Numerical Simulation of Fluid Motion. Edited by J. Noye. North Holland. 1978. Pages ix-580. Price $66.75.

REVIEWED BY M. HOLT[5]

In this volume, the papers presented at an International Conference on Numerical Methods applied to Problems in Fluid Dynamics, held at Monash University, Melbourne, Australia, in 1976, are published. The volume reveals clearly that Australia is rapidly becoming a leading center in Computational Methods and ranks well among the longer established centers in U.S., U.S.S.R., and Western Europe. The major contributions in the volume are from Australia itself, but there are also two papers from New Zealand, one from New Guinea, and one from the U.S.

The volume begins with a long and thorough account, by B. J. Noye, of finite-difference methods as applied to the Linear Heat Conduction Equation in one or more dimensions. This updates the existing monographs on this topic, such as the classical book by Richtmyer and Morton, and could serve as the basis for a graduate text. The second work, by Clive Fletcher, consists of an exhaustive but very readable description of Galerkin methods. This is certainly more complete than other works on this topic known to the reviewer and covers Fletcher's own contributions to Galerkin techniques as well as recent work on combining Galerkin methods with finite-element and spectral methods. Two shorter survey articles follow, the first, by G. P. Steven, deals with the applications of finite-element methods to fluid flow problems and the second, by Fix, discusses hybrid finite-element methods. The remaining survey papers concern Marker and Cell techniques (Browne), a critical comparison of numerical techniques for solving fluid flow problems (Pearson), and a relativistic approach to numerical solutions of dynamic systems problems (Barnett).

The second part of the volume, dealing with applications, begins with a long paper on the simulation of tides and currents in gulfs by Noye and Tronson, followed by three other papers on oceanographical problems. Morrison and Smith apply network techniques to open channel flows in estuaries, while a further paper by Noye concerns the effect of wind on circulation in lakes and other large bodies of water. Interspersed with three other papers on hydraulic problems are two papers on cavity flows by Gupta and Patterson, respectively, a paper on Supersonic Cone Flow by Fletcher, one introducing thermal and buoyancy effects into fluid flow problems (Stevens), the application of Galerkin techniques to sound propagation in nonuniform ducts (Eversman) and a discussion of sea breezes by Pearson and Williams. The volume ends with a paper by Wallington on the numerical analysis of geophysical field data.

The editor and organizers of the conference are to be commended on assembling this collection of important new contributions in Numerical Fluid Dynamics.

Elastic-Plastic Fracture. Edited by J. D. Landes, J. A. Begley, and G. A. Clarke. ASTM Special Technical Publication 668. American Society for Testing and Materials. 1979. Pages 1–771. Price $58.75.

REVIEWED BY A. S. KOBAYASHI[6]

A symposium on Elastic-Plastic Fracture sponsored by ASTM Committee E-24 Committee was held in Atlanta, Ga., in November, 1977, to provide a forum for discussing the state of science in elastic-plastic fracture. The 33 papers contained in this symposium proceedings are grouped into the following three parts: Elastic-Plastic Fracture Criteria and Analysis; Experimental Test Techniques and Fracture Toughness Data; and Application of Elastic-Plastic Methodology. Of particular interest to JAM readers are the first and third parts of this book which will be briefly reviewed in the following.

The analysis papers in the first part dealt with new as well as assessment of existing criteria for stable crack growth and ductile instability. The first paper by Paris, et al., presented a forceful justification for a new nondimensional material parameter, the "tearing modulus" as a material's resistance to tearing stability. The next paper by Hutchison, et al., provided the theoretical basis for use of J-integral for crack growth analysis in the previous paper. Shih, et al., and Kanninen, et al., followed with experimental and numerical justifications for the use of crack opening angle in addition to the tearing modulus as a resistance to crack growth. Two-dimensional elastic-plastic finite-element analysis was used by Sorensen, McMeeking, et al., Nakagaki, et al., Miller, et al., and D'Escatha, et al., to determine J-integral changes with stable crack growth and/or in the presence of finite strains, the crack surface energy release rate, G^{Δ}, for stable crack growth and a ductile damage function based on void nucleation, growth, and coalescence.

