
REVIEWED BY A. S. KOBAYASHI

This 438 page proceeding contains 28 of the 30 papers which were presented at a U.S.-Japan Seminar on "Strength and Structure of Solid Materials" held at the Minnowbrook Conference Center of Syracuse University, October 7 through 11, 1974. Thirty-six researchers from each country, 18 each from the United States and Japan, participated in the five topical sessions of continuum mechanics, fracture of metals, effects of elevated temperature, fatigue and nonmetals and composites.

In Session 1 on continuum mechanics, an exotic combination of finite-element analysis with statistical distribution of mechanical properties throughout the individual finite elements was used by H. Miyamoto, who coined such study as metallurgical mechanics, to predict the macroscopic responses of aluminum tri-crystal and the fracturing processes in grinding wheel material and cast iron. G. C. Sib used the elastic theory of strain energy density to study crack propagation and shear lip of a through crack in a ductile plate and an extensive study on the compliances of an elastic and elastic-plastic solids with two and three-dimensional multiple cracks was presented by H. Okamura. Some stress-intensity factors for surface and corner flaws were discussed by A. S. Kobayashi while H. Nishitani applied the method of continuously embedded point forces to solve numerous two and three-dimensional problems in fracture mechanics. As the only experimental paper in this session, T. Hayama and S. Hashimoto described a fully automated X-ray stress measuring system.

In a leading paper in Session 2 on fracture of metals, V. Weiss proposed a relation between void nucleation phase of microstructure and fracture toughness in medium strength, high toughness material. Void initiation, growth and coalescence during ductile fracture of sintered copper was studied in meticulous details by K. Ohji, K. Ogura, and Y. Matoh while extensive data correlation of KIC with KIC with fractographically derived stretched zone widths in high strength steel was presented by H. Kobayashi, H. Nakazawa, and A. Nakajima.

P. F. Packman, J. K. Malpani, and F. M. Wells developed statistical concepts and analysis techniques to examine the probability of detecting small surface flaws and showed that 95/95 confidence levels can be obtained in the probabilities of detecting surface flaws of 0.05 in. by advanced aerospace NDI production inspection procedures. M. Mori, F. Nakashima, and T. Toguchi found through fractography that the high strain region in fatigue notched specimens were used to test the COD. J. A. Joyce and F. A. McClintock concluded that the dJC criterion can be used effectively in predicting elastic fracture initiation in large steel and aluminum parts from laboratory-size specimens whose behavior is elastic-plastic or fully plastic.

L. F. Coffin presented an extensive review on fatigue life prediction at elevated temperature as the opening paper of Session 3 on effects of elevated temperature. In a following paper S. Taira and M. Fujino showed among other results that the thermal fatigue strengths of steel is lower than the isothermal fatigue strength tested at the maximum cyclic temperature of the thermal fatigue tests. K. Kotera and M. Nishida described various power law relations for crack extension rate through fractographic examinations of fatigue cracks at room and elevated temperature. Thermal fatigue parameters were used to characterize the fatigue strengths of five cast irons by S. Yamamoto and H. Yamamoto.

As the opening paper of Session 4 on fatigue, T. Kunio, M. Shimizu, K. Yamada, and Y. Kimura showed that the heterogeneity in microstructure has significant effect on the fatigue crack growth rate and presented a Monte-Carlo simulation of crack growth. A. J. McEvily, D. Beukelmann, and K. Tanaka showed that crack initiation and Stage I growth is a large part of the total life of a fatigue crack under large scale yielding condition. Statistical fracture mechanics and crack-morphological fracture mechanics were used by H. Kitaigawa, I. Susuki, R. Yui, and O. Sakaguna to refine crack growth modeling of stable and fatigue crack growths. H. Nakazawa and H. Kobayashi studied Stages I and II fatigue cracks in low carbon steel through fracture mechanics and fractography while S. Taira and K. Tanaka used X-ray microbeam diffraction technique to measure the local stresses and plastic strains surrounding a fatigue crack and established crack propagation in several carbon steels. Accumulated plastic strain and cyclic strain range near a fatigue crack in aluminum alloy were correlated with crack growth rate by H. W. Liu and A. S. Kuo. Fatigue crack growth rate of surface flaws in 5083-0 aluminum plate subjected to combined tensile and bending stresses were evaluated by M. Takahashi, H. Tanaka, and N. Ito while extensive data correlation of KIC with KIC with fractographically derived stretched zone widths in high strength steel was presented by H. Kobayashi, H. Nakazawa, and A. Nakajima.

In a leading paper in Session 5 on nonmetals and composites was presented by G. P. Sendeckyj who showed that the various two-parameter fracture mechanics theories predicted the fracture toughness values of quasi-isotropic laminates but not of 90° or 90° laminates. W. G. Knass then presented a comprehensive state of art review on crack propagation criteria in nonsimple viscoelastic solids. M. Takahashi, T. Kunio, and M. L. Williams showed that slow crack growth rates in a modified epoxy could not be readily correlated with the modified Griffith theory. S. Shimamura and H. Miyairi then presented a

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7 Volume 3 of this series was not available at the time of this review.
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BOOK REVIEWS


REVIEWED BY S. LEIBOVICH

This book contains accounts of most of the lectures presented at the Bat-Sheva Seminar on MHD-Flows and Turbulence held at the Ben-Gurion University during March 17–20, 1975. The title suggests a focus on turbulence in MHD flows, but few of the papers integrate the two topics. In fact, the book contains an odd miscellany of subject matter.

