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ANGEL CHURCH

An Assessment of Dynamic Fracture Mechanics for the Analysis of Crack Arrest in a Pressurized Thermal Shock Event, Project 1543-13 Springer Science & Business Media
This report summarizes the work completed in the months of June 1996 - December 1999 for the principal investigator's Young Investigator Program grant. As such, the report represents a final summary of work, organized as follows. First, in a brief summary chapter, a review of the accomplishments of the work supported from June 1996 to December 1999 is given providing an overview of the successes

during that period. Next, two chapters giving details of new work during the six months since the last annual report are presented. In these results, an experimentally useful solution for the stress intensity factor history at the comer of an impacting punch is derived for isotropic and orthotropic materials. Then that solution is compared to experimental measurements of the stress intensity factor history at the comer of an impacting punch in both isotropic and anisotropic materials. Good agreement between model and experiments is seen.

Nonlinear and Dynamic Fracture Mechanics

Cambridge University Press

Fracture mechanics is a vast and growing field. This book develops the basic elements needed for both fracture research and engineering practice. The emphasis is on continuum mechanics models for energy flows and crack-tip stress- and deformation fields in elastic and elastic-plastic materials. In addition to a brief discussion of computational fracture methods, the text includes practical sections on fracture criteria, fracture toughness testing, and methods for measuring stress intensity factors and energy release rates. Class-tested at Cornell, this book is designed for students, researchers and practitioners interested in understanding and contributing to a diverse and vital field of knowledge.

Indirect Boundary

Element Formulations for Dynamic Fracture Mechanics ASTM International
This work describes the formulation and numerical implementation of both two- and three-dimensional indirect boundary element methods (for example, the fictitious load method and the displacement discontinuity method). It also provides an analysis of crack problems in elastostatic and elastodynamic fracture mechanics, and methods for evaluating weight functions for dynamic problems.

Dynamic Fracture Mechanics: Propagating cracks
Computational Mechanics
Under rapid loading conditions and/or for a rapidly propagating crack, the mass density of a material affects the fields of stress and deformation. For such dynamic fracture problems plastic deformation in the immediate vicinity of a crack tip is investigated in this paper. Both stationary and propagating crack tips are considered. For a stationary crack tip, deformation theory is employed for the first phase of the loading when the fields are increasing monotonically with time. The general character of the near-tip fields is analyzed both with respect to its variation with time and with polar angle. The non-linear near-tip fields are related to the linearly elastic far-field by means of a path-independent integral. In the second part of the paper we consider rapidly propagating cracks. We

discuss the near-tip fields for various models of material behavior. In particularly we briefly review some earlier work by Achenbach and Kanninen for a rapidly propagating Mode-III crack, in a material which displays strain hardening. In the last part of the paper we consider the fields near a rapidly propagating crack-tip in an elastic-perfectly plastic material for the case that inertial terms are of importance. The system of governing equations in the plastic region is presented and shown to be hyperbolic in nature. As a first approximation the steady-state case with respect to the moving crack-tip is considered and an asymptotic analysis of the near-tip field is carried out. (Author).

Cracks and Fracture

Springer Science & Business Media

Cracks and Fracture consists of nine chapters in logical sequence. In two introductory chapters, physical processes in the vicinity of the crack edge are discussed and the fracture process is described. Chapter 3 develops general basic concepts and relations in crack mechanics, such as path independent integrals, stress intensity factors and energy flux into the crack edge region. Chapters 4-7 deal with elastostatic cracks, stationary or slowly moving elastic-plastic cracks, elastodynamic crack mechanics and elastoplastic aspects of fracture, including dynamic fracture mechanics. Appendices include general formulae,

the basic theory of analytic functions, introduction to Laplace and Hankel transforms and description of certain basic relations, for instance for stress waves in solids. There is an extensive bibliography, containing references to both classical and recent work, and a comprehensive index. Presents an extensive bibliography containing references to both classical and recent works and a comprehensive index Appendices include general formulas, the basic theory of analytic functions, introduction to Laplace and Hankel transforms, and descriptions of certain basic relations, for instance for stress waves in solids

