cluding summaries of 28 invited lectures. The complete texts of the invited lectures will appear in a hard-bound volume which is in preparation. The papers are divided into seven categories: General Theory, Metals and Composites, Geological Materials, Discontinuous Media, Concrete, Granular Materials and Aggregates, and Implementation and Evaluation. The objective of the conference was to stimulate interaction between researchers concerned with the theoretical and experimental aspects of developing constitutive models of deformable solids and those concerned with the implementation of constitutive laws in engineering analysis and design.

Many individuals who are active in the field of the conference contributed articles and, consequently, the volume provides a reasonably complete picture of the current state of development of models for describing the mechanical behavior of solids. Of course, the volume would be more valuable if it contained complete texts of the overview lectures as well as the contributed articles.

Theory of Laminar Flames. By J. D. Buckmaster and G. S. S. Ludford. Cambridge University Press, New York, 1982. 266 Pages. Price $49.50.

REVIEWED BY H. W. EMMONS[8]

A mixture of a gaseous fuel and oxidizer (air) will, if within the appropriate composition range, propagate a reaction that converts the reactants to products and produces heat and light: a flame. The process involves the diffusion of heat and reactive chemical specie from the reaction zone to the unignited mixture: the feedback of energy and specie.

The principal obstacle to the progress in the analysis of laminar combustion is the usually very complex series of chemical reactions needed for even very simple overall chemical reactions and the nonlinear nature of the Arrheneous relation for the chemical rate of each of the many chemical reactions actually occurring.

The book under review undertakes the task of introducing its readers to the progress that has been made in this analysis for very simple hypothetical forward reactions with an activation energy E in the Arrheneous formula which is very large ($E/R \gg T$). Under these conditions singular perturbation methods make it possible to attain solutions with considerable rigor and fair accuracy.

The book begins with a derivation of the required basic equations and continues with their application to a series of flame spread problems. The study of steady flame phenomena is followed by that of slowly varying flames (SVF's) and near equidiffusional flames (NEF's).

The study of nonsteady flames naturally leads to consider questions of flame stability under various perturbed conditions.

The calculation of flow fields is discussed in general terms but is presented at length for flames as discontinuities and for flames in a preassigned approach flow field. There is an occasional discussion of various known experimental facts, even a few flame photographs. These are used as suggestive of the kind of phenomena to be looked for in subsequent solutions. Various reasonable-looking flow fields are analytically reproduced, but no attempt is made to show their quantitative accuracy.

For anyone who desires to get started on the further development of the applied mathematics of problems of the laminar flow of multicomponent reacting gas mixtures, this book is superb. Anyone who is already familiar with combustion phenomena who desires to acquire a knowledge of the present status of the analytic understanding of what happens will find this book superior to the slow process of finding, critically reading, and absorbing the significance of the large number of papers now available. Anyone not familiar with combustion phenomena who wants to acquire that familiarity and the more physical and important intuitive understanding will find this book disappointing. The authors state (for a specific problem but generally applicable to the whole book) "...we regard the models as mathematical idealizations whose study can provide some insight into the nature of diffusion flames." And again, "..., which shows an early appreciation of activation-energy asymptotics (though not in the formal sense of this monograph)."

Needless to say, the reviewer made no attempt to check the correctness of the 819 equations printed in this book. Only an equation, which for some reason appeared to be wrong was checked and indeed the text formula for γ immediately following equation 60 is wrong ($\gamma = 1/(1-R/mC_p)$).

Boundary Element Methods in Solid Mechanics. By S. L. Crouch and A. M. Starfield. Allen & Unwin, Winchester, Mass., 1983. 322 Pages. Price $30.00.

REVIEWED BY F. J. RIZZO[9]

The authors are of the opinion that boundary elements methods "... have not received the attention they deserve ..." compared with finite difference and finite element methods. Chief among several reasons for this, in their view, is the apparently somewhat "abstruse" character of many of the "... technical papers on boundary element methods." They suggest that the mathematics often used in these papers "... has prevented many from seeing the simple and attractive algorithm that ultimately emerges."

