1, Finite Motions. By A. C. Eringen and E. S. Suhubi. Academic Press Inc., Publishers. 111 5th Ave., New York, N. Y. 10003. Published September, 1974. 335 Pages. Cost $38.50.

REVIEWED BY S. C. COWIN[3]

This book is the first volume in a two-volume set concerned with the dynamics of elastic bodies. The present volume deals with finite motions and the second volume will deal with infinitesimal motions. The stated objective of the book is as a textbook for advanced graduate study and as an initial guide for research in elastodynamics. In the opinion of the reviewer volume 1 fulfills the stated objective. The book gives an organized introduction to the topic suitable for a beginning research worker. The authors present lengthy summaries of many recent papers which have not been previously summarized. The substantial majority of the results presented in volume 1 were published after 1960. The present edition of this textbook is not exhaustive in the sense of a treatise; many experts in the elastodynamics will fail to find topics that they themselves would have included.

The first chapter is entitled *Basic Theory* and it gives very brief sketches of continuum kinematics, balance laws, and constitutive equations for thermoelastic solids. The constitutive equations are developed for finite deformations as well as for the linear and quadratic approximations. The second chapter is entitled *Propagation of Singular Surfaces.* The first half of this chapter is concerned with the development of the compatibility conditions for singular surfaces while the second half is concerned with shock and acceleration waves in elastic materials. This second chapter seems particularly well organized and quite current. Recent papers by D. R. Bland, B. T. Chu, and E. S. Suhubi on shocks and by P. J. Chen on the growth of acceleration waves are discussed at some length. The third chapter has the title *Finite Motions of Elastic Bodies.* The first third of this chapter presents the work of J. K. Knowles on the quasi-equilibrated radial oscillations of tubes and spherical shells. The second third presents the work of D. R. Bland on simple waves and the work of L. Davidson on plane waves. The last third concerns the work of E. Varley. Varley's work on simple waves is discussed and then there is a 20-page summary of a 1973 paper by H. M. Cekirge and Varley on reflection and transmission at an interface. The fourth and last chapter is entitled *Small Motions Superimposed on Large Static Deformations.* After the basic equations for this situation are developed, the work of M. Hayes and R. S. Rivlin on plane waves and surface waves in homogeneously deformed bodies is presented. Then torsional and longitudinal oscillations of an initially stretched circular cylinder are discussed. The chapter ends with an account of the work of H. Demiray and E. S. Suhubi on oscillations of an initially twisted circular cylinder. In addition to the four chapters, there are two appendices—one on tensor analysis and one on quasi-linear systems of hyperbolic equations.

Finite-Element Analysis. By R. H. Gallagher. Prentice-Hall, Englewood Cliffs, N. J. 1975. 420 Pages, $19.95 Cloth.

REVIEWED BY D. S. GRIFFIN[4]

Emergence of the finite-element technique from a curiosity to a standard tool of structural analysis has created the need for a basic instructional text. This is one of the first books written specifically to fulfill that need. The author has drawn heavily upon the material developed in conjunction with the very popular short courses he has conducted for a number of years, primarily for practicing engineers. The book is devoted almost entirely to the development of basic theoretical principles, but is relatively uncluttered with mathematical formalism. It concentrates primarily upon methods of finite-element formulation for linear elastic structural problems. Solution methods and practical applications are not considered, although the author does include some very interesting numerical results on accuracy and convergence for several different element formulations.

Introductory matter includes a brief history of the finite-element method and description of representative applications; a presentation of basic definitions, terminology, coordinate systems, and properties possessed by all finite-element relationships independent of their mode of formulation; and a review of the basic relationships in the theory of elasticity.

The book describes both the direct method of element formula-

[2] Professor and Director, School of Aerospace, Mechanical and Nuclear Engineering, The University of Oklahoma, Norman, Okla. Mem. ASME.

[3] Professor of Mechanical Engineering, Tulane University, New Orleans, La.

[4] 206 Coleen Drive, Pittsburgh, Pa.

tion and the currently more popular variational method, including the principle of virtual work, minimum potential energy, minimum complementary energy, displacement hybrid and generalized potential energy formulations, and the calculus of variations. Although there is greater emphasis on the displacement (stiffness) method, formulations based on assumed stress fields (flexibility) and combinations of displacement and stress fields are also described. Specific forms of elements are examined for plane stress, solids of general and special (plane strain and bodies of revolution loaded axisymmetrically and nonaxisymmetrically) form, and plate flexure applications. Element formulation is also described for the special case of elastic instability.

This relatively self-contained text is directed toward the conventional course offering. It contains numerous example problems suitable for use as teaching aids or for assignment. The subject matter requires some familiarity with structural analysis, the theory of elasticity, partial differential equations, and the algebra of large-order equations. The book is appropriate as a first text for students at the senior or graduate level specializing in solid or structural mechanics. It should also appeal to practicing engineers seeking an introduction to the technology and a reference for basic formulation procedures. The strength of this text derives primarily from the author's considerable experience in teaching the finite-element method to students of varied backgrounds, and from his easy style of presentation.