The topics given greatest attention are theoretical papers (5) on laminar MHD duct flows, and descriptions of experimental MHD facilities or programs (5 papers). In addition, there is one paper each on homogenous MHD turbulence theory, on turbulence in ordinary fluid dynamics, and on the 'Toms effect, and abstracts of other two papers.

Most of the papers are very short, highly condensed reviews of recent progress made by the contributors. The book is therefore not one that individuals are likely to buy for their personal bookshelves.


REVIEWED BY P. A. LIBBY

The field of turbulence contains many facets and is rich in problems of an applied and fundamental nature. Consequently there are each year a variety of meetings, symposia, workshops, etc., on various aspects of turbulence. This volume presents the contributions to the Fourth Symposium on Turbulence in Liquids held at the University of Missouri-Rolla in 1975. Generally the papers are concerned with measurements employing various techniques, hot film, and laser anemometry and electrochemical techniques to provide data on turbulent phenomena in water but well known in gases as well. In fact, some papers are devoted to measurements in air, clearly not consistent with the title of the symposium, in air-water mixtures and in blood. Five papers involve pressure measurements at a wall. Many papers are followed by written discussions which aid considerably in placing the proceeding contribution in some perspective, relative to the extensive relevant literature.

Workers in the field of experimental turbulence will want at the least peruse this volume in order to keep track of developments in their field.


REVIEWED BY J. TINSLEY ODEN

Over the past five years, there have been a number of national and international meetings designed to bring engineers and mathematicians together who have a common interest in finite-element methods. By enlarge, these meetings have been failures. There has either been too much emphasis on mathematics to interest those engineers who attended or the flavor has been so applied as to repulse the mathematicians who have attended. Also, these meetings are frequently burdened by poor communication between one camp and another.

There have been, however, one or two of these meetings that were of notable successes, and the MAFELAP Meetings are among them. This is particularly true of the Second MAFELAP Meeting which, in the reviewer's opinion, surpassed the first in not only the quality of papers presented, but also the breadth of the topics covered and the importance of many of the new results. The present volume contains the proceedings of this conference which was held in April of 1975 at Brunel University in Uxbridge, England. John Whiteman, Director of the Institute for Computational Mathematics at Brunel, organized the meeting which highlighted invited lecturers and a number of contributed papers. Having attended the meeting myself, I believe that there was an unusually good flow of information between the theorists and those with more applied orientation. Perhaps it was the choice of the speakers or perhaps the hospitality provided at the meeting were conducive to this, but there was more. It seems that many people saved some of their better results to report at this meeting.

The present volume contains forty-three (43) papers presented at the meeting, some of them representing very important developments in the theory and application of finite-element methods. Let me mention a few: Two independent papers, one by A. R. Mitchell and another by R. McLeod, discussed various technical problems encountered in using curved finite elements. Mitchell's paper, in particular, showed how essential boundary conditions can be matched exactly on curved linear triangular elements. In McLeod's paper, he represented an enlargement and extension of the main ideas of Mitchell's paper. This paper, together with an interesting paper by R. E. Bannhill, "Blending Function Finite Elements for Curve Boundaries", represent what is commonly referred to as the interpolation theories surrounding finite-element methods: i.e., the technique of using finite elements for curve fitting.

There were some other important developments: D. S. Watkins reported on a new Hermite cubic blending finite element which involves C1 interpolation functions. This element should prove to be quite competitive for plate bending problems.

Among the most exciting papers in the volume were two on a self-adaptive approach for finite-element methods, one by Ivo Babuska and another by G. Sewell. Here the idea is to specify a priori a degree of accuracy that the user desires and to allow the computer to refine the mesh accordingly. Babuska's paper represents a significant step in producing adaptive finite-element mesh generators. A similar paper was presented by G. Sewell in which a quite different method was proposed for adaptive mesh refinement. Sewell's method employed triangular elements and was confined to Poisson-type problems.

Frequently in the mathematical theory of finite elements, the question arises as to whether or not the constants appearing in the error bounds can be evaluated. An important step toward answering this question was proposed in the paper by J. A. Gregory which estimates on the constants for linear interpolation on triangles was provided. There were several papers on parabolic and hyperbolic problems—one of some interest by M. Zlamal on heat conduction problems and another by A. Cella on accuracy and stability of finite-element methods for parabolic and hyperbolic equations.

An important paper describing nonconforming elements for solving transport equations was presented by P. Lesaint and another intriguing paper on degenerate interface problems was contributed by G. H. Meyer and G. Sewell. Variational methods for free-boundary problems were studied by M. J. O'Carroll and H. T. Harrison and on discretization in time for parabolic equations by N. R. Nassif, finite-element solutions in space and time for heat transfer problems by M. M. Cecchi, viscoelastic problems by J. Brilla, and semidiscrete Galerkin techniques with time...