Application of Dynamic Fracture Mechanics to the Investigation of Catastrophic Failure in Aircraft Structures

Elsevier

This book provides an up-to-date knowledge on theory and experimental results of rate-dependent fracture processes in metallic materials. The objective is to expose the current status of a growing branch of fracture mechanics called generally "Dynamic Fracture". Crack dynamics takes into account not only the effects of inertia but also rate sensitivity of a material under consideration. This volume has been prepared by four leading authorities in fracture dynamics: D.R. Curran, J.F. Kalthoff, J.R. Klepaczko and F. Nilsson. A broad range of problem is covered: dynamic fracture theory, application of

dynamic fracture mechanics, dynamic crack inition and microstatistical fracture mechanics in dynamic fracture. The book in its present format may serve as a text supplement in lecturing on fracture mechanics. On the other hand, it may serve as an instructional aid in engineering of fracture prevention.

Fracture Mechanics

Springer Science & Business Media

The objective of this work is to develop a procedure by which crack tip plasticity can be taken directly into account in rapid crack propagation. To set the stage, a background description of linear elastic dynamic fracture mechanics is first given. Existing solutions for dynamic crack propagation and for quasistatic crack growth accompanied by crack tip plasticity are reviewed. It is found that existing dynamic plastic fracture solutions are essentially confined to strip yield (Dugdale model) plastic zones that are collinear with the crack. The ultimate goal of the research reported in this paper is to provide the basis of a computational procedure for plastic dynamic crack propagation in structures of engineering interest. The prerequisite for such a development is knowledge of the nature of the crack tip singularity, which can be obtained via an asymptotic analysis in which attention is focused on the very near crack tip region. Here we have considered the specific case of crack propagation in antiplane strain (Mode

III). The results suggest some interesting general conclusions, and the analysis has pointed the way to the solution of the Mode I problem.

Crack Dynamics in Metallic Materials

Computational Mechanics

From time to time the International Journal of Fracture has presented matters thought to be of special interest to its readers. In previous special issues (December 1980 and April 1981), Dr H.W. Liu as Guest Editor presented a series of review papers dealing with fatigue processes and characteristics in metals and non-metals. Continuing this policy, which is consistent with our stated objectives, a second review dealing with time depen dence in the fracture process, including the effect of material inertia but essentially excluding very strong shock effects in solids, has been assembled under the generic term "dynamic fracture". We hope that the ensuing state-of-the-art review will yield an instructive and timely product which readers will find useful. To assist us in presenting this subject, we have prevailed upon a well-known worker in dynamic fracture, Dr W.G. Knauss, Professor of Aeronautics and Applied Mechanics, California Institute of Technology to act as Guest Editor for this special double issue. On behalf of the editors and publisher, I wish to express our indebtedness to Professor Knauss and his invited authors for undertaking this special effort.

Investigation of Static and

Dynamic Fracture of Orthotropic Media by Photomechanics Springer Science & Business Media Partial Contents: Fundamental considerations in dynamic fracture; The behaviour of cracks under thermal transient loading; Dynamic analysis of crack growth and arrest in a pressure vessel subjected to thermal and pressure loading; The role of crack arrest in the evaluation PWR pressure vessel integrity during PTS transients; A dynamic analysis of crack propagation and arrest in pressurized thermal shock (PTS) experiments; A new finite element technique for modelling stable crack growth; On the nature of crack propagation and arrest in a damaging material; A viscoplastic constitutive model for dynamic fracture; Crack tip parameters and temperature rise in dynamic crack propagation; Large deformations near a propagating crack tip; The influence of specimen boundary conditions on the fracture toughness of running cracks; An experimental and analytical investigation of axial crack propagation in long pipes; Stress fringe signatures for propagating cracks; Dynamic photoelastic investigation of two pressurized cracks approaching one another; Dynamic fracture mechanics with electromagnetic force and its application to fracture toughness testing; Fracture behavior under high rates of loading; Finite element modelling of dynamic cracking in wide plates; Short pulse