Stability Theory and Its Applications to Structural Mechanics. By Clive L. Dym Noordhoff International Publishing-Leyden. 1974. Pages viii-191. $16.01 cost.

REVIEWED BY C. S. HSU[5]

It is indeed with great pleasure to review this book because this reviewer fully shares the author's view on how structural stability should be taught. The author stated in the Preface, to quote directly, that, "It represents my view that structural stability should be taught as a mathematical discipline which examines the stability of motion. Thus, if static approaches are to be used, they must be justified within the framework of a dynamic description. Further, if linearizations are to be used, they should be consistently developed, and they should not be highly dependent on free-body diagrams or physical intuition. Finally, the subject matter should be as open-ended as is possible in a short (one semester) introduction, so that applications to and commonalities with other disciplines are not made unnecessarily obscure."

With this approach in mind the author first discusses in the first three chapters stability of discrete systems. Definitions of dynamic stability, asymptotic stability and instability, and various dynamic stability theorems are given. Also discussed are the direct method of Liapunov and the static approach of using minimum potential energy for stability determination under certain circumstances.

The concepts of stability and various stability theorems are then generalized for continuous systems in Chapter 4. Of course, the most important aspect in this generalization is the fact that one must work with function spaces instead of Euclidean spaces. While all the norms of a Euclidean space are equivalent, this is no longer true for function spaces. Thus it is essential to make use of the concept of equivalent metrics of a space and to discuss stability and instability *with respect to* a class of equivalent metrics. To complete the systems approach to continuous systems the author treats several elastic stability problems in Chapter 9 by the direct method of Liapunov using Liapunov functionals. In both Chapters 4 and 9 the author has stated that the exposition on many topics follows quite closely the work by R. H. Plaut.

The specific structural members treated in Chapters 4–7 are columns, plates, and arches. Nonlinear governing equations are derived and postbuckling behavior is also treated by using the Koiter method and the Budiansky-Hutchinson formulation. Since the intent of the book is to cover the basic concepts and methods of analysis, it is most appropriate and understandable that no treatment is given to shell stability problems.

Thus, by presenting elastic stability in the context of stability theory of dynamical systems, the author has given us an excellent modern textbook for a graduate course on dynamic stability of structures. It fills a need and can be recommended most highly. Undoubtedly some instructors may wish to de-emphasize some topics covered here and, perhaps, to supplement the book with topics of their own choice. For instance, some discussions on problems involving follower forces could probably be added in a course of this kind. These problems demonstrate the inadequacy of the static approach and also provide a link to the nonself-adjoint systems of aeroelasticity. One such aeroelasticity problem is indeed discussed in Chapter 9. However, since it is discussed as an application of Liapunov's direct method, the pertinent physical behavior is not brought out. A second possible addition would be a chapter on dynamic stability theory based entirely upon the three-dimensional nonlinear theory of hyperelasticity, in the spirit of Goodier, Pearson, Hill, et al. A very concise and entirely rigorous formulation is now available in an article by R. J. Knops and E. W. Wilkes "Theory of Elastic Stability," *Encyclopedia of Physics*, Vol. VIa/3, pp. 125–302. Based upon that formulation, the classical buckling equations of columns and plates can be derived, and through the derivation the students can gain new understanding of these equations and the minimum potential energy principle. This reviewer has found that this formulation can be covered in approximately 6 hr for students who have had an introductory course in continuum mechanics which is now a standard part of many curricula. These two additions suggested in the foregoing could fulfill further the intentions of the author as quoted in the first paragraph of this review.

Elasticity In Engineering Mechanics. By A. P. Boresi and P. P. Lynn. Prentice Hall, Inc., Englewood Cliffs, N. J. August, 1974. V-475 Pages. Cost $24.95. Cloth.

REVIEWED BY Y. Y. HUNG[6]

This text is primarily meant for use in advanced undergraduate or beginning graduate course, providing students with fundamentals of solid mechanics. It is a slight revision of the book *Elasticity in Engineering Mechanics* by A. P. Boresi, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1965. The major difference from the previous book is that index notation is emphasized.

Chapter 1 gives a clear indication of the trends and scopes of the field of elasticity. Separate theories of strain and stress are treated in Chapters 2 and 3, respectively. The reviewer feels that it is more appropriate for Chapter 3 to appear before Chapter 2. Generalized Hooke's law is discussed in Chapter 4, emphasizing on isotropic homogenous linearly elastic materials. Chapters 5 and 6 deal with plane elasticity, and Chapter 7 with prismatic bars. An introduction to thermoelasticity is given in the closing chapter.

An outstanding feature in this book is the extensive use of Appendix at the end chapter which should help those who are interested in the development of more advanced topics. Also a large selection of problems are available at the end of the chapter which would be useful to the students as well as teachers.

The reviewer believes that this text will be more valuable if a chapter on the introduction to finite-element methods in elasticity is added.

[5] Professor of Applied Mechanics, University of California, Berkeley, Calif.

[6] Assistant Professor, Oakland University, School of Engineering, Rochester, Mich.