The application papers were directed toward elastic-plastic fracture of pressure vessels, pipelines, and fracture specimens. Chell used an equivalent J-integral analysis to interpret the failure assessment curve by Harrison while Harrison, et al., discussed the application of COD approach for material selection, defect assessment, and failure investigation of actual structures. Elastic-plastic fracture mechanics was used by McHenry, et al., to study the maximum surface flaw size in pipeline girthwelds and Simpson, et al., used COD and elastic-plastic R-curves to describe ductile fracture of Zr-2.5Nb pressure tube alloy. Mcdonald, on the other hand, used plastic stress singularity strength to correlate fracture data of A36 and HSLA structure steel connections and Merkle used an empirical equation to analyze nozzle corner cracks. Notch root plasticity was used by Hammonda, et al., to study fatigue crack growth, and Brose, et al., and Mowbray correlated fatigue crack growth of 304 stainless steel and chromium-molylodenum-vanadium steel, respectively, with cyclic J.

The excellent summary by Landes and Clarke could have been reproduced here in place of this review if it would have not been for its length. As Landes so rightly stated in the Introduction, . . . "The variety of topics covered should be of interest to a large number of researchers working in the elastic-plastic area. This publication represents the first major collection of papers devoted solely to the topic of elastic-plastic fracture."

Turbulent Shear Flows I. Edited by F. Durst, B. E. Launder, F. W. Schmidt, and J. H. Whitelaw. 1979. Springer-Verlag, New York/Heidelberg, Berlin. Pages 415. Price $29.80

REVIEWED BY P. A. LIBBY[7]

This book contains the contributions to the First International Symposium on Turbulent Shear Flows held in 1977 at the Pennsylvania State University. This July, the Second Symposium was held in London; thus this series appears to be well founded and due for a long life. The successful initiation of a new series of international scale meetings and the proceedings resulting therefrom on turbulent shear flows indicates the interest this specialized topic attracts among engineering scientists throughout the world.

The proceedings include 26 papers within the framework of five chapters with the following titles: Free Flows, Wall Flows, Recirculating Flows, Developments in Reynolds Stress Closures, and New Directions in Modeling. Of considerable novelty and value are introductions to each chapter written by an expert and placing the in-

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dividual contributions in perspective relative to the broader topic. The editors of subsequent volumes in this series and in fact of similar proceedings would be well advised to follow this practice; the literature of turbulent flows involves a variety and scope which makes it difficult for an "outsider" to make proper assessments of new contributions, of problems calling for attention, etc. Thus the introductory remarks add significantly to the value of this volume.

The contributions in the first three chapters are equally divided between experiment and theory while the subject of the last two chapters restricts their contents to developments in theory and numberical methods. It is the nature of current turbulence research that few papers deal with both experiment and theory.

Workers in turbulence research and engineers responsible for applications involving turbulent flows will find this volume a valuable addition to their reference library and will anticipate subsequent volumes in the series.

Advances in Analysis of Geotechnical Instabilities. Edited by J. C. Thompson. University of Waterloo Press. 1978. Pages 230. Price $15.

REVIEWED BY J. W. RUDNICKI[8]

This volume collects five invited papers which were contributed during September, 1976, to October, 1977, for a symposium on geotechnical instabilities. A sixth article which is included, "The Application of Mechanics to Rock Engineering," by C. Fairhurst, is reprinted from the *Proceedings of the Third Symposium on Engineering Applications of Solid Mechanics.*

This latter article provides a good overview of the subject of this volume and would be an appropriate introduction although it appeared fifth in the actual arrangement of papers. Fairhurst suggests that progress in geomechanics design has been hampered by the difficulties presented by natural materials, but he emphasizes the usefulness of theoretical analysis as a basis for good design even when material properties are not precisely known. Improvements in prediction of tensile failure of rock which have been made using the Griffith approach to fracture are discussed as an example. Fracture mechanics has, however, developed far beyond the analysis of Griffith and these developments, although not discussed, could perhaps lead to comparable improvements. This example illustrates one disappointing aspect of the volume: With the exception of a paper by I. Vardoulakis ("Equilibrium Bifurcation of Granular Earth Bodies"), which applies a bifurcation analysis to study the development of shear bands in sand, the articles describe modifications of standard approaches to problems in geomechanics. However, in view of the motivation for the symposium, which Thompson states in the editor's preface is the inadequate understanding of the mechanics of instability in geotechnical materials, I had hoped for the description of more novel approaches. In spite of my disappointment over this one feature, I did find the problems and variety of approaches which were discussed to be very interesting. This volume will be of interest to workers in geotechnical engineering as well as to those in other areas of mechanics who wish an introduction to this field.