fracture mechanics. Dynamic fracture Springer Science & Business Media Covering a wide variety of topics in dynamic fracture mechanics, this volume presents state-of-the-art experimental techniques and theoretical analysis on dynamic fracture in standard and exotic materials. Written by world renowned researchers, this valuable compendium contains eleven chapters on crack initiation, crack propagation, crack arrest, crack-stress wave interactions, and experimental, analytical and numerical methods in dynamic fracture mechanics. Contents: Modeling Dynamic Fracture Using Large-Scale Atomistic Simulations (H-J Gao & M J Buehler); Dynamic Crack Initiation Toughness (D Rittel); The Dynamics of Rapidly Moving Tensile Cracks in Brittle Amorphous Material (J Fineberg); Optical Methods for Dynamic Fracture Mechanics (H V Tippur); On the Use of Strain Gages in Dynamic Fracture (V Parameswaran & A Shukla); Dynamic and Crack Arrest Fracture Toughness (R E Link & R Chona); Dynamic Fracture in Graded Materials (A Shukla & N Jain); Dynamic Fracture Initiation Toughness at Elevated Temperatures with Application to the New Generation of Titanium Aluminides Alloys (M Shazly et al.); Dynamic Fracture of Nanocomposite Materials (A Shukla et al.). Readership: Researchers, practitioners, and graduate students in fracture mechanics and

materials science.
Application of Dynamic Fracture Mechanics Concepts to Composites: Final Report 2000
Springer Science & Business Media
New developments in the applications of fracture mechanics to engineering problems have taken place in the last years. Composite materials have extensively been used in engineering problems. Quasi-brittle materials including concrete, cement pastes, rock, soil, etc. all benefit from these developments. Layered materials and especially thin film/substrate systems are becoming important in small volume systems used in micro and nanoelectromechancial systems (MEMS and NEMS). Nanostructured materials are being introduced in our every day life. In all these problems fracture mechanics plays a major role for the prediction of failure and safe design of materials and structures. These new challenges motivated the author to proceed with the second edition of the book. The second edition of the book contains four new chapters in addition to the ten chapters of the first edition. The fourteen chapters of the book cover the basic principles and traditional applications, as well as the latest developments of fracture mechanics as applied to problems of composite materials, thin films, nanoindentation and cementitious materials. Thus the book provides an introductory coverage of the traditional and contemporary

applications of fracture mechanics in problems of utmost technological importance. With the addition of the four new chapters the book presents a comprehensive treatment of fracture mechanics. It includes the basic principles and traditional applications as well as the new frontiers of research of fracture mechanics during the last three decades in topics of contemporary importance, like composites, thin films, nanoindentation and cementitious materials. The book contains fifty example problems and more than two hundred unsolved problems. A "Solutions Manual" is available upon request for course instructors from the author.

Crack Tip Plasticity in Dynamic Fracture Mechanics Computational Mechanics

Dynamic fracture in solids has attracted much attention for over a century from engineers as well as physicists due both to its technological interest and to inherent scientific curiosity. Rapidly applied loads are encountered in a number of technical applications. In some cases such loads might be applied deliberately, as for example in problems of blasting, mining, and comminution or fragmentation; in other cases, such dynamic loads might arise from accidental conditions. Regardless of the origin of the rapid loading, it is necessary to understand the mechanisms and mechanics of fracture under dynamic loading conditions in order to

design suitable procedures for assessing the susceptibility to fracture. Quite apart from its repercussions in the area of structural integrity, fundamental scientific curiosity has continued to play a large role in engendering interest in dynamic fracture problems In-depth coverage of the mechanics, experimental methods, practical applications Summary of material response of different materials Discussion of unresolved issues in dynamic fracture

Dynamic Fracture of Piezoelectric Materials Springer

Addresses crack propagation with constant or variable velocity in elastic as well as elastic-plastic bodies and elastic lattice. Recent material on experimental methods in dynamic fracture mechanics has increased dramatically, and this work provides important emphasis on these methods.

Soviet Dynamic Fracture Mechanics Research CRC Press

This volume focuses on the development and analysis of mathematical models of fracture phenomena.