From this viewpoint, the authors have produced a book in which physical interpretation and intuitive reasoning are used to the utmost. Indeed, their development is so physical and so directed toward a computational scheme that the steps in their development may significantly alter whatever previous understanding the reader may have had of the terminology "boundary element methods." This terminology, which seems well on its way to supplanting the terminology "integral equation methods" or "boundary integral equation (BIE) methods," has been, since it was introduced, an understandable choice for obvious reasons. But boundary elements always seemed to this reviewer to be at least related to integral equations, i.e., as a way of numerically solving them. In this book, however, it seems that the concept of an integral equation is not at all necessary to introduce, understand, and use boundary element methods. Indeed, integral equations are hardly mentioned until the sixth chapter (of eight) where the concept is definitely less important to the authors' purpose than that of an influence function. All of this strikes thie reviewer as astonishing! Nevertheless, the whole development in this book is interesting, lucid, and, no doubt, correct for its intended audience and purpose such that the expressed astonishment is, in the end, quite pleasant. One may disagree on the degree to which physical interpretation in such detail is necessary or even helpful in understanding boundary elements for one who would not find most of the

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regular literature abstruse. But there is little doubt that many people interested in the subject will welcome this approach.

Chapter 1 contrasts finite elements with boundary elements in the most elementary and qualitative terms. The comparison is enticingly in favor of the latter. The contrast in the two methods for exterior domain problems is especially significant. Chapter 2 provides the rudiments of linear elasticity theory needed in subsequent chapters. Chapter 3 introduces Flamant's solution for a concentrated load on a half plane to motivate and illustrate the significance of a singular solution in the authors' view of the methodology. Boundary elements are here first identified in connection with an illustrative numerical problem. An integral equation is also finally identified at the end of the chapter, more for completeness than as an essential ingredient in the development.

The next three chapters form the heart of the book. Chapters 4 and 5 develop two "indirect" boundary element methods whereas Chapter 6 develops a "direct" one. The distinction between indirect and direct methods is first given in Chapter 1 and the reader may find some of the authors' statements regarding the use and historical development of the two methods problematic. Chapter 7 acknowledges the limited application of the development in preceding chapters to plane classical elasticity and the simplicity of the assumption that all contours are approximated by piecewise linear line segments (boundary elements) over which all prescribed or unknown functions (e.g. tractions or displacements) are assumed constant. A higher order formulation involving linear variation of functions over the elements is discussed here as well as certain special elements and considerations for inhomogeneous and anisotropic bodies. Chapter 8 is devoted to applications in rock mechanics and geological engineering. Finally, three appendices contain listings of three computer programs based on the text material. Solved problems are present throughout the text.

From the title categorization ". . . in Solid Mechanics," anyone looking for explicit treatment of problems other than plane static elasticity will be disappointed. References to boundary element treatments of other classes of problems, e.g., time-dependent problems, are also far from exhaustive. The "more elaborate numerical approximations" referred to in the last two paragraphs of Chapter 6 should be, and to a large extent are, the rule in modern use of boundary elements. It may be difficult to appreciate this from the emphasis given to the very simplest approximation techniques not only in the text but also as the basis for the three computer codes in the appendices.

Despite these criticisms, the practicing analyst largely disinterested in the traditional integral equation basis for boundary elements, and primarily interested in solving problems by these methods, should find this book a welcome and intuitively appealing introduction to the subject.

Although finite element techniques are widely used, boundary element methods (BEM) offer a powerful alternative, especially in tackling problems of three-dimensional plasticity. This book describes the application of BEM in solid mechanics, beginning with basic theory and then explaining the numerical implementation of BEM in nonlinear stress analysis. The book includes a state-of-the-art CD-ROM containing BEM source code for use by the reader. This book will be especially useful to stress analysts in industry, research workers in the field of computational plasticity, and postgraduate student Solid mechanics and structural mechanics deal with the relationships between stresses and strains, displacements and forces, stresses (strains) and forces for given boundary conditions of solids and structures. These relationships are vitally important in modelling, simulating and designing engineered structural systems. Forces can be static and/or dynamic.Â There are displacement and force boundary conditions for solids and structures. For heat transfer problems there are temperature and convection boundary conditions. Structures are made of structural components that are in turn made of solids.Â Therefore in this topic, shell structures will be modelled by combining plate elements and 2D solid elements. Equations For Three-Dimensional Solids. This work explains the boundary element technique with diagrams and with listings of computer programs for three methods. The authors use a system of highlighting key words and the book is designed for anyone in rock mechanics and mining sciences who has some grounding in the theory of elasticity. After a review of relevant aspects of elasticity theory.Â Select the department you want to search in.