Elements of the Mechanical Behavior of Solids. By Nam P. Suh and Arthur P. L. Turner. Scripta Book Co., Washington, and McGraw-Hill Book Company, New York. 1975. xiii-615 Pages.

REVIEWED BY LF. COFFIN, JR. [3]

The practicing mechanical engineer has long recognized that real materials problems generally result from the closely coupled interplay between continuum mechanics, microstructure, basic deformation, and fracture processes and the environment. It is unfortunate that the traditional discipline approaches in our academic structure has impeded the development of this unified view in the minds of students at the formative stages of their engineering education. The availability of a text designed for the classroom and aimed at this interdisciplinary approach is indeed refreshing.

The stated purpose of this book, according to authors Suh and Turner is to provide mechanical engineers with a basic knowledge of the mechanical behavior of common structural materials. An overlying order is felt to exist which ties materials engineering together. Connecting links exist between the three major regimes of the study of materials—the atomistic, the microstructural, and the continuum. It is the authors' aim to develop and strengthen these connecting links so as to achieve a more unified view of the subject in the student's minds. This, they feel, can be done by relating the fundamentals of the subject matter to real problems and applications.

Subjects covered in the text include continuum mechanics, elastic behavior, plastic response (continuum treatment), atomistic basis of plastic behavior, visco-elastic-plastic deformation of polymers, time-dependent plastic deformation of metals (creep), ductile and brittle fracture, fatigue, and surface phenomenon. The level of continuum mechanics employed requires as a prerequisite an introductory course in applied mechanics. No prior exposure is needed to those topics dealing with physical processes. The book has been used in a preliminary version in a one-semester junior-level course at M.I.T. for at least three years.

An attractive feature of the book is the large number of clearly explained examples. Problems, too, are numerous and deal with all phases of the subject matter. They appear either as specifically directed to the subject matter at hand or in an open-ended form. In the latter case, the instructors' background of experience may be challenged. The text is some 600 pages in length, well illustrated, referenced, and indexed. It is difficult to find its comparison in current publications. One might consider it to be an undergraduate version of McClintock and Argon's classic, "Mechanical Behavior of Materials." It contains a wealth of subject matter of use to the practicing engineer, which it presents in a clear, informative style. The book would also appeal to those who wish to update themselves in this important field.

Because the book ventures into new territory, it is easy to find omissions. While continuum and atomistic topics are given considerable attention, the student is provided with little information on the influence of the microstructure or of the environment on mechanical behavior. The metallurgical aspects associated with achieving or controlling the microstructure for strength, hardness, ductility, creep resistance, or defect tolerance should also be introduced quite early into an interdisciplinary course in mechanical properties. A similar comment applies to the influence of gaseous and aqueous environments on fracture and fatigue. Hopefully this book will endure, so that in further editions these important topics can be included. Despite these comments, I would strongly recommend this book for inclusion in any curriculum on the mechanical behavior of solids.

[3] Metallurgy Laboratory, Corporate Research and Development, General Electric Co., Schenectady, N.Y.

Photoplasticity. By Jan Javornicky. Published in co-edition with Academia, Publishing House of the Czechoslovak Academy of Sciences and Elsevier Scientific Publishing Co., Amsterdam—London—New York. 1974. 312 Pages. $34.75.

REVIEWED BY J. W. DALLY [4]

The author, a chief research scientist at the Institute of Theoretical and Applied Mechanics and a lecturer in experimental mechanics on the Faculty of Civil Engineering in Prague, Czechoslovakia, has prepared an excellent book on photoplasticity. The coverage is sufficiently complete that the treatment can be considered a treatise on photoplasticity and will be of immense value to the investigators performing research in this area. The treatment also nicely spans the entire range from the theoretical concepts to the practical applications and thus, the book will serve as a useful reference to the experimentalists working in the field of plasticity.

The book is divided into four parts. Part I contains a well-written treatment of inelastic deformations covering 70 pages including: deformation behavior and mechanisms of plastic deformation, theories of viscoelasticity, viscosity and plasticity, and modeling problems in plasticity. This discussion is well integrated and nicely covers the mechanics of material deformation and provides the theoretical foundation necessary for subsequent experimental developments.

The main contribution of this text is in Part II, where photoplasticity experiments with amorphous model materials is treated. This part covers 127 pages and is the most complete treatment of classical photoplasticity available today. The author develops the topic systematically—treating first the correlation between the structure of polymers and their mechanical behavior. Next, birefringence is discussed and an excellent chapter (6) on model materials is included. The theory of photoplasticity is covered and then procedures for experiments in plasticity, viscoelasticity, viscoplasticity, and viscous flow are outlined. The coverage is completed by a chapter describing many of the known applications to engineering problems.

The study of plasticity in polycrystalline model materials is the subject of an extremely interesting treatment in Part III. Again the coverage is logical, systematic and complete, and this part of the treatise should provide exciting reading to those researchers trying to model slip, grain boundary effects, and material texture.

The last part of the text is a brief treatment of the applications of birefringent coatings to the plasticity problem. The coverage in this section is more than adequate, and the application of these methods to practical engineering problems is evident; however, much of the material covered is routine.

The text is very well referenced with 422 titles listed in the bibliography. References to Russian work not well known in the U. S. are particularly valuable. Th : text, translated by Dr. S. Tryml, has not suffered in the process since it is easily read and understood.

Photoplasticity by Javornicky is a substantial contribution to experimental mechanics and should be studied by every serious worker in the field.

[4] Professor, University of Maryland, Department of Mechanical Engineering, College Park, Md.

An Introduction to the Elastic Stability of Structures. By George J. Simitses. Published by Prentice-Hall, Inc. 1976. 253 Pages. Cost $18.95 cloth copy.

REVIEWED BY J. W. HUTCHINSON [5]

This little book should serve nicely for a first exposure to structural buckling problems for undergraduates or beginning graduate students. It starts out slowly and clearly with several simple models. Right from the start the author introduces the student to the various

[5] Professor, Harvard University, Division of Engineering and Applied Physics, Cambridge, Mass.

approaches which are used to assess the stability of elastic structures under conservative loads. In his designation, these are from the point of view of static bifurcation, dynamics, potential energy, and imperfection analysis. A qualitative discussion of postbuckling behavior is also given in connection with the simple models. After this introduction the book goes on to columns, frames, columns on elastic foundations, rings, and arches. A number of specific problems in each category are treated. Problems are assigned at the end of each chapter. Except for a snap-through analysis of a shallow arch, the emphasis in almost all cases is on problems involving a bifurcation point. The analysis of each problem is generally quite clearly laid out and should be easy for a student to follow. A discussion of energy-based calculational methods is included. The author gives a discussion of five such methods which he labels methods of Timoshenko, Rayleigh-Timoshenko, Rayleigh-Ritz, Trefftz, and Galerkin. Here a student may become confused because the close mathematical interconnection among these methods is not clearly brought out. There is no important distinction between several of them. A short last chapter emphasizes, by way of two examples, that a dynamic approach must be used to analyze problems involving nonconservative loads.

In summary the book covers mainly classical topics, although recently acquired understanding is weaved into the background discussion. It doesn't touch on plates or shells but this is not unreasonable for a self-contained introductory text. No chapter deals with any of the numerical methods such as finite differences or finite elements which have had such an impact on the calculation of buckling loads. Aside from this one possible omission the book should be useful as the basis of an undergraduate course or a portion of a graduate level course on structural stability.

Treatise on Materials Science and Technology. By H. Herman. Vol. 1. Academic Press Inc., Publishers, 111 5th Avenue, New York, N. Y. 10003, Cost $18.50. 346 Pages.

REVIEWED BY T. MURA[6]

This first volume of the series *Treatise On Materials Science and Technology*—presents a variety of topics in materials science and engineering by different authors. In the words of the editor, the objectives of these volumes are to present fundamental properties and characterization of wide ranging materials so as to establish an association between the science and technology of materials. In this volume most of the topics covered are in the area of composite materials including energetics of interfaces (Article 1) quantitative treatment of microstructures (Article 5), and mechanical properties (Articles 2 and 3). It would have been desirable for the whole volume to have been devoted to this important class of materials. In this sense the inclusion of Article 4 on interstitial interactions in b.c.c. alloys and Article 6 on chemical vapor deposition in the same volume is surprising. The articles appear to be quite selective in their content and treatment and hence are more appropriate as good reference papers rather than general review papers presenting the state of the art in the particular field.

In Article 1, W. A. Tiller discusses the energetics, kinetics, and topography of interfaces. The treatment here is atomistic in nature rather than phenomenological. It should, therefore, be of interest to solid state physicists and physical metallurgists involved in mechanism studies of phase transformations and surface reactions. The second article by A. S. Argon covers different modes of failure of a restricted group of laminar composites. The treatment is statistical in nature beginning with the effects of an isolated failure, then followed by the statistical sequential process of subcritical crack growth leading to general fracture instability. V. K. Tewary and R. Bullough present a theory of elastic wave propagation in composite materials in the fourth article. This theory is based on the Born-Von Karman model for a discrete lattice and considers the propagation of elastic waves of wavelength of the order of the fiber spacings. This enables the determination of such critical parameters as the bond strength. Hasson and Arsenault review a large body of information on internal friction data of b.c.c. ternary alloys. The objective is to elucidate information on substitutional-interstitial solute interactions in b.c.c. matrix and then evaluate their role in the phenomenon of solid solution softening. A discussion of relevant mechanical properties in conjunction with the internal friction data would have been very appropriate to the general theme of the paper. Quantitative treatment of microstructures of multiphase materials is becoming increasingly popular with the advent of automatic microstructure analyzing microscopes. The quantitative treatment of the dynamics of microstructural change by R. T. De Hoff is a useful contribution in the area of characterization of the evolution of microstructure. The final article is by R. W. Haskell and J. G. Byrne and deals with the subject of chemical vapor deposition. This is a fairly specialized field in the area of materials processing and would have been more appropriate in another volume dealing exclusively with specialized material processing techniques. The paper, nevertheless, provides useful information on tungsten chemical vapor deposition for engineers involved in this field.

Review of Continuum Physics. Edited by A. Cemal Eringen. Volume 2. Academic Press Inc., New York, N. Y. Publication Date: February, 1973. Cost $49.00.

REVIEWED BY L. WHEELER[7]

Although referred to in the Preface as the second volume of a treatise, this book is a loosely coordinated collection of articles. It does not conform to the notion of a treatise in the traditional sense.

The articles are divided into three groups: Basic Principles, Constitutive Equations, and Methods of Solution. The first part offers nothing new, being in essence a textbook-level description which can be found in a number of other readily available sources.

The second part is the most significant part of the book. In addition to being well written, the articles in this part comprise an integrated and reasonably comprehensive discussion of recent contributions to the literature.

The last portion of the book contains an excellent article bearing the title Singular Surfaces and Waves. But in addition, it contains one called Complex Function Technique that seems out of place. Considering that the third part of the book is supposed to deal with methods of solution, it has to be regarded as a disappointment. Perhaps one would hope to instead see a discussion of the formulation of boundary-value problems, initial-value problems, and history-value problems, as well as results on the uniqueness, stability, and existence of solutions.

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[6] Professor, Northwestern University, Department of Civil Engineering, Technological Institute, Sheridon, Evanston, Ill.

[7] Associate Professor, University of Houston, Department of Mechanical Engineering, Houston, Texas.