Dynamic Fracture Mechanics Springer Science & Business Media

Papers from the 21st National Symposium on Fracture Mechanics, held in Annapolis, Md., June 1988, present new work in elastic-plastic fracture, dynamic fracture, transition fracture in steels, micromechanical aspects of the fracture process, computational mechanics, fracture mechanics testing, and a

Dynamic Fracture Mechanics CRC Press - self-contained and well illustrated - complete and comprehensive derivation of mechanical/mathematical results with enphasis on issues of practical importance - combines classical subjects of fracture mechanics with modern topics such as microheterogeneous materials, piezoelectric materials, thin films, damage - mechanically and mathematically clear and complete derivations of results

Dynamic Fracture Toughness: Papers World Scientific Dynamic Fracture of Piezoelectric Materials focuses on the Boundary Integral Equation Method as an efficient computational tool. The presentation of the theoretical basis of piezoelectricity is followed by sections on fundamental solutions and the numerical realization of the boundary value problems. Two major parts of the book are devoted to the solution of problems in homogeneous and inhomogeneous solids. The book includes contributions on coupled electro-mechanical models, computational methods, its validation and the simulation results, which reveal different effects useful for engineering design and practice. The book is self-contained and well-illustrated, and it serves as a graduate-level textbook or as extra reading material for students and researchers. Dynamic Fracture Mechanics Elsevier

The main scope of this Cargese NATO Advanced Study Institute (June 5-17 2000) was to bring together a number of international experts, covering a large spectrum of the various Physical Aspects of Fracture. As a matter of fact, lecturers as well as participants were coming from various scientific communities: mechanics, physics, materials science, with the common objective of progressing towards a multi-scale description of fracture. This volume includes papers on most materials of practical interest: from concrete to ceramics through metallic alloys, glasses, polymers and composite materials. The classical fields of damage and fracture mechanisms are addressed (critical and sub-critical quasi-static crack propagation, stress corrosion, fatigue, fatigue-corrosion . . . . as well as dynamic fracture). Brittle and ductile fractures are considered and a balance has been carefully kept between experiments, simulations and theoretical models, and between the contributions of the various communities. New topics in damage and fracture mechanics - the effect of disorder and statistical aspects, dynamic fracture, friction and fracture of interfaces - were also explored. This large overview on the Physical Aspects of Fracture shows that the old barriers built between the different scales will soon "fracture". It is no more unrealistic to imagine that a crack initiated through a molecular dynamics

description could be propagated at the grain level thanks to dislocation dynamics included in a crystal plasticity model, itself implemented in a finite element code. Linking what happens at the atomic scale to fracture of structures as large as a dam is the new emerging challenge.

Fracture Mechanics

Springer Science & Business Media

Fracture Mechanics is a graduate level text/professional reference that describes the analytical methods used to derive stress and strain functions related to fracture mechanics. The focus of the book will be on modeling and problem solving as tools to be used in interpreting the meaning of a mathematical solution for a particular engineering problem or situation. Once this is accomplished, the reader should be able to think mathematically, foresee metallurgically the significance of microstructural parameters on properties, analyze the mechanical behavior of materials, and recognize realistically how dangerous a crack is in a stressed structure, which may fail catastrophically. This book differs from others in that the subject matter is organized around the modeling and predicating approaches that are used to explain the detrimental effects of crack growth events. Thus, this book will take a more practical approach and make it especially useful as a basic reference for professional engineers.

Applicability of Dynamic

Fracture Mechanics to the Initiation and Propagation of Adiabatic Shear Bands
Amer Society of Mechanical
In this book a new phenomenological approach to brittle medium fracture initiation under shock pulses is developped. It provides an opportunity to estimate fracture of media with and without macrodefects. A qualitative explanation is thus obtained for a number of principally important effects of high-speed dynamic fracture that cannot be clarified within the framework of previous approaches. It is possible to apply this new strategy to resolve applied problems of disintegration, erosion, and dynamic strength determination of structural materials. Specialists can use the methods described to determine critical characteristics of dynamic strength and optimal effective fracture conditions for rigid bodies. This book can also be used as a special educational course on deformation of materials and constructions, and fracture mechanics.