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Book Reviews

Analysis and Performance of Fiber Composites. By Bhagwan D. Agarwal and Lawrence J. Broutman. John Wiley & Sons, Inc., New York. 1980. Pages xi–355. Price, $24.50.

REVIEWED BY C. W. BERT[1]

As the composite materials field unfolds, there is a need for text and reference books with more diversified viewpoints. Many of the early books were overbalanced in favor of the materials aspects, later books were perhaps overbalanced in favor of the mechanics aspects. This book aims to reach the middle ground between these two viewpoints. Thus it is more mechanics-oriented and less "descriptive" than Broutman and Krock's early text (*Modern Composite Materials,* Addison-Wesley, Reading, Mass., 1967), yet it is definitely oriented more toward materials and less toward structural mechanics than Robert M. Jones' more recent text (*Mechanics of Composite Materials,* McGraw-Hill, New York, 1975).

This book was commissioned and reviewed by the Society of Plastics Engineers and is part of its monograph series. Thus it is understandable that it is perhaps most suitable as a textbook in an introductory course on composites for undergraduates majoring in materials science, aerospace, mechanical, or civil engineering, rather than as a reference book or textbook for graduate students in mechanics.

The first chapter is a very general introduction. Chapter 2 covers the strength, failure modes, and thermal expansion of unidirectional composites. Chapter 3 is devoted entirely to short-fiber composites, which is believed to be unique to this book. This topic is especially timely due to the current strong interest of the automotive industry in this kind of composite, due to its potential for large-volume, low-cost production. Chapter 4 treats the elastic stiffness of a single orthotropic layer and its behavior under in-plane biaxial loading. Chapter 5 is concerned with the small-deflection, linearly elastic behavior of a thin laminate, based on the Kirchhoff hypothesis.

Chapter 6 is a *pot pourri:* laminated behavior after first-ply failure, free-edge effects, fracture mechanics (including the recently proposed Whitney-Nuismer criteria), and an elementary treatment of the design of adhesive and mechanical joints. Chapter 7 is a very extensive treatment of the critically important topic of material damage due to fatigue, impact, and environmental interaction. In Chapter 8 is presented what is believed to be the first treatment in a textbook (as opposed to a reference book) of the usually neglected, yet truly important, topic of experimental characterization.

The book is both well written and well illustrated. It is especially gratifying to see some of the failure modes introduced by means of actual microphotographs, supplemented by the usual schematic diagrams and mathematical analyses. Example problems suitable for individual attack or classroom assignment are interspersed throughout the book. For persons with less background in applied mathematics and advanced mechanics, there are Appendices on matrices and tensors and on the theory of elasticity.

This book is highly recommended as an introductory textbook on the analysis and prediction of performance of composites. It is especially suitable for those persons with only an elementary background in solid mechanics. However, by the same token it may not contain much information of a reference nature for the experienced researcher in the field. Those interested in the structural analysis of composite-material plates must still turn to the aforementioned book by Jones or to a more recent book by Richard M. Christensen (*Mechanics of Composite Materials,* John Wiley & Sons, Inc., New York, 1979).

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Similarity, Self-Similarity and Intermediate Asymptotics. By G. I. Barenblatt. Plenum Publishing Corp., New York. 1979. Pages xvii–218. Price $35.

REVIEWED BY J. D. COLE[2]

Have you ever wondered why some authors can write down similarity forms for solutions (to p.d.e's say), based on simple dimensional considerations, others have to struggle to find the right form, to use deep analysis to uncover the critical exponents. This question is the starting point of the study by Dr. Barenblatt in a book which is an excellent translation from the earlier Russian edition.

In a series of short chapters the author develops a general classification for self-similar solutions illustrating his points by means of concrete examples, the only practical way here. The logical thread is the following:

The basic concepts of dimensional analysis (Π-theorem) are carefully presented first and used throughout. The examples of fundamental solution of the one-dimensional heat equation, and the propagation of a strong blast wave due to a point explosion are given as examples where pure dimensional analysis works to give self-similar solutions. Self-similarity is defined by $u(r, t) = u_0(t)\ f\ (r/r_0(t))$. The idea that these solutions are intermediate asymptotics valid after some time for a finite source, but for not too long or far (due to boundaries or weak shocks) is explained next. It is pointed out that the limit from the general solution (nonself-similar) to intermediate asymptotic (self-similar) is, more often than not, not uniform. This means that pure dimensional analysis does not suffice to characterize the self-similar solution. Examples for this are one-dimensional heat flow with diffusivity κ if $\partial u/\partial t > 0$, κ_1 if $\partial u/\partial t < 0$, or the point explosion with energy release at the shock front. In the first case the self-similar solution can no longer be interpreted as that due to a point source Q but rather Ql^α = constant; l = characteristic length of initial distribution, α = exponent found from a nonlinear eigenvalue problem and

$$u = \frac{Ql^\alpha}{(\kappa t)^{1+\alpha/2}} f\left(\frac{x}{\sqrt{\kappa t}}; \frac{\kappa_1}{\kappa}\right)$$

Self-similar solutions are classified as follows: the first kind—passage

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Concern about global warming has led to renewed interest in the more sustainable use of natural fibres in composite materials. This important book reviews the wealth of recent research into improving the mechanical properties of natural-fibre thermoplastic composites so that they can be more widely used. The first part of the book provides an overview of the main types of natural fibres used in composites, how they are processed and, in particular, the way the fibre-matrix interface can be engineered to improve performance. Part two discusses the increasing use of natural-fibre composites in s Composites are widely used as high-performance engineering materials in the aerospace, aviation, automobile, building, electronics, sports-goods, and other industries. Thermal analysis of composites. The most important effects that can be analyzed by DSC are melting behavior and the glass transition. DSC can also be used to determine the curing kinetics of matrix resins and influence of additives.Â For TGA, the main applications are compositional analysis, for example filler and fiber content, and thermal stability. TMA is normally used to study the expansion or shrinkage of materials and the glass transition.