"Instability" is a term which can have many interpretations, even within the confines of mechanics, and the following short synopsis of articles in this volume indicates a variety of approaches:

The first article by G. Gudehus discusses the application of an approach often taken in classical soil mechanics design: the deformation at failure is assumed to occur along discrete sufaces and instability is identified with the limiting state of static equilibrium. H. Lippman also uses this interpretation of instability in his article on "translatory rock bursting" but, after reducing the problem to one dimension, he employs an elastic-plastic analysis to identify the limiting state of equilibrium. I. Vardoulakis considers instability as the development of zones of localized shear deformation. An article by R. H. Fakunding and others describes the geology of the Clarendon-Linden fault system in western New York and surface features (e.g., faults, joints, "popups") which appear to reflect some process of mechanical instability. Although this article contains much terminology from structural geology which may be unfamiliar to many readers, it does make clear the difficulties which are faced in interpreting field data and infering mechanical processes from observations of the end state. The final article entitled "Discontinuity Models of Problems in Geomechanics," by A. M. Starfield summarizes and critically reviews computer methods for predicting the response of jointed rock masses.

The article by Vardoulakis illustrates the improvements which can result from more detailed analysis. The point-of-view that localization of deformation can be explained as a bifurcation from homogeneous deformation, has recently proven to be very fruitful in studying this phenomenon in a variety of materials (see, for example, the review by J. R., Rice, "The Localization of Plastic Deformation," *Proceedings of the 14th International Congress of Theoretical and Applied Mechanics,* Edited by W. T. Koiter, Delft, North Holland, Vol. 1, 1976, p. 207). Vardoulakis finds that this approach yields predictions for the orientation of shear bands which are in much better agreement with his experimental observations than are the standard Coulomb or Roscoe predictions.

Fracture of Composite Materials. Edited by G. C. Sih and V. P. Tamuzs. Sijthoff and Noordhoff, Alphen aan den Rijn—The Netherlands. 1979, Pages xvi–413. Price $35.

REVIEWED BY C. W. SMITH[9]

This volume constitutes the *Proceedings of the First U.S.A.–U.S.S.R. Symposium on Fracture of Composite Materials* which was held at the Hotel Jūrmala, Riga, U.S.S.R., September 4–7, 1978. The purpose of the meeting was to assemble a small group of researchers "to review fundamentals, discuss problem areas and display the current developments" pertaining to the fracture characteristics of polyphase materials.

The volume includes a total of 33 technical papers, 16 of which described studies conducted within the U.S.S.R., and 17 papers dealt with research conducted in the U.S.A. and in Europe. The volume is divided into five sections which may be briefly summarized as follows:

Section I (*Microfracture*) contains papers on micro and macrocracks (Mileiko), dispersed fracture (Tamuzs) microcrack enlargement criteria (Kuksenko, Frolov, and Orlov), and fracture kinetics (Regel, Leksovskii, and Pozdnyakov) which involved both analytical and experimental approaches.

Section II (*Statistical and Analytical Methods*) deals with stochastic models of fracture (Bolotin), computer simulation of fracture processes (Kopyov, Ovchinsky, and Bilsagayev), failure analysis (Wu), failure prediction (Chou), and interface crack analysis (Dunders and Comninou).

Section III (*Fracture Analysis*) contains a variety of papers which include both analytical and experimental aspects. Fracture mechanics (Sih), interaction of cracks (Vanin), implication of experimental observations (Smith), failure modes (Tarnopolskiy), finite-element analysis (Herrmann and Braun), multiple fracture (Kelly), polymer reinforcement (Knauss and Mueller), and fracture